TECHNICAL STANDARDS AND SPECIFICATION MANUAL FOR GAS DISTRIBUTION SYSTEMS

Safety, Design, Construction, Operation and Maintenance of Natural Gas Distribution Systems in Alberta

Fourth Edition

JUNE, 1999

Alberta

ENERGY
UTILITIES BRANCH

Foreword

This Fourth Edition of the Technical Standards and Specifications Manual has been updated to reflect changes to technical standards, which have occurred since 1991.

This manual is issued in accordance with provisions of Section 2(1) of the Gas Distribution Act and should therefore be considered as having the same authority as the Act.

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Table of Contents

PAGE

List of Figures

PAGE

Appendices

1. Scope and Application

The scope of this manual is illustrated with Figure 1.1 and includes:

(a) Any part of a gas distribution system within a franchise area which has been approved and issued under the authority of the Gas Distribution Act.

(b) Any gas distribution pipeline operating at 700 kPa or less which is located within Alberta

This manual covers the key aspects of safety, design, construction and operation which the Chief Officer (as defined in the Gas Distribution Act) (the Branch) considers necessary for the orderly and effective development of gas distribution systems.

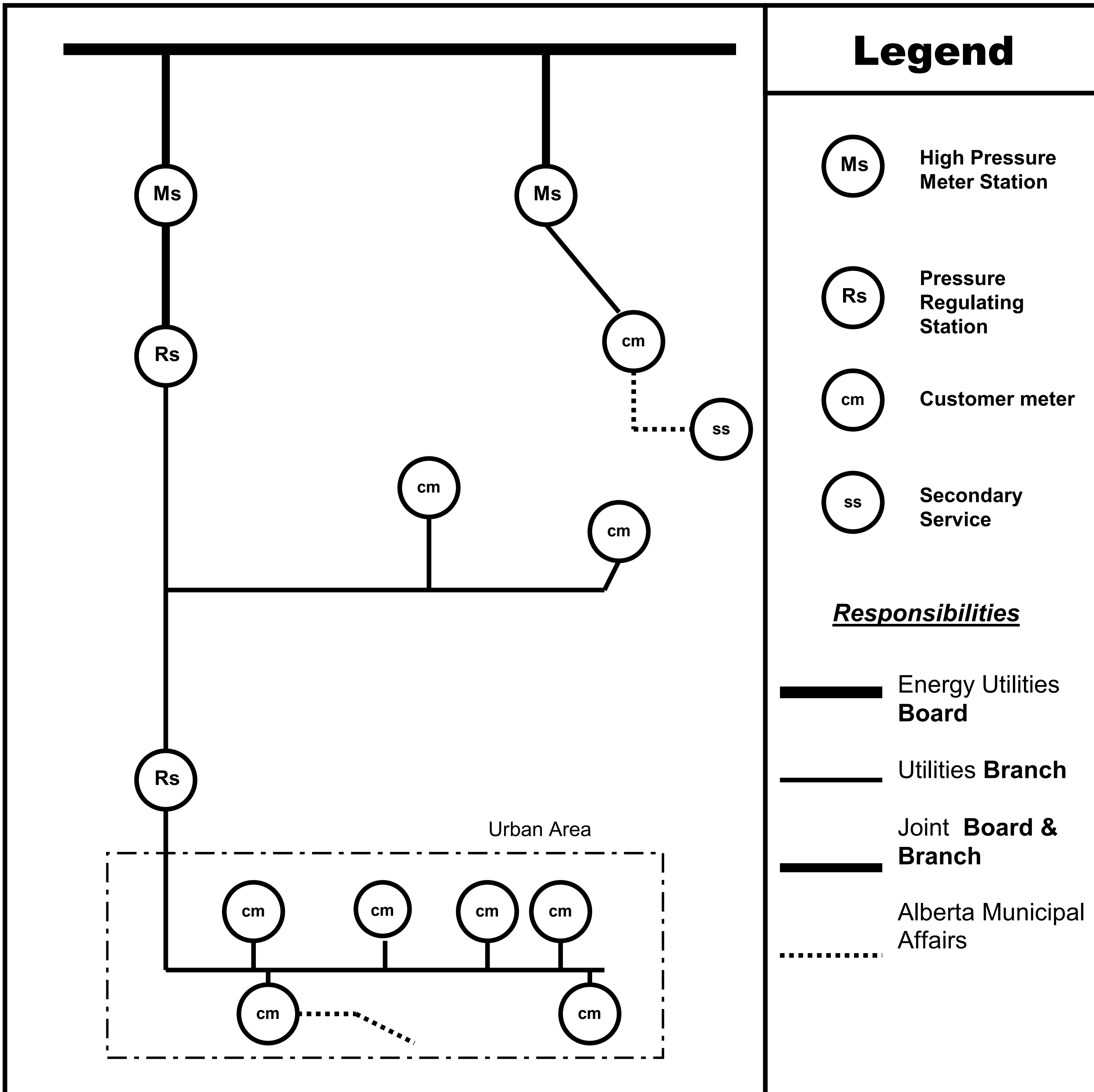

FIGURE 1.1 SCOPE OF MANUAL

NOTES:

1. High pressure pipelines that are downstream of transmission pipelines have a joint Board/Branch responsibility as per the Gas Distribution Act.
2. Secondary gas line downstream of the service regulator (Customer meters) are the under the regulatory authority of Municipal affairs.

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2. Reference Legislation, Regulations and Standards

The design, construction and operation of gas distribution systems are subject to statutes and regulations issued by the Government of Alberta and the Government of Canada. In addition, applicable publications of the Canadian Standards Association (CSA), the Canadian Gas Association (CGA) and other organizations should be consulted.

The latest edition of the CSA standard published as “CSA Z662-99 Oil & Gas Pipeline Systems” should be considered as the principal guideline for the design, construction and operation of distribution systems. Regulations covering gas pipeline systems in Alberta require compliance with the CSA Z662 standard, although these regulations include some variations to provisions in the standard. Where such conflicts exist, the applicable regulation should be considered as overriding the standard in all cases.

Since the scope of this manual covers some distribution pipelines, which fall within the jurisdictions of the Branch, the Energy Utilities Board (the Board) and The Technical Services Branch of Alberta Municipal Affairs (Municipal Affairs), the following principles should apply where *dual jurisdiction* exists:

(a) Where a minimum specification issued by the Board exceeds a specification contained in this manual, the Board’s specification shall prevail.

(b) Where a minimum specification contained in this manual exceeds a specification issued by the Board, the specification in this manual shall prevail.

(c) Similarly, where a minimum specification issued by Municipal Affairs exceeds a similar specification contained in this manual, the Municipal Affair’s specification shall prevail.

3. Definitions

(a) "The Branch" means the Utilities Branch of the Department of Energy.

(b) "Distribution System" means an integrated network of distribution pipelines and associated appurtenances.

(c) "Distribution Pipeline" means a pipeline used to transport and deliver gas to consumers.

(d) "Distributor" means the person or corporation that owns a distribution pipeline or distribution system.

(e) "Ground disturbance" means any work, operation or activity that results in a disturbance of the earth including, without limitation, excavating, digging, trenching, plowing, drilling, tunneling, auguring, backfilling, blasting, topsoil stripping, land leveling, peak removing, quarrying, clearing and grading, but does not include:

(i) Except as otherwise provided in sub-clause (ii) below, a disturbance of the earth to a depth of less than 300 mm that does not reduce the earth cover over the pipeline to less than the depth of cover provided when the pipeline was installed.

(ii) Cultivation to a depth of less than 450 mm below the surface of the ground.

(f) "High pressure pipeline" means a distribution pipeline, which is designed or is intended to be operated at a pressure in excess of 700 kPa.

(g) "Low pressure pipeline" means a distribution pipeline which is designed or is intended to be operated at a pressure 700 kPa or less.

(h) "Main" means that part of a distribution system from the outlet of a regulator station and upstream of service lines.

(i) "Service line" means a distribution pipeline dedicated to serving a single consumer.

4. Design

4.1 General

In designing a new distribution system, or an addition or improvement to an existing system, a certain amount of judgment and flexibility is required. For example, some judgment is usually required in deriving the peak hour design load to serve consumers' needs. This is particularly so when the utilization of the appliances which will consume the gas cannot be forecast with a sufficient degree of accuracy. An example of the need for flexibility is a loop line, which is required to decrease the pressure drop across the system. Often, a number of optional locations exist for this loop while the loop itself can be altered in relation to its length and diameter.

In such cases, the Branch will acknowledge and generally accept the fact that the designer may select a design option of his or her own choosing. However, the Branch requests the use of an alternative design where in its opinion the alternative will be more effective and cost efficient.

4.2 Establishing Peak Hour Design Loads

In the design of a distribution system, pipe sizing is influenced primarily by the maximum hourly volume of gas, which the system is required to transport. Accordingly, if the designer is to ensure that the system design will meet (but not greatly exceed) the requirements of the consumers served by the system, peak hour design loads must be derived with a certain amount of care.

The volume of gas, which the system must transport, is determined from a combination of the following criteria:

4.2.1. Maximum Connected Load

The maximum connected load of the individual consumer can be calculated by establishing and tabulating the burner input rating of all appliances. This assumes the possibility that, for example, that a consumer may operate a furnace, water heater, clothes dryer, oven and all stove top burners at the same time. While this may not happen too often, this total potential load should be used to size the service line and, of course, the gas meters.

Establishing the maximum connected load for purposes of sizing the service line and meter is not quite so simple in cases where, for example, special agricultural equipment such as irrigation engines and grain dryers are served from the same service line and meter. Due to the seasonal utilization of this equipment, it is unrealistic to simply total the maximum burner rating of appliances and equipment. In such cases, the designer must apply some judgment.

4.2.2 Peak Design Loads

The peak design load is the hourly load which is used to size system mains and is derived by applying a "coincidence factor" to the maximum connected load. The value of the coincidence factor varies indirectly with the number of consumers being served from the main which is being sized - the greater the number of consumers, the smaller the value of the coincidence factor. For example, a main servicing a large group of consumers may be required to transport a peak design load of perhaps as little as only 50% of the total connected load of that group of consumers due to such factors as the intermittence of gas demand for heating load, the variations which exist in the personal habits of consumers, and the burner rating of furnaces relative to building heat loss. In this example, the coincidence factor of 0.5 would ensure that the main would be sized to carry sufficient but not excessive capacity to meet the needs of consumers at peak flow conditions.

4.2.3 Establishing Coincidence Factors

It is the designer's responsibility to establish realistic coincidence factors for sizing mains. The designer will recognize that each distribution system is unique in this respect due to the significant variations that exist between the number and type of consumers, the influence of seasonal loads, industrial loads that are not sensitive to ambient temperature changes, and other factors. Since the only detailed studies, which have been conducted on the subject of coincidence factors, have focused on systems servicing large cities, there are no substantive industry guidelines available to assist the designer in deriving coincidence factors for a rural gas distribution system. A designer should, therefore, establish his own guidelines based on a comparison between the theoretical pressure drop from calculation and the actual pressure drop being experienced at the lowest ambient temperature experienced.

4.2.4 Consumer Load Surveys

Where a consumer load survey is to be conducted to provide the designer with maximum connected loads and to permit extrapolation of peak design loads, the form illustrated in Figure 4.1 or an acceptable equivalent should be utilized.

Care must be taken in establishing future load requirements and the requirements for large load equipment since this information has a significant impact on system sizing and costs. While allowance should be made for future additional loads, if appropriate, the load established should be a realistic projection of the consumer's future requirements. Similarly, large load equipment should be carefully analyzed to ensure that the volume of gas set aside for this requirement is sufficient but not excessive.

4.2.5 Degree Day Method

Where it is necessary to consider the loads of existing consumers (for example, designing a loop line), the peak design load for those consumers may be reasonably estimated by considering the consumers' actual consumption for a specific billing period and the number of degree-days locally for that same period. A discussion on this method can be found in Appendix A.

The advantage of the degree-day method is that it is based on actual consumption and eliminates the need for new load surveys. Its use is, however, essentially limited to existing consumers who have generated a billing history and whose peak design load is primarily influenced by ambient temperatures, i.e. space heating purposes.

4.3 Sizing of Distribution Systems

As noted in Section 4.2, the principal factor influencing the sizing (i.e. pipe diameter) of a distribution system is the peak design load which the system is required to transport. The next most significant factor is the mathematical model used to calculate dynamic pressure loss over a segment of pipeline and hence determine its size. A number of suitable models exist which are applicable to a rural gas system design including the General Flow Equation and the IGT Flow Equation. These models, and any other comparable models that utilize the Reynolds Number for prediction of flow conditions within a distribution pipeline, are generally acceptable to the Branch.

4.4 General Design of Distribution Systems

A designer will usually have many options available for routing and sizing a new distribution system or an addition to a system to improve capacity. The location of consumers in relation to the gas source, the ability to gain right-of-entry to lands, and the terrain conditions in the area are the principal factors, which the designer must consider.

Improvements to existing distribution systems to overcome inadequate flow capacity should consider the following options:

(a) A simple loop line paralleling the existing system main for a sufficient distance. The segment of the existing system to be looped should be carefully selected to ensure maximum impact at minimum cost.

(b) As an alternative to looping, consideration should be given to interconnecting systems.

(c) Crossings of major obstacles such as railways, highways, roads and canals should not be looped unless the existing crossing is in a deteriorated condition or will create a flow bottleneck, or connecting the loop to the existing main at either side of the crossing is impractical or uneconomical due to distance, costs or other factors.

4.5 Routing of Distribution Systems

The routing selected for a new distribution system or an improvement to an existing system should be determined for a combination of the following criteria:

(a) The requirements of any government body, or any regulatory authority, having jurisdiction over the land, waterway, railway, or roadway affected by the location of pipelines on or adjacent to that property.

(b) The requirements of any landowner whose property will be directly or indirectly affected by the location of pipelines on or adjacent to that property.

(c) The requirements of any owner of a utility line whose pipeline or cable is to be traversed by a distributor’s pipelines. In addition, the designer should take account of the effect of adjacent overhead power lines on a steel or aluminum pipeline that is to be located adjacent to that power line.

(d) Any proposal to amend the use of the land in which it is proposed to locate pipelines.

(e) The sub-surface condition of the land in which it is proposed to locate pipelines. Where it is feasible to do so, location of pipelines in land with sub-surface rock, in either solid or loose formation, should be avoided.

(f) The surface condition of the land in which it is proposed to install distribution pipelines. Where it is feasible to do so, location of pipelines in swamp, muskeg, or bodies of water, or in land, which is covered by timber or dense brush, should be avoided.

(g) The possibility of soil erosion or removal. When necessary, a geotechnical study should be conducted to assist the designer in establishing effective methods of avoiding or controlling severe soil erosion which could adversely affect the condition and operation of pipelines.

(h) The location of all suitable gas sources having regard to the proximity of the majority of consumers to be served from the pipeline system supplied from the selected gas source.

(i) The ease of access to the location of pipelines for initial construction and for subsequent inspection, maintenance and repair of pipelines. Where it is feasible and within economic reason to do so, pipelines should be located by a "grid system" based on the following principles:

- Location in an east-west or north-south direction.
- Location at established parallel distances from east-west or north-south roads and fence lines.
- Changes of direction at right angles.

(j) The capital cost associated with alternative routes.

4.6 Depth of Cover and Clearance

For normal operation conditions, pipelines should be installed with the following minimum depths of cover:

(a) For service lines located within farmyards and other private properties where ground disturbances are minimal, the depth of cover may be 600 mm.

(b) For other service lines and for mains, the minimum depth of cover shall be 800 mm.

(c) For crossing of highways, roads, railways, canals, watercourses and foreign pipelines or cables, the minimum depth of cover should be determined from Section 4.7.

The minimum clearance to be maintained between a pipeline and any other facility or structure that it parallels or crosses should be in accordance with the latest edition of the CSA-Z662.

4.7 Crossings of Other Facilities

The design of any distribution pipeline crossing of highways, roads, railways, canals, watercourses and foreign pipelines or cables must receive the prior approval of the owner, administrator or authorized agent of the right-of-way or facility that is to be crossed. Typical crossing profile designs and dimensions acceptable to the Branch are illustrated in Figures 4.2 to 4.7 inclusive.

The depth of cover for buried pipelines at all crossing locations should be determined from a review of operational safety factors which may cause damage to a pipeline. These factors include stress loading, sub-surface materials, special soil cultivation methods within the right-of-way, and potential ground disturbances above or adjacent to the pipeline.

The depths of cover specified in Figures 4.2 to 4.7 inclusive should be considered only as standard dimensions that reflect the operational factors typically found at each type of facility to be crossed. However, it may very often be prudent or necessary to increase the depth of cover to address special factors that may be revealed in consultation with the owner, administrator or agent for the facility being crossed. In particular, planned improvements to highways or roads should be considered and the location and/or the depth of the crossing should take account of any development plans by the road authority.

Since the distributor is usually faced with the cost of replacing or lowering its crossing when road improvements take place, it is in the distributor's interests to initiate consultation and hence ensure that the crossing is located and designed so that it will remain undisturbed for its operational lifespan, even if future development takes place at the crossing site. This consultative process applies to the following aspects of highway or road crossings as outlined in Figures 4.2 and 4.3:

(a) The depth of cover under the lowest point in the right-of-way (usually the ditch bottom) which is, as a minimum, either 1100 mm or 1400 mm depending on the type of road being crossed (see Figure 4.3).

(b) These depths of cover should be adequate for most crossings, but should be increased if, following consultation with the road authority, it is determined that future roadway development plans will necessitate pipe replacement or lowering.

(c) The standard distance of any vertical bends from the edge of the right-of-way as specified in Figure 4.3 where this standard distance is difficult to maintain due to terrain and/or access problems, application may be made to the road authority for a lesser distance. However, where approval for a lesser distance is granted by the road authority, the distributor will have to accept the responsibility for the cost of lowering or relocating the pipeline should this be required by future roadway development.

(d) Crossings of undeveloped road allowances should only be made at the nominal installation depth of 800-mm following consultation with the road authority and confirmation that the road allowance is unlikely to be developed. If road development is planned, the crossing should be designed and installed to suit the profile of the proposed road.

4.8 Pipelines Parallel to Roads Administered by Counties and Municipal Districts

Municipal authorities are required from time to time to alter, widen or relocate the rights-of-way of roads that fall under their administration. Where a distribution pipeline exists parallel to and within proximity of the existing right-of-way of a road, the new design may require that the pipeline be relocated or lowered. While this is often unavoidable, good planning techniques can usually eliminate the need for future relocation or lowering. To facilitate good planning and avoid unnecessary pipeline relocation or lowering, a control area or zone as illustrated in Figure 4.8 should be used in the design of gas distribution systems. For distribution pipelines operating at a pressure of 700 kPa or less, the control area concept should not be considered as a minimum distance parallel to and on either side of an existing road right-of-way in which the municipal authority has the inherent right to either approve or reject a pipeline installation (it should be noted, however, that the Pipeline Act does in fact require that high pressure pipelines to be constructed under that Act shall not be located within 30 meters of the boundary of a municipal road without the approval of the local authority).

The various control areas illustrated in Figure 4.8 should be used by a designer of a low-pressure distribution pipeline to consider future planning. If an initial design of a low-pressure pipeline paralleling a municipal road falls within one of the control areas illustrated, the designer should consider the following options:

(a) Redesign the pipeline route such that it lies outside any control area.

(b) Consult with the municipal authority to determine if there is likelihood that the road may be altered, widened or relocated such that the pipeline would be affected. If necessary, the pipeline route should be redesigned to avoid future conflict with road planning. If consultation with the municipal authority indicates that there is a good possibility that future road planning should not affect the proposed pipeline route, then that route may be retained.

The basis for the consultative process related to control areas for low-pressure distribution pipelines is the mutual and common interests of the distributor and the municipal authority, as well as the need for both parties to demonstrate reasonableness. These aspects are discussed in more detail in Appendix B.

4.9 Use of Road Rights-of-way as Pipeline Rights-of-way

The use of road rights-of-way as pipeline rights-of-way in rural areas should be avoided wherever possible and should be used only where extenuating circumstances exist. In all cases, the prior approval of the road authority must be obtained before the pipeline installation can proceed and the authority must be consulted to ensure that roadway maintenance, sign installation or other work will not cause damage to or interfere with the operation of the pipeline.

Unless otherwise approved by the road authority, the pipe should be located under the bar ditch on the back slope side. The entire length of the pipeline should be placed parallel to the centerline of the road or highway maintaining a consistent offset as much as physically possible.

The minimum depth of cover as specified in Figure 4.3 should be a vertical depth measured from the lowest point of the bar ditch as illustrated in Figure 4.9. Warning signs should be installed along the entire length of the pipeline route within the road or highway rights-of-way at such frequency or intervals as are required to clearly identify the location of the pipeline. The maximum distance between warning signs should be approximately 300 meters.

This specification does not apply to pipeline installations within hamlets, subdivisions or incorporated urban areas.

FIGURE 4.1

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LOAD SURVEY FORMS FOR ALBERTA GAS UTILITIES

DISTRIBUTOR: ______________________ TELEPHONE: ______________________

N

W — E

S

NEW SURVEY ☐

RESURVEY

Changed ☐ Unchanged ☐

Customer ______________________

Phone ____________ Date of survey ____________

1/4 Section ____________ Section ____________

Township ______ Range ______ West of ______ meridian

Lot ______ Block ______ Plan No. ____________

Surveyed by ______________________

PRESENT BTU/HR REQUIREMENTS

APPLIANCE	TYPE OF BUILDING	BUILDING DIMENSIONS	BASEMENT	# OF STOREYS	BTU/HR
Furnace			Yes No		
Furnace			Yes No		
Furnace			Yes No		
C.H. boiler			Yes No		
			Yes No		
			Yes No		
			Yes No		
Water heater					
Water heater					
Clothes dryer					
Stove					
					☐

FUTURE BTU/HR REQUIREMENTS

APPLIANCE	TYPE OF BUILDING	BUILDING DIMENSIONS	BASEMENT	# OF STOREYS	YEAR	BTU/HR
			Yes No			
			Yes No			
			Yes No			
			Yes No			
						☐

LARGE LOAD EQUIPMENT

Gas engine BHP ______________________ x 12 000 BTU/HR = ☐

Maximum seasonal use ______________________ to ______________________

Number of hours in operation per day ______________________ average

Grain Dryer ☐

Maximum seasonal use ______________________ to ______________________

Other (specify) ☐

Remarks – existing meter type and size (if applicable) ______________________

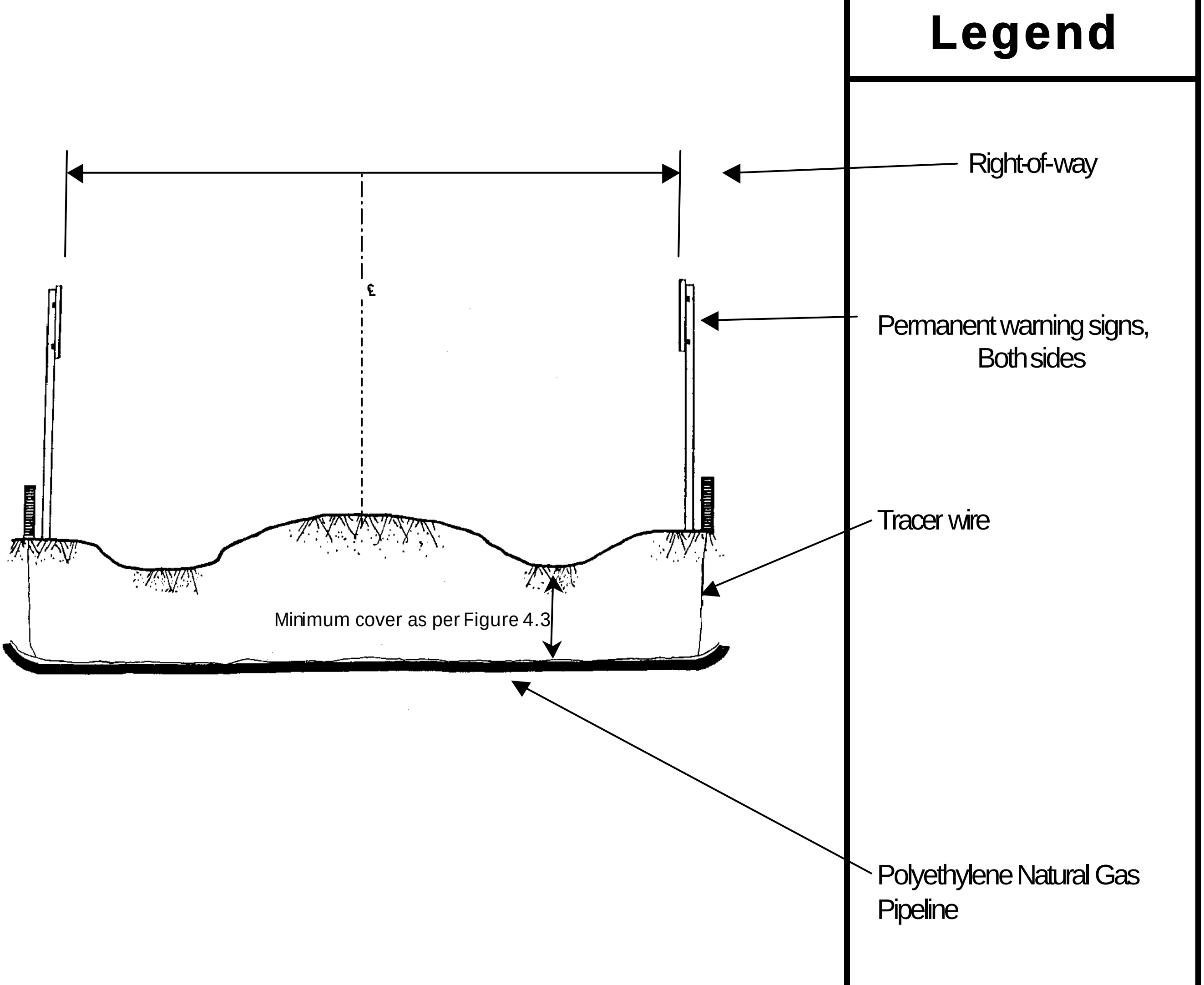

FIGURE 4.2 : TYPICAL HIGHWAY OR ROAD CROSSING

NOTES:

1. For nominal Right-Of-Way widths see Table 4.3.
2. Minimum depth of cover to be maintained for entire with of Right-Of-Way or as in Table 4.3.
3. Tracer wire to be brought to the surface ina protective sleeve on both sides of the Right-of-Way or on one side of the Right-Of-Way and laid continuously across the right-Of-Way.

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Legend

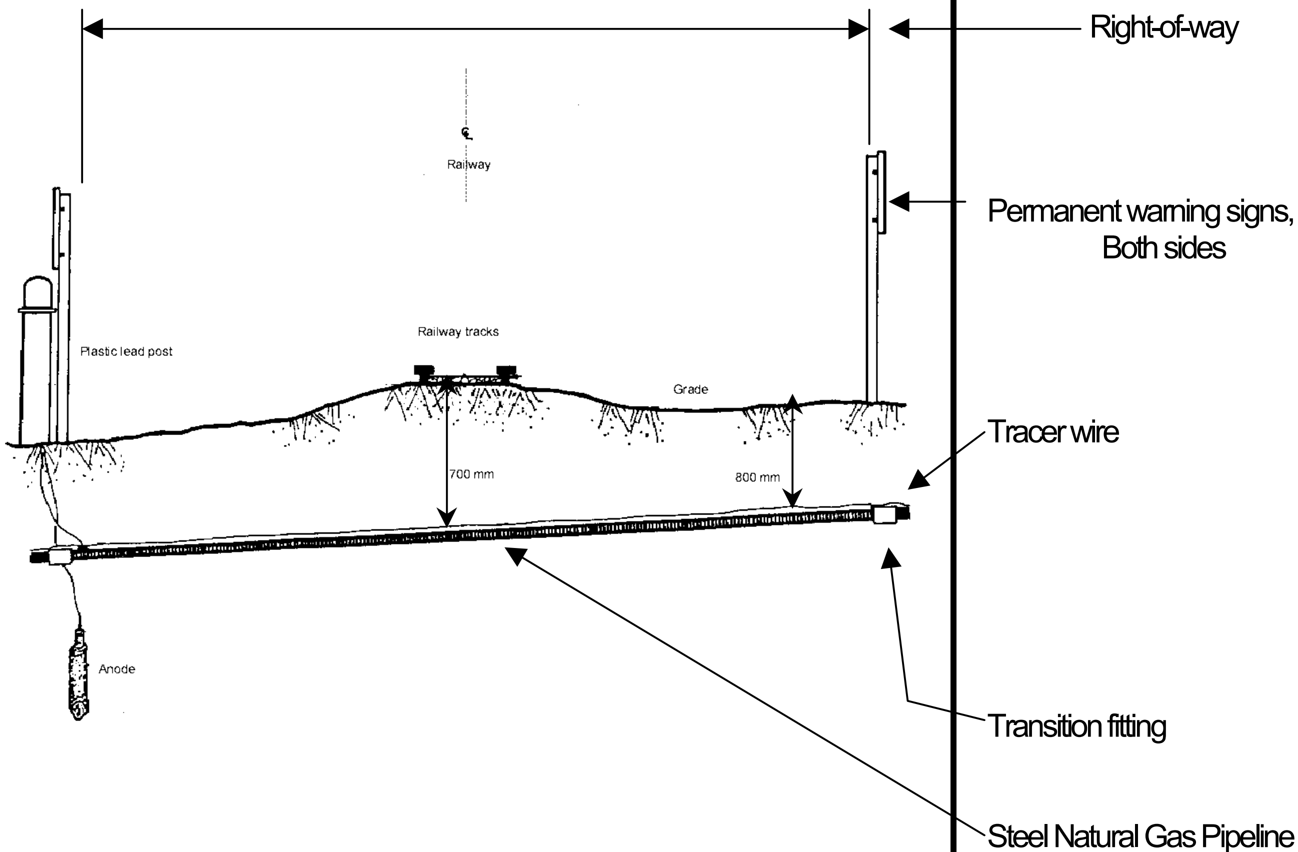

FIGURE 4.4 : TYPICAL RAILWAY CROSSING

NOTES:

1. All railway crossings to be built and maintained with General Order E10 (as revised at time of construction) by the Canadian Transport commission.
2. Crossing materials may be either uncased Schedule 40 steel carrier pipe c/w suitable coating and cathodic protection or cased SDR 11 PE with Schedule 40 steel casing. Material to be specified in consultation with railway owner.

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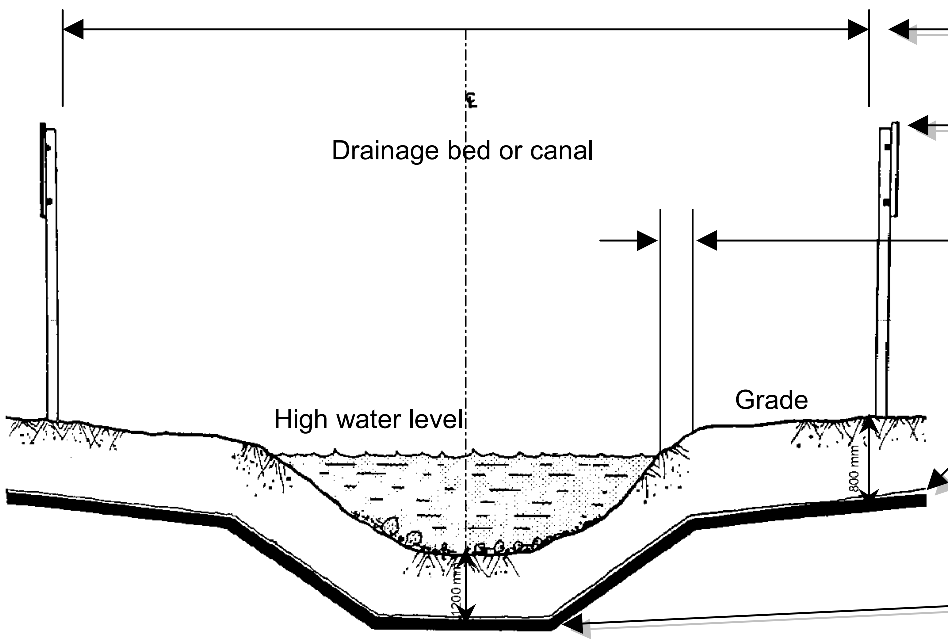

Legend

- Right-of-way
- Permanent warning signs, both sides
- 3 m backset, both sides
- Tracer wire
- Polyethylene natural gas pipeline

FIGURE 4.5 TYPICAL WATER/CANAL CROSSING

NOTES:

1. Minimum cover to be kept until 3 m backset of the high water mark.
2. Cover may depend on outcome of hydrological designs when requested by governing body.

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June 2001

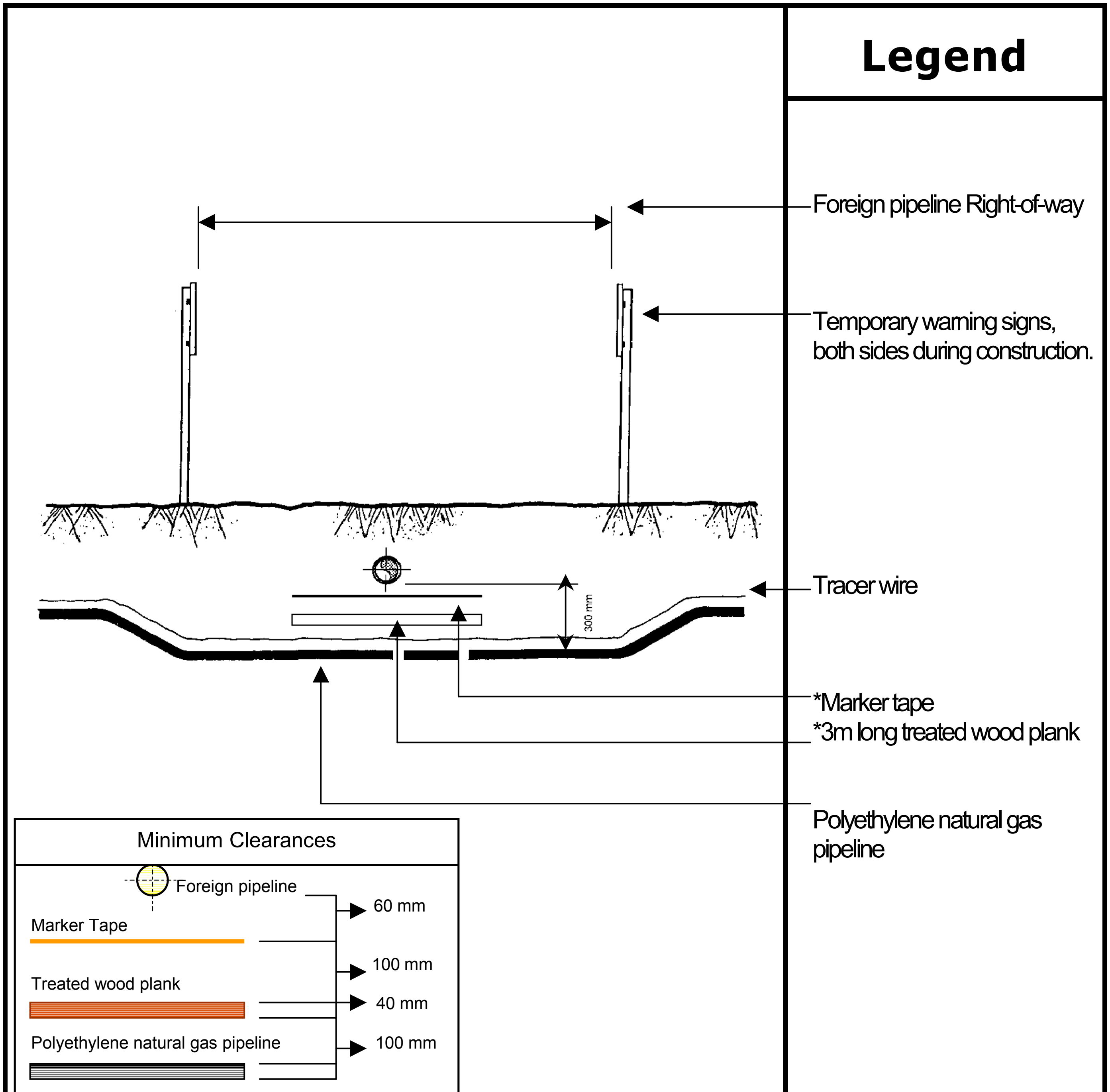

FIGURE 4.6 TYPICAL PIPELINE CROSSING

NOTES:

1. Foreign pipeline locations to be determined in the field.
2. *Installation of marker tape and treated wood plank is optional, unless specified by foreign pipeline owner

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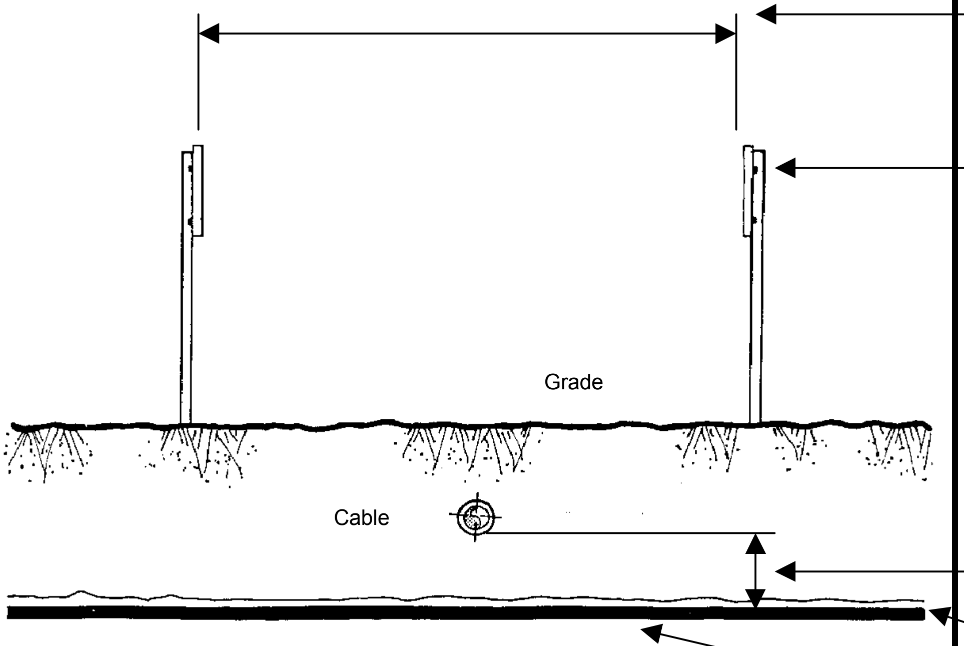
June 2001

Legend



Right-of-way

Temporary warning signs, both sides during construction if applicable.

300 mm minimum cover or as per company specifications.

Tracer wire

Polyethylene natural gas pipeline

FIGURE 4.7 TYPICAL CABLE CROSSING

NOTES:

1. Temporary warning signs during construction are optional and depend on local conditions at time of Installation.

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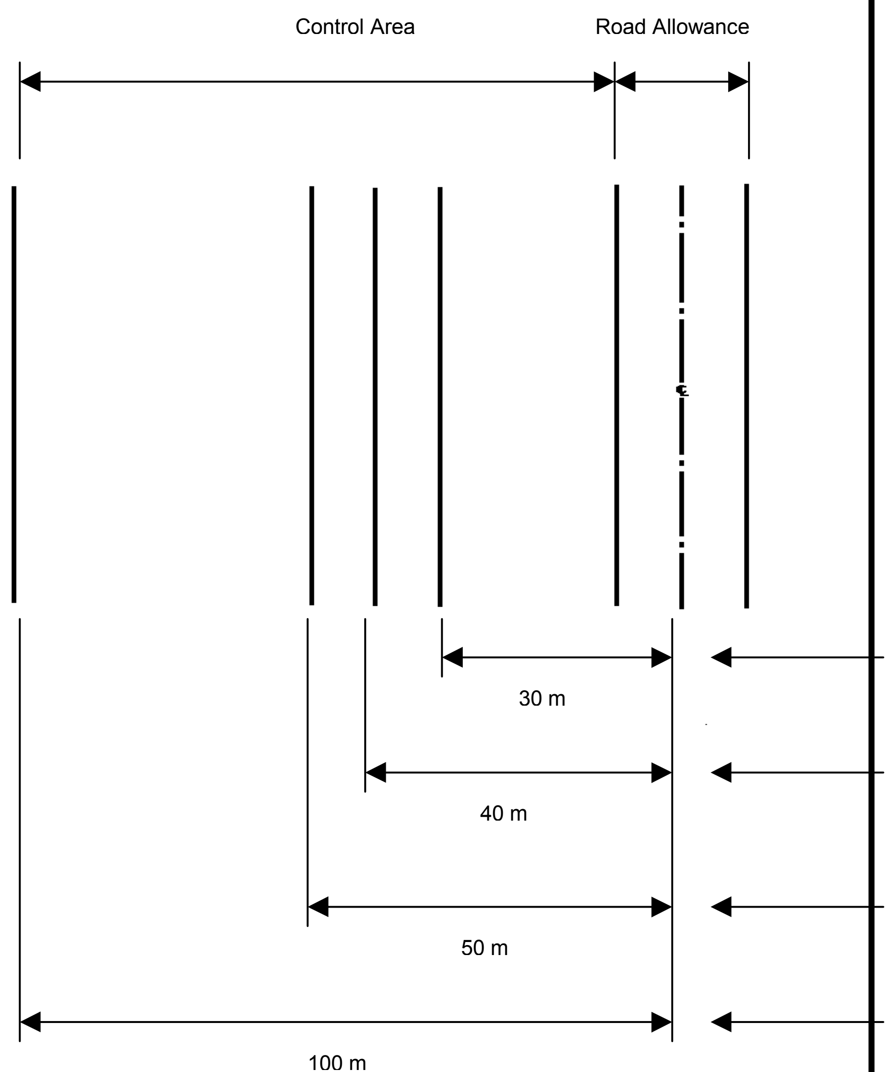

30 m from the center line of road for internal subdivision roads and service roads

40 m from the center line of road for local municipal roads on statutory road grid including forced road, road diversions and service roads along highway

50 m from the center line of road for municipal roads designated as secondary roads or park roads

100 m from the center line of any municipal roadway in areas of extreme adverse terrain conditions such as ravines and steep hills

FIGURE 4.8 CONTROL AREA FOR PIPELINES PARALLEL TO LOCAL MUNICIPAL ROADS

NOTES:

1. Normal road allowance widenings may be equal on both sides because of terrain conditions or development constraints.
2. Control area is both of the sides of the center line of roadway.

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June 2001

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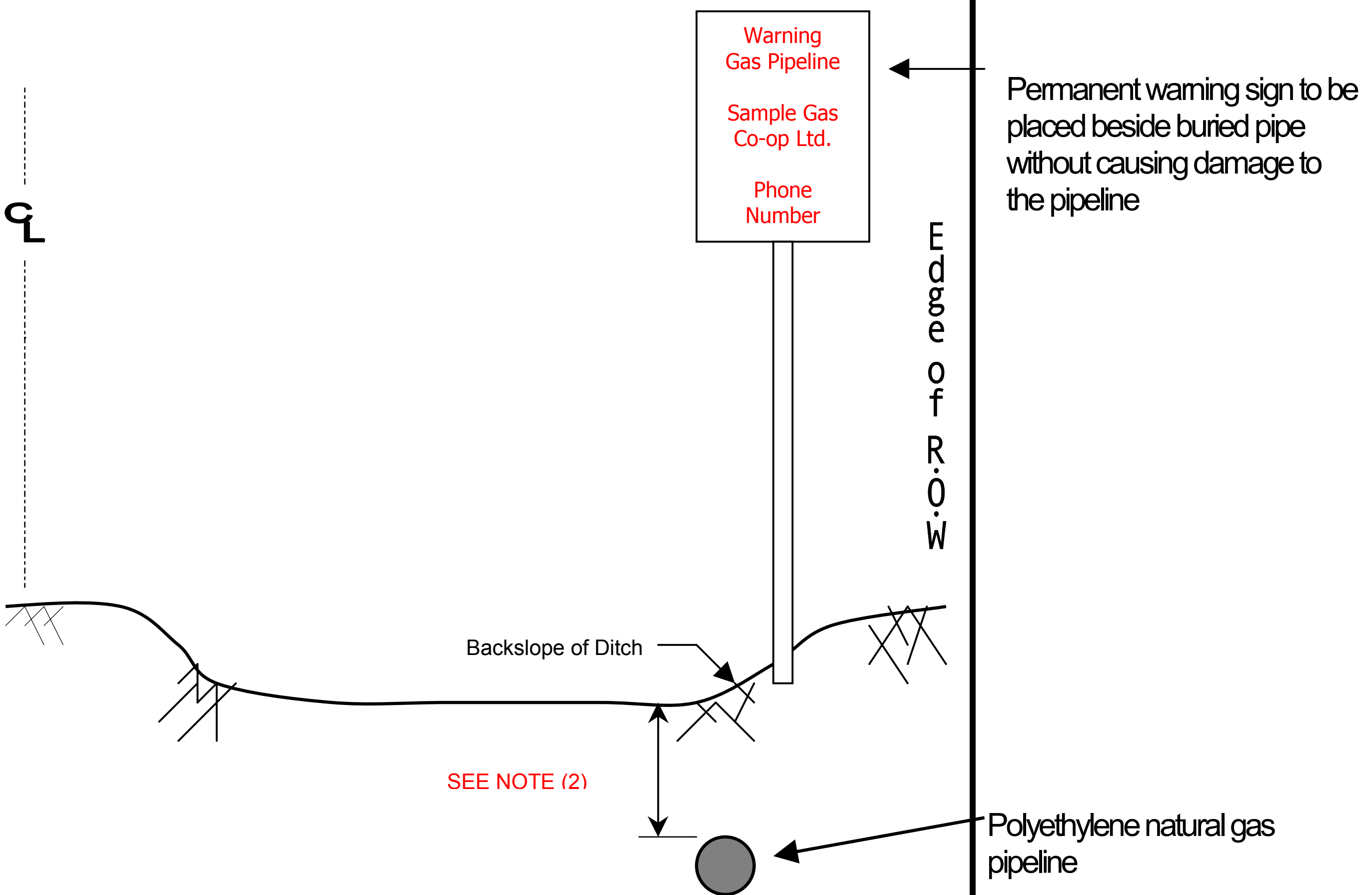

FIGURE 4.9 PIPE INSTALLATIONS IN RURAL ROAD/ HIGHWAY RIGHTS-OF-WAY

NOTES:

1. Maximum distance between warning signs shall be approximately 300 m.
2. Minimum depth of cover as outlined in Figure 4.3

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June 2001

5. Construction

5.1 General

Construction of distribution systems or pipelines which fall within the scope of this manual must not commence until the distributor is in receipt of all approvals, permits or rights-of-entry granted by regulatory authorities having jurisdiction, landowners, and the owners or administrators of any other lands or any facilities which are to be crossed. All construction must be carried out in accordance with approved designs and specifications and with recognized safety practices.

5.2 Material Specifications

All materials intended for installation within the scope of this manual must comply with the requirements of any regulatory authority having jurisdiction and with any applicable CSA standard. Gas meters and ancillary instruments and controls must comply with the requirement of Measurement Canada. In addition, only polyethylene pipe which has been released for installation under the Branch's Quality Assurance Program should be accepted for installation.

Materials should be selected in accordance with the following criteria:

(a) Safety of installation and operation.

(b) Efficiency of operation.

(c) Initial capital cost of construction.

(d) Operating and maintenance costs.

(e) Availability of spare and replacement parts during the anticipated operating life.

(f) The physical and chemical properties of the natural gas which is to be transmitted.

(g) Where applicable, the atmospheric and environmental conditions under which the materials will operate.

(h) The frequency, extent, and type of servicing which will be provided by the distributor.

Tracer wire manufactured from 16 gauge solid core copper wire with an extruded polyethylene coating should be installed simultaneously with polyethylene pipe. Above ground connectors for tracer wire should be specifically designed and manufactured to provide electrical continuity for the tracer wire.

5.3 Materials Handling

Suitable techniques should be developed to prevent damage to materials during transportation, storage, and installation. During transportation, all materials should be loaded and secured to the vehicle in a suitable manner such that damage to materials is prevented. Line pipe in particular should be protected by:

(a) Ensuring that the vehicle is free of protruding nails or other sharp objects, which could damage the pipe.

(b) Ensuring that the pipe is firmly secured and properly supported to prevent spillage from the vehicle.

Materials should be stored and handled in a suitable manner to prevent damage from mechanical handling equipment, other vehicles, and weather conditions. Line pipe should be stacked to a maximum height such that damage to bottom layers by crushing does not occur, and care should be taken to