PART 1 GENERAL

1.1 References

.1 Canada Labour Code, Canada Occupational Safety and Health Regulations.

.2 Canadian Standards Association (CSA)

.1 CSA S350-[M1980], Code of Practice for Safety in Demolition of Structures.

.3 Nunavut Territory

.1 Safety Act

1.2 Work Permit

.1 Obtain building permits related to project prior to commencement of Work.

1.3 Safety Assessment

.1 Perform site specific safety hazard assessment related to project.

1.4 Meetings

.1 Pre-construction meetings: attend health and safety pre-construction meeting.

1.5 Regulatory Requirements

.1 Comply with specified standards and regulations to ensure safe operations at site containing hazardous or toxic materials.

1.6 Responsibility

.1 Be responsible for safety of persons and property on site and for protection of persons off site and environment to extent that they may be affected by conduct of Work.

.2 Comply and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.7 Unforeseen Hazards

.1 Should any unforeseen or peculiar safety-related factor, hazard, or condition become evident during performance of Work, immediately stop work and advise Engineer verbally and in writing.

1.8 Correction of Non-Compliance

.1 Immediately address health and safety non-compliance issues identified by Engineer.

.2 Provide Engineer with written report of action taken to correct non-compliance of health and safety issues identified.

.3 Engineer may stop Work if non-compliance of health and safety regulations is not corrected.

1.9 Work Stoppage

.1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

.2 Assign responsibility and obligation to Health and Safety Officer to stop or start Work when, at Health and Safety Officer's discretion, it is necessary or advisable for reasons of health or safety. Engineer may also stop Work for health and safety considerations.

END OF SECTION

PART 1 GENERAL

1.1 Record Drawings

.1 Engineer will provide two (2) sets of white prints for record drawing purposes.

.2 Maintain project record drawings and record accurately deviations from Contract documents.

.3 Record changes in red. Mark on one set of prints and at completion and prior to final inspection, neatly transfer notations to second set and submit both sets to Engineer.

.4 Record following information:

.1 Depths of various elements of buried piping and culverts, etc. in relation to project benchmark.

.2 Horizontal and vertical location of underground utilities and appurtenances referenced to project benchmark.

.3 Location of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of structure.

.4 Field changes of dimension and detail.

.5 Changes made by Change Order or Field Instruction.

.5 Redlined drawings:

.1 Redlined drawings must be completed by the Contractor and submitted to Engineer for review. Provide final redlined copies including all necessary changes.

.2 Provide reduced copies of as-built drawings for inclusion in final Operation and Maintenance Manual.

.3 Provide to Engineer two copies of final as-built drawings.

.4 Substantial Completion WILL NOT be awarded without completed as-built drawings.

END OF SECTION

PART 1 GENERAL

1.1 Operations and Maintenance Manual

.1 Operations and Maintenance Manuals for the project will be compiled and presented to the Consultant by the Contractor, as outlined in Section 2.1.2.

.2 Manuals are to cover all installed items requiring or likely to require operating, maintenance, or repairs.

.3 The Contractor's work includes: the complete authoring, organization, and supply of O&M manual material as detailed in this section.

.4 All work described in this section is the Contractor's work except where specifically indicated otherwise.

.5 The number of copies required is five (5).

.6 The draft Operation and Maintenance manual is to be submitted for review by the Engineer a minimum of six weeks prior to substantial completion.

.7 The final approved and completed Operation and Maintenance Manuals are to be delivered to the Engineer at least 14 days before the Substantial Completion inspection. Deliver any outstanding information prior to requesting final inspection. The data is to be separated into individual manual sets, organized into applicable categories of work parallel to the specification sections and each chapter in order and identified.

.8 Substantial Completion WILL NOT be awarded without completed Operation and Maintenance Manuals.

1.2 Reference Standards

.1 The Contractor's Operation and Maintenance manual submissions are to conform to the current edition of "Specifications for Operations and Maintenance Manuals", Department of Public Works and Services, Government of Nunavut.

PART 2 FORMAT

2.1 Organization

.1 The provision of Binders and Dividers are the responsibility of the Consultant.

.2 The completed manual will contain 10 chapters. The responsibility for production of each chapter is indicated below:

.1 Introduction (by Engineer)

.2 Index (by Contractor)

.3 Background, Design Data (by Engineer)

.4 Schematic, Functional Data (by Engineer)

.5 Components Details (by Contractor)

.6 Operating Procedures (by Contractor)

.7 Maintenance Procedures (by Contractor)

.8 Testing and Certification Data (part by Contractor)

.9 Manufacturer Data and Service Information (by Contractor)

.10 Appendices (by Engineer)

.3 Group information logically by system within chapters to the greatest possible extent. Organize the information on each system in the most logical fashion, for example, from supply point through to point of use.

2.2 Language

.1 English for all information.

2.3 Testing and Certification Data (Chapter 8)

.1 Provide data sheets that provide actual operating conditions after the systems have been balanced or adjusted to design conditions. Data required includes balancing of air and water systems, final control settings, field check data on all motors including rpm, voltage, phase, and actual current under normal loads, alignment certificates from millwrights, electrical load balancing, etc.

.2 Include all data sheets recording concrete test results, data tests for leakage, drain operation, ground test, pump capacity tests, etc.

.3 List all items that require periodic inspection by independent inspectors. List the frequency of inspection, the inspection agency to contact, including address and current phone number.

.4 Include a photocopy of each certificate issued by the independent inspectors who make inspections pursuant to health, safety, and other regulations of a similar nature. Indicate where the original of each such certificate is filed and where it is to remain displayed.

.5 Include the originals of manufacturer's warranties in Copy 1 of the manual.

.6 Include clear, legible photocopies in copies 2 through 5.

.7 Group warranties together to form a section in Chapter 8.

2.4 Manufacturer's Information (Chapter 9)

.1 This chapter of the Operation and Maintenance manual provides a collection of all manufacturer's service manuals, parts lists, operating and maintenance instructions, performance curves, and other applicable data that may be required in future years.

.2 Include information needed for operation, maintenance and repair of every component of mechanical and electrical systems, and any other system requiring or likely to require operation or routine maintenance.

.3 Preface this section with an index. List in order each item by the manufacturer's name and the pieces of equipment to which it refers. Include supplier's name, address, and phone number.

.4 Include:

.1 Maintenance instructions for finished surface and materials.

.2 Copy of hardware and paint schedules.

.5 Include all service manuals, data sheets, and other manufacturer's information for each component.

.6 Manufacturer's information is to be original in all copies of the manual. Photocopies are not acceptable.

.7 On the first page of each inclusion, identify the piece of equipment to which it refers. Include nameplate information such as model, size, capacity, serial number, etc.

.8 Remove pages from manufacturer's information that are irrelevant to the equipment provided to this project.

.9 Where tables and curves are given for the full range of sizes, underline in red in all copies the data that refers to the installed equipment. If more than one size or type in the same table was used, add the identification for each in the margin to assist positive identification. Draw a thick diagonal black line across all data not applicable to equipment provided.

.10 If any warning instructions are included which, if ignored, could significantly affect the equipment, mark these with red arrows in all copies, to draw to the operator's attention.

.11 Service manuals must be the operating and maintenance type, which gives parts lists, preferably including an exposed or sectioned drawing for guidance in assembling, installation details, lubrication, and operations details. Sales types of brochures, which give only a very general description and few details, are not acceptable.

.12 Mount any items that are smaller than 8½"x 11", on a full page, for inclusion in the manual.

.13 Include all wiring diagrams complete with wire coding.

END OF SECTION

PART 1 GENERAL

1.1 General

.1 The contractor shall contact the operating personnel at the beginning of the project and encourage them to come on site at least once a week for the duration of the project. During these periods, the Contractor give a full explanation of the various systems as the project progresses.

.2 Maintain a log of all site visits. Maintenance personnel that login/out are to be witnessed by the Contractor. Provide the log record to the Engineer at the Substantial Completion inspection.

1.2 Related Work

.1 Commission the various process, mechanical, electrical, and control systems for the work performed under this project, and any changes to the rest of the system as a result of the completed work.

.2 See specific specification sections for additional and/or detailed procedures for commissioning.

1.3 Submissions

.1 The Contractor shall furnish his detailed methodology and schedule for the commissioning of each plant process at least twenty (20) working days prior to planned start of commissioning for the process. The plan shall include the following:

.1 Detailed schedule of events.

.2 Methods for introducing flow, disposing of partially treated water, and disposing of any waste generated during commissioning.

.3 Planned attendance of manufacturer's representatives.

.4 Contingency plans in the event of a process malfunction.

.5 Drawings and sketches as required to illustrate the planned sequence of events.

.2 The Contractor and Engineer shall discuss and mutually agree to the provisions of the commissioning plan.

1.4 Co-ordination

.1 The Contractor shall co-ordinate with Subcontractors to ensure their attendance as necessary to make any adjustments or to facilitate any minor repairs during commissioning.

1.5 Inspection/Take-over Procedures

.1 Two weeks prior to the Substantial Completion inspection, operating personnel shall be given instruction for a period of one week with a minimum of two hours per day. Instruction is to be provided during regular work hours. Languages of instruction to be in English.

.2 Prior to application for Substantial or Final Certificate of Completion, carefully inspect the work and ensure it is complete, that major and minor construction deficiencies are complete and/or corrected and the building is clean and in condition for occupancy. Notify the Engineer in writing, of satisfactory completion of the work and request an inspection.

.3 During the inspection, the Engineer will prepare a list of deficiencies and defects. Correct all deficiencies identified.

.4 When the deficiencies and defects have been corrected and requirements of the Contract have been performed, make application for Certificate of Final Completion. Refer to General Conditions Article GC43, Engineer's Certificates for specifics to application.

.5 When the above requirements have been met, set date for final inspection.

.6 In the event the facility is not ready for commissioning or cannot be successfully commissioned on the date set for commissioning and the Contractor has not notified the Engineer in sufficient time to prevent unnecessary travel, the Contractor shall pay for travel and accommodation costs for subsequent trips by the Engineer and Owner and all of their agents and representatives.

.7 The Certificate of Final Completion will not be issued until all requirements of the Contract have been met.

PART 2 PRODUCTS

2.1 Equipment

.1 All process equipment shall be satisfactorily installed and tested as per the requirements of the specifications and drawings. The electrical and the control systems and any related services pertaining to each piece of equipment shall be completed and shall be operational.

2.2 Power

.1 Be responsible for all electrical power and fuels used during commissioning.

2.3 Chemicals

.1 Supply all chemicals required to satisfactorily complete commissioning.

2.4 Manpower

.1 Supply all staff required during commissioning necessary to operate the plant processes.

.2 Once a process has been successfully commissioned, provide supervisory staff to train and supervise the Owner's staff for a period of three (3) full day while still being responsible for the operation of the plant until turnover.

2.5 Systems

.1 The systems which must be commissioned include; but are not limited to:

.1 Transmission pipeline main and freeze protection system.

.2 Alarms, monitoring and metering.

.3 Motor controls.

.4 Chlorination system.

.5 Heating system

PART 3 EXECUTION

3.1 Preparation

.1 Each item of process equipment included in the process system to be commissioned shall be satisfactorily tested.

.2 Piping systems shall be finished and tested.

.3 All services shall be operational.

.4 Electrical connections shall be complete and inspected if required by the permit to the satisfaction of the governing authorities.

.5 Control systems shall be fully operational.

3.2 Sequence

.1 The process systems shall be commissioned from upstream to downstream.

3.3 Commissioning

.1 Raw water will be introduced in a manner that precludes the damage of any equipment or structures.

.2 For a period of twenty-four (24) hours, twice during commissioning, each process system shall be subjected to flows and loads as close to design conditions as possible. Where necessary to achieve this, augment flows from other sources or operate a part of the system at any time to exaggerate the naturally occurring flows and loads.

.3 Operate all systems in automatic, manual-remote and manual-local modes as applicable.

.4 Ensure all bypasses and backup provisions function satisfactorily.

.5 Induce all minor and major process alarm conditions. Ensure the process reacts as designed, and the applicable alarms are annunciated.

3.4 Testing

.1 Acquire all samples as directed by the Engineer to provide a basis for process evaluation.

.2 Arrange and be responsible for the transportation to a qualified laboratory of all the samples to be tested at an outside facility. Be responsible for the analyses and communication of results to the Engineer.

.3 Co-operate with the Engineer in undertaking all analyses of samples to be tested at the plant.

3.5 Acceptance

.1 The commissioning of a continuously operating process, mechanical or electrical system, shall be considered acceptable when the system has operated in a stable manner, satisfying the specified basic design criteria for a period of fourteen (14) consecutive days.

.2 Where a system operates intermittently, commissioning shall be considered acceptable when the system has been operated in a stable manner, satisfying the specified basic design criteria, as often as required during a period of fourteen (14) consecutive days but in no case less than four (4) days.

END OF SECTION

PART 1 GENERAL

1.1 Related Sections

.1 Section 02559 - Factory Pre-insulated Piping Systems for Utility Applications

.2 Section 02561 – Pre Fabricated Steel Vaults.

1.2 References

.1 American Society for Testing and Materials (ASTM)

.1 ASTM C 117- 95, Test Method for Material Finer Than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.

.2 ASTM C 136- 95a, Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.3 ASTM D 422- 63(1990), Test Method for Particle-Size Analysis of Soils.

.4 ASTM D 698- 91, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3) (600 kN-m/m^3).

.5 ASTM D 4318- 95, Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.1- 88, Sieves, Testing, Woven Wire, Inch Series.

.2 CAN/CGSB-8.2- M88, Sieves, Testing, Woven Wire, Metric.

.3 Canadian Standards Association (CSA)

.1 CAN/CSA-A23.1- 94, Concrete Materials and Methods of Concrete Construction.

1.3 Definitions

.1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.

.1 Rock : any solid material in excess of 0.25 m^3 and which cannot be removed by means of duty mechanical excavating equipment having a 0.95 to 1.15 m^3 bucket. Frozen material not classified as rock.

.2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.

.2 Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

.3 Waste material: excavated material unsuitable for use in work or surplus to requirements.

.4 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of work.

.5 Unsuitable materials:

.1 Weak and compressible materials under excavated areas.

.2 Frost susceptible materials under excavated areas.

.3 Frost susceptible materials:

.1 Fine grained soils with plasticity index less than 10 when tested to ASTM D 4318, and gradation within limits specified when tested to ASTM D 422 : Sieve sizes to CAN/CGSB-8.1.

.2 Table

Sieve Designation	% Passing
2.00 mm	100
0.10 mm	45 - 100
0.02 mm	10 - 80
0.005 mm	0 - 45

.3 Coarse-grained soils containing more than 20 % by mass passing 0.075 mm sieve.

.6 Unshrinkable fill: very weak mixture of Portland cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.4 Samples

.1 Submit samples in accordance with Section 01330 - Submittal Procedures.

.2 Inform Engineer at least 4 weeks prior to commencing work, of proposed source of fill materials and provide access for sampling.

.3 Submit 70 kg samples of type of fill specified.

.4 Ship samples prepaid to Yellowknife, in tightly closed containers to prevent contamination.

1.5 Protection of Existing Features

.1 Existing buried utilities and structures:

.1 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.

.2 Prior to commencing excavation work, notify applicable owner or authorities having jurisdiction, establish location and state of use of buried utilities and structures. Owners or authorities having jurisdiction to clearly mark such locations to prevent disturbance during work.

.3 Confirm locations of buried utilities by careful test excavations.

.4 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.

.5 Where utility lines or structures exist in area of excavation, obtain direction of Engineer before removing or re-routing. Costs for such work to be paid by Owner.

.6 Record location of maintained, re-routed and abandoned underground lines.

.2 Existing buildings and surface features:

.1 Conduct, with Engineer , condition survey of existing buildings and other plants, fencing, service poles, wires, survey bench marks and monuments which may be affected by work.

.2 Protect existing buildings and surface features from damage while work is in progress. In event of damage, immediately make repair to approval of Engineer.

.3 Where required for excavation, cut roots or branches as approved by Engineer.

1.6 Shoring, Bracing and Underpinning

.1 Protect existing features in accordance with Section 01560 - Temporary Barriers and Enclosures and applicable local regulations.

.2 Engage services of qualified professional engineer who is registered or licensed in Nunavut, Canada in which work is to be carried out to design and inspect cofferdams, shoring, bracing and underpinning required for work.

.3 Submit design and supporting data at least 2 weeks prior to commencing work.

.4 Design and supporting data submitted to bear stamp and signature of qualified professional engineer registered or licensed in Nunavut, Canada.

PART 2 PRODUCTS

2.1 Materials

.1 Type 1 and Type 2 fill: properties to the following requirements:

.1 Crushed, pit run or screened stone, gravel or sand.

.2 Gradations to be within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.1.

.3 Table

Sieve Designation	% Passing	
	Type 1	Type 2
75 mm	-	100
50 mm	-	-
37.5 mm	-	-
25 mm	100	-
19 mm	75-100	-
12.5 mm	-	-
9.5 mm	50-100	-
4.75 mm	30-70	22-85

Sieve Designation	% Passing	
	Type 1	Type 2
2.00 mm	20-45	-
0.425 mm	10-25	5-30
0.180 mm	-	-
0.075 mm	3-8	0-10

.2 Type 3 fill: selected material from excavation or other sources, approved by Engineer for use intended, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse or other deleterious materials.

.3 Unshrinkable fill: proportioned and mixed to provide:

.1 Maximum compressive strength of 0.4 MPa at 28 days.

.2 Maximum Portland cement content of 25 kg/m^3.

.3 Minimum strength of 0.07 MPa at 24 h.

.4 Concrete aggregates: to CAN/CSA-A23.1.

.5 Portland cement: Type 10.

.6 Slump: 160 to 200 mm.

PART 3 EXECUTION

3.1 Site Preparation

.1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

.2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

3.2 Stripping of Topsoil

.1 Commence topsoil stripping of areas as directed by Engineer after area has been cleared of brush, weeds and grasses and removed from site.

.2 Strip topsoil to depths as directed by Engineer. Do not mix topsoil with subsoil

.3 Stockpile in locations as directed by Engineer. Stockpile height not to exceed 2 m.

.4 Dispose of unused topsoil as directed by Engineer.

3.3 Stockpiling

.1 Stockpile fill materials in areas designated by Engineer. Stockpile granular materials in manner to prevent segregation.

.2 Protect fill materials from contamination.

3.4 Excavation

.1 Excavate to lines, grades, elevations and dimensions as indicated Engineer.

.2 Excavation must not interfere with normal 45° splay of bearing from bottom of any footing.

.3 For trench excavation, unless otherwise authorized by Engineer in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.

.4 Dispose of surplus and unsuitable excavated material off site.

.5 Do not obstruct flow of surface drainage or natural watercourses.

.6 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

.7 Notify Engineer when bottom of excavation is reached.

.8 Obtain Engineer approval of completed excavation.

.9 Remove unsuitable material from trench bottom to extent and depth as directed by Engineer.

.10 Correct unauthorized over-excavation as follows:

- .1 Fill under bearing surfaces and footings with fill concrete.
- .2 Fill under other areas with Type 2 fill compacted to not less than 90 % of corrected maximum dry density.

.11 Hand trim, make firm and remove loose material and debris from excavations. Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil. Clean out rock seams and fill with concrete mortar or grout to approval of Engineer.

3.5 Fill Types and Compaction

.1 Use fill of types as indicated. Compaction densities are percentages of maximum densities obtained from ASTM D 698.

.2 Place bedding and surround material in unfrozen condition.

3.6 Backfilling

.1 Vibratory compaction equipment: Use a hand compactor in trench. Use of sidewalk tamper not permitted. Use jumping jack for pipe bedding.

.2 Do not proceed with backfilling operations until Engineer has inspected and approved installations.

.3 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.

.4 Do not use backfill material that is frozen or contains ice, snow or debris.

.5 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.

.6 Backfill around pipe to proceed such that the backfill on both sides of pipe are brought up at the same rate.

.7 Place unshrinkable fill in areas as indicated. Consolidate and level unshrinkable fill with internal vibrators.

.1 Place bedding and surround material as specified elsewhere.

.2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.

.3 Place layers simultaneously on both sides of installed work to equalize loading. Difference not to exceed 1 m.

3.7 Restoration

.1 Upon completion of work, remove waste materials and debris, trim slopes, and correct defects as directed by Engineer.

.2 Replace topsoil as directed by Engineer.

.3 Reinstate pavement and sidewalks to elevation that existed before excavation.

.4 Clean and reinstate areas affected by work as directed by Engineer.

END OF SECTION

PART 1 GENERAL

1.1 Related Work

Section 02315 Excavating, Trenching and Backfilling

1.2 References

.1 ASTMC518- 91, Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

.2 ASTMD638M- 89, (D638-90), Test Method for Tensile Properties of Plastics.

.3 ASTMD1248- 84(1989), Specification for Polyethylene Plastics Molding and Extrusion Materials.

.4 ASTMD1505- 90, Test Method for Density of Plastics by the Density-Gradient Technique.

.5 ASTMD1621- 73(1979), Test Method for Compressive Properties of Rigid Cellular Plastics.

.6 ASTMD1622- 88, Test Method for Apparent Density of Rigid Cellular Plastics.

.7 ASTMD2657- 90, Practice for Heat Joining of Polyolefin Pipe and Fittings.

.8 ASTMD2837- 90, Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.

.9 ASTMD2856- 87, Test Method for Open Cell Content of Rigid Cellular Plastics by the air Pycnometer.

.10 ASTMF714- 90, Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

.11 ASTMG14- 83, Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test).

.12 CAN/CSA-B137.1- M89, Polyethylene Pipe, Tubing and Fittings for Cold Water Pressure Services.

1.3 Product Data

.1 Submit product data in accordance with Section 01330 - Submittal Procedures.

1.4 Material Certification

.1 At least 4 weeks prior to commencing work submit manufacturer's test data and certification that materials meet requirements of this section.

.2 Record Drawings

.3 Provide data necessary to produce record drawings on project completion in accordance with the following requirements:

.1 Give details of pipe material, location of fittings, maintenance and operating instructions.

PART 2 PRODUCTS

2.1 Carrier Core Pipe

.1 Polyethylene pressure pipes to CSAB137.1 ASTMF714:

.1 Type PE3408 for ASTMF714, DR 17.

.2 Pressure rating:

.1 DR 17 for ASTMF714.

.2 Polyethylene to polyethylene joints: thermal butt fusion joined to ASTMD2657.

.3 Polyethylene fittings: to AWWA C906 for pipe sizes NPS4 to NPS63.

2.2 Factory Applied Insulation

.1 Pipes to be cleaned of surface dust or dirt and treated if necessary to ensure positive bond of foam to entire pipe surface.

.2 Material: rigid polyurethane foam factory applied.

.3 Insulation thickness: 50 mm.

.4 Density: to ASTMD1622, 0.032 to 0.048g/cm^3.

.5 Closed cell content: to ASTMD2856, 90 % minimum.

.6 Water absorption: to ASTMD2842, 4.0 g/1000 cm^3, maximum 4.25% by volume.

.7 Compressive strength: to ASTMD1621, up to 240 kPa.

.8 Thermal conductivity: to ASTMC518, 0.022 to 4 W/m C°.

.9 Service Temperature: minus 45°C to plus 120°C.

.10 Centering of pipe within insulation: no more than plus or minus 6mm off center.

.11 Protect insulation on both ends of pipe from moisture and sunlight by 3mm thick continuous concentration of black asphalt mastic compound.

2.3 Outer Jacket for Buried Applications

.1 Material: factory applied high-density polyethylene jacket, black in colour (UV inhibited).

.2 Density of HDPE jacket: to ASTMD1505, 0.940 g/cm^3 minimum.

.3 Sealant: synthetic polymers or modified rubber mastic.

.4 Jacket thickness: 1.14 mm minimum.

.5 Elongation: to ASTMD638, 400 % maximum 6 month test.

.6 Service temperature: minus 45 °C to plus 120 °C maximum.

.7 Water vapour transmission rate: 3 g/m^2/24 h average.

.8 Tensile strength: 25 kg/cm width minimum.

.9 Impact strength: to ASTMG14, 7.79 N/m at minus 40 °C minimum.

2.4 Insulated Pipe Joints for Buried Applications

.1 Material: rigid polyurethane half shells with heat shrink sleeves and mastic sealant to provide moisture-proof seal.

.2 Pre-formed rigid polyurethane halves, as indicated, with properties as described in paragraph 2.2.

.3 Heat shrink sleeves: adhesive coated cross-linked polyethylene sleeve.

.4 Sleeves: to cover entire exposed joint length plus overlap of about 100 mm of pipe coating on either side.

.5 Waterproofing mastic sealant for coating exposed ends of insulation after field cutting or trimming has been carried out: as described in paragraph 2.7.3.

2.5 Insulation Kits for Fittings

.1 Material: rigid urethane foam with fully bonded FRP glass reinforced polyester or polymer protective coating on all exterior surfaces including ends. Kits to be supplied complete with silicone caulking for seams, stainless steel attachment straps and clips, and heat shrink sleeves to seal between pipe and insulation cover.

.2 Rigid urethane foam insulation.

.1 Density: to ASTMD1622, 0.03 g/cm^3 minimum.

.2 Compressive strength: to ASTMD1621, 137 kPa minimum.

.3 Closed cell content: 92 % minimum.

.4 Water absorption: to ASTMD2842, 0.02g/m^2.

.5 K Factor: to ASTMC518, 0.02 W/m°C maximum.

.3 FRP coating.

.1 Glass reinforced polyester fully bonded to insulation.

.2 Laminating resin black in colour, UV inhibited.

.3 Thickness: 2.54 mm minimum.

.4 Exterior surface: resin-rich hot coat of 0.25 mm minimum thickness.

.4 Polymer coating: to ASTMD3574.

.1 Two component high density polyurethane coating, black in colour.

.2 Density: 1170 kg/m 2 .

.3 Abrasion: durometer D scale: 60.

.4 Tensile strength: 11,000 kPa minimum.

.5 Tear strength: 26.5 N/mm minimum.

2.6 Insulation Accessories

.1 Heat shrink tape for sealing insulation half shells against moisture adaptable to flexible installations.

.1 Crosslinked polyolefin backing with a hot melt adhesive coating.

.2 Backing thickness: 0.35 mm minimum.

.3 Adhesive thickness: 0.51 mm.

.4 Service temperature: minus 18 to plus 20 °C maximum.

.5 Tensile strength: 16 N/mm.

.2 High density polyethylene tape for minor repair of the outer jacket or completion of straight insulation joints in field where irregular surfaces are not involved.

.1 Adhesive backed tape to be heated to approximately 50°C prior to installation.

.2 Backing thickness: 0.50 mm average.

.3 Adhesive thickness: 0.127 mm average.

.4 Service temperature: minus 34 to plus 82 °C.

.5 Tensile strength: 10 N/mm.

.6 Colour: black.

.3 Asphalt mastic vapour barrier coating to waterproof exterior surfaces of half shells or sprayed in place foam.

.1 Colour: black.

.2 Solids by volume: 62%.

.3 Coverage: 14 L at 9.0 m^2.