

Glossary

Abrasion - Wear or scour by hydraulic traffic.

Abrasion and Scratch Resistance - Ability of a material to resist the infliction of damage in the form of scratches, grooves and other minor imperfections.

Abutment - A wall supporting the end of a bridge or span, and sustaining the pressure of the abutting earth.

Acceptance - By the owner of the work as being fully complete in accordance with the contract documents.

Action - A positively charged ion which migrates through the electrolyte toward the cathode under the influence of a potential gradient.

Addenda - Written or graphic instruments issued prior to the execution of the agreement, which modify or interpret the contract documents, drawings and specifications, by addition, deletions, clarifications or corrections.

Additive - A substance added in a small amount for a special purpose such as to reduce friction, corrosion, etc.

Aerial Sewer - An unburied sewer (generally sanitary type) supported on pedestals or bents to provide a suitable grade line.

Aerobic - Presence of unreacted or free oxygen (O_2).

Aggressive - A property of water which favors the corrosion of its conveying structure.

Aggressive Index (AI) - Corrosion index established by the American Water Works Association (AWWA) Standard C-400; established as a criterion for determining the corrosive tendency of the water relative to asbestos-cement pipe; calculated from the pH, calcium hardness (H), and total alkalinity (A) by the formula $AI = pH + \log_{10}(A \times H)$

Agreement - The written agreement between the owner and the contractor covering the work to be performed; the contract documents are attached to and made a part of the agreements. Also designated as the contract.

Alkalinity - The capacity of a water to neutralize acids; a measure of the buffer capacity of a water. The major portion of alkalinity in natural waters is caused by (1) hydroxide, (2) carbonates, and (3) bicarbonates.

Anaerobic - An absence of unreacted or free oxygen [oxygen as in H_2O or Na_2SO_4 (reacted) is not "free"].

Angle of Repose - The angle which the sloping face of a bank of loose earth, gravel, or other material, makes with the horizontal.

Anode - (opposite of cathode) The electrode at which oxidation or corrosion occurs.

Apparent Tensile Strength - A value of tensile strength used for comparative purpose that is determined by tensile testing pipe rings in accordance with ASTM D 2290. This differs from true tensile strength of the material due to a bending moment induced by the change in contour of the ring as it is tested. Apparent tensile strength may be at yield, rupture or both.

Apparent Tensile Yield - The apparent tensile strength calculated for the yield condition.

Application for Payments - The form furnished by the engineer which is to be used by the contractor in requesting progress payments, and an affidavit of the contractor that progress payments theretofore received from the owner on account of the work been applied by the contractor to discharge in full all of the contractor's obligations stated in prior applications for payment.

Approval - Accept as satisfactory.

Aqueous - Pertaining to water; an aqueous solution is a water solution.

Areaway - A paved surface, serving as an entry area basement or subsurface portion of a building, which is provided with some form of drainage that may be connected to a sewer line.

ASTM - American Society of Testing and Materials and technical organization formed for the development of standards on characteristics and performance of materials, products, systems and services, and the promotion of related knowledge.

Available Water - Water necessary for the performance of work, which may be taken from the fire hydrant nearest the worksite, given conditions of traffic and terrain which are compatible with the use of the hydrant for performance of work.

Backfill Density - Percent compaction for pipe backfill (required or expected).

Base (course) - A layer of specified or selected material of planned thickness, constructed on the subgrade (natural foundation) or subbase for the purpose of distributing load, providing drainage or upon which a wearing surface or a drainage structure is placed.

Base Resin - Plastic materials prior to compounding with other additives or pigments.

Batter - The slope or inclination from a vertical plane, as the face or back of a wall.

Bedding - The earth or other material on which a pipe or conduit is supported.

Berm - The space between the toe of a slope and excavation made for Bedding – The earth or other material on which a pipe or conduit is supported.

Bid - The offer or process of the bidder submitted on the prescribed form setting forth the prices for the work to be performed.

Bidder - Any person, firm, or corporation submitting a bid for the work.

Biological Corrosion - Corrosion that results from a reaction between the Pipe material and organisms such as bacterial, algae, and fungi.

Bituminous (coating) - Of or containing bitumen; as asphalt or tar.

Bonds - Bid, performance and payment bonds and other instruments of security furnished by the contractor and his surety in accordance with the contract documents and in accordance with the law of the place of the project.

Boring - An earth-drilling process used for installing conduits or pipelines, or obtaining soil samples for evaluation and testing.

Bridge - A structure for carrying traffic over a stream or gully, or other traffic ways including the pavement directly on the floor of the structures. A structure measuring 10 ft. or more in clear span.

Bridge Plank (deck or flooring) - A corrugated steel sub-floor on a bridge to support a wearing surface.

Brittle Failure - A pipe failure mode that exhibits no visible (to the naked eye) material deformation (stretching, elongation, or necking down) in the area of the break.

Brittleness Temperature - Temperature at which 50% of the tested specimens will fail when subjected to an impact blow.

Building Sewer - The conduit which connects building wastewater sources, to the public or street sewer, including lines serving homes, public buildings, commercial establishments, and industrial structures. The building sewer is referred to in two sections: (1) the section between the building line and the property line, frequently specified and supervised by plumbing or housing officials; and (2) the section between the property line and the street sewer, including the connection thereto frequently specified and supervised by sewer, public works, or engineering officials (Referred to also as "house sewer," "building connection,)" "service connection," or "lateral connection").

Buoyancy - The power of supporting a floating body, including the tendency to float an empty pipe (by exterior hydraulic pressure).

Burst Strength - The internal pressure required to cause a pipe or fitting to fail within a specified time period.

Butt Fusion - A method of joining polyethylene pipe where two pipe ends are heated and rapidly brought together under pressure to form a homogeneous bond.

Bypass - An arrangement of pipes and valves whereby the flow may be passed around a hydraulic structure or appurtenance. Also, a temporary setup to route flow around a part of a sewer system.

Bypass Pumping - The transportation of sewage which flows around a specific sewer pipe/line section or sections via any conduit for the purpose of controlling sewage flows in the specified section or sections without flowing or discharging onto public or private property.

Caisson - A watertight box or cylinder used in excavating for foundations or tunnel pits to hold out water so concreting or other construction can be carried on.

Camber - Rise or crown of the center of a bridge, or Bowline through a culvert, above a straight line through its ends.

Cantilever - The part of a structure that extends beyond its support.

Carbon Black - A black pigment produced by the incomplete burning of natural gas or oil, that possesses excellent ultraviolet protective properties.

Catastrophic Rainfall Event - Rainfall event of return frequency far in excess of any sewerage design performance criteria typically, say, a 20 to 200 year storm.

Cathode - The electrode of an electrolytic cell at which reduction is the principal reaction (Electrons flow toward the cathode in the external circuit). Typical cathodic processes are cations taking up electron and being discharged, oxygen being reduced, and the reduction of an element or group of elements from a higher to a lower valence state.

Cathodic Corrosion - An unusual condition (especially with Al, Zn, Pb) in which corrosion is accelerated at the cathode because the cathodic reaction creates an alkaline condition which is corrosive to certain metals.

Cathodic Protection - Preventing corrosion of a pipeline by using special cathodes (and anodes) to circumvent corrosive damage by electric current. Also a function of zinc coatings on iron and steel drainage products - galvanic action.

Cavitation - Formulation and sudden collapse of vapor bubbles in a liquid; usually resulting from local low pressures - as on the trailing edge of a propeller; this develops momentary high local pressure which can mechanically destroy a portion of a surface on which the bubbles collapse.

CCTV - Closed circuit television.

Cell - Electrochemical system consisting of an anode and a cathode immersed in an electrolyte. The anode and cathode may be separate metals or dissimilar areas on the same metal. The cell includes the external circuit which permits the flow of electrons from the anode toward the cathode (See Electrochemical Cell).

Cell Classification - Method of identifying thermoplastic materials, such as polyethylene, as specified by ASTM D 3350, where the Cell Classification is based on these six properties for PE are: Density, Melt Index, Flexural Modulus, Tensile Strength at Yield, Environmental Stress Crack Resistance, and Hydrostatic Design Basis.

Cellar Drain - A pipe or series of pipe which collect wastewater which leaks, seeps, or flow into subgrade parts of structures and discharge them into a building sewers or by other means dispose of such wastewater's into sanitary, combined or storm sewers (Referred to also as "basement drain").

Change Order - A written order to the contractor authorizing an addition, deletion or revision in the work, within the general scope of work of the agreement, authorizing an adjustment in the agreement price or agreement time.

Chemical Resistance - Ability to render service in the transport of a specific chemical for a useful period of time at a specific concentration and temperature.

Chimney - The cylindrical, variable height portion of the manhole structure having a diameter as required for the manhole frame. The chimney extends from the top of the corbel or cone to the base of the manhole frame and is used for adjusting the finished grade of the manhole frame.

Circumferential Coefficient of Expansion and Contraction - The fractional change in circumference of a material for a unit change in temperature. Expressed as inches of expansion or contraction per inch of original circumference per °F.

Coefficient of Thermal Expansion and Contraction - The fractional change in length of a material for a unit change in temperature.

Cofferdam - A barrier built in the water so as to form an enclosure from which the water is pumped to permit free access to the area within.

Cohesive Soil - A soil that when unconfined has considerable strength when air-dried, and that has significant cohesion when submerged.

Cold Bend - To force the pipe into a curvature without damage, using no special tools, equipment or elevated temperatures.

Collector Sewer - A sewer located in the public way collects the wastewater's discharged through building sewers and conducts such flows into larger interceptor sewers and treatment works. (Referred to also as "street sewer.")

Combined Sewer - A sewer intended to serve as both a sanitary sewer and a storm sewer, or as both an industrial sewer and a storm sewer.

Compaction - The densification of a soil by means of mechanical manipulation.

Composite Pipe - Pipe consisting of two or more different materials arranged with specific functional purpose to serve as pipe.

Compound - A mixture of a polymer with other ingredients such as fillers, stabilizers, catalysts, processing aids, lubricants, modifiers, pigments, or curing agents.

Compounding - The process where additives and carbon black are homogeneously mixed with the base polyethylene resin in a separate and additional process to produce a uniform compound material for polyethylene pipe extrusion.

Compression Gasket - A device which can be made of several materials in a variety of cross sections and which serves to secure a tight seal between two pipe sections (e.g., "O" rings).

Conductivity - A measure of the ability of a solution to carry an electrical current. Conductivity varies both with the number and type of ions the solution carries.

Conduit - A pipe or other opening, buried or aboveground, for conveying hydraulic traffic, pipelines, cables or other utilities.

Consolidation - The gradual reduction in the volume of a soil mass resulting from an increase in compaction.

Contamination - The presence of a substance not intentionally incorporated in a product.

Contract Documents - The Agreement, Addenda, Instructions to Bidders, Contractor's Bid, the Bonds, the Notice of Award, the General Conditions, the Supplementary Conditions, Special Conditions, Technical Conditions, the Specifications, Drawings, Drawing Modifications, and Notice to Proceed, all make up the Contract Documents.

Contract Price - The total moneys payable to the Contractor under the Contract Documents.

Contract Time - The number of calendar days stated in the Agreement for the completion of the work.

Contracting Officer - The owner (guarantee) - The Individual who is authorized to sign the contract documents on behalf of the owner's governing body.

Contractor - The person, firm or corporation with whom the owner has executed the agreement.

Corbel or Cone - That portion of a manhole structure, which slopes upward, and inward from the barrel of the manhole to the required chimney or frame diameter. "Corbel" refers to section built of brick or block, while "cone" refers to a precast section.

Core Area - That part of a sewer network containing the critical sewers, and other sewers where hydraulic problems are likely to be most severe and require detailed definition within a flow simulation model.

Corrosion - The destruction of a material or its properties because of a reaction with its (environment) surroundings.

Corrosion Fatigue - Fatigue type cracking of metal caused by repeated or fluctuating stresses in a corrosive environment characterized by shorter life than would be encountered as a result of either the repeated or fluctuating stress alone or the corrosive environment alone.

Corrosion Index - Measurement of the corrosivity of a water (e.g. Langelier Index, Ryznar Index, Aggressive Index, etc.)

Corrosion Rate - The speed (usually an average) with which corrosion progresses (it may be linear for a while); often expressed as though it was linear, in units of mdd (milligrams per square decimeter per day) for weight change, or mpy (milligrams per year) for thickness changes.

Corrosion Resistance - Ability of a material to withstand corrosion in a given corrosion system.

Corrosion-erosion - Corrosion which is increased because of the abrasive action of a moving stream; the presence of suspended particles greatly accelerates abrasive action.

Cracks - Crack lines visible along the length and/or circumference.

Crazing - Apparent fine cracks at or under the surface of a plastic.

Creep - The dimensional change, with time, of a material under continuously applied stress after the initial elastic deformation. The time dependent part of strain due to a constant stress.

Crew - The number of persons required for the performance of work at a site as determined by the contractor in response to task difficulty and safety considerations at the time or location of the work.

Critical Pressure - The minimum internal compressed gas pressure at which rapid crack propagation (RCP) can be sustained along a section of plastic pipe.

Critical Sewers - Sewers with the most significant consequences in the event of structural failure.

Crosslink - The formation of a three dimensional polymer by means of interchain reactions resulting in changes in physical properties.

CTS - Copper tube sizing convention for PE tubing.

Density, Base Resin - The mass per unit volume at a standardized temperature of 23°C of a base resin prior to compounding with additives and modifiers.

Density, Pipe Compound - The mass per unit volume of a compound at standardized temperature of 23°C. Note this is pipe compound density, not base resin density.

Design Coefficient (DC) - A number greater than 1.00 that when divided into the Minimum Require Strength (MRS) establishes the maximum design stress of the product for the application. The DC takes into consideration the variables in resin and processing involved in the production of plastic pipe. The user needs to also consider other variables such as: shipping, handling, installation and service of properly installed thermoplastic pressure piping systems.

Design Factor (DF) - A number less than 1.00 that takes into consideration the variables in resin and processing as well as the variables involved in the shipping, handling, installation and service of properly installed thermoplastic pressure piping systems.

Design Stress - (ISO12162) Allowable stress (MPa) for a given application. It is derived by dividing the MRS by the design coefficient C then rounding to the next lower value in the R-20 series (ISO 3). (For HDB rated materials see Hydrostatic Design Stress).

Dimension Ratio (DR) - The ratio of pipe diameter to wall thickness. It is calculated by dividing the specified outside diameter of the pipe, in inches, by the minimum specified wall thickness, in inches. Specifying PE pipes with the same DR regardless of O.D. assures all pipes will have the same design pressure assuming the PEs have the same HDB rating. The standard dimension ratio (SDR) is a common numbering system that is derived from the ANSI preferred number series R-10.

Dimple - A term used in tight fitting pipeline reconstruction, where the new plastic pipe forms an external departure or a point of expansion slightly beyond the underlying pipe wall where unsupported at side connections. The dimples are used for location and reinstatement of lateral sewer service.

Ductile Failure - A failure mode that exhibits material deformation (stretching, elongation, or necking down) in the area of the break.

Easement - A liberty, privilege, or advantage without profit which the owner of one parcel of land may have in the hand of another. In this agreement, all land, other than public streets, in which the owner has sewer system lines or installations and right of access to such lines or installations.

Easement Access - Areas within an easement to which access is required for performance of work.

Effluent - Outflow or discharge from a sewer or sewage treatment equipment.

EHMWHD - Extra High Molecular Weight High Density as originally noted in ASTM D1248, Grade P34 materials were specifically EHMW high-density polyethylene materials.

Elastic Modulus - A measure of the stress buildup associated with a given strain.

Electrofusion - A heat fusion joining process where the heat source is an integral part of the fitting.

Elevated Temperature Testing - Tests on plastic pipe above 23°C (73°F) for HDB rated materials and 20°C (68°F) for MRS rated materials.

Elongation - (strain) The increase in length of a material stressed in tension.

Embankment (or fill) - A bank of earth, rock or other material constructed above the natural ground surface.

Embrittlement - Loss of ductility of a material resulting from a chemical or physical change.

Emergency Repair - A repair that must be made while the main is pressurized, or flowing.

End Section - Flared attachment on inlet and outlet of a culvert to prevent erosion of the roadbed improve hydraulic efficiency, and improve appearance.

Endurance Limit - The maximum stress that a material can withstand for an infinitely large number of fatigue cycles (See Fatigue Strength).

Energy Gradient - Slope of a line joining the elevations of the energy head of a stream.

Energy Head - The elevation of the hydraulic gradient at any section, plus the velocity head.

Engineer - The person, firm or corporation named as such in the contract documents; the "Engineer of Record".

Environment - The surroundings or conditions (physical, chemical, mechanical) in which a material exists.

Environmental Stress Crack Resistance (ESCR) - The resistance to crack or craze under the influence of specific chemicals and stress and/or mechanical stress.

Environmental Stress Cracking - Under certain conditions of temperature and stress in the presence of certain chemicals, polyethylene may begin to crack sooner than it would at the same temperature and stress in the absence of those chemicals. The susceptibility to crack or craze under the influence of specific chemicals, stress, and/or mechanical stress.

Epoxy - Resin formed by the reaction of bisphenol and epichlorohydrin.

Equalizer - A culvert placed where there is no channel but where it is desirable to have standing water at equal elevations on both sides of a fill.

Erosion - Deterioration of a surface by the abrasive action of moving fluids. This is accelerated by the presence of solid particles or gas bubbles in suspension. When deterioration is further increased by corrosion, the term "Corrosion-Erosion" is often used.

Erosion Corrosion - A corrosion reaction accelerated by the relative movement of the corrosive fluid and the metal surface.

ESCR - Environmental Stress Crack Resistance. The ability to resist environmental stress cracking when tested under standards such as ASTM F 1248 and F 1473.

Ethylene Plastics - Plastics based on polymers of ethylene or copolymers of ethylene with other monomers, the ethylene being in greatest amount by mass.

Exfiltration - The leakage or discharge of flows being carried by sewers out into the ground through leaks in pipes, joints, manholes, or other sewer system structures; the reverse of "infiltration."

Existing Linear Feet - The total length of existing sewer pipe in place within designated sewer systems as measured from center of manhole to center of manhole from maps or in the field.

Experimental Grade (E) - A PPI HSB recommended rating that is valid for a limited duration, given to those materials covered by data that do not yet comply with the full requirements of the Standard Grade, but satisfy the applicable minimum preliminary data requirements which are detailed in TR-3.

Extrusion - A process whereby heated or unheated plastic forced through a shaping orifice becomes one continuously formed piece.

Fabricated Fittings - Large diameter polyethylene fittings fabricated by fusing together special shapes to create reducer fittings, tees, ells and bends.

Fatigue - The phenomenon leading to fracture under repeated or fluctuating stresses having a maximum value less than the tensile strength of the material.

Fatigue Strength - The stress to which a material can be subjected for a specified number of fatigue cycles.

Field Orders - A written order issued by the engineer clarifies or interprets the contract documents in accordance with the terms of the contract or orders minor changes in the work in accordance with the terms of the contract.

Filter - Granular material or geotextile placed around a submarine pipe to facilitate drainage and at the same time strain or prevent the admission of silt or sediment.

Flash Point - Temperature at which a material begins to vaporize.

Flexible - Readily bent or deformed without permanent damage.

Flexural Modulus - The ratio, within the elastic limit, of the applied stress in the outermost fibers of a test specimen in three point static flexure, to the calculated strain in those outermost fibers (ASTM D 790).

Flexural Strength - (Flexural Modulus of Rupture) - The maximum calculated stress in the outermost fibers of a test bar subjected to three point loading at the moment of cracking or breaking (ASTM D 790). The maximum stress in the outer fiber of a test specimen at rupture.

Flow Attenuation - The process of reducing the peak flow rate, in a sewer system, by redistributing the same volume of flow over a longer period of time.

Flow Control - A method whereby normal sewer flows or a portion of normal sewer flows are blocked, retarded, or diverted (bypassed) within certain areas of the sewer collection system.

Flow Reduction - The process of decreasing flows into a sewer system or of removing a proportion of the flow already in a sewer system.

Flow Simulation - The modeling of flow in surface water or combined sewer systems using a dynamic digital model.

Fold and Form Pipe - A pipe rehabilitation method where a plastic pipe manufactured in a folded shape of reduced cross-sectional area is pulled into an existing conduit and subsequently expanded with pressure and heat. The reformed plastic pipe fits snugly to and takes the shape of the ID of the host pipe.

Fouling - An accumulation of deposits. This term includes accumulation and growth of marine organisms on a submerged metal surface and also includes the accumulation of deposits (usually inorganic) on heat exchanger tubing.

Foundation Drain - A pipe or series of pipes which collect groundwater from the foundation or footing of structures and discharge it into sanitary, storm, or combined sewers, or to other points of disposal for the purpose of draining unwanted waters away from such structures.

Fracture Mechanics - A quantitative analysis for evaluating structural reliability in terms of applied stress, crack length, and specimen geometry.

Fractures - Cracks visibly open along the length and/or circumference of the conduit with the pieces still in place.

Galvanic Cell - A cell consisting of two dissimilar metals in contact with each other and with a common electrolyte (sometimes refers to two similar metals in contact with each other but with dissimilar electrolytes; differences can be small and more specifically defined as a concentration cell).

General Corrosion - Corrosion in a uniform manner.

Glass Transition Temperature - The temperature below which a plastic is more brittle and glassy.

Gradation - Sieve analysis of aggregates.

Grade - Profile of the center of a roadway, or the invert of a culvert or sewer. Also refers to slope, or ratio of rise or fall of the grade line to its length. (Various other meanings.)

Gradient - See Grade.

Grain - A portion of a solid metal (usually a fraction of an inch in size) in which the atoms are arranged in an orderly pattern. The irregular junction of two adjacent grains is known as a grain boundary; also a unit of weight, 1/7000th of a pound; also used in connection with soil particles i.e. = grain of sand.

Granular - Technical term referring to the uniform size of grains or crystals in rock.

Graphitization (graphitic corrosion) - Corrosion of gray cast iron in which the metallic constituents are converted to corrosion products, leaving the graphite flakes intact, Graphitization is also used in a metallurgical sense to mean the decomposition of iron carbide to form iron and graphite.

Groin - A jetty built at an angle to the shoreline, to control the waterflow and currents or to protect a harbor or beach.

Ground Water Table (or level) - Upper surface of the zone of saturation in permeable rock or soil. (When the upper surface is confined by impermeable rock, the water table is absent.)

Grout - A fluid mixture of cement, and water (and sometimes sand), that can be poured or pumped easily; also encompasses chemical mixtures recognized as stopping water infiltration through small holes and cracks.

Grouting - (1) The joining together of loose particles of soil in such a manner that the soil so grouted becomes a solid mass which is impervious to water, (see also PIPE JOINT SEALING) (2) The process of flowing a cement/water grout (without sand) into the annular space between a host pipe and a slipline pipe.

Haunch - That portion of the pipe barrel extending below the pipe springline.

Haunching - The act of placing embedment material below the springline.

Head (Static) - The height of water above any plane or point of references (the energy possessed by each unit of weight of a liquid, expressed as the vertical height through which a unit of weight would have to fall to release the average energy posed). The standard inch-pound unit of measure is feet of water. The relation between pressure in psi and feet of head at 68°F is 1 psi = 2.310 ft of head.

Headwall - A wall (of any material) at the end of a culvert or, drain to serve one or more of the following purposes: protect fill from scour or undermining; increase hydraulic efficiency, divert direction of flow, and serve as a retaining wall.

Height Of Cover (HC) - Distance from crown of a culvert or conduit to the finished road surface, or ground surface, or the base of the rail.

High-Density Polyethylene (HDPE) - A plastic resin made by the copolymerization of ethylene and a small amount of another hydrocarbon. The resulting base resin density, before additives or pigments, is greater than 0.941 g/cm.

Holiday - Any discontinuity or bare spot in a coated surface.

Hoop Stress - The circumferential force per unit areas, psi, in the pipe wall due to internal pressure.

Hydraulic Cleaning - Techniques and methods used to clean sewer lines with water e.g. water pumped in the form of a high velocity spray and water flowing by gravity or head pressure. Devices include high velocity jet cleaners, cleaning balls, and hinged disc cleaners.

Hydraulic Gradient or Hydraulic Grade Line - An imaginary line through the points to which water would rise in a series of vertical tubes connected to the pipe. In an open channel, the water surface itself is the hydraulic grade line.

Hydraulic Radius - The area of the water prism in the pipe or channel divided by the wetted perimeter. Thus, for a round conduit flowing full or half full, the hydraulic radius is $d/4$. Another term sometimes used for this quantity is hydraulic mean depth.

Hydraulics - That branch of science or engineering which treats water or other fluid in motions.

Hydrocarbon, Gaseous - An organic compound made up of the elements of carbon and hydrogen that exists as a gas at ambient conditions (14.7 psi, 73.4°F).

Hydrocarbon, Liquid - An organic compound made up of the elements of carbon and hydrogen that exists as a liquid at ambient conditions (14.7 psi, 73.4°F).

Hydrogen Blistering - Subsurface voids produced in a metal by hydrogen absorption in (usually) low strength alloys with resulting surface bulges.

Hydrogen Induced Cracking (HIC) - A form of hydrogen blistering in which stepwise internal cracks are created that can affect the integrity of the metal.

Hydrogen ion (pH) - Refers to acidity or alkalinity of water or soil. An ion is a charged atom or group of atoms in solution or in a gas. Solutions contain equivalent numbers of positive and negative ions.

Hydrogen Stress Cracking - A cracking process that results from the presence of hydrogen in a metal in combination with tensile stress. It occurs most frequently with high strength alloys.

Hydrostatic Design Basis (HDB) - One of a series of established stress values specified in Test Method D 2837 "Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials" for a plastic compound obtained by categorizing the LTHS determined in accordance with Test Method D 2837. HDB refers to the categorized LTHS in the circumferential, or hoop direction, for a given set of end use conditions. Established HDBs are listed in PPI TR-4.

Hydrostatic Design Stress HDB (HDS_{HDB}) - The estimated maximum tensile stress (psi) in the wall of the pipe in the circumferential orientation due to internal hydrostatic pressure that can be continuously applied with a high degree of certainty that failure of the pipe will not occur.

$$HDS_{HDB} = HDB \times DF$$

Hydrostatic Design Stress MRS (HDS_{MRS}) - The estimated maximum tensile stress (psi) in the wall of the pipe in the circumferential orientation due to internal hydrostatic pressure that can be continuously applied with a high degree of certainty that failure of the pipe will not occur. $HDS_{MRS} = MRS/C$

I. D. - Inside diameter of pipe or tubing.

Ignition Temperature - Temperature at which the vapors emitted from a material will ignite either without exposure to a flame (self-ignition) or when a flame is introduced (flash ignition).

Impact - Stress in a structure caused by the force of a vibratory, dropping, or moving load. This is generally a percentage of the live load.

Impact Strength - The ability of a material to withstand shock loading.

Impervious - Impenetrable. Completely resisting entrance of liquids.

Inert Material - A material which is not very reactive, such as a noble metal or plastic.

Infiltration - The water entering a sewer system, including building sewers, from the ground, through such means as defective pipes, pipe joints, connections, or manhole walls. Infiltration does not include, and is distinguished from inflow.

Infiltration/Inflow - A combination of infiltration and inflow wastewater volumes in sewer lines, with no way to distinguish the basic sources, and with the effect of usurping the capacities of sewer systems and facilities.

Inflow - The water discharged into a sanitary sewer system, including service connections from such sources as roof leaders, cellar, yard, area drains, foundation drains, cooling water discharges, drains from springs and swampy areas, manhole catch basins, storm waters, surface runoff, street washwaters and/or drainage. Inflow does not include and is distinguished from infiltration.

Ingredient - Any chemical, mineral, polymer or other ingredient that has been added to a resin composition for the purpose of imparting certain desired processing or product performance properties.

Inhibitor - (1) A chemical substance or combination of substances which, when present in the environment, prevents or reduces corrosion without significant reaction with the components of the environment. (2) A substance which sharply reduces corrosion, when added to water, acid, or other liquid in small amounts. (3) A chemical additive that delays the chemical reaction in epoxy resin systems.

Injection Molding - The process of forming a material by melting it and forcing it, under pressure, into the cavity of a closed mold.

Insert Stiffener - A length of tubular material, usually metal, installed in the ID of the pipe or tubing to reinforce against OD compressive forces from a mechanical compression type fitting.

Inspector - The owner's on-site representative responsible for inspection and acceptance, approval, or rejection of work performed as set forth in these specifications.

Inspector (Construction Observer, Resident Inspector, Construction Inspector, Project Representative) - An authorized representative of the engineer assigned to observe the work and report his findings to the engineer.

Interaction - The division of load carrying between pipe and backfill and the relationship of one to the other.

Intercepting Drain - A ditch or trench filled with a pervious filter material around a subdrainage pipe.

Interceptor Sewer - A sewer which receives the flow of collector sewers and conveys the wastewaters to treatment facilities.

Intergranular Stress Corrosion Cracking (IGSCC) - Stress corrosion cracking in which the cracking occurs along grain boundaries.

Internal Corrosion - Corrosion that occurs inside a pipe because of the physical, chemical, or biological interactions between the pipe and the water as opposed to forces acting outside the pipe, such as soil, weather, or stress conditions.

Internal Erosion - Abrasion and corrosion on the inside diameter of the pipe or tubing due to the fluid or slurry that is being transported.

Internal Pipe Inspection - The television inspection of a sewer line section. A CCTV camera is moved through the line at a slow rate and a continuous picture is transmitted to an above ground monitor. (See also PHYSICAL PIPE INSPECTION.)

Inversion - The process of turning a fabric tube inside out with water or air pressure as is done at installation of a cured in place pipe.

Invert - That part of a pipe or sewer below the spring line - generally the lowest point of the internal cross section.

Invert Level (elevation) - The level (elevation) of the lowest portion of a liquid-carrying conduit, such as a sewer, which determines the hydraulic gradient available for moving the contained liquid.

Ion - An electrically charged atom (e.g., Na^+ , Al^{3+} , Cl^- , S^{2-}) or group of atoms known as "radicals" (e.g., NH_4^+ , SO_4^{2-} , PO_4^{3-}).

Ionization - Dissociation of ions in an aqueous solution (e.g., $\text{H}_2\text{CO}_3 \rightarrow \text{H}^+ + \text{HCO}_3^-$ or $\text{H}_2\text{O} \rightarrow \text{H}^+ + \text{OH}^-$).

IPS - Iron pipe sizing convention for PE pipe.

Jacking (for conduits) - A method of providing an opening for drainage or other purposes underground, by cutting an opening ahead of the pipe and forcing the pipe into the opening by means of horizontal jacks.

Joint, Butt-Fused - A thermoplastic pipe connection between two pipe ends using heat and force to form the bond.

Joint, Electrofused - A joint made with an Electrofusion fitting in which the heating source is an integral part of the fitting.

Joint, Flanged - A mechanical joint using pipe flanges, a gasket, and bolts.

Joint, Heat-Fused - A thermoplastic pipe connection made using heat and usually force to form the fusion bond.

Joint, Mechanical - A connection between piping components employing physical force to develop a seal or produce alignment.

Joint, Saddle-Fused - A joint in which the curved base of the saddle fitting and a corresponding area of the pipe surface are heated and then placed together to form the joint.

Joint, Socket-Fused - A joint in which the joining surfaces of the components are heated, and the joint is made by inserting one component into the other.

Joints - The means of connecting sectional lengths of sewer pipe into a continuous sewer line using various types of jointing materials. The number of joints depends on the lengths of the pipe sections used in the specific sewer construction work.

Kip - A force unit equal to 1000 pounds.

Lateral - Any pipe connected to a sewer.

Linear Foot - Being one foot to the length of a sewer line.

Long-Term Strength - The hoop stress in the wall of the pipe is sufficiently low that creep (relaxation) of the materials is nil and assures service life in excess of 50 years.

Long-Term Hydrostatic Strength (LTHS) - The hoop stress that when applied continuously, will cause failure of the pipe at 100,000 hours (11.43 years). This is the intercept of the stress regression line with the 100,000-h coordinate as defined in ASTM D 2837. Note -The typical condition uses water as the pressurizing fluid at 23°C (73°F).

Low-Density Polyethylene Plastics (LDPE) - Polyethylene plastics, having a standard density of 0.910 to 0.925 g/cm³.

Lower Confidence Limit (LCL) - A calculated statistical value used in ASTM D 2837 to determine the suitability of a data set for use in determining LTHS and HDB.

Lower Confidence Limit of the Predicted Hydrostatic Strength (σ_{LPL})(ISO 9080) - A quantity in MPA, with the dimension of stress, which represents the 97.5% lower confidence limit of the predicted hydrostatic strength at temperatures T and time t.

LP-Gas - Liquid petroleum gas, permitted to be piped in PE piping, in vapor phase, Maximum Allowable Operating Pressure only at pressures \leq 30 psig.

MAG PIPE - Magnetically detectable polyethylene pipe.

Major Blockage - A blockage (structural defect, collapse, protruding service connection, debris) which prohibits manhole-to-manhole cleaning, TV inspections, pipe flow, or rehabilitation procedures.

Manhole Section - The length of sewer pipe connecting two manholes.

Manning's Formula - An equation for the value of coefficient c in the Chezy Formula, the factors of which are the hydraulic radius and a coefficient of roughness: an equation itself used to calculate flows in gravity channels and conduits.

Maximum Allowable Operating Pressure - The highest working pressure expected and designed for during the service-life of the main.

Maximum Allowable Operating Pressure (MAOP) - In USA Regulation for gas piping, the highest allowed pressure, in psig, as determined in accordance with US CFR, Title 49, Part 192.121 and as represented in the following: $MAOP = 2 \times HDB, \times 0.32 / (DR-1)$

Mechanical Cleaning - Methods used to clean sewer lines of debris mechanically with devices such as rodding machines, bucket machines, winch-pulled brushes, etc.

Mechanical Fitting - Fitting for making a mechanical joint to provide for pressure integrity, leak tightness, and depending on category, as defined in ASTM F 1924, resistance to end loads and pull-out.

Median Barrier - A double-faced guardrail in the median or island dividing two adjacent roadways.

Medium Density Polyethylene Plastics (MDPE) - Those branched polyethylene plastics, having a standard density of 0.926 to 0.940 g/cm³.

Melt Flow - A measure of the molten material's fluidity.

Melt Flow Rate - The quantity of thermoplastic material in grams that flows through an orifice during a 10-minute time span under conditions as specified by ASTM D 1238.

Melt Index - A measurement of a polymer's molten flow properties (ASTM D 1238), is related to molecular weight, or the length of the individual polymer chains. Generally, lower melt indices represent higher molecular weights while higher values indicate lower molecular weights. For any given PE resin, a lower melt index (higher molecular weight) will normally have superior physical properties.

Melt Viscosity - The resistance of the molten material to flow.

Melting Point - That temperature at which the plastic transitions to a completely amorphous state.

Minimum Required Pressure (MRP) - One of a series of established pressure values for a plastic piping component (multilayer pipe, fitting, valve, etc.) obtained by categorizing the long-term hydrostatic pressure strength in accordance with ISO 9080.

Minimum Required Strength (MRS) – (ISO 12162) The lower confidence limit in accordance with ISO 9080 at 20°C for 50 years with internal water pressure, rounded down to the next smaller value of the R-10 series or of the R-20 series conforming to ISO 3 and ISO 497, and categorized in accordance with ISO 12162, “Thermoplastic materials for pipes and fittings for pressure applications – Classification and designation – Overall service (design) coefficient.”

Modification - (1) A written amendment of the contract documents signed by both parties. (2) A change order. (3) A written clarification or interpretation issued by the engineer in accordance with the terms of the contract. (4) A written order for a minor change or alteration in the work issued by the engineer pursuant to the terms of the contract. A modification may only be issued after execution of the agreement.

Modulus of Elasticity (E) - ASTM D 638 The ratio of stress (nominal) to corresponding strain below the proportional limit of a material.

Molecular Weight Distribution - The ratio of the weight average molecular weight (M_w) to the number average molecular weight (M_n). This gives an indication of the distribution.

Molecular Weight, Number Average (abbreviation M_n) - The total weight of all molecules divided by the number of molecules.

Molecular Weight, Weight Average (abbreviation M_w) - The sum of the total weight of molecules of each size multiplied by their respective weights divided by the total weight of all molecules.

Moment of Inertia - Function of some property of a body or figure - such as weight, mass, volume, area, length, or position, equal to the summation of the products of the elementary portions by the squares of their distances from a given axis.

Moment, Bending - The moment which produces bending in a beam or other structure. It is measured by the algebraic sum of the products of all the forces multiplied by their respective lever arms.

Multilayer Pipe – (Composite Pipe). **TYPE 1:** A pressure rated pipe having more than one layer (bonded together) in which at least 60% of the wall thickness is polymeric material that has an HDB (Hydrostatic Design Basis) or MRS (Minimum Required Strength), from which the pressure rating of the pipe is determined by pipe size and pipe wall construction.

Multilayer Pipe – (Composite Pipe). **TYPE 2:** A pressure rated pipe having more than one layer (bonded together) where at least 60% of the wall thickness is polymeric material, where the pipe pressure rating is determined by pipe size and pipe wall construction, and this pipe rating is listed by a PDB (Pressure Design Basis) or MRP (Minimum Required Pressure).

Multilayer Pipe – (Composite Pipe). **TYPE 3:** Non-pressure rated pipe comprising more than one layer in which at least 60% of the wall thickness is polymeric material.

Neutral Axis - An axis of no stress.

Nominalize - To classify a value into an established range or category.

Non-Pressure Pipe - Pipe designed for gravity-conveyed medium which must resist only intermittent static pressures and does not have a pressure rating.

Non-Uniform Corrosion - Corrosion that attacks small, localized areas of the pipe. Usually results in less metal loss than uniform corrosion but causes more rapid failure of the pipe' due to pits and holes.

Notch Sensitivity - The extent to which an inclination to fracture is increased by a notch, crack, scratch, or sudden change in cross-section. **NOTE:** The SDB is used only for a material intended for molding applications. The SDB shall not be used for pipe applications.

Notice of Award - The written notice by owner to the apparent successful bidder stating that upon compliance with the conditions precedent to be fulfilled by him within the time specified, the owner will execute and deliver the agreement to him.

Notice to Proceed - A written notice given by the owner to the contractor (with a copy to the engineer) fixing the date on which the contract time will commence to run and on which contractor shall start to perform his obligations under the contract documents.

Nylon (Polyamides) - Plastics based on resins composed principally of a long-chain synthetic polymer amide, which has recurring amide groups as an integral part of the main polymer chain.

O.D. - Outside diameter of pipe or tubing.

Odorants - To enhance safety, the fuel gas industries add chemical compounds to their gases, with a unique odor, to alert the user if a leak occurs. This odor is designed to be readily detectable when the fuel gas mixes with the atmosphere at low concentrations. The compounds used as odorants usually consist of aliphatic mercaptans, such as propyl and tertiary butyl mercaptan, and sulfides, such as thiopane or dimethyl sulfide at ordinary temperatures. Most gas odorants are liquids at full concentrations, and, in this state, might be harmful to some plastic pipe materials. However, in the small amounts sufficient to odorize a gas they are in the vapor state and cause no harm to plastic piping.

Outfall (or outlet) - In hydraulics, the discharge end of drains and sewers.

Out-of-Roundness - The allowed difference between the maximum measured diameter and the minimum measured diameter (stated as an absolute deviation).

Ovality - (%) - $((\text{max_measured_O.D.}) - (\text{min_measured_O.D.}) \div (\text{average_O.D.})) \times 100$

Overflow - (1) The excess water that flows over the ordinary limits of a sewer, manhole, or containment structure. (2) An outlet, pipe, or receptacle for the excess water.

Owner - A public body of authority, corporation as partnership, or individual for whom the work is to be performed.

Oxidation - Loss of electrons, as when a metal goes from the metallic state to the corroded state.

Parapet - Wall or rampart, breast high. Also, the wall on top of an abutment extending from the bridge seat to the underside of the bridge floor and designed to hold the backfill.

Pascal's Law - Pressure exerted at any point upon a confined liquid is transmitted undiminished in all directions.

Pavement, Invert - Lower segment of a corrugated metal pipe provided with a smooth bituminous material that completely fills the corrugations, intended to give resistance to scour, erosion, and to improve flow.

PE - Polyethylene

PE 2406 - Medium-density polyethylene with ESCR in accordance with ASTM D1693 equal to or greater than 600 hours or a PENT value per ASTM D1473 equal to or greater than 10 hours and a hydrostatic design basis of 1250 psi.

PE 3408 - High-density polyethylene with ESCR in accordance with ASTM D1693 equal to or greater than 600 hours or a PENT value per ASTM D1473 equal to or greater than 10 hours and a hydrostatic design basis of 1600 psi.

PE 80 - A polyethylene classified by the ISO MRS system as having a minimum required strength of 8.0 MPa (1160 psi) in accordance with ISO 12162.

PE 100 - A polyethylene classified by the ISO MRS system as having a minimum required strength of 10.0 MPa (1450 psi) in accordance with ISO 12162.

PENT - The common name given for a test to determine the slow crack resistance of PE materials by placing a razor-notched tensile bar under a constant tensile load of 2.4 MPa at 80°C in accordance with ASTM F 1473.

Perched Water Table - In hydrology, the upper surface of a body of free ground water in a zone of saturation, separated by unsaturated material from an underlying body of ground water in a differing zone of saturation.

Periphery - Circumference or perimeter of a circle, ellipse, pipe-arch, or other closed curvilinear figure.

Permeability - Penetrability

PEX - Crosslinked polyethylene

pH - A measure of the acidity or alkalinity of a solution. A value of seven is neutral. Numbers lower than seven are acid, with the lower numbers more acid. Numbers greater than seven (up to 14) indicate alkalinity, with the higher numbers more alkaline.

Physical Pipe Inspection - The crawling or walking through manually accessible pipelines. The logs for physical pipe inspection record information of the kind detailed under TELEVISION INSPECTION. Manual inspection is only undertaken when field conditions permit this to be done safely. Precautions are necessary.

Pile, Bearing - A member driven or jetted into the ground and deriving its support from the underlying strata and/or by the friction of the ground on its surface.

Pipe - Nominal Weight - The pipe or tubing weight, expressed in pounds per 100 feet, calculated in accordance with PPI TN-7 by using the nominal diameter, and the nominal wall thickness of the pipe.

Pipe Joint Sealing - A method of sealing leaking or defective pipe joints which permit infiltration of groundwater into sewers by means of injecting chemical grout into and/or through the joints from within the pipe.

Pipeline Reconstruction - The insitu repair of an existing pipeline that has suffered loss of pressure integrity or has been structurally damaged. The liner becomes the principal pressure containment or structural element of the insitu composite pipe structure.

Pipeline Rehabilitation - The insitu repair of an existing pipeline, which has become corroded or abraded, by insert renewal of a liner which rehabilitates the bore of the pipeline but does not contribute significantly to increased pressure capability or increased structural strength, yet does improve flow efficiency/hydraulics.

Pitting - Highly localized corrosion resulting in deep penetration at only a few spots.

Pitting Factor - The depth of the deepest pit divided by the "average penetration" as calculated from weight loss.

Planting Piping - Installation procedure that digs a trench and lays the pipe in one step.

Plastic - A polymeric material that contains as an essential ingredient one or more organic polymeric substances of large molecular weight, is solid in its finished state, and, at some stage in its manufacture or processing into finished articles (See Thermoplastic and Thermoset).

Plastic Pipe - A hollow cylinder of a plastic material in which the wall thicknesses are usually small when compared to the diameter and in which the inside and outside walls are essentially concentric and which follows the O.D. sizing convention of steel pipe (IPS) or the sizing convention of ductile iron pipe (DIPS).

Plastic Tubing - A particular size of smooth wall plastic pipe in which the outside diameter is essentially the same as the corresponding size of copper tubing (CTS) or other tubing sizing conventions.

Plate - A flat-rolled iron or steel product.

Plough-in Piping - Installation procedure that splits the earth and pulls the pipe into position.

Poly (Vinyl Chloride) (PVC) - A polymer prepared by the polymerization of vinyl chloride as the sole monomer.

Polyester - Resin formed by condensation of polybasic and monobasic acids with polyhydric alcohols.

Polyethylene - A ductile, durable, virtually inert thermoplastic composed of polymers of ethylene. It is normally a translucent, tough solid. In pipe grade resins, ethylene-hexene copolymers are usually specified with carbon black pigment for weatherability.

Polymer - A substance consisting of molecules characterized by the repetition (neglecting ends, branch junctions, and other minor irregularities) of one or more types of monomeric units.

Polymerization - A chemical reaction in which the molecules of a monomer are linked together to form polymers. When two or more different monomers are involved, the process is called copolymerization.

Ponding - (1) Jetting or the use of water to hasten the settlement of an embankment - requires the judgment of a geotechnical engineer. (2) In hydraulics, ponding refers to water backed up in a channel or ditch as the result of a culvert of inadequate capacity or design to permit the water to flow unrestricted.

PPI (Plastic Pipe Institute) - A trade organization whose Membership is composed of manufacturers of plastic pipe, fittings, and valves; plastic materials for piping; metallic fittings for plastic piping; and equipment that is used for fabricating, joining or installing plastic piping.

Precipitation - Process by which water in liquid or solid state (rain, sleet, snow) is discharged out of the atmosphere upon a land or water surface.

Pressure Class (PC) - (AWWA C906) The design capacity to resist working pressure up to 80°F (27°C) maximum service temperature, with specified maximum allowances for reoccurring positive surges above working pressure.

Pressure Design Basis (PDB) - One of a series of established pressure values for a plastic piping component (multilayer pipe, fitting, valve, etc.) obtained by categorizing the long-term hydrostatic pressure strength determined in accordance with an industry test method that uses linear regression analysis. Although ASTM D 2837 does not use "pressure values", the PPI Hydrostatic Stress Board uses the principles of ASTM D2837 in plotting log pressure vs. log time to determine a "long-term hydrostatic pressure strength" and the resulting "Pressure Design Basis" for multilayer pipe that is listed in PPI TR-4.

Pressure Pipe - Pipe designed to resist continuous pressure exerted by the conveyed medium.

Pressure Rating - Estimated maximum internal pressure that allows a high degree of certainty that failure of the pipe will not occur.

Pressure Rating, HDB (PR_{HDB}) - The estimated maximum pressure (psig) that the medium in the pipe can exert continuously with a high degree of certainty that failure of the pipe will not occur. $PR_{HDB} = 2 (HDB) (DF)/(DR-1)$

Pressure Rating, MRS (PR_{MRS}) - The estimated maximum pressure (bar) that the medium in the pipe can exert continuously with a high degree of certainty that failure of the pipe will not occur. $PR_{MRS} = 20 (MRS)/(DR-1) C$

Pressure, Surge - The maximum positive transient pressure increase (commonly called water hammer) that is anticipated in the system as the result of a change in velocity of the water column.

Pressure, Working - The maximum anticipated sustained operating pressure, in pounds per square inch gauge, applied to the pipe or tubing, exclusive of surge pressures.

Primary Properties - The properties used to classify polyethylene materials.

Profile - Anchor pattern on a surface produce by abrasive, blasting or acid treatment.

Project - The entire construction to be performed as provided in the contract documents.

PSF - Pounds per square foot. $PSF = lb/in^2 \times 144$

PSI - Pounds per square inch.

PSIG - Pounds per square inch gauge.

Pull-in Piping - Also referred to as insert renewal; installation procedure whereby pipe is pulled inside old mains and service lines to provide the new main or service line.

Quality Assurance Test - A test in a program that is conducted to determine the quality level. DISCUSSION—Quality assurance includes quality control, quality evaluation, and design assurance. A good quality assurance program is a coordinated system, not a sequence of separate and distinct steps.

Quality Control Test - A production, in-plant test that is conducted at a given test frequency to determine whether product is in accordance with the appropriate specification(s).

Quick Burst Test - (ASTM D 1599) An internal pressure test designed to produce rupture (bursting) of a piping component in 60-70 seconds determined in accordance with ASTM D 1599.

Radian - An arc of a circle equal in length to the radius; or the angle at the center measured by the arc.

Radius of Gyration - The distance from the reference at which all of the area can be considered concentrated that still produces the same moment of inertia. Numerically it is equal to the square root of the moment of inertia, divided by the area.

Rainfall - Precipitation in the form of water (usage includes snow).

Rapid Crack Propagation (RCP) - A running-crack failure associated with lower temperatures and compressed gas media, initiated by a significant impact. Cracks, once initiated, run at high speed (300 to 1400 ft/sec) and result in cracks many feet in length.

Rate Process Method (RPM) - A three coefficient mathematical model for calculating plastic piping performance projections at use conditions - see TN-16.

Reduction - Gain of electrons, as when copper is electro-plated on steel from a copper sulfate solution (opposite of "Oxidation").

Regression Analysis - An evaluation of the long-term hoop stress data. A linear curve is calculated using the least Squares method to fit the logarithm of hoop stress versus the logarithm of the resulting hours-to-failure.

Regulator - A device for controlling the quantity of sewage and storm water admitted from a combined sewer collector line into an interceptor, pump station or treatment facility, thereby determining the amount and quality of the flow discharged through an overflow device to receiving waters or other points of disposal.

Rehabilitation - All aspects of upgrading the performance of existing sewer systems. Structural rehabilitation includes repair, renovation and renewal. Hydraulic rehabilitation covers replacement, reinforcement, flow reduction or attenuation and occasionally renovation.

Reinforcement - The provision of an additional sewer which in conjunction with an existing sewer increases overall flow capacity.

Renewal - Construction of a new sewer, on or off the line of an existing sewer. The basic function and capacity of the new sewer being similar to those of the old.

Renovation - Methods by which the performance of a length of sewer is improved by incorporating the original sewer fabric, but excluding maintenance operations such as isolated local repairs and root or silt removal.

Repair - Rectification of damage to the structural fabric of the sewer and the reconstruction of short lengths, but not the reconstruction of the whole of the pipeline.

Replacement - Construction of a new sewer, on or off the line of an existing sewer. The function of the new sewer will incorporate that of the old, but may also include improvement or development work.

Reprocessed Plastic - A thermoplastic prepared from usually melt processed scrap or reject parts by a plastics processor, or from non-standard virgin material or non-uniform virgin material.

Resin Impregnation (wet-out) - A process used in cured-in-place pipe installation where a plastic coated fabric tube is uniformly saturated with a liquid thermosetting resin while air is removed from the coated tube by means of vacuum suction.

Resins - An organic polymer, solid or liquid: usually thermoplastic or thermosetting.

Retaining Wall - A wall for sustaining the pressure of earth or filling deposited behind it.

Revetment - A wall or a facing of wood, willow mattresses, steel units, stone or concrete placed on stream banks to prevent erosion.

Reworked Plastic - A plastic from a manufacturer's own production that has been reground or pelletized for reuse by that same manufacturer.

Reynolds Number - A dimensionless quantity named after Osbourne Reynolds who first made known the difference between laminar and turbulent flow. The practical value of the Reynolds Number is that it indicated the degree of turbulence in a flowing liquid. It depends on the hydraulic radius of the conduit, the viscosity of the water and the velocity of flow. For a conduit of a given size, the velocity is generally the major variable and the Reynolds Number will increase as the velocity of flow increases.

Right Bank - That bank of a stream which is on the right when one looks downstream.

Ring Compression - The principal stress in a confined thin circular ring subjected to external pressure.

Rip Rap - Rough stone of various large sizes placed compactly or irregularly to prevent scour by water or debris.

Roadway (highway) - Portion of the highway included between the outside lines of gutters or side ditches, including all slopes, ditches, channels and appurtenance necessary to proper drainage, protection and use.

Roof Leader - A drain or pipe that conducts storm water from the roof of a structure downward and thence into a sewer for removal from the property, or onto the ground for runoff or seepage disposal.

Roughness Coefficient - A factor in the Kutter, Manning, and other flow formulas representing the effect of channel (or conduit) roughness upon energy losses in the flowing water.

Runoff - That part of precipitation carried off from the area upon which it falls. Also, the rate of surface discharge of the above. That part of precipitation reaching a stream, drain or sewer. Ratio of runoff to precipitation is a "coefficient" expressed decimally.

Saddle Fitting - A fitting used to make lateral connection to a pipe in which a portion of the fitting is contoured to match the OD of the pipe to which it is attached.

Samples - Physical examples which illustrate materials, equipment or workmanship and establish standards by which the work will be judged.

Sanitary Sewer - A sewer intended to carry only sanitary and industrial wastewaters from residences, commercial buildings, industrial parks, and institutions.

Scaling - (1) High temperature corrosion resulting in formation of thick corrosion product layers. (2) Deposition of insoluble materials on metal surfaces, usually inside water boilers or heat exchanger tubes.

SDR (Standard Dimension Ratio) - The ratio of the average outside diameter to the minimum wall thickness. A common numbering system that is derived from the ANSI preferred number series R-10.

Secondary Stress - Forces acting on the pipe in addition to the internal pressure such as those forces imposed due to soil loading and dynamic soil conditions.

Section Modulus - The moment of inertia of the area of a section of a member divided by the distance from the center of gravity to the outermost fiber.

Sectional Properties - End area per unit of widths, moment of inertial, section modulus, and radius of gyration.

Seepage - Water escaping through or emerging from the ground along a rather extensive line or surface, as contrasted with a spring, the water of which emerges from a single spot.

Serviceability of The Piping System - Continued service life with a high degree of confidence that a failure will not occur during its long-term service.

Sewer Cleaning - The utilization of mechanical or hydraulic equipment to dislodge, transport, and remove debris from sewer lines.

Sewer Interceptor - A sewer which receives the flow from collector sewers and conveys the wastewaters to treatment facilities.

Sewer Pipe - A length of conduit, manufactured from various materials and in various lengths, that when joined together can be used to transport wastewaters from the points of origin to a treatment facility. Types of pipe are: Acrylonitrile-butadiene-styrene (ABS); Asbestos-Cement (AC); Brick Pipe (BP); Concrete Pipe (CP); Cast Iron Pipe (CIP); Polyethylene (PE); Polyvinylchloride (PVC); Vitriified Clay (VC).

Sewer, Building - The conduit which connects building wastewater sources to the public or street sewer, including lines serving homes, public buildings, commercial establishments and industry structures. The building sewer is commonly referred to in two sections: (1) the section between the building line and the property line, frequently specified and supervised by plumbing or housing officials; and (2) the section between the property line and the street sewer, including the connection thereto, frequently specified and supervised by sewer, public works, or engineering officials. (Referred to also as "house sewer," "building connection," or "service connection.")

Shaft - A pit or wall sunk from the ground surface into a tunnel for the purpose of furnishing ventilation or access to the tunnel.

Sheeting - A wall of metal plates or wood planking to keep out water, soft or runny materials.

Shop Drawings - All drawings, diagrams, illustrations, brochures, schedules, and other data which are prepared by the contractor, a subcontractor, manufacturer supplier or distributor and which illustrate the equipment, materials or some portion of the work as required by the contract documents.

Siphon (Inverted) - A conduit or culvert with a U or V shaped grade line to permit it to pass under an intersecting roadway, stream or other obstruction.

Site - Any location where work has been or will be done.

Site Access - An adequately clear area of a size sufficient to accommodate personnel and equipment required at the location where work is to be performed, including roadway or surface sufficiently unobstructed to permit conveyance of vehicles from the nearest paved roadway to the work location.

Skew (or Skew Angle) - The acute angle formed by the intersection of the line normal to the centerline of the road improvement, with the centerline of a culvert or other structure.

Slide - Movement of a part of the earth under force of gravity.

Slit-Type Failure - A form of brittle failure that exhibits only a very small crack through the wall of the pipe with no visible material deformation in the area of the break.

Slow Crack Growth (SCG) - the slow extension of the crack with time.

Smooth Radius Bend - A contoured sweep or bend with no sharp or angular sections.

Social Costs - Costs incurred by society as a result of sewerage works and for which authorities have no direct responsibility. These include unclaimed business losses due to road closures and the cost of extended journey times due to traffic diversions.

Socket Fusion Joint - A joint in which the joining surfaces of the components are heated, and the joint is made by inserting one component into the other.

Softening Temperature - There are many ways to measure the softening temperature of a plastic. The commonly reported Vicat Softening Temperature method is to measure the temperature at which penetration of a blunt needle through a given sample occurs under conditions specified in ASTM D 1525.

Solar Radiation - The emission of light from the sun, including very short ultraviolet wavelengths, visible light, and very long infrared wavelengths.

Solubility - The amount of one substance that will dissolve in another to produce a saturated solution.

Spalling - The spontaneous chipping, fragmentation, or separation of a surface or surface coating.

Span - Horizontal distance between supports, or maximum inside distance between the sidewall of culverts.

Special Conditions - When included as a part of the contract documents. Special conditions refer only to the work under this contract.

Specific Gravity - The density of a material divided by the density of water usually at 4°C. Since the density of water is nearly 1 g/cm³, density in g/cm³ and specific gravity are numerically nearly equal.

Specifications - Those portions of the contract documents consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the work.

Spillway - (1) A low-level passage serving a dam or reservoir through which surplus water may be discharged; usually an open ditch around the end of a dam, a gateway, or a pipe in a dam. (2) An outlet pipe, flume or channel serving to discharge water from a ditch, ditch check, gutter or embankment protector.

Spring Line - A line along the length of the pipe at its maximum width along a horizontal plane. The horizontal midpoint of a sewer pipe.

Springing Line - Line of intersection between the intrados and the supports of an arch. Also the maximum horizontal dimension of a culvert or conduit.

Spun Lining - A bituminous lining in a pipe, made smooth or uniform by spinning the pipe around its axis.

Stabilizer - An ingredient used in the formulation of some plastics to assist in maintaining the physical and chemical properties of the materials at their initial values throughout the processing service life of the material.

Standard Dimension Ratio (SDR) - A specific ratio of the average specified outside diameter to the minimum specified wall thickness for outside diameter-controlled plastic pipe, the value of which is derived by adding one to the pertinent number selected from the ANSI Preferred Number Series 10. Specifying PE pipes with a given SDR regardless of O.D. assures all pipes will have the same design pressure assuming the PEs have the same HDB rating.

Standard Grade (S) - A PPI HSB recommended rating that is valid for a five-year period, given to those materials that comply with the full data requirements of TR-3.

Standard Thermoplastic Material Designated Code - In this designation system, which is widely used by major national product standards, the plastic is identified by its standard abbreviated terminology in accordance with ASTM D 1600, "Standard Terminology Relating to Abbreviations, Acronyms, and Codes for Terms Relating to Plastics", followed by a four or five digit number. The first two or three digits, as the case may be, code the material's ASTM classification (short-term properties) in accordance with the appropriate ASTM standard specification for that material. The last two digits of this number represent the PPI recommended HDS (0.5 design factor) at 73°F (23°C) divided by one hundred. For example, PE 2406 is a grade P24 polyethylene with a 630-psi design stress for water at 73.4°F (23°C). The hydrostatic design stresses for gas are not used in this designation code.

Strength Design Basis (SDB) - Refers to one of a series of established stress values (specified in Test Method D 2837) for a plastic molding compound obtained by categorizing the long-term strength determined in accordance with ASTM Test Method F 2018, "Standard Test Method for Time-to-Failure of Plastics Using Plane Strain Tensile specimens".

Stress Crack - An internal or external crack in a plastic caused by tensile or shear stresses less than the short-term tensile strength of the material. The development of such cracks is frequently related to and accelerated by the environment to which the material is exposed. More often than not, the environment does not visibly attack, soften or dissolve the surface. The stresses may be internal, external, or a combination of both.

Stress Relaxation - The decay of stress with time at constant strain.

Sustained Pressure Test - A constant internal pressure test for an extended period of time.

Tensile Strength at Break - The maximum tensile stress (nominal) sustained by the specimen during a tensile test where the specimen breaks.

Tensile Strength at Yield - The maximum tensile stress (nominal) sustained by the specimen during a tensile test at the yield point.

Thermal Stabilizers - Compounds added to the plastic resins when compounded that prevent degradation of properties due to elevated temperatures.

Thermoplastic - A plastic, such as PE, that can be repeatedly softened by heating and hardened by cooling through a temperature range characteristic of the plastic, and that in the softened state can be shaped by flow into articles by molding or extrusion.

Thermoset - A material, such as epoxy, that will undergo or has undergone a chemical reaction by the action of heat, chemical catalyst, ultraviolet light, etc., leading to an infusible state.

Thermosetting - Resins that are composed of chemically cross-linked molecular chains, which set at the time the plastic is first formed; these resins will not melt, but rather disintegrate at a temperature lower than its melting point, when sufficient heat is added.

Threading - The process of installing a slightly smaller pipe or arch within a failing drainage structure.

Toe Drain - A subdrain installed near the downstream toe of a dam or levee to intercept seepage.

Toe-in - A small reduction of the outside diameter at the cut end of a length of thermoplastic pipe.

Tuberculation - Localized corrosion at scattered locations resulting in knob-like mounds.

Ultraviolet Absorbers (Stabilizers) - Compounds that when mixed with thermoplastic resins selectively absorb ultraviolet rays protecting the resins from ultraviolet attack.

Underdrain - See subdrain.

Uniform Corrosion - Corrosion that results in an equal amount of material loss over an entire pipe surface.

UV Degradation - Sunlight contains a significant amount of ultraviolet radiation. The ultraviolet radiation that is absorbed by a thermoplastic material may result in actinic degradation (i.e., a radiation promoted chemical reaction) and the formation of heat. The energy may be sufficient to cause the breakdown of the unstabilized polymer and, after a period of time, changes in compounding ingredients. Thermoplastic materials that are to be exposed to ultraviolet radiation for long periods of time should be made from plastic compounds that are properly stabilized for such conditions.

Velocity Head - For water moving at a given velocity, the equivalent head through which it would have to fall by gravity to acquire the same velocity.

Vinyl Plastics - Compositions of polymers and ingredients that are based on polymers of vinyl chloride, or copolymers of vinyl chloride with other monomers, the vinyl chloride being in the greatest amount by mass.

Virgin Plastic - A plastic material in the form of pellets, granules, powder, floc, or liquid that has not been subjected to use or processing other than that required for its initial manufacture.

Voids - A term generally applied to paints to describe holidays, holes, and skips in the film. Also used to describe shrinkage in castings or welds.

Wale - Guide or brace of steel or timber, used in trenches and other construction.

Water Table - The upper limit of the portion of ground wholly saturated with water.

Watershed - Region or area contributing to the supply of a stream or lake; drainage area, drainage basin, catchment area.

Weatherability - The properties of a plastic material that allows it to withstand natural weathering; hot and cold temperatures, wind, rain and ultraviolet rays.

Wetted Perimeter - The length of the perimeter in contact with the water. For a circular pipe of inside diameter "d", flowing full, the wetted perimeter is the circumference, d . The same pipe flowing half full would have a wetted perimeter of $d/2$.

Work - Any and all obligations, duties and responsibilities necessary to the successful completion of the project assigned to or undertaken by contractor under the contract documents, including all labor, materials, equipment and other incidentals, and the furnishing thereof.

Working Pressure (WP) - The maximum anticipated, sustained operating pressure applied to the pipe exclusive of transient pressures.

Working Pressure Rating (WPR) - The capacity to resist Working Pressure (WP) and anticipated positive transient pressure surges above working pressure.

Written Notice - The term "notice" as used herein shall mean and include all written notices, demands, instructions, claims, approvals, and disapproval required to obtain compliance with contract requirements. Written notice shall be deemed to have been duly served if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or to an authorized representative of such individual, firm or corporation, or if delivered at or sent by registered mail to the last business address known to him who gives the notice. Unless otherwise stated in writing, any notice to or demand upon the owner under this contract shall be delivered to the owner through the engineer.

Yield Point (ASTM D 638) - The stress at which a material exceeds its elastic limit. Below this stress, the material will recover its original size and shape on removal of the stress. The first point on the stress-strain curve at which an increase in strain occurs without an increase in stress.

Yield Strength (ASTM D 638) – The stress at which a material exhibits a specified limiting deviation from the proportionality of stress to strain. Unless otherwise specified, this stress will be the stress at the yield point, and when expressed in relation to the tensile strength, shall be designated as Tensile Strength at Yield or Tensile Stress at Yield.

Organizations and Associations

AASHTO American Association of State Highway & Transportation Officials

444 N. Capitol St., N.W., Suite 225
Washington, DC 20001
(202) 624-5800
www.aashto.org

ACS American Chemical Society

1155 Sixteenth Street NW
Washington, DC 20036
(800) 333-9511
www.acs.org

AGA/PMC American Gas Association

Plastic Materials Committee
400 N. Capitol Street NW
Washington, DC 20001
(202) 824-7336
www.aga.com

ANSI American National Standards Institute

11 W. 42nd St., 13th Floor
New York NY 10036
(212) 642-4900
www.ansi.org

APC American Plastics Council

1300 Wilson Blvd.
Arlington, VA 22209
1-800-2-HELP-90
www.americanplasticscouncil.org

API American Petroleum Institute

1220 L St., N.W.
Washington, DC 20005
(202) 682-8000
www.api.org

APGA American Public Gas Association

Suite 102
11094-D Lee Highway
Fairfax, VA 22030
(703) 281-2910
www.apga.org

APWA American Public Works Association

Mark Twain Building
06 W. 11th Street Suite 1080
Kansas City, MO 64105
www.apwa.net

ASAE American Society of Agricultural Engineers

2950 Niles Road
St. Joseph, MI 49085
(616) 429-0300
www.asae.org

ASCE American Society of Civil Engineers

345 East 47th St.
New York NY 10017
(212) 705-7496
www.asce.org

- ASDWA Association of State Drinking Water Administrators**
1120 Connecticut Avenue, NW Suite 1060
Washington, DC 20036
(202) 293-765
(202) 293-7656
www.asdwa.org
- ASHRAE American Society of Heating, Refrigerating and Air-Conditioning Engineers**
1791 Tullie Circle, N.E.
Atlanta, GA 30329
(404) 321-5478
(404) 636-8400
(800) 527-4723
www.ashrae.org
- ASME American Society of Mechanical Engineers**
345 East 47th St.
New York, NY 10017
(212) 705-7722
www.asme.org
- ASTM ASTM International**
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959
(610) 832-9500
www.astm.org
- ASTPHLD Association of State and Territorial Public Health Laboratory Directors**
1211 Connecticut Avenue, NW, Suite 608
Washington, DC 20036
(202) 822-5227
(202) 887-5098
www.astphld.org
- AWWA American Water Works Association**
6666 West Quincy Ave.
Denver, CO 80235
(303) 794-7711
www.awwa.org
- AWWRF American Water Works Research Foundation**
6666 West Quincy Avenue
Denver, CO 80235
(303) 347-6118
www.awwarf.org
- BOCA Building Officials and Code Administrators**
4051 West Flossmoor Road
Country Club Hills, IL 60478
(708) 799-2300
(708) 799-4981
www.bocai.org
- CABO The Council of American Building Officials**
5203 Leesburg Pike, Suite 708
Falls Church, VA 22041
www.cabo.org
- CMA Chemical Manufacturers Association**
2501 M Street NW
Washington, DC 20037
(202) 887-1378

- CERF** **Civil Engineering Research Foundation**
1015 15th St., NW
Washington, DC 20005
(202) 789-2200
(202) 289-6797
www.cerf.org
- CSA** **Canadian Standards Association**
178 Rexdale Blvd.
Rexdale, Ont. M9W 1R3, Canada
(416) 747-4000
www.csa.ca
- DOT/OPS** **U.S. Department of Transportation
Office of Pipeline Safety**
400 7th Street SW
Washington, DC 20590
www.opts.dot.gov
- DOT/TSI** **U.S. Department of Transportation
Transportation Safety Institute**
P.O. Box 25082
Oklahoma City, OK 73125
(405) 686-2466
tsi.dot.gov
- FHA** **Federal Housing Authority**
820 First Street, NE
Washington, DC 20002-4205
(202) 275-9200
(202) 275-9212
www.hud.gov/fha/fhahome.ht
- FM** **Factory Mutual**
1151 Boston Providence Turnpike
P.O. Box 688
Norwood, MA 02062
(617) 762-4300
- GPTC** **Gas Piping Technology Committee**
400 N. Capitol Street NW
Washington, DC 20001
(202) 824-7335
- GTI** **Gas Technology Institute**
1700 South Mount Prospect Road
Des Plaines, IL 60018
(847) 768-0500
www.gastechnology.org
- GRI** **Geosynthetic Research Institute at Drexel University**
33rd and Lancaster Walk
Rush Bldg. - West Wing
Philadelphia, PA 19104
(215) 895-2343
www.drexel.edu
- HSB** **Hydrostatic Stress Board**
Plastics Pipe Institute
1825 Connecticut Ave. NW, Suite 680
Washington, DC 20009
(202) 462-9607
www.plasticpipe.org

- HUD Department of Housing and Urban Development**
451 7th Street, SW
Washington, DC 20410
(202) 708-4200
(202) 708-4829
(800) 347-3735
www.hud.gov
- IAPMO International Association of Plumbing and Mechanical Officials**
20001 S. Walnut Drive
Walnut, CA 91789
(714) 595-8449
www.iapmo.org
- ICBO International Conference of Building Officials**
5360 S. Workman Mill Road
Whittier, CA 90601
(213) 699-0541
www.icbo.org
- IGSHPA International Ground Sourced Heat Pump Association**
374 Cordell South
Stillwater, OK 74078
(405) 744-5175
www.igshpa.okstate.edu
- ISO International Standard Organization**
11 West 42nd Street
New York, NY 10036
(212) 642-4900
(212) 398-0023
www.ansi.org
- ISO/SC4 International Standards Organization**
Secretariat for Subcommittee SC4 "Gas"
GASTEC
Postbus 137, 7300 Ac Apeldoorn
Wilmsdorf 50
Apeldoorn Netherlands
055-494 949
- NACE National Association of Corrosion Engineers**
P.O. Box 218340
Houston, TX 77218
(713) 492-0535
www.nace.org
- NACO National Associations of Counties**
440 First Street, N.W.
Washington, DC 20001
(202) 393-6226
www.naco.org
- NASSCO National Association of Sewer Service Companies**
101 Wymore Rd., Suite 501
Altamonte, FL 32714
(407) 774-0304
www.nassco.org
- NASTT North American Society for Trenchless Technology**
435 N. Michigan Ave., Suite 1717
Chicago, IL 60611
(312) 644-0828
www.bc.irap.nrc.ca/nodig

NCSL National Conference of State Legislatures

1560 Broadway, Suite 700
Denver, CO 80202
(303) 830-2200
www.ncsl.org

NEMA National Electrical Manufacturers Association

2101 L Street NW
Washington, DC 20037
(703) 841-3200
(703) 841-3300
www.nema.org

NFPA National Fire Protection Association

1 Batterymarch Park
Quincy, MA 02269
(617) 770-3000
www.nfpa.org

NGA National Governors' Association

444 North Capitol Street
Washington, DC 20001
(202) 624-5300
www.nga.org

NRWA National Rural Water Association

2915 S. 13th Street
Duncan, OK 73533
(405) 525-0629
(405) 255-4476
www.nrwa.org

NSF NSF International

NSF Bldg.
P.O. Box 130140
Ann Arbor, MI 48113
(313) 769-8010
(313) 769-0109
(800) NSF-MARK
www.nsf.org

NTSB National Transportation Safety Board

800 Independence Ave., S.W., Room 820A
Washington, DC 20594
(202) 382-6600
www.nts.gov

NUCA National Utility Contractors Association

4301 N. Fairfax Drive Suite 360
Arlington, VA 22203
(703) 358-9300
www.nuca.com

NWRA National Water Resources Association

3800 N. Fairfax Drive, Suite 4
Arlington, VA 22203
(703) 524-1544
www.nwra.org

NWWA National Well Water Association

6375 Riverside Drive
Dublin, OH 43017

- PCGA Pacific Coast Gas Association**
1350 Bayshore Highway, Suite 340
Burlingame, CA 94010
(415) 579 7000
- PHCC-NA Plumbing, Heating, Cooling Contractors Association**
180 S. Washington Street
P.O. Box 6808
Falls Church, VA 22040
(703) 237-8100
(703) 237-7442
(800) 533-7694
www.naphcc.org
- PPFA Plastic Pipe and Fittings Association**
800 Roosevelt Road
Building C, Suite 200
Glen Ellyn, IL 60137
(708) 858-6540
www.ppfahome.org
- PVRC Pressure Vessel Research Council of the Welding Research Council**
345 East Fifty -Seventh Street
New York, NY 10017
www.forengineers.org/pvrc
- RCAP Rural Community Assistance Program**
602 South King St., Suite 402
Leesburg, VA 20175
(703) 771-8636
www.rcap.org
- SBCCI Southern Building Codes Council International**
900 Montclair Road
Birmingham, AL 35213
(205) 591-1853
www.sbcci.org
- SCA Standards Council of Canada**
45 O'Connor Street, Suite 1200
Ottawa, ON K1P6N7
(613) 238-3222
www.scc.ca
- SwRI Southwest Research Institute**
6220 Culebra Rd.
P.O. Drawer 28510
San Antonio, TX 78284
(512) 522-3248
www.swri.org
- UL Underwriters Laboratories, Inc.**
333 Pfingsten Road
Northbrook, IL 60062
(847) 272-8800
www.ul.com
- Uni-Bell Uni-Bell PVC Pipe Association**
2655 Villa Creek Drive, Suite 155
Dallas, Texas 75234
(214) 243-3902
www.uni-bell.org

VI **The Vinyl Institute**
1300 Wilson Blvd., Suite 800
Arlington, VA 22209
(703) 741-5670
(703) 741-5672
www.vinyinfo.org

WEF **Water Environment Federation**
601 Wythe St.
Alexandria, VA 22314
(703) 684 2492
(703) 684-2452
www.wef.org