

## Glossary

This glossary of terms is intended to provide definitions for specific words and expressions currently used by the plastic pipe industry or are related to the manufacture, installation and use of polyethylene pipe for different applications.

### A

**Abrasion** - Wear or scour by hydraulic sediment load.

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

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

**Aerobic** - Presence of unreacted or free oxygen (O<sub>2</sub>).

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

**Alkalinity** - The capacity of 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<sub>2</sub>O or Na<sub>2</sub>SO<sub>4</sub> (reacted) is not "free"].

**Annulus** - Free space between the existing pipe and any lining.

**Antioxidant** - Additives that inhibit oxidation at normal or elevated temperatures.

**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.

**Aqueduct** - Large pipe or conduit to convey water from a distant source.

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

**Auger boring** - A technique for forming a bore from a drive pit to a reception pit, by means of a rotating cutting head. Spoil is removed back to the drive shaft by helically wound auger flights rotating in a steel casing. The equipment may have limited steering capability.

## **B**

**Back reamer** - A cutting head attached to the leading end of a drill string to enlarge the pilot bore during a pull-back operation to enable the carrier or sleeve or casing to be installed in.

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

**Barrel** - The vertical section in a manhole between the rim and the base.

**Base** - The structure that supports a manhole.

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

**Bedding** - A prepared layer of material below a pipeline to ensure uniform support.

**Benching or bench** - The floor of a manhole into which the channel is set; the bench is raised so that it can drain to the channel.

**Bentonite** - Colloidal clay sold under various trade names that forms a slick slurry or gel when water is added. Also known as drillers mud.

**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.

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

**Blister** -An imperfection on the surface of a plastic article caused by a pocket of air or gas beneath the surface.

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

**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.

**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.

## **C**

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

**Carrier pipe** - The tube that carries the product being transported and which may go through casings at highway and railroad crossings. On occasion it may be bored direct under the highways and railroads.

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

**Casing** - A pipe used to line bore holes through which a pipe(s) called carrier pipes or ducts are installed. Usually not a Product Pipe.

**Catch basin** - A small buried structure to divert overland storm water flow into sewer flows.

**Cavitation** - Formation 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 used to carry out internal inspection and survey of pipelines.

**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.

**Centerline** - The vertical distance between the center of the drive chuck and the ground plane, or the mid point alignment of a civil engineering construction project.

**CFM** - Cubic Feet per Minute; a measure of flow volume. One CFM equals 0.472 liters per second.

**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.

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

**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.

**Colebrook White Prandtl** - A formula for calculating the flow through pipes.

**Collector Sewer** - A sewer located in the public way collects the wastewaters discharged through building sewers and conducts such flows into larger interceptor sewers and pumping and treatment works.

**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.

**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).

**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.

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

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

**Corrosion Resistance** – The ability of a material to withstand corrosion.

**Cover** - The lid at the top of the manhole, which can be removed when access to the interior of the manhole is required.

**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.

**Crossing** - Pipeline installation in which the primary purpose is to provide one or more passages beneath a surface obstruction.

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

**Crown** - (1) Top of pipe segment, or (2) The highest elevation within a pipe.

**CTS** – Copper tube sizing convention for PE tubing

## **D**

**Data logger** - Keyboard-type device used to electronically record process data.

**Debris** - Accumulation of material consisting of organic (human waste, food wastes, etc.), (sand, gravel, wood, etc.), grease or roots.

**Deflection** – Ring deflection is the percent decrease in pipe's vertical diameter due to soil and live loading. It is essentially equal to the corresponding increase in horizontal diameter.

**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 Required 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).

**Dewater** - Any method used to lower the water table in the vicinity.

**Dielectric Strength** - A measure of the voltage required to puncture a material, expressed in volts per millimeters of thickness (ASTM D-149).

**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.

**Directional drilling** - A steerable system for the installation of pipes, conduits and cables in a shallow arc using a surface launched drilling rig. Traditionally the term applies to large scale crossings in which a fluid-filled pilot bore is drilled using a fluid-driven motor at the end of a bend-sub, and is then enlarged by a washover pipe and back reamer to the size required for the product pipe. The required deviation during pilot boring is provided by the positioning of a bent sub. Tracking of the drill string is achieved by the use of a downhole survey tool.

**Discharge point** - The point where sewer flows are discharged.

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

**Drilling fluid/mud** - A mixture of water and usually bentonite and/or polymer continuously pumped to the Cutting Head to facilitate cutting, reduce required torque, facilitate the removal of cuttings, stabilize the borehole, cool the head and lubricate the installation of the Product Pipe. In suitable soil conditions water alone may be used.

## **E**

**Effluent** - A generic term used to indicate the relative strength of sewer flows; from stormwater to wastewater to industrial effluent, for example.

**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** - The increase in length of a material under tension stress.

**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.

**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.

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

**Environmental Stress Cracking** - The susceptibility to crack or craze under the influence of specific chemicals stress and/or mechanical stress.

**Environmental Stress Crack Resistance (ESCR)** - Is the ability to resist environmental stress cracking under the influence of specific chemicals and stress and/or mechanical stress.

**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.

**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.

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

## **F**

**Fabricated Fittings** – large diameter polyethylene fittings fabricated by fusing together special shapes to create reducer fittings, tees, elbows 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.

**Feet per second** - US customary unit for velocity. One foot per second equals 304.8 millimeters per second; or 0.3048 meters per second. (abbrev. ft/s or fps).

**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 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.

**Force main** - A pipeline that conveys sanitary, combined or stormwater flow under pressure from a pumping (or lift) station to a discharge point.

**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.

## **G**

**Gallons per minute** - US customary unit to measure liquid volume discharge rate. One gallon per minute equals 0.063 liters per second. (abbrev. GPM).

**Glass Transition Temperature** - the temperature below which a plastic is more brittle and glassy

**Gradation** - Sieve analysis of aggregates.

**Grade** - The elevations shown on plans and/or survey grade stakes for the installation of the sewer or carrier pipe. In most cases, it is given to the invert but can also be given to the top of the pipe or casing.

**Grain** - 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.

**Gravity sewer** - A sewer that is designed to operate under open channel conditions (below pipe full capacity) up to a maximum design flow at which point it will become surcharged.

**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, (2) The process of flowing a cement/water grout (without sand) into the annular space between a host pipe and a slipline pipe.

**Gusher** - Applied to infiltration to quantify water flowing under pressure into a sewer in a continuous way through a defect or faulty joint.

## **H**

**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.

**Height Of Cover (HC)** - Distance from crown of a 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.

**Hoop Stress** - The circumferential force per unit areas, psi, in the pipe wall caused by internal pressure within the pipe.

**Horizontal directional drilling (HDD)** - See directional drilling.

**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, 73.4T).

**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).

**Hydrostatic Design Basis (HDB)** – Hydrostatic design basis can be defined as the normalized long-term strength or calculated hoop strength of the material at 100,000 hours obtained by long-term hydrostatic testing of pipe samples from which the probable safe life of the pipe at various stress levels (working pressures) and at various temperatures can be predicted.

**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

**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.

**Inert Material** - A material that 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 sewer system, and service connections from sources on the surface.

**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.

**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. .

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

**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 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.

**Invert** - The lowest point on the pipe circumference; also the defined channel in the manhole platform that directs flow from inlet pipe to outlet pipe. (2) The inside bottom, lowest elevation, of a sewer pipe.

**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.

**IPS** – iron pipe sizing convention for PE pipe

**Izod Impact Strength** - A measure of impact strength determined by the difference in energy of a swinging pendulum before and after it breaks a notched specimen held vertically as a cantilever beam.

## J

**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 pipe into a continuous line using various types of jointing materials. The number of joints depends on the lengths of the pipe sections used in the specific construction work.

## K

**K-Factor** - A term sometimes used for thermal insulation value or coefficient of thermal conductivity.

## L

**Lateral** - A service line that transports fluid to a main line.

**Lb/ft** - US customary units for weight per unit length. One lb/ft equals 1.488 kilograms per meter.

**Linear Foot** - Being one foot to the length of a pipeline.

**Lining** - An internal, non-structural coating or lining material applied to a pipe.

**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 (LDPE)** - Polyethylene, having a standard density of 0.910 to 0.925 g/cm<sup>3</sup>.

**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 (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 £ 30 psig.

## M

**Machining** - Any of a number of processes, such as drilling, turning, sanding, etc., which may be performed on a piece of plastic.

**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** - A structure that allows access to the sewer system.

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

**Manning's Formula** - An equation itself used to calculate flows in gravity channels and conduits:

Or 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.

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

**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.

**Mechanical Property** - Properties of plastics which are classified as mechanical include abrasion resistance, creep, ductility, friction resistance, elasticity hardness, impact resistance, stiffness and strength.

**Medium Density Polyethylene Plastics (MDPE)** - Those branched polyethylene plastics, having a standard density of 0.926 to 0.940 g/cm<sup>3</sup>.

**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."

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

**Molecular Weight** -The sum of the atomic weights of all atoms in a molecule

**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.

## **N**

**Neutral Axis** - An axis of no stress.

**Nominal size** - Size of pipe used to define the internal working diameter.

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

**Notch Sensitivity** - The extent to which an inclination to fracture is increased by a notch, crack, scratch, or sudden change in cross-section.

## **O**

**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.

**Open cut** - The method by which access is gained to the required level underground for the installation, maintenance or inspection of a pipe. The excavation is then backfilled and the surface restored.

**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** – (%) is defined as a percentage of the minimum measured diameter subtracted from the maximum measured diameter and the result divided by the average measured diameter and multiplied by 100.

$$\text{Ovality} = (\%), \quad \frac{\text{maximum measured diameter} - \text{minimum measured diameter}}{\text{average measured diameter}} \times 100$$

Ovality = (%),

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

## **P**

**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.

**Permeability** - Penetrability.

**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.

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

**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

**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.

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

**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.

**Poisson's Ratio** - The constant relating the changes in dimensions which occur when a material is stretched. It is obtained by dividing the change in width per unit length by the change in length per unit length.

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

**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 (PRHDB)** - 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.  $PRHDB = 2 (HDB) (DF)/(DR-1)$

**Pressure Rating, MRS (PRMRS)** - 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.  $PRMRS = 20 (MRS)/(DR-1) C$

**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.

**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.

## **Q**

**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.

## **R**

**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.

**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.

**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.

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

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

**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.

**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.

**Riser** - A thin ring located between the rim and barrel of a manhole. Used to bring the manhole to final grade.

**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.

## **S**

**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.

**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.

**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 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); Vitrified Clay (VC).

**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 pipe 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.

**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.

**Slipline** - A rehabilitation technique covering the insertion of one pipe inside an existing pipe.

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

**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.

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

**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/cm, density in g/cm and specific gravity are numerically nearly equal.

**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.

**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 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 73oF (23oC) 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.

**Storm mains** - Primary collector pipelines in the storm water collection system.

**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.

**Surcharge** - When the line flow exceeds the hydraulic carrying capacity of the line.

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

## T

**Tailwater** - The water just downstream from a structure.

**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.

**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.

**Thermal Conductivity** - The ability of a material to conduct heat; a physical constant for the quantity of heat that passes through a unit cube of material in a unit of time when the temperature difference is 1Fo.

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

**Transition Temperature** -The temperature at which a polymer changes from (or to) a viscous or rubbery condition (or from) a hard and relatively brittle one.

**Trenchless technology** - Techniques for utility line installation, replacement, rehabilitation, renovation, repair, inspection, location and leak detection, with minimum excavation from the ground surface.

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

## U

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

**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.

**V**

**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.

**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.

**Viscoelasticity** - This property, possessed by all plastics to some degree, dictates that while plastics have solid-like characteristics such as elasticity, strength and form-stability, they also have liquid-like characteristics such as flow depending on time, temperature, rate and amount of loading.

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

**W**

**Wastewater** - The liquid conveyed in a sewer system.

**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  $d/2$ .

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

**Working Pressure Rating (WPR)** is the capacity to resist Working Pressure (WP) and anticipated positive transient pressure surges above working pressure.

**Y**

**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** - The stress at which a material exhibits a specified limiting deviation from the proportionality of stress to strain.

**Young's Modulus** - The ratio of tensile stress to tensile strain below the proportional limit.

## **COMMON ABBREVIATIONS**

**ANSI** American National Standards Institute, (formerly USASI, formerly ASA)  
**ASTM** American Society for Testing and Materials; now just ASTM International.  
**AWWA** American Water Works Association  
**CTS** Copper Tubing Size  
**DIPS** Ductile Iron Pipe Size  
**DIN** German Industrial Norm  
**DOT** Department of Transportation, a bureau of U.S.Federal Government  
**DR** Dimension Ratio  
**DVGW** Germany Society for Gas and Water  
**DVS** German Welding Society  
**EOTA** European Organization for Technical Approvals  
**ESC** Environmental Stress Cracking  
**ESCR** Environmental Stress Cracking Resistance  
**HDB** Hydrostatic Design Basis  
**HDBC** Hydrostatic Design Basis Category  
**HDPE** High Density Polyethylene  
**HDS** Hydrostatic design Stress  
**IPS** Iron Pipe Size  
**ISO** International Standards Association  
**JIS** Japanese Industrial Standard  
**KRV** German Plastic Pipe Society  
**LPG** Liquefied Petroleum Gas  
**LTHS** Long-Term Hydrostatic Strength  
**MDPE** Medium Density Polyethylene  
**MRS** Minimum Required Strength  
**PE** Polyethylene  
**PPI** Plastics Pipe Institute  
**RCP** Rapid Crack Propagation  
**SCG** Slow crack growth  
**SDR** Standard Dimension Ratio  
**SPE** Society of Plastic Engineers  
**SPI** Society of the Plastics Industry, Inc.  
**UL** Underwriters Laboratories, the non-profit safety testing organization.  
**WWTP** Wastewater Treatment Plant.