CHAPTER 26

WELL CONSTRUCTION STANDARDS

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Section 1. General Information. This part contains minimum standards for design and construction and for the abandonment of wells covered by this part. The applicant or permittee shall provide for design and construction to protect Groundwaters of the State in accordance with the water quality standards contained in Chapter 8, Water Quality Rules and Regulations.

All American Society for Testing of Materials (ASTM), American Water Works Association (AWWA) and American Petroleum Institute (API) specifications listed are intended to mean the latest revision.

Section 2. Definitions Specific to Chapter 26.

(a) "Abandoned well" means a well regulated under this part for which use has been discontinued for more than one year and the owner does not desire to maintain this well for future use; or its use has been permanently discontinued or is in such a state of disrepair that it cannot be used for its intended purpose.

(b) "Annular space" means the space between the well casing and the wall of the drilled hole or between two well casings.

(c) "Artificial recharge well" means well constructed to introduce water into the ground as a means of replenishing groundwater basins.

(d) "Commercial, municipal and industrial waste well" means well constructed to dispose of unusable waste or contaminated water resulting from a commercial activity, municipal collection, storage or treatment facility or an industrial activity.

(e) "Conductor casing" means a tubular retaining structure installed in the upper portion of a well between the wall of the drilled hole and the inner well casing.

(f) "Confining formation" means an impermeable bed or a bed of distinctly lower permeability than the adjacent material in which groundwater may be moving.

(g) "Destroyed well" means a well that has been properly filled so that it cannot produce water nor act as a vertical conduit for the movement of groundwater.

(h) "Geothermal well" means a well constructed to extract or return water to the ground after it has been used for heating or cooling purposes.

(i) "Key seating" means a stuck drill pipe or casing caused by an abrupt change in direction or dogleg in the drilled hole.

(j) "Miscellaneous discharge well" means a well constructed for a special process discharge of limited time and scope.

(k) "Observation and monitor well" means a well constructed for the purpose of observing or monitoring groundwater conditions.

(l) "Production casing" means a tubular retaining structure installed in the upper portion of a well between the wall of the drilled hole and the inner well casing.

(m) "Sounding tube" means the access to the well casing that allows the water level in the well to be periodically determined. All sounding tubes should have a screw cap.

(n) "Special process discharge well" means a well constructed for the use of a subsurface discharge for recovering a product or fluid at the surface. Special process discharges are defined in detail in Chapter 9, Wyoming Water Quality Rules and Regulations.

(o) "Test well" means a well constructed for obtaining information needed to design a well prior to its construction. Test wells are cased and could be converted to observation or monitoring wells.

(p) "Watertight" means impermeable to water except when under such pressure that structural discontinuity is produced.

Section 3. Application. These standards shall apply to the types of wells listed below. Before a change of use for an existing well can occur, construction standards contained in this part shall be met for the new use.

(a) Well type list requiring permits under Water Quality Rules and Regulations.

(i) Commercial, municipal and industrial waste wells.

(ii) Special process discharge wells.

(iii) Artificial recharge and miscellaneous discharge wells.

(iv) Geothermal wells.

(v) Observation and monitoring wells.

(vi) Test wells.

(b) Standards concerning construction, maintenance and operation of oil or gas producing, storage, injection or disposal wells are administered by the Oil and Gas Conservation Commission and therefore are not contained herein.

Section 4. Well Construction Not Specifically Covered By This Part; Deviations.

(a) The Administrator may grant a deviation from the standards provided the applicant or permittee can supply documentation of reliability, mechanical integrity, design and construction to protect Groundwaters of the State in accordance with the water quality standards contained in Chapter 8, Wyoming Water Quality Rules and Regulations. Such documentation shall include:

(i) Theoretical technology; or

(ii) Full scale operation at another site with similar conditions; or

(iii) A pilot project of scope and length to justify a deviation.

Section 5. Well Location/Siting.

(a) The top of the casing shall terminate above grade or above any known conditions of flooding from runoff or standing water. The area around the well shall slope away from the well. Surface drainage shall be directed away from the well.

(b) Where a well is to be near a building, the well shall be located at a distance from the building to provide access for repairs, maintenance, etc.

Section 6. Sealing the Annular Space. The annular space shall be sealed to protect it against contamination or pollution by entrance of surface and/or shallow subsurface waters. Annular seals shall be installed to provide protection for the casing against corrosion, to ensure structural integrity of the casing, and to stabilize the upper formation.

(a) Minimum depths of seal below ground surface for various uses of wells will be:

Type Well	Minimum Depth of Seal
Commercial, municipal and industrial waste	30 feet
Special process discharge	30 feet
Artificial recharge and miscellaneous discharge	30 feet
Geothermal wells	30 feet
Observation and monitoring	20 feet
Test wells	30 feet

(b) Sealing conditions. Following are requirements to be observed in sealing the annular space.

(i) Wells situated in unconsolidated, caving material shall have an oversized hole, at least four inches greater in diameter than the production casing, drilled. A conductor casing shall be installed. The space between the conductor casing and the production casing shall be filled with sealing material. The conductor casing may be withdrawn as the sealing material is placed.

(ii) Wells situated in unconsolidated material stratified with significant clay layers shall have an oversized hole of at least four inches greater in diameter than the production casing drilled, with the annular space filled with sealing material. If a clay formation is encountered within five (5) feet of the bottom of the seal, the seal should be extended five (5) feet into the clay formation.

(iii) Wells situated in soft consolidated formations shall have an oversized hole of at least four inches greater in diameter than the production casing. The annular space between the production casing and the drilled hole shall be filled with sealing material.

(iv) Wells situated in "hard" consolidated formations (crystalline or metamorphic rock) shall have an oversized hole drilled with the annular space filled with sealing material.

(c) Sealing material. The sealing material shall consist of neat cement grout, sand cement grout, bentonite clay or concrete.

(i) Cement used for sealing mixtures shall meet the requirements of ASTM C150 "Standard Specifications for Portland Cement" or API 10B "Recommended Practices for Testing Oil-Well Cements and Cement Additives". Materials used as additives for Portland Cement mixtures in the field shall meet the requirements of ASTM C494 "Standard Specifications for Chemical Admixtures for Concrete" or API RP 10B.

(ii) Neat cement shall be composed of one sack of Portland Cement (94 pounds) to 4½ to 6½ gallons of clean water.

(iii) Sand-cement grout shall be composed of not more than two parts by weight of sand and one part of Portland cement to 4½ to 6½ gallons of clean water per sack of cement.

(iv) Concrete used shall be "Class A" or "Class B". Aggregates shall meet the requirements of ASTM C33 "Standard Specifications for Concrete Aggregates".

(v) Special quick-setting cement, retardants to setting, and other additives, including hydrated lime to make the mix more fluid or bentonite to make the mix more fluid and reduce shrinkage, may be used.

(vi) Bentonite clay mixtures shall be composed of bentonite clay and clean water thoroughly mixed before placement so that there are no balls, clods, etc.

(vii) Used drillers mud or cuttings or chips from drilling the borehole shall not be used as sealing material.

(viii) The minimum time that must be allowed for materials containing cement to "set" shall be in accordance with ASTM C150 or API RP10B. When necessary these times may be reduced by use of accelerators as determined by the well contractor.

(d) Thickness of seal. The thickness of the seal shall be at least two (2) inches and not less than three (3) times the size of the largest coarse aggregate used in the sealing material

(e) Placement of seal. Before placing the seal, all loose cuttings, chips, or other obstructions shall be removed from the annular space by flushing with water or fluid drilling mud. The sealing material shall be placed when possible, in one continuous operation from the bottom up. The fluid used to force the final sealing material through the casing shall remain under pressure, to prevent back flow, until the sealing material is set.

Section 7. Surface Construction Features.

(a) Openings. Openings into the top of the well that are designed to provide access to the well, (e.g.), for measuring, chlorinating, adding gravel, etc., shall be protected against entrance of surface waters or foreign matter by installation of water tight caps or plugs. Access openings designed to permit the entrance or egress of air or gas shall terminate above the ground and above known flood levels and shall be protected against the entrance of foreign materials by installation of down turned and screened "U" bends. All other openings (holes, crevices, cracks, etc.) shall be sealed.

A sounding tube, tap hole with plug, or similar access for the introduction of water level measuring devices may be affixed to the casing of the well as long as the proper seal is maintained. Access ports for water level or pressure measuring devices are required by the State Engineer on all wells greater than four inches diameter.

Section 8. Casing.

(a) The casing shall provide structural stability to prevent casing collapse during installation as well as drill hole wall integrity when installed, be of required size to convey liquid at a specified injection/recovery rate and pressure, and be of required size to allow for sampling.

(i) Steel casing shall meet the following conditions:

(A) Standard and line pipe. This material shall meet one of the following specifications:

(I) API Std. 5L, "Specifications for Line Pipe."

(II) API Std. 5LX, "Specifications for High-Test Line Pipe."

(III) ASTM A53 "Standard Specification for Pipe Steel, Black and Hot Dipped, Zinc Coated Welded and Seamless."

(IV) ASTM A120 "Standard Specifications for Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses."

(V) ASTM A134 "Standards Specifications for Electric-Fusion (arc) - Welded Steel Plate Pipe (Sizes 16 inches and over)."

(VI) ASTM A135 "Standard Specifications for Electric - Resistance - Welded Steel Pipe."

(VII) ASTM A139 "Standard Specification for Electric-Fusion (arc) - Welded Steel Pipe (Sizes 4 inches and over)."

(VIII) ASTM A211 "Standard Specifications for Spiral - Welded Steel or Iron Pipe."

(IX) AWWA C200 "AWWA Standard for Steel Water Pipe 6 inches and Larger."

(B) Structural steel. This material shall meet one of the following specifications:

(I) ASTM A36 "Standard Specification for Structural Steel."

(II) ASTM A242 "Standard Specifications for High Strength Low Alloy Structural Steel."

(III) ASTM A283 "Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars of Structural Quality."

(IV) ASTM A441 "Tentative Specifications for High-Strength Low Alloy Structural Manganese Vanadium Steel."

(V) ASTM A570 "Standard Specification for Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality."

(C) High Strength Carbon steel sheets or "well casing steel." Each sheet of material shall contain mill markings that identify the manufacturer and specify that the material is well casing steel that complies with the chemical and physical properties published by the manufacturer.

(D) Stainless Steel casing shall meet the provisions of ASTM A409 "Standard Specification for Welded Large Diameter Austenitic Steel Pipe for Corrosive or High Temperature Service."

(ii) Plastic can also be used for casing in many locations and under a variety of circumstances. The two groups of plastic materials available are thermoplastics and thermosets.

(A) Thermoplastics. This material shall meet the requirements of ASTM F 480 "Standard Specification for Thermoplastic Water Well Casing Pipe and Couplings made in Standard Dimension Ratios (SDR)."

(B) Thermosets. This material shall meet the requirements of the following specifications:

(I) ASTM D2996 "Standard Specification for Filament Wound Reinforced Thermosetting Resin Pipe."

(II) ASTM D2997 "Standard Specification for Centrifugally Cast Reinforced Thermosetting Resin Pipe."

(III) ASTM D3517 "Standard Specification for Reinforced Plastic Mortar Pressure Pipe."

(IV) AWWA C950 "AWWA Standards for Glass - Fiber - Reinforced Thermosetting - Resin Pressure Pipe."

(iii) Concrete pipe used for casing should conform to the following specifications:

(A) ASTM C14 "Standard Specifications for Concrete Sewer, Storm Drain, and Culvert Pipe."

(B) ASTM C76 "Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe."

(C) AWWA C300 "AWWA Standards for Reinforced Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids."

(D) AWWA C301 "AWWA Standards for Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids."

(iv) Galvanized sheet metal pipe or natural wood shall not be used as casing.

(b) All casing shall be placed with sufficient care to avoid damage to casing sections and joints. All joints in the casing above the perforations or screens shall be watertight. The uppermost perforations shall be at least below the minimum depth of seal. Casing shall be equipped with centering guides to ensure even thickness of annular seal and/or gravel pack.

(i) Metallic casing. Steel casing may be joined by either welding or by threading and coupling.

(ii) Plastic (non-metallic) casing. Depending on the type of material and its fabrication, plastic casing may be joined by solvent welding or may be mechanically joined. Compatibility between potential contaminants and the sealing agent used shall be demonstrated.

Section 9. Sealing/Cementing Off Strata. Where a well penetrates more than one aquifer or water bearing strata, every aquifer and/or strata shall be sealed off to prevent migration of water from one aquifer or strata to another.

(a) Strata shall be sealed off by placing impervious material opposite the strata and opposite the confining formation(s). The seal shall extend above and below the strata no less than ten (10) feet. The sealing material shall fill the annular space in the interval to be sealed, and the surrounding void spaces that might absorb the sealing material. The sealing material shall be placed from the bottom to the top of the interval to be sealed.

(b) Commercial, municipal and industrial waste and artificial recharge wells shall be sealed/ cemented in order that all aquifers are isolated over the entire length of casing(s) and shall be surrounded by a minimum of two (2) inches of sealant. The sealant/cement plug used to isolate the aquifer(s) shall extend fifty (50) feet above and below the interface between confining layer and the aquifer(s).

(c) Sealing material shall consist of neat cement, cement grout, or bentonite clay as per Section 6 (c).

Section 10. Well Construction, Completion, Development and Evaluation.

(a) Developing, redeveloping, or conditioning a well shall be done by methods that will not cause damage to the well or cause adverse subsurface conditions that may destroy barriers to the vertical movement of water between aquifers.

(b) The well opening shall be closed with a cover to prevent the introduction of undesirable material into the well and to ensure public safety whenever the well is not in use or when maintenance is being performed on the well.

(c) During well development, every well shall be tested for plumbness and alignment in accordance with AWWA or API approved standards, (i.e., deviation checks). The plumbing and alignment tests shall be documented to ensure problems such as key seating, or fatigue failures will not occur.

(d) All injection/recharge wells used for discharge of commercial, municipal or industrial wastes shall inject fluid through a tubing with a packer set immediately above the injection zone or tubing with an approval fluid seal as an alternative.

(e) At a minimum, all commercial, municipal and industrial waste, special process discharge, artificial recharge and miscellaneous discharge wells deviation checks and cement bond logs shall be conducted and documented. The Water Quality Division should be contacted prior to well construction or operation to determine the need for additional logs and tests.

Section 11. Plugging and Abandonment.

(a) All wells that are no longer useful (including test wells) must be plugged in order to ensure that groundwater supply is protected and preserved for further use and to eliminate the potential physical hazard. A well is considered "abandoned" when it has not been used for a period of one year, unless the owner demonstrates their intention to use the well again by properly maintaining the well in such a way that:

(i) The well has no defects that will allow the impairment of quality of water in the well or in the water bearing formations penetrated.

(ii) The well is covered and the cover is watertight.

(iii) The well is marked so that it can be clearly seen.

(iv) The area surrounding the well is kept clear of brush or debris.

Observation or test wells used in the investigation or management of usable sources of groundwater by state agencies or by engineering or research organizations are not considered

"abandoned" so long as they are maintained for this purpose. These wells shall be covered with an appropriate cap, and labeled for their particular use.

(b) Preliminary work. Before a well is plugged and abandoned, it shall be investigated by the permittee (owner/ operator) to determine its condition, details of construction and whether there are obstructions that will interfere with the process of filling and sealing.

(c) Filling and sealing. Following are requirements to be observed when plugging wells:

(i) Wells wholly situated in unconsolidated material in an unconfined groundwater zone shall have the uppermost thirty (30) feet sealed with impervious material. The remainder of the well shall be filled with clay, sand, or other suitable inorganic matters as described in paragraph e.

(ii) Wells penetrating several aquifers or formations containing usable water sources shall have the uppermost thirty (30) feet sealed with an impervious material. All screened or perforated intervals shall be sealed to prevent vertical movement of waters from the producing or injected formation. Impervious material shall be placed opposite the confining formation above and below (and including) the screened or perforated interval for a minimum of fifty (50) feet or more.

(iii) Any uncased hole below the well shoe shall be filled with an impervious material as described in paragraph e. to a depth of at least fifty (50) feet above the shoe.

(iv) Whenever production casing has been severed or inadvertently removed the well bore shall be filled with impervious material from a point fifty (50) feet below to a point 50 feet above the point of severance or to the surface limit.

(v) Wells penetrating creviced or fractured rock shall have the portions of the well opposite this formation sealed with neat cement, sand cement grout or concrete. If these formations extend to considerable depth, alternate layers of coarse stone and cement grout or concrete may be used to fill the well.

(vi) Wells in nonfractured, consolidated formations shall have the uppermost thirty (30) feet filled with impervious material and the non-creviced, consolidated formation portion of the well may be filled with clay or other suitable material.

(d) Placement of material. The following requirements shall be observed in placing fill or sealing a plugged or abandoned well.

(i) No material shall be placed in the well unless the Administrator has been notified that plugging and abandonment operations are to commence. A minimum of thirty (30) days notice must be given.

(ii) The well shall be filled with the appropriate material as described in paragraph e. from the bottom of the well up.

(iii) Sealing materials shall be placed in the interval or intervals to be sealed by methods that prevent free fall, dilution and/or separation of aggregates from cementing materials.

(iv) When the underground pressure head producing flow is such that a counterpressure must be applied to force a sealing material into the annular space, this counterpressure shall be maintained for the length of time required for the cementing mixture to set as specified in Section 6, paragraph (c) (viii) of this part.

(v) To ensure that the well is filled and there has been no bridging of the material, verification shall be provided that the volume of material placed in the well installation at least equals the volume of the empty hole.

(e) Material. Requirements for sealing and fill materials are as follows.

(i) Impervious sealing materials. Sealing materials shall have a permeability of 10 - 7 cm/sec or less. Impervious materials include neat cement, sand-cement grout, concrete, and bentonite clay as described in Section 6, paragraph (c). Used drilling muds are not acceptable.

(ii) Filler material. Materials such as clay, silt, sand, gravel, crushed stone, native soil, and mixtures of these materials, as well as those described in paragraph (i) above may be used as filler material. Material containing organic matter or used drilling muds shall not be used.

(f) Markings. The top of the plug of any plugged and abandoned well shall show clearly, by permanent markings, whether inscribed in the cement or on a steel plate embedded in the cement, the permit number, well identification number and date of plugging.

(g) Reports. Within fifteen (15) days after a well has been plugged and abandoned, the owner shall file a plugging record with the Water Quality Division.