



Rules of
Department of Natural Resources
Division 23—Well Installation
Chapter 4—Monitoring Well Construction Code

Title	Page
10 CSR 23-4.010 Definitions (Rescinded February 28, 2019).....	3
10 CSR 23-4.020 Certification and Registration for Monitoring Wells (Rescinded February 28, 2019)	3
10 CSR 23-4.030 Location of Wells (Rescinded February 28, 2019).....	3
10 CSR 23-4.040 Drilling Methods for Monitoring Wells (Rescinded July 30, 2011).....	3
10 CSR 23-4.050 General Protection of Groundwater Quality and Resources	3
10 CSR 23-4.060 Construction Standards for Monitoring Wells	3
10 CSR 23-4.070 Monitoring Well Development (Rescinded July 30, 2011)	5
10 CSR 23-4.080 Plugging of Monitoring Wells	5



**Title 10—DEPARTMENT OF
NATURAL RESOURCES
Division 23—Well Installation
Chapter 4—Monitoring Well
Construction Code**

10 CSR 23-4.010 Definitions
(Rescinded February 28, 2019)

AUTHORITY: sections 256.603, 256.606, and 256.626, RSMo 2000. Emergency rule filed Nov. 16, 1993, effective Dec. 11, 1993, expired April 9, 1994. Original rule filed Aug. 17, 1993, effective March 10, 1994. Amended: Filed July 13, 1994, effective Jan. 29, 1995. Amended: Filed Nov. 1, 1995, effective June 30, 1996. Amended: Filed Nov. 18, 2010, effective July 30, 2011. Rescinded: Filed June 27, 2018, effective Feb. 28, 2019.

10 CSR 23-4.020 Certification and Registration for Monitoring Wells
(Rescinded February 28, 2019)

AUTHORITY: sections 256.606, 256.614, and 256.626, RSMo 2000. Emergency rule filed Nov. 16, 1993, effective Dec. 11, 1993, expired April 9, 1994. Original rule filed Aug. 17, 1993, effective March 10, 1994. Amended: Filed Nov. 1, 1995, effective June 30, 1996. Amended: Filed Nov. 18, 2010, effective July 30, 2011. Rescinded: Filed June 27, 2018, effective Feb. 28, 2019.

10 CSR 23-4.030 Location of Wells
(Rescinded February 28, 2019)

AUTHORITY: sections 256.606 and 256.626, RSMo 2000. Emergency rule filed Nov. 16, 1993, effective Dec. 11, 1993, expired April 9, 1994. Original rule filed Aug. 17, 1993, effective March 10, 1994. Amended: Filed Nov. 18, 2010, effective July 30, 2011. Rescinded: Filed June 27, 2018, effective Feb. 28, 2019.

10 CSR 23-4.040 Drilling Methods for Monitoring Wells
(Rescinded July 30, 2011)

AUTHORITY: sections 256.606 and 256.626, RSMo Supp. 1991. Original rule filed Aug. 17, 1993, effective March 10, 1994. Amended: Filed July 13, 1994, effective Jan. 29, 1995. Rescinded: Filed Nov. 18, 2010, effective July 30, 2011.

10 CSR 23-4.050 General Protection of Groundwater Quality and Resources

PURPOSE: This rule prevents the use of monitoring wells for any purpose other than the purpose for which they were designed and allows certain modifications to the application of these rules.

(1) Monitoring wells shall not be converted to any other type of well unless advanced written approval is obtained from the department.

(2) Monitoring wells shall be constructed so that aquifer mixing does not occur and may not be screened through the soil-bedrock horizon unless advanced written approval is obtained from the department. Drilling water shall be of potable quality.

AUTHORITY: sections 256.606 and 256.626, RSMo 2016. Emergency rule filed Nov. 16, 1993, effective Dec. 11, 1993, expired April 9, 1994. Original rule filed Aug. 17, 1993, effective March 10, 1994. Amended: Filed Nov. 1, 1995, effective June 30, 1996. Amended: Filed Nov. 18, 2010, effective July 30, 2011. Amended: Filed June 27, 2018, effective Feb. 28, 2019.*

**Original authority: 256.606, RSMo 1991 and 256.626, RSMo 1985, amended 1991.*

10 CSR 23-4.060 Construction Standards for Monitoring Wells

PURPOSE: This rule describes the minimum construction standards for monitoring wells.

(1) Riser Pipe and Screen Material.

(A) Chemical Compatibility. If used in a monitoring well, the riser pipe and screen material selected shall resist chemical corrosion for the life of the proposed monitoring program and be new and free from contaminants that would adversely affect the quality of the groundwater.

(B) Riser Pipe and Screen Materials. The following types of riser pipe and screen materials may be used:

1. Thermoplastic materials, including polyvinyl chloride (PVC) and acrylonitrilebutadiene-styrene (ABS);

2. Metallic materials, including carbon steel, low-carbon steel, galvanized steel, and stainless steel (304 and 316);

3. Fluoropolymer materials, including polytetrafluoroethylene (PTFE), tetrafluoroethylene (TFE), fluorinated ethylene propylene (FEP), perfluoroalkoxy (PFA), polyvinylidene fluoride (PVDF), and polyamides (such as Nylon); and

4. Other types of riser pipe and screen may be used upon advanced written approval from the department.

5. Industry standard mesh material or pre-manufactured slotted screen is the only approved material for screening; hand-cut solid wall pipe is not allowed.

(C) Thermoplastic and fluoropolymer riser pipe shall—

1. Be new and meet ASTM standards;

2. Be a minimum diameter of two inches (2") except that direct-push wells may have riser pipe with a minimum nominal diameter of three-quarters of an inch (3/4");

3. Be a minimum of Schedule 40 for wells one hundred feet or less ($\leq 100'$) and a minimum of Schedule 80 for wells greater than one hundred feet ($> 100'$). Gas-migration wells using a soil gas implant and tubing are exempt from this requirement; and

4. Be joined to screen by a watertight mechanical type joint.

(D) Metallic riser pipe shall—

1. Be a minimum diameter of two inches (2") except that direct-push wells may have riser pipe and screen with a minimum diameter of three-quarters of an inch (3/4").

2. Have an equivalent wall thickness—

A. For carbon, low-carbon, and galvanized steel not less than Schedule 40;

B. For stainless steel not less than Schedule 5; and

C. For joint wall thickness shall not less than Schedule 40; and

3. Be joined by a watertight mechanical joint or welded.

(2) Casing Material.

(A) Casing Materials. The following types of casing shall be used:

1. Thermoplastic materials;

2. Fluoropolymer materials;

3. Metallic materials, including steel casing material that meets the minimum specifications pursuant to 10 CSR 23-3.030(1). The joining of two (2) dissimilar metals is not allowed; or

4. Other types of casing may be used upon advanced written approval from the department.

(B) Casing diameter shall be a minimum of four inches (4") larger than the outside diameter of the riser pipe being installed.

(C) Casing borehole diameter shall be a minimum of four inches (4") larger in diameter than the outside diameter of the casing.

(D) The casing, if installed, shall be grouted full-length with high solids bentonite slurry or cement slurry pursuant to 10 CSR 23-4.060(9) using the tremie method or one (1) of the pressure grouting methods pursuant to 10 CSR 23-3.030(1)(B). Extend the annular



seal for the riser from a point at least two feet (2') below the base of the casing up to the base of the surface completion.

(3) Monitoring well boreholes shall—

(A) Be clean and free of obstructions;

(B) Have a diameter that is at least four inches (4") larger than the outside diameter of the riser pipe and screen;

(C) For gas-migration type wells using soil vapor implants, be a minimum of one inch (1") in diameter and be exempt from these borehole standards if properly plugged within thirty (30) days of completion; and

(D) For direct-push wells, be a minimum of three and one-quarter inches (3.25") in diameter and be exempt from these borehole standards if properly plugged within thirty (30) days of completion.

(4) Open-hole completions may be allowed upon advanced written approval by the department. If approved, the open-hole portion shall be in competent, consolidated bedrock, with the casing extending from the surface to the minimum total depth and minimum depth into bedrock pursuant to 10 CSR 23-3.090 for a domestic well at that location. The casing shall be grouted full-length using methods and materials pursuant to 10 CSR 23-4.060(2)(E).

(5) Installation of Well Screen and Riser Assembly. The well screen and riser assembly shall be centered in the borehole before the installation of the filter pack, unless a prepack filter is used. Extend the riser pipe from the well screen into the surface completion. Monitoring wells greater than fifty feet (>50') in depth shall have centralizers installed at the base of the well screen and at the top of the filter pack. A centralizer is not necessary for direct-push wells or wells constructed through hollow-stem augers.

(6) Primary Filter Pack. All monitoring wells shall have a primary filter pack installed using one (1) of the following methods. Other methods may be used upon advanced written approval by the department.

(A) Artificially Constructed Filter Pack Placement. Place the filter pack material evenly around the well screen via a tremie pipe. The tremie pipe must be placed within five feet (5') of the bottom of the well screen and the filter pack material poured into the tremie pipe while the pipe is slowly removed. Fill the borehole with filter pack material to within one to five feet (1'-5') above the well screen. If the well is drilled using the hollow stem auger method, the filter pack material may be poured through the hollow stem auger

as it is removed from the borehole. Prepacked filter pack assemblies may be used in lieu of artificially constructed filter pack placement.

(B) Naturally Developed Filter Pack Placement. The existing geologic material may be allowed to collapse around the well screen provided the well can be developed.

(C) The primary filter pack on shallow monitoring wells shall extend a minimum of six inches (6") above the top of the well screen.

(D) Soil vapor implants shall have a minimum primary filter pack of six inches (6") above and below each implant.

(7) Secondary Filter Pack. All monitoring wells shall have a secondary filter pack unless non-slurry bentonite is used as a bentonite seal or annular seal. The secondary filter pack shall extend from one foot to two feet (1'-2') above the primary filter pack and consist of one foot to two feet (1'-2') of clean fine sand.

(8) Bentonite Seal. A bentonite seal of two feet (2') or greater is required if the annular seal is composed of slurry grout material and a secondary filter pack is not used.

(A) Placement of the Bentonite Seal in the Saturated Zone. When the bentonite seal is to be emplaced in the saturated zone, only bentonite chips or pellets may be used. To avoid flash swelling and bridging, the fine bentonite material, which may develop during transport, shall not be introduced into the well bore. Place the bentonite chips evenly around the riser pipe.

(B) Placement of the Bentonite Seal in the Unsaturated Zone. When the top of the secondary filter pack is in the unsaturated zone, bentonite chips, pellets, or granules may be used provided the bentonite is hydrated in place with potable water. Bentonite slurry may be used to fill the annular space from the top of the secondary filter pack, if present, to the surface seal via a tremie pipe. If the total depth of the slurry being placed exceeds five feet (5'), use a side discharge to limit disruption of the filter packs.

(9) Installation of the Annular Seal. The annular seal must extend from the secondary filter pack or bentonite seal to the base of the surface completion. The combined annular seal and bentonite seal (if a bentonite seal is utilized) must be at least two feet (2') thick unless monitoring for shallow contaminants. Monitoring wells constructed for shallow monitoring must have a minimum combined annular seal and bentonite seal (if a bentonite seal is used) of at least one foot (1'). The following grout types are permitted in monitor-

ing wells:

(A) Bentonite Slurry-Grout. High solids sodium bentonite slurry, at least twenty to thirty percent (20%-30%) by weight solids, must be tremie grouted from the bottom to the top of the annular space in one (1) continual operation;

(B) Non-slurry Bentonite. Chipped or pelletized varieties that are designed to fall through standing water may be used when sealing the annulus of a well that is below the saturated zone. Granulated and powdered bentonite must never be poured through standing water because they will flash swell and bridge off before getting to the bottom of the annular space. Bentonite chips or pellets may be used to seal portions of the annular space that are in the unsaturated zone. Granulated and powdered varieties are not permitted to be used in the unsaturated zone unless they are used to create a slurry, due to their flash swelling properties which would prevent hydration of the complete column of bentonite. When using bentonite chips or pellets in the unsaturated zone, it must be hydrated after each three feet (3') interval has been emplaced. To properly hydrate the bentonite, a minimum of three (3) times as much water as bentonite must be used. Water used must be of potable quality;

(C) Cement Slurry.

1. Cement slurry may only be used if additives are incorporated to minimize shrinkage.

A. The powdered bentonite additive must be thoroughly mixed with the water before it is added to the cement. Powdered bentonite from two percent to six percent (2%-6%) by weight must be added.

B. Other shrinkage reducing additives may be used provided advanced written approval is obtained from the department;

2. The water used to mix cement slurry must be of potable quality; and

3. Cement slurry must be emplaced in the annulus via a tremie pipe placed to the bottom of the annular space. The tremie pipe must have a side discharge which directs the grout away from the bentonite seal, reducing the potential for infiltration. The grouting of the annular space must be completed in one (1) continual operation, lifting the tremie pipe as the space fills. A staged grouting procedure may be used provided advanced written approval is obtained from the department; or

(D) Other types of grout may be used provided advanced written approval is obtained from the department.

(10) Surface completion on all monitoring wells is required.



(A) Above-Ground Completions. Above-ground completions must meet the following standards:

1. The protective casing must extend from at least one and one-half feet (1 1/2') above the finished grade of the ground surface to a point at least two feet (2') below the finished grade, except as stated in 10 CSR 23-4.060(10)(B) of this rule for flush-mount completions. The above-ground completion must be placed in a hole that is at least eight inches (8") in diameter larger than the above-ground completion size. Protective posts are required for above-ground completed monitoring wells in traffic areas. The protective casing must be centered in this hole and concrete poured around the casing to secure it. Cement or bentonite slurry is not allowed. All water must be removed from the enlarged hole before concrete is added. The surface of the concrete must slope away from the protective casing so that pooling of surface water does not occur;

2. A weep hole or alternate method must be employed to ensure water does not accumulate inside the protective casing to the point that the top of the riser is submerged; and

3. A locking well cap and a suitable lock must be attached to the top of the above-ground completion. The riser pipe must be sealed with a watertight cap and must extend at least two feet (2') above the finished surface grade in flood prone areas.

(B) Flush-Mount Well Completions. The flush-mount assembly must be at least eight inches (8") in length and have a tamper-resistant watertight lid. The riser pipe must be sealed with a watertight cap. The flush-mount surface completion must be set into a hole that is at least eight inches (8") in diameter larger than the diameter of the flush-mount assembly and set in concrete. If the monitoring well is being placed through asphalt or concrete, a hole that is at least four inches (4") in diameter larger than the diameter of the flush-mount assembly must be constructed. The flush mount must then be set in concrete. Cement or bentonite slurry is not allowed.

(C) All monitoring wells must be uniquely identified at the surface completion.

(11) Alternate monitoring well construction procedures, methods, or technologies may be used provided advanced written approval is obtained from the department.

(12) The installation and use of sampling, development, maintenance, or testing devices and equipment in monitoring wells is not regulated except that the installation of a pumping system in wells used for remediation or

clean-up must be performed by a non-restricted pump installation contractor.

(13) Nested well construction may be allowed upon advanced written approval by the department. Gas-migration wells constructed using soil vapor implants shall meet minimum primary filter pack requirements pursuant to 10 CSR 23-4.060(6), have a minimum bentonite seal of one foot (1') placed between each primary filter pack, and have a minimum of one and one-half feet (1.5') of bentonite seal placed between the uppermost primary filter pack and the base of the surface completion.

AUTHORITY: sections 256.606 and 256.626, RSMo 2016. Emergency rule filed Nov. 16, 1993, effective Dec. 11, 1993, expired April 9, 1994. Original rule filed Aug. 17, 1993, effective March 10, 1994. Amended: Filed July 13, 1994, effective Jan. 29, 1995. Amended: Filed Nov. 1, 1995, effective June 30, 1996. Amended: Filed Nov. 18, 2010, effective July 30, 2011. Amended: Filed June 27, 2018, effective Feb. 28, 2019.*

**Original authority: 256.606, RSMo 1991 and 256.626, RSMo 1985, amended 1991.*

10 CSR 23-4.070 Monitoring Well Development

(Rescinded July 30, 2011)

AUTHORITY: sections 256.606, 256.626, and 256.637, RSMo 1994. Original rule filed Aug. 17, 1993, effective March 10, 1994. Amended: Filed July 13, 1994, effective Jan. 29, 1995. Amended: Filed Nov. 1, 1995, effective June 30, 1996. Rescinded: Filed Nov. 18, 2010, effective July 30, 2011.

10 CSR 23-4.080 Plugging of Monitoring Wells

PURPOSE: This rule sets standards for the plugging of monitoring wells.

(1) When plugging a monitoring well, the following minimum requirements shall be met:

(A) Remove all pumps, sampling equipment, debris, or other substances;

(B) Remove the surface completion from the borehole ensuring that the grout seal is not disturbed. Cut off riser pipe and/or casing two feet (2') below ground surface;

(C) Fill the well from bottom to within one foot (1') of ground surface with grout pursuant to 10 CSR 23-4.060(9);

(D) After the grout is fully cured, check for settlement and top off if necessary. Fill

remaining hole with soil or pave.

(E) Flush mount completions in paved areas may be left in place and filled with asphalt or concrete;

(F) A monitoring well may be completely excavated as opposed to being plugged with grout. If the well is over drilled, the borehole shall be completely filled with grout pursuant to 10 CSR 23-4.060(9); and

(G) A non-restricted monitoring well installation contractor must be on site at all times during the excavation and plugging operations.

(2) Temporary monitoring wells ten feet (10') or greater in depth must be plugged by removing any temporary pipe and filling the well from total depth to two feet (2') from the ground surface with approved grout, with the remainder of the well filled with compacted uncontaminated native material or grout. Temporary monitoring wells shall be plugged within thirty (30) days of the date of completion.

AUTHORITY: sections 256.606, 256.615, and 256.623, RSMo 2016. Emergency rule filed Nov. 16, 1993, effective Dec. 11, 1993, expired April 9, 1994. Original rule filed Aug. 17, 1993, effective March 10, 1994. Amended: Filed July 13, 1994, effective Jan. 29, 1995. Amended: Filed Nov. 1, 1995, effective June 30, 1996. Amended: Filed Nov. 18, 2010, effective July 30, 2011. Amended: Filed June 27, 2018, effective Feb. 28, 2019.*

**Original authority: 256.606, RSMo 1991; 256.615, RSMo 1991; and 256.623, RSMo 1985, amended 1991.*