

SECTION 02201

EXCAVATION AND BACKFILL FOR STRUCTURES

PART 1 GENERAL

1.01 SUMMARY

- A. Work to be performed under this section shall include all labor, equipment, materials and miscellaneous items necessary to perform all clearing and grubbing, excavation, backfilling, compacting, testing and related work not specified elsewhere, as shown on the Drawings and required by the Specifications.
- B. All work within the rights-of-way of the Federal Government, the Colorado Division of Highways, County Governments or Municipal Governments shall be done in compliance with requirements issued by those agencies. All such requirements shall take precedence over these Specifications. It shall be the Contractor's responsibility to secure all required excavation permits and pay all costs thereof.

1.02 REFERENCE STANDARDS

- A. Colorado Department of Transportation "Standard Specifications for Road and Bridge Construction," latest edition.

1.03 SUBMITTALS

- A. The Contractor shall prepare and submit information for all imported backfill material.

1.04 FIELD CONDITIONS

- A. Existing Utilities. Underground utilities, except service lines, known to the Engineer have been shown on the Drawings. Locations are approximate only and may prove to be inaccurate. The Contractor is responsible for verification of the existence, location and protection of all utilities within the construction limits.
 - 1. Before commencing with work, the Contractor shall notify all public and private companies who may have utilities within the project limits. The Contractor shall coordinate with these entities all excavation performed. The Contractor shall obtain all permits required by utility owners.
 - 2. In the event of damage to any existing utility, the Contractor shall be solely responsible for the repair and payment for repair of all such damage.
 - 3. The Contractor shall make arrangements for and pay all costs for relocation of utilities requiring relocation as indicated on the Drawings. Should utility obstructions, not shown on the Drawings, be encountered and require relocation, the Contractor shall notify the Owner and the Engineer and shall make arrangements necessary for such relocation. The Owner shall pay the costs for such relocation.
- B. Existing Improvements. The Contractor shall restore or protect from damage all existing improvements encountered in performance of the work. Improvements damaged as a

result of this work shall be restored to original condition or better, as determined by the Owner.

1. Adjacent property shall be protected by the Contractor from any damage. The Contractor shall be held solely liable for any damage to adjacent property and shall be responsible for all costs resulting from repair of such damage.

C. Soil Conditions. It shall be the responsibility of the Contractor to examine soil conditions and characteristics, including the presence of groundwater that will be encountered within the limits of construction.

1.05 PROTECTION OF WORK

A. Safety. All excavations shall be protected by barricades, lights, signs, etc. as required by governing federal, state and local safety codes, Owner requirements and regulations.

B. Sheeting, shoring and bracing. Except where banks are cut back on a stable slope, provide and maintain sheeting, shoring and bracing systems necessary to protect adjoining grades and structures from caving, sliding, erosion or other damage, and suitable forms of protection against bodily injury, all in accordance with applicable codes and governing authorities.

1. Remove sheeting and shoring systems as excavations are backfilled in a manner to protect the construction or other structures, utilities or property. Do not remove any sheeting after backfilling.

2. Sheeting and shoring systems shall be structurally designed and sufficiently braced to provide necessary restraining of retained backfill. Prior to installation of such systems, methods of installation and materials proposed shall be discussed with and approved by Engineer. All systems shall be in strict compliance with local, state and federal safety regulations. Contractor is solely liable for non-compliance.

C. Site Drainage. Excavation to be protected from surface water drainage at all times.

1.06 BLASTING

A. No blasting shall be permitted without written consent of the Engineer. Blasting shall be done only after Engineer receives permission from the appropriate governmental authority (ies). Blasting shall be performed only by properly licensed, experienced individuals and in a manner such that no damage to any property or persons will occur due to either the blast or debris.

B. Contractor shall provide proof of insurance as required by these Specifications, the governing authority or as required by Engineer prior to any blasting. All damage as the result of blasting shall be repaired, at the Contractor's expense, to the satisfaction of the Engineer. All earth or rock loosened by blasting shall be removed from excavations prior to proposed construction.

1.07 CONSTRUCTION IN ACCESS ROADS

A. When construction operations are located within access roads, make provisions at cross access roads and walks for free passage of vehicles and pedestrians. Do not block access roads or walks without prior approval.

PART 2 PRODUCTS

2.01 All materials for construction fills and backfills shall meet specified requirements for gradation and other factors defining suitability for the intended use. All classes of suitable material shall be free from perishable matter, debris, frozen material and stones and/or cemented pieces larger than permitted by the specified gradation. Classification of materials shall be as follows:

2.02 MATERIALS FOR STRUCTURE BACKFILL

A. Structure backfill shall be composed of materials designated as Class 1, Class 2, Class 3 or Class 4.

1. Class 1 Backfill (CDOT Section 703.08 - Class 1). Class 1 backfill shall be composed of materials from excavations, borrow areas, or other sources. This material shall conform to the following requirements when tested with laboratory sieves:

Sieve Designation	% by Weight Passing
2 inch	100
No. 4	30-100
No. 50	10-60
No. 200	5-20

In addition, this material shall have a liquid limit not exceeding 35 and a plasticity index of not over 6 when determined in conformity with AASHTO T89 and T90.

2. Class 2 Structure Backfill (CDOT Section 703.08 - Class 2). Class 2 structure backfill shall be composed of suitable materials developed from excavation, borrow areas or other sources. If the material contains rock fragments which, in the opinion of the Engineer, will be injurious to the structure, the material will not be used for backfilling. In addition, no rock larger than 4" shall be placed within the structure backfill zones shown in CDOT M-Standards M-206-1 and M-206-2.
3. Class 3 Backfill (CDOT Section 703.03 - Class 6). Class 3 backfill shall consist of crushed stone, crushed slag, crushed gravel, or natural gravel conforming to the following requirements when tested with laboratory sieves.

Sieve Designation	% by Weight Passing
3/4 inch	100
No. 4	30-65
No. 8	25-55
No. 200	3-12

In addition, this material shall have a liquid limit not exceeding 30 and a plasticity index of not over 6 when determined in conformity with AASHTO T89 and T 90.

4. Class 4 Backfill (CDOT Section 703.03 - Class 2). Class 4 backfill shall be composed of suitable materials developed from excavation, borrow areas, or other sources. If the material contains rock fragments that in the opinion of the Engineer will be injurious to the structure, the native material will not be used for backfilling and the Contractor will be required to furnish Class 1 backfill material at a unit price mutually agreed upon between Contractor and Owner.

2.03 TOPSOIL

- A. Topsoil shall consist of selectively excavated, loose, friable loam reasonably free of admixtures of sub-soil, refuse, stumps, roots, rocks, brush, weeds or other material which would be detrimental to the proper development of vegetative growth.

PART 3 EXECUTION

3.01 SITE PREPARATION

- A. Clearing. Remove all vegetation, stumps, roots, organic matter, debris and other miscellaneous structures and materials from work site. Dispose of off-site.
- B. Topsoil Removal. Strip existing topsoil from all areas to be distributed by construction. Topsoil to be stockpiled separately from excavated materials.
- C. Preservation of Trees. Existing trees to be protected from damage throughout duration of the project. Refer to plans for designation of all trees, shrubs, plants and other vegetation within the project site to remain. Do not remove trees outside of excavated or filled areas, unless their removal is authorized by the Owner. Protect trees from permanent damage by construction operations.

3.02 CONSTRUCTION REQUIREMENTS

- A. The excavation and embankments required shall be finished to smooth and uniform surfaces. Materials shall not be wasted without permission of the Owner. The Engineer and Owner reserves the right to change grade lines, cut slopes or fill lines during the progress of the work.

3.03 STRUCTURE EXCAVATION

- A. Material outside of the limits of excavation will not be disturbed. Prior to beginning excavation operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with these Specifications. The Contractor shall not excavate beyond the dimensions and elevations established.
- B. Structure excavation shall include all earthwork required for the construction of Work to the lines and grades called for on the Drawings.
- C. If any areas are inadvertently over-excavated, fill such over-excavation with Class 1 or Class 3 backfill.
 - 1. Tolerances. In those areas upon which a sub base or base course material is required, or upon which a structure is to be constructed directly, deviation of not more than 1 inch shall be permitted when tested with a 16-foot straight edge. Deviation from grade shall not exceed 1 inch at any point.
 - a. In those areas where no additional construction, other than topsoil addition, will occur, the finished surface shall be smooth and shall not deviate from grade by more than 0.5 foot at any point.
 - 2. Groundwater Control. Contractor to maintain facilities on site to remove all groundwater from excavated area and keep water below the bottom of the excavation to a point such that a firm base for equipment or concrete installation

exists. Facilities shall be maintained until all backfilling is in place at least 24 inches above anticipated water levels before dewatering equipment removal. All water removal shall be in accordance with the CDPHE dewatering permit and is also subject to approval by the Engineer.

- a. Removal of water by bucketing, sump or trench diversions, intermittent pumping, or sump or submersible pumps is considered incidental to excavation work. Inclusion of a bid item for dewatering indicates dewatering by continuous pumping, well-point type systems is expected. If such dewatering system is required, in the opinion of the Engineer, this work to be paid for as indicated in the bid schedule, or if not included in the bid schedule to be considered extra work paid for at a price negotiated between Contractor and Owner prior to the start of dewatering.
3. Stockpile Excavated Material. Excavated material to be stockpiled so as not to endanger the work or public safety. Maintain existing vehicular and pedestrian traffic with minimum disruption. Maintain emergency access and access to existing monitoring wells, fire hydrants and water valves
 - a. Maintain natural drainage courses and street gutters.
 - b. Backfill material to be segregated from stock piled topsoil and unusable backfill materials.
4. Over-excavation. Whenever the site is over-excavated more than 0.1' to eliminate point bearing by rocks or stones beneath proposed structures or when grade tolerances are exceeded, the Contractor is to re-establish grade using Class 1 backfill. Compaction shall be to 95% maximum density. All work to re-establish grade shall be at the Contractor's expense.
5. Unstable Materials. Materials which are not capable of supporting superimposed loadings are defined as unstable materials. Should unstable materials be encountered during excavation, immediately notify Engineer. If, in the opinion of the Engineer, unstable soil excavation is required and the Contractor could not have reasonably been expected to discover the existence of such materials during his site investigation, then a contract price for Unstable Soil Excavation shall be negotiated between Owner & Contractor. No payment shall be made for materials excavated prior to notification of the Engineer and negotiation of payment for extra work.
 - a. Inclusion of a bid item for Unstable Soil Excavation indicates such excavation is anticipated. The Contractor is to notify the Engineer prior to any unstable soil excavation; no payment shall be made for excavation prior to authorization of Engineer.
6. Rock Excavation. Rock excavation shall be defined as removal of boulders in excess of three (3) cubic yards or solid or fractured rock, which requires techniques, such as blasting or jacking for removal, other than those which are being employed by the Contractor or are normally used in excavation, such as use of backhoes, trenchers, draglines, etc. Should unanticipated rock conditions be encountered, immediately notify the Engineer. If in the opinion of the Engineer, rock excavation is required and the Contractor had in fact made a diligent and determined effort to remove the material using normal excavation procedures as stated above and the Contractor could not have reasonably been expected to determine the existence of such material during his site investigation, then a contract price for Rock Excavation shall be negotiated between the Contractor and the Owner. No payment shall be made for excavation performed prior to determination of a negotiated price.

- a. Rock shall be removed to a 4" depth below grade. In addition, all rock loosened during jacking, blasting, etc. shall be removed from the site. For payment purposes, maximum depth to be paid for shall be 12" below required grade. All over-excavation shall be replaced as specified in Subsection 3.03, D.
- b. Inclusion of a bid item for Rock Excavation indicates such excavation is anticipated. Contractor to notify Engineer prior to any rock excavation; no payment shall be made for excavation prior to notification.

3.04 BACKFILLING

- A. Do not begin backfilling until construction below grade has been approved, underground utility systems have been inspected, tested and approved and trash and debris have been cleaned from the excavation.
- B. Place approved excavated material in successive uniform maximum loose layers in the same order as removed; not exceeding 8 inches for the full width of the cross-section in all accessible areas. Place material in successive uniform loose layers not exceeding 4 inches in areas not accessible or permitted for the use of self-propelled rollers or vibrators. Do not place fill on muddy or frozen subgrade, or until subgrade is approved by the Engineer.
- C. Construct fills to the lines and grades indicated on the Drawings within tolerances stated in this Specification. Use suitable materials removed from the excavation prior to obtaining material from borrow areas. Where otherwise suitable material is too wet, aerate, dry or blend to provide the moisture content specified for compaction.

3.05 COMPACTION

- A. During placing and/or compacting operations with earth or earth-and-rock mixtures, the moisture content of materials in the layers being compacted shall be near optimum and uniform throughout the layer. In general, maintain the moisture content of the material being placed and compacted within 2% of optimum condition as determined as ASTM Standard D698.
 - 1. Compaction Equipment. Perform all compaction with approved equipment well suited to location and material being compacted. Use heavy vibratory rollers or sheepsfoot rollers where heavy equipment is authorized by Engineer. Do not operate heavy equipment closer to structures than a horizontal distance equal to height of backfill above bottom of structure foundation. Compact remaining area with hand tampers suitable for material being compacted. Place and compact backfill around pipes with care to avoid damage.

Compact fill materials to following densities at optimum moisture content based on ASTM D698 or AASHTO T99 as shown on the Drawings or as follows:

- a. Structure fill under or within 5' horizontally of all concrete structures: 95%
- b. pavements, roadways, sidewalks, curbs, utility lines or other improvements: 95%
- c. Backfill within public or designated rights-of-way: 90% or as shown on the Drawings.
- d. Backfill within undeveloped, green or undesignated area: 85%.

- e. Backfill for any fill for overcut grading in areas of lot/home construction: 95%.
- 2. Jetting. Jetting and water inundation are generally not permitted methods of compaction. The Engineer may allow jetting under certain field conditions. Techniques including depth of lifts, amount of water to be used, penetration of hose jet, etc., shall be at the direction of the Engineer. No jetting will be allowed on materials with a 200-minus gradation of greater than 15%. Contractor shall pay cost of all water used, soil classification testing and compaction testing and any retesting or recompaction required. No jetting shall be done prior to written approval and direction of the Engineer.
- 3. Maintenance. Contractor to maintain all backfill in satisfactory condition during the extent of the contract and warranty period. All surface deterioration determined to be the responsibility of the Contractor and all settlement shall be repaired at once by the Contractor upon notice by the Owner. All costs for repair and all liability as a result of surface deterioration or settlement shall be the responsibility of the Contractor.

3.06 SURFACE RESTORATION

- A. All existing surface improvements and site conditions disturbed or damaged during construction are to be restored to a condition equal to pre-construction condition. All restoration costs are considered incidental to excavation and backfill.
 - 1. Improvements. Replace, repair or reconstruct all improvements as required. Work will not be accepted until restoration is accepted by Owner and all affected property owners.
 - 2. Final Grading. The Contractor is to re-establish existing final grade or finish to final grades as modified and shown on the Drawings. The Contractor is to backfill to proper subgrade elevation with backfill material to allow placement of surface improvements or materials.
 - 3. Roadways. All roadways are to be restored to original condition with material types removed. Additional requirements are:
 - a. Minimum base course material on gravel roadways or minimum depth gravel beneath hard surface roadways to be 8", unless shown otherwise on the Drawings.
 - b. Minimum asphalt pavement surfacing to be 3", unless shown otherwise on the Drawings.
 - c. Minimum concrete pavement surfacing to be 6", unless shown otherwise on the Drawings.

3.07 INSPECTION AND TESTING

- A. Inspection and testing to be performed at the direction of the Owner. Contractor to cooperate fully with all persons engaged in testing. Contractor to excavate as required to allow testing; Contractor to backfill all test excavations in accordance with these Specifications.

3.08 DENSITY TESTING AND CONTROL

- A. Reference Standards. Density/moisture relationships to be developed for all soil types encountered according to ASTM D698 or AASHTO T99. Description

- B. Field Testing. Testing for density during compaction operations to be done in accordance with ASTM D2922 using nuclear density methods.
 - C. Frequency of Testing. Frequency of testing to be done at the direction of the Engineer
 - D. Retesting. In the event of failure to meet compaction criteria, Contractor shall re-excavate and re-backfill at direction of Engineer. All retesting to be paid for by Contractor and to be performed by soils testing firm approved by the Engineer
- 3.09 PAYMENT FOR TESTING
- A. Owner responsible for all costs of initial testing of backfill. Contractor to pay all costs of any retesting required.

END OF SECTION

SECTION 02221

TRENCHING, BACKFILLING AND COMPACTION

PART 1 GENERAL

1.01 SUMMARY

- A. Work to be performed under this section shall include all labor, equipment, materials and miscellaneous items necessary to perform all excavation, backfilling and compaction of underground pipelines, conduits, cables and appurtenances shown on the Drawings and specified herein.
- B. All work within the rights-of-way of the Federal Government of the Colorado Division of Highways, County Governments or Municipal Governments shall be done in compliance with requirements issued by those agencies. All such requirements shall take precedence over these Specifications. It shall be the Contractor's responsibility to secure all required excavation permits and pay all costs thereof. Contractor will be required to obtain necessary road cut permits.

1.02 SUBMITTALS

- A. Bedding Material
 - 1. Submit sieve analysis
- B. Select Fill
 - 1. Submit sieve analysis

1.03 FIELD CONDITIONS

- A. Existing Utilities. Underground utilities known to the Engineer have been shown on the Drawings. Locations are approximate only and may prove to be inaccurate. The Contractor is responsible for verification of the existence, location and protection of all utilities within the construction area.
 - 1. Before commencing with work, the Contractor shall notify all public and private companies who may have utilities within the project limits. The Contractor shall coordinate with these entities all excavation performed. The Contractor shall obtain all permits required by utility owners.
 - 2. In the event of damage to any existing utility, the Contractor shall be solely responsible for the repair and payment for repair of all such damage.
 - 3. The Contractor shall make arrangements for and pay all costs for relocation of utilities requiring relocation as indicated on the Drawings. Should utility obstructions, not shown on the Drawings, be encountered and require relocation, the Contractor shall notify the Owner and the Engineer and shall make arrangements necessary for such relocation. The Owner shall pay the costs for such relocation.
- B. Existing Improvements. The Contractor shall restore or protect from damage all existing improvements encountered in performance of the work. Improvements damaged, as a

result of this work shall be restored to original condition or better, as determined by the Engineer.

1. Adjacent property shall be protected by the Contractor from any damage. The Contractor shall be held solely liable for any damage to adjacent property and shall be responsible for all costs resulting from repair of such damage.

C. Soil Conditions. It shall be the responsibility of the Contractor to examine soil conditions and characteristics, including the presence of groundwater that will be encountered within the limits of construction.

1.04 PROTECTION OF WORK

A. Safety. All excavation shall be protected by barricades, lights, signs, etc., as required by governing federal, state and local safety codes and regulations.

B. Sheeting, Shoring and Bracing. Where trench walls are not excavated at a stable slope, the Contractor shall provide and maintain support sufficient to prevent caving, sliding or failure and property or bodily damage. Any damage due to inadequate support shall be repaired at the sole expense of the Contractor.

1. Under normal construction conditions, support shall be removed as work progresses. Support shall remain installed if directed by the Engineer or if pipe does not have sufficient strength to support backfill based on trench width as defined by the sheeting. Sheeting shall not be removed after the start of backfilling.

2. Use of a movable trench shield or coffin box will not be allowed where pipe strength is insufficient to support backfill as defined by the trench width after the trench shield is removed.

3. The Contractor shall be held solely responsible for any violation of applicable safety standards. Particular attention is called to minimum requirements of OSHA and COSH (Colorado Occupational Safety and Health).

C. Site Drainage. Excavation to be protected from surface water at all times. At no time shall excavated area be allowed to fill with storm water runoff. Contractor shall provide proper, temporary drainage structures at their cost to detour runoff from excavated areas.

1.05 BLASTING

A. No blasting shall be permitted without written consent of the Engineer. Blasting shall be done only after Engineer receives permission from the appropriate governmental authority(ies). Blasting shall be performed only by properly licensed, experienced individuals and in a manner such that no damage to any property or persons will occur due to either the blast or debris. Contractor shall provide proof of insurance as required by these Specifications, the governing authority or as required by Engineer prior to any blasting. All damage as the result of blasting shall be repaired, at the Contractor's expense, to the satisfaction of the Engineer. All earth or rock loosened by blasting shall be removed from excavations prior to proposed construction.

1.06 CONSTRUCTION IN ACCESS ROADS

- A. When construction operations are located within access roads make provisions at access roads and walks for free passage of vehicles and pedestrians. Do not block streets or walks without prior approval.

PART 2 PRODUCTS

2.01 EMBEDMENT MATERIAL

- A. Pipeline embedment material shall comply with the appropriate classes as listed below and as illustrated in the Construction Drawings:
 - 1. Class A - Use where improper trenching or unexpected trench conditions require its use as determined by the Engineer.
 - a. Characteristics - Concrete cradle foundation with densely compacted Class 6 aggregate base backfill to 12" above top of pipe, or densely compacted Class 6 aggregate granular foundation with concrete arch cover to 6" above top of pipe.
 - 2. Class B - Use for all PVC, DIP, CMP and concrete pipe under normal construction conditions.
 - a. Characteristics - Densely compacted Class 6 aggregate granular foundation of depth shown on Typical Details with densely compacted Class 6 aggregate 12" above top of pipe.

2.02 SELECT MATERIAL

- A. Subject to approval by the Engineer, select material shall be allowed in place of the aggregate backfill for Class B when excavation and soil conditions allow, but only if approved by Engineer. Contractors shall bid project based upon Class B. If Class A or select material is used, price adjustments shall be made.
 - 1. Characteristics - Soil materials free from rocks, clods, and organic material.

2.03 CONCRETE FOR EMBEDMENT

- A. Shall be 2000 psi concrete (28-day compressive strength).

2.04 BACKFILL MATERIAL

- A. Characteristics - Native materials free from debris, organic matter and frozen material. Uniformly graded sufficient to allow proper compaction.
- B. Gradation - No boulders greater than 6-inch diameter in top 12 inches of backfill.
 - 1. Generally no boulders greater than 12-inch diameter in remainder of trench. Limited number of boulders not exceeding 24-inch diameter to be allowed at discretion of Engineer provided boulders can be uniformly dispersed and will not interfere in compactive effort.

PART 3 EXECUTION

3.01 SITE PREPARATION

- A. Clearing. Remove all vegetation, stumps, roots, organic matter, debris and other miscellaneous structures and materials from project site. Dispose of off site.
- B. Topsoil Removal. Strip existing topsoil from all areas to be disturbed by construction. Topsoil to be stockpiled separately from excavated materials.

3.02 TRENCH EXCAVATION

- A. Limits of Excavation. Trenches to be excavated along lines and grades shown on the Drawings, or as modified in the field by the Engineer. Trench widths for pipe loading to be measured 12 inches above top of pipe.
 - 1. Minimum trench width to be the outside diameter of the pipe or conduit plus 16 inches.
 - 2. Maximum trench width to be the outside diameter of the pipe or conduit plus 24 inches for all pipes or conduits with outside diameter of 24 inches or less, and plus 30 inches for all pipes or conduits with outside diameters greater than 24 inches.
 - 3. If maximum trench width is exceeded, Contractor will provide at his expense, higher strength pipe or special bedding including concrete at the direction of the Engineer.
 - 4. Trench excavation not to be completed more than 100 feet in advance of pipe installation. Backfill to be completed within 100 feet of pipe installation.
- B. Groundwater Control. Contractor to maintain facilities on-site to remove all groundwater from trench and keep water at least 12 inches below the trench bottom to a point such that a firm base for pipe or conduit installation exists. Facilities shall be maintained until all concrete is cured and backfilling is in place at least 24 inches above anticipated water levels before water removal is discontinued; all water removal shall be subject to approval by the Engineer.
- C. Stockpile Excavated Material. Excavated material to be stockpiled so as not to endanger the work or public safety. Maintain existing vehicular and pedestrian traffic with minimum disruption. Maintain emergency access and access to existing fire hydrants and water valves. Maintain natural drainage courses and street gutters.
 - 1. Backfill material to be segregated from stockpiled topsoil and unusable backfill materials.
- D. Excavation for Appurtenances. Excavation to be done in accordance with these Specifications and as shown on the Drawings. Adequate working clearances to be maintained around appurtenances. Provisions for base and bottom preparations shall apply to all appurtenances. Precautions to be taken to maintain trench widths in the vicinity of adjacent pipelines and conduits.

3.03 BOTTOM PREPARATION

- A. Undisturbed Foundation. Where soils are suitable and have adequate strength, bottom to be graded and hand-shaped such that pipe barrel rests uniformly on undisturbed soil. All rocks or stones, which may result in a point bearing on the pipe, shall be removed.
 - 1. Undisturbed grades shall be within 0.1 feet \pm tolerance. Soils for final pipe grade placed within these limits shall be fine granular (100% passing No. 4 sieve) or may be native materials, hand compacted to 95% maximum density.
- B. Bell Holes. Material to be removed to allow installation of all fitting and joint projections without affecting placement of pipe.
- C. Over-excavation. Whenever trench is over-excavated to eliminate point bearing by rocks or stones or when undisturbed grade tolerances of 0.1' are exceeded, the Contractor is to re-establish grade using Class 6 aggregate bedding material. Compaction shall be 95% maximum density. All work to re-establish grade shall be at the Contractor's expense.
- D. Unstable Materials. Materials incapable of supporting superimposed loadings are defined as unstable materials. Should unstable materials be encountered during excavation, immediately notify Engineer. If, in the opinion of the Engineer, unstable soil excavation is required and the Contractor could not have reasonably been expected to discover the existence of such materials during his site investigation, then a contract price for Unstable Soil Excavation shall be negotiated between Owner and Contractor. No payment shall be made for materials excavated prior to notification of the Engineer and negotiation of payment for extra work.
- E. Inclusion of a bid item for Unstable Soil Excavation indicates such excavation is anticipated. The Contractor is to notify the Engineer prior to any unstable soil excavation; no payment shall be made for excavation prior to authorization of Engineer.
- F. Rock Excavation. Rock excavation shall be defined as removal of boulders in excess of three (3) cubic yards of solid or fractured rock, which makes hand shaping of the bottom impossible and which requires techniques, such as blasting or jacking for removal, other than those which are being employed by the Contractor or are normally used in trench excavation, such as use of backhoes, trenchers, draglines, etc. Should unanticipated rock conditions be encountered, immediately notify the Engineer. If in the opinion of the Engineer, rock excavation is required and the Contractor has in fact made a diligent and determined effort to remove the material using normal excavation procedures as stated above, and the Contractor could not have reasonably been expected to determine the existence of such material during his site investigation, then a contract price for rock excavation shall be negotiated between the Contractor and the Owner. No payment shall be made for excavation performed prior to determination of a negotiated price.
 - 1. Rock shall be removed to a 4" depth below grade. Additionally, all rock loosened during jacking, blasting, etc., shall be removed from the trench. For payment purposes, maximum trench width to be paid for shall be as defined in Subsection 3.02, A. Maximum depth to be paid for shall be 12" below required grade. All over-excavation shall be replaced as specified in Subsection 3.03, C.
 - 2. Inclusion of a bid item for rock excavation indicates such excavation is anticipated. Contractor to notify Engineer prior to any rock excavating; no payment shall be made for excavation prior to notification.

3.04 BACKFILLING

- A. Tamping Equipment. Except immediately next to the pipe, mechanical or air operated tamping equipment to be used. Hand equipment, such as T-bar, to be used to pipe if necessary. Care to be taken when compacting under, alongside and immediately above pipe to prevent crushing, fracturing or shifting of the pipe. The Contractor is to note densities required for materials being backfilled and shall use appropriate approved equipment to obtain those densities.
1. Wheel rolling is not considered to be an adequate compaction technique to meet these Specifications and will not be allowed. Where 85% compaction is required, wheel rolling may be considered. Before acceptance, the Contractor shall backfill a portion of the trench and pay for density testing to verify adequacy of the proposed backfill techniques.
 2. A hydro hammer may be allowed to obtain the specified density up to 4' in depth. The Contractor will be required to re-excavate those areas that have been tamped so that density tests can be taken to insure that the specified intensity is being obtained full depth.
- B. Moisture Control. Generally maintain moisture of backfill material with $\pm 2\%$ of optimum moisture content as determined by ASTM D698. Maintain closer tolerances as needed to obtain densities required.
- C. Compaction. Maximum density (100%) based on ASTM D698 or AASHTO T99.
1. Bedding Material, including material used for over-excavation of any kind: 95%.
 2. Select Material: 95%.
 3. Backfill beneath existing or proposed pavement, roadways, sidewalks, curbs, utility lines and other improvements or within 5' horizontally of such improvements: 95%.
 4. Backfill within public or designated right-of-way: 90% or as shown on the Drawings.
 5. Backfill within undeveloped, green or undesignated area: 85%.
 6. Backfill for any fill over over-cut grading in areas of lot/home construction: 95%.
- D. Placing Backfill. The maximum loose lifts of backfill material to be placed in the reverse order as removed and as follows: use smaller lifts where necessary to obtain required densities:
1. Bedding and select material: 6" (or see Section 3.03A).
 2. Backfill Material: 12" where 95% compaction required; 24" where less than 95% compaction required.
- E. Backfilling Appurtenances. Backfilling to be done generally at the same time as adjacent pipelines. Backfilling procedure to conform to this section. Use special techniques or materials as shown on drawings.
- F. Disposal of Excess Excavation. Contractor to dispose of excess excavation off site. Disposal in any case shall be the sole responsibility of the Contractor.
- G. Jetting. Jetting and water inundation are generally not permitted methods of compaction. The Engineer may allow jetting under certain field conditions. Techniques including depth of lifts, amount of water to be used, penetration of hose jet, etc., shall be at the direction of the Engineer. No jetting will be allowed on materials with a 200 minus

gradation of greater than 15%. Contractor shall pay cost of all water used, soil classification testing and a retesting or recompaction required. No jetting shall be done prior to written approval and direction of the Engineer.

- H. Maintenance of Backfill. Contractor to maintain all backfill in a satisfactory condition during the extent of the contract and warranty period. All surface deterioration determined to be the responsibility of the Contractor and all settlement shall be repaired at once by the Contractor upon notice by the Owner. All costs for repair and all liability as a result of surface deterioration or settlement shall be the responsibility of the Contractor.
- I. Clay Barrier Water Stops. Because of the presence of ground water, a clay barrier may be required to be installed full depth in trench in place of all bedding material and backfill. This barrier shall be full depth and two feet thick and installed every 500 lineal feet of trench. Clay barrier installation shall be considered incidental to the pipe installation and not paid for separately.

3.05 SURFACE RESTORATION

- A. All existing surface improvements and site conditions disturbed or damaged during construction to be restored to a condition equal to pre-construction condition. All restoration costs are considered incidental to excavation and backfill.
 - 1. Improvements. Replace, repair or reconstruct all improvements as required. Work will not be accepted until Engineer and all affected property owners accepts restoration. Improvements include, by example, other utilities, culverts, structures, curb and gutter, mailboxes, signs, sprinkler systems, etc.
 - 2. Final Grading. The Contractor is to re-establish existing final grade or finish final grades as modified and shown on the Drawings. The Contractor is to backfill to proper subgrade elevation with backfill material to allow placement of surface improvements or materials.
 - 3. Roadways. All roadways to be restored to original condition with material types removed.
 - a. Minimum base course material on gravel roadways or minimum depth gravel on hard surface roadways to be 8", unless shown otherwise on Drawings.
 - b. Minimum bituminous surfacing to be 3" unless shown otherwise on Drawings.
 - c. Minimum concrete pavement surfacing to be 6", unless shown otherwise on Drawings.

3.06 COMPACTION

- A. It should be fully understood that it will be the sole responsibility of the Contractor to achieve the specified densities for all embedment and backfill material placed. Contractor will be responsible for ensuring that correct methods are being used for the placement and compaction of said materials. Correct backfill methods include, but are not limited to:
 - 1. Use of proper equipment for existing soil condition encountered.
 - 2. Moisture content of existing soils; determination if water should be added or if soil should be air dried to reduce moisture content.
 - 3. Thickness of backfill lift.

- B. Contractor may, at his own expense, have an approved geotechnical engineer monitor the methods of backfill and compaction used to ensure that the desired densities are being obtained.
- C. Inspection and testing will be performed as directed by the Engineer. Testing will be conducted as a quality control check to verify the Contractor's compliance with the standards indicated in the Specifications.

3.07 INSPECTION AND TESTING

- A. Inspection and testing to be performed at the direction of the Engineer. Contractor to cooperate fully with all persons engaged in testing. Contractor to excavate as required to allow testing. Contractor to backfill all test excavations in accordance with these Specifications. Any areas that require a specified density, including fill, backfill, trenches, embankments, road base, hot bituminous pavement, backfill for structures, shall be tested.

3.08 DENSITY TESTING AND CONTROL

- A. Reference Standards. Density/moisture relationships to be developed for all soil types encountered according to ASTM D698 or AASHTO T99.
- B. Field Testing. Testing for density during compaction operations to be done in accordance with ASTM D2922 using nuclear density methods
- C. Frequency of Testing. Minimum of one (1) test every 250' trench per lift or as directed by Engineer. Contractor to excavate to depths required by Engineer for testing and backfill test holes to density specified. Testing to be paid for by Owner.
- D. Retesting. In the event of failure to meet compaction criteria, Contractor shall re-excavate and re-backfill at direction of Engineer. All retesting to be paid for by Contractor and to be performed by soils testing firm approved by the Engineer.

3.09 PAYMENT FOR TESTING

- A. Owner responsible for all costs of initial testing of backfill. Contractor to pay all costs of any retesting required.

END OF SECTION

SECTION 02555

WATER TRANSMISSION AND DISTRIBUTION LINES

PART 1 GENERAL

1.01 SUMMARY

- A. Work under this Section shall include furnishing all materials, labor, equipment and miscellaneous items necessary to install, disinfect, and test all potable water, non-potable and yard piping distribution and transmission pipelines and appurtenances as specified herein and shown on the Drawings.

1.02 SUBMITTALS

- A. Product data including catalog sheets and descriptive literature shall be submitted for all materials and equipment specified. Submittal shall state manufacturer's compliance with all published standards referenced herein.

1.03 PROTECTION OF WORK

- A. All pipe fittings, valves and equipment shall be carefully handled, stored and protected in such a manner as to prevent damage to materials and protective coatings and linings. At no time shall such materials be dropped or dumped into trench.
- B. Precaution shall be taken to prevent foreign matter from entering the pipe, fittings and valves prior to and during installation. Place no debris, tools, clothing or other materials in the pipe during installation.
- C. At such time as pipe installation is suspended, either temporarily or overnight, the open end of the pipe shall be sealed with a watertight plug to prevent entrance of trench water, debris or foreign matter.
- D. Under no circumstances shall trench water be allowed to enter the pipeline. When water is present in the trench, the seal shall remain in place until such time as the trench is pumped dry. Whenever trench water becomes evident, adequate measures shall be taken to prevent pipe floatation.
- E. If, in the opinion of the Engineer, the Contractor is incapable of keeping the pipe free of foreign matter during installation, the Engineer shall require the Contractor to cover the pipe ends with close woven bags until the start of the joining operation.

PART 2 PRODUCTS

- A. This item covers the types of materials that will be required for the construction and installation of water lines. All materials used shall be new, of the best quality available, and conform to applicable standards as indicated herein. [NOTE:

Local jurisdiction specifications (i.e., municipality, district, etc.), will govern when two or more alternatives are given in these specifications, or where there is a discrepancy between these specifications and local jurisdiction specifications.

2.01 DUCTILE IRON PIPE AND FITTINGS

A. Ductile Iron Pipe

1. Reference Standard - ANSI 21.51/AWWA C151, latest edition.
2. Pipe joints shall be push on.
3. Pressure Rating – Special Thickness CL52.
4. Restrained Joint, where specified – EBAA Iron Megalug Series 1100 or 1700.
5. Conductivity straps or brass wedges
6. Tracer wire – 10 gauge

B. Fittings

1. Type - All fittings shall be mechanical joint, except where specifically shown or detailed otherwise.
2. Reference Standard - ANSI/AWWA C153, latest edition, for mechanical "compact" joints.
3. Material - Ductile iron, DIP fittings, sleeves and valves shall be polyethylene encased.
4. Pressure Rating - 350 psi.

C. Joints

1. Mechanical, Reference Standard - ANSI A. 21.53/AWWA C153, latest edition.
2. Push-on, Reference Standard - ANSI A 21.15/AWWA C115, Class 125.
3. Flanged, Reference Standard - ANSI B 16.1, Class 125.

D. Gaskets

1. Gasket shall be suitable for the specified pipe sizes, pressure and temperature.
2. Reference Standard - AWWA C111, latest edition.
3. Lubricant - A non-toxic vegetable soap lubricant shall be supplied with the pipe.

E. Protective Coating

1. Underground Service - Manufacturer's standard bituminous coating - minimum 1 mil thickness.
2. Polyethylene Film Envelope - Polyethylene encasement shall conform to AWWA C105, latest edition, or ANSI A.21.5. Film shall be Class C with a nominal thickness of 8 mils. Tape for securing the film shall have a minimum thickness of 8 mils and a minimum width of 2 inches. The polyethylene film shall be free of streaks, pinholes, tears or blisters.

F. Protective Lining

1. Type – “Standard Cement Mortar Lining” unless specifically detailed otherwise in the project drawings.
2. Reference Standard - ANSI A 21.4/AWWA C104, latest edition.
3. Thickness – standard

2.02 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. PVC Pipe

1. Materials - ASTM D1784, Type 1, Grade 1, PVC 1120, 2000 psi design stress.
2. Reference Standard - AWWA C900, latest edition, 4" - 12".
3. Class - 200 (DR-14), 4" - 12".
4. Reference Standard - AWWA C905, latest edition, 14" - 48".
5. Class - 235 (DR-18), 14" - 48".
6. Markings - Manufacturer's name, nominal size, class pressure rating, PVC 1120, NSF logo, identification code.
7. Specialties - Tracing wire, 14-gauge stranded copper insulated wire.
8. Size - Shall conform to outside diameter of DIP.

B. Fittings

1. Type - All fittings shall be mechanical joint except where specifically shown or detailed otherwise.
2. Reference Standard - ANSI/AWWA C110/A.21.10 or C153/A.21.53, latest edition.
3. Pressure Rating - 250 psi for C110; 350 psi for C153.
4. Gasket Reference Standard - AWWA C111, latest edition.
5. DIP fittings, sleeves and valves shall be polyethylene encased.

C. Joints

1. Push-on rubber gasket.
2. Gasket Reference Standard - AWWA C111, latest edition.

D. Use only where specified.

2.03 HYDRANTS

A. Flushing Hydrant

1. Inlet Size – 2 inch FIP.
2. Outlet Size - 2 1/2 inch NST.
3. Bury Depth – As shown on drawings.
4. Operation – shut-off valve with integral drain to prevent freeze.
5. Manufacturer Reference – Kupferle Foundry Company #77 Mainguard

Hydrant or Equal.

B. Yard Hydrant

1. Inlet Size - 1 inch.
2. Overall Bury Depth – As shown on drawings.
3. Operation – freezeless with backflow preventer and hose connection.
4. Manufacturer Reference – Woodford Freezeless Sanitary Yard Hydrant Model S3 or Equal.

2.04 VALVES

A. Gate Valves

1. Mueller A-2360 or U.S. Pipe Metro Seal 250
 - a. resilient seat
 - b. AWWA C509
 - c. Up to 12"
2. Process valves = See section 15102.

B. Butterfly Valves

1. Mueller Lineseal III Epoxy coated or Pratt "Groundhog"
 - a. buried service
 - b. rubber seat
 - c. epoxy coated
 - d. AWWA C504
 - e. 14" and larger
2. Process valves = See section 15103.

C. Ball Valves

1. Up to 2 inches – Bronze or stainless steel one piece body, chrome plated brass ball, Teflon seats and stuffing box ring, lever handle with solder or threaded ends.
2. Over 2 inches – Cast steel flanged body, chrome plated steel ball, Teflon seat and stuffing box seals with lever handle.
3. For Air Piping – Cast steel flanged body, stainless steel ball, full port, lever handle, for service temperatures to 300 degrees F.

D. Combination Air Release Valve

1. Size – 2".
2. Inlet - Pipe Thread FNPT.
3. Materials
 - a) Body - Cast Iron.
 - b) Float - Stainless Steel.
 - c) Seat - Buna-N.
 - d) Lever Frame – Delrin.
4. Pressure Rating - 200 psi.

5. Manufacturer's Reference – APCO 144 or Valmatic 202C.2.
6. Performance – Located at main line high points to permits efficient filling or draining of long pipelines, for protection against vacuum, and will continuously vent pockets of air as they accumulate in pipeline.
7. Where specified on main line.

E. Pressure Reducing Valves

1. Pressure Reducing Valve – CLA-VAL 90-01 or 690-01
2. Combination Pressure Reducing, Pressure Sustaining – CLA-VAL 92-01 or 692-01.
3. Where specified on main line.

2.05 VALVE BOXES

A. Screw Type - Three Piece

1. Material - Cast Iron.
2. Size - 5 1/4 inch diameter.
3. Type - Three piece adjustable screw type.
4. Cover - Deep socket type with the word "water" cast in the top.
5. Tyler 6850 or approved equal.

2.06 DEBRIS CAPS

- A. See section 3.05 below.

2.07 MECHANICAL COUPLINGS

- A. Only M.J. solid sleeves allowed.

2.08 WATER SERVICE & TAP COMPONENTS

A. Corporation Stops

1. Material - Brass or bronze.
2. As shown on Drawings.
3. Reference Standard - AWWA C800, latest edition.
4. Thread inlet - Tapered (CC) Type for 3/4 inch or IP for greater than 1 inch.
5. Thread outlet - compression connection.
6. Manufacturer's Reference - Mueller 25008.

B. Copper Service Pipe (for sizes up to 2 inch)

1. Reference Standard - AWWA C800.
2. Material - Type K Copper, ASTM B88.
3. Size - As shown on Drawings.

C. Eagle Pure-Core HDPE Service Pipe (pipe ID controls)

1. Reference Standard - AWWA C901.
2. Material – SDR9 CTS, HDPE 3408, AWWA C901 and ASTM D2737.
3. Size - As shown on Drawings. Pipe ID controls lines size to match service size (i.e. use 1" pipe for an ¾" service due to I.D.)
4. Tracer wire

D. Curb Box

1. Material - Cast iron box, complete w/lid and red brass screw.
2. Type – Mueller H-10314 up to 1 ½"; Mueller H10334 in concrete or asphalt; Mueller H10336 for 1 ½" and larger.

E. Curb Stop

1. Materials - Cast bronze body, resilient O-ring seal, standard tee-head operator. Teflon ball valve.
2. Size - As shown on Drawings.
3. Inlet - compression connection.
4. Outlet - compression connection.
5. Manufacturer's Reference - Mueller B-25209.

F. Service Clamps

1. For use with Ductile Iron Pipe:
 - a) Materials - Bronze service clamp, O-ring gasket, double strap, (CC) threads.
 - b) Manufacturer's Reference - Mueller BR-2 Series or approved equal.

F. Service Fittings

1. Mueller 110 or approved equal.

2.09 JOINT RESTRAINTS

A. Mechanical Joint Retainer Glands

1. For use with ductile iron pipe:
 - a) Materials - Multiple wedge, ductile iron ASTM A536, 60-42-10 minimum.
 - b) Manufacturer's reference - EBAA Iron Series 1100 Megalug or Ford Uni-flange Series 1400.
2. For use with PVC pipe:
 - a) Materials - Multiple wedge ductile iron A536, 60-42-10 minimum.
 - b) Manufacturer's reference - EBAA Iron Series 2000PV or Ford Uni-flange Series 1500 "Circle-Lock".

B. Push-on Joint Restraints

1. For use with ductile iron pipe:
 - a) Materials - Ductile iron retainer gland and restraint ring ASTM-536, 60-42-10 minimum, 526 alloy steel tie bolts ANSI/AWWA C111/A21.11.
 - b) Manufacturer's reference - EBAA Iron Series 1700 Megalug restraint harness or Ford Uni-flange Series 1450.
2. For use with PVC pipe:
 - a) Materials - Ductile iron restraint harness ASTM 536, 60-42-10 minimum.
 - b) Manufacturer's reference - EBAA Iron Series 1600 (C-900) and Series 2800 (C-905) or Ford Uni-flange Series 1350.

2.10 TAPPING SLEEVES

- A. Romac SST III stainless steel, or approved equal.

2.11 CONCRETE FOR THRUST BLOCKS AND ENCASING OF PIPE

- A. Concrete for thrust blocks and for encasing the water pipe line shall have a 28-day compressive strength of not less than 3000 psi.

2.12 TRACER WIRE

- A. No. 10 gauge insulated, stranded copper. All splices to be watertight, underground type.
- B. Tracer wire is required for all pipes.

2.13 MAGNETIC TAPE

- A. Detectable marking tape shall consist of a minimum of 5 mil (0.0005") overall thickness; five-ply composition; ultra-high molecular weight 100% virgin polyethylene; acid alkaline and corrosion resistant.
- B. Elongation properties shall be in accordance with ASTM D882-80A and shall be less than 150% at break. The tape shall have a 20 gauge (0.0020") solid aluminum foil core, encapsulated within 2.55 mil (0.00255") polyethylene backing.
- C. Tape color and legend combination shall be in accordance with APWA or local requirements. The color shall be blue. The legend shall read "*CAUTION - WATERLINE BELOW*".
- D. The tape tensile strength shall be in accordance with ASTM D882-80A and be not less than 7800 psi.
- E. Tape width shall be 3/4 of the diameter of the pipeline being protected.

Tape Width	2"	3"	6"	12" or wider
Tape Bury Depth	6"- 18"	6"- 28"	6"- 36"	6"- 36"
- F. The tape shall be as manufactured by T. Christy Enterprises, or equal.
- G. Where specified, magnetic tape shall be placed 2 feet above the top of pipe.

PART 3 EXECUTION

3.01 CLEANING AND INSPECTION

- A. Clean all pipe, fittings, valves and related material thoroughly of all foreign material and inspect for cracks, flaws or other defects prior to installation. Mark all defective, damaged or unsound materials with bright marking crayon or paint and remove from jobsite.
- B. The Contractor shall take all necessary precautions to prevent any construction debris from entering the water lines during construction of water lines and appurtenances. If this debris should enter the distribution system, the Contractor shall furnish all labor and material necessary to clean the system. Under no circumstances will the Contractor flush the debris into an existing distribution system.

3.02 VERIFICATION

- A. Verify dimensions and class of all existing and proposed pipe, valves, fittings and equipment prior to installation to ensure the piping system will fit together properly.

3.03 PIPE EMBEDMENT

- A. Placing Embedment Material - Refer to Section 02221 for placement methods.
- B. Embedment Classes - Refer to Section 02222 for embedment materials as listed below:
 - 1. Use Class 6 aggregate 4" below pipe and 12" above pipe for all pipe materials. Contractor shall compact trench bottom before placing bedding and shall compact bedding.

3.04 PIPE INSTALLATION

- A. Methodology. Pipe shall be laid in straight section with bell ends facing the direction of laying unless otherwise directed by the Engineer. Where pipe is laid on a grade of ten percent (10%) or greater, the installation shall proceed uphill with the bell ends facing upgrade. The pipeline shall be installed so that a continuous positive or negative grade is maintained between high and low points to avoid air pockets. Jointing of the pipe shall be made in accordance with the directions of the manufacturer of the pipe and the manufacturer of the coupling.
 - 1. The pipe shall be brought to correct line and grade, and secured in place with the specified bedding material as directed in Section 02221.
- B. Pipeline Depth. As indicated on Drawings, or as per local jurisdiction but always below frost level. Depth shall be based on depth below finished grade of a project and not existing grade. Contractor shall be responsible for keeping pipelines from freezing if fire line is temporarily installed above frost line before fill material is installed.
- C. Concrete Encasement. Install concrete encasement where indicated on the drawings or as required by other sections of this Specification. Concrete shall have a three thousand (3,000) psi compressive strength. Reinforcing shall consist of four (4) evenly spaced longitudinal No. 4 rebar.
- D. Installation of Ductile Iron Pipelines.
 - 1. Pipe Handling. Pipe should be lowered into the trench with ropes, slings or machinery. Under no circumstances should the pipe be pushed off the bank and allowed to fall into the trench.
 - 2. Pipe Laying. Pipe shall be laid in straight sections, in an uphill direction, with bell ends facing in the direction of laying, unless directed otherwise by the Engineer.
 - 3. Jointing of Push-on Joints. In joining the pipe, the exterior four inches of the pipe at the spigot end and the inside of the adjoining bell shall be thoroughly cleaned to remove oil, grit, tar (other than standard coating) and other foreign matter. The gasket shall be placed in the bell as per manufacturer's installation instruction. A thick film of the pipe manufacturer's joint lubricant shall be applied to the gasket over its entire

surface. The spigot end of the pipe shall then be wiped clean and inserted into the bell to contact the gasket. The pipe shall be forced all the way into the bell by crowbar or by jack and choker slings. Check the position of the gasket with a feeler gauge to ensure it is not rolled.

4. Pipe Cutting. The cutting of pipe for fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or lining and so as to leave a smooth end at right angles to the axis of the pipe. The flame cutting of pipe by means of an oxyacetylene torch will not be allowed.
5. Polyethylene Film Envelope. Encase main and fittings using procedures recommended by manufacturer. Special care shall be used at all overlap joints.

E. Installation of Polyvinyl Chloride (PVC) Pipe.

1. Pipe Handling. Pipe should be carefully lowered into the trench to avoid pipe falling into trench.
2. Pipe Laying. Pipe shall be laid in straight sections with bell ends facing the direction of laying. When pipe laying is not in progress, the open end of the pipe shall be closed by a watertight plug.
3. Jointing the Pipe. The outside of the spigot and the inside of the bell shall be thoroughly wiped clean. Set the rubber ring in the bell with the marked edge facing toward the end of the bell. Lubricate the spigot end using a thin film of the manufacturer-supplied lubricant. Push the pipe spigot into the bell. Position the completed joint so that the mark on the pipe end is in line with the end of the bell.
4. Pipe Cutting. The cutting of pipe for fitting or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe and so as to leave a smooth end at right angles to the axis of the pipe. Bevel the end of the pipe with a beveling tool after the pipe is cut. Place a clearly visible position mark at the correct distance from the end of the field-cut pipe.

3.05 INSTALLATION OF PIPELINE APPURTENANCES

- A. General. Install all valves, meters, manholes, and other equipment appurtenant to pipeline at the locations indicated on the drawings or as otherwise designated by the Engineer to accommodate field conditions. Document "record" measurements prior to backfill referencing all appurtenant equipment to the nearest permanent surface improvement.
- B. Installation of Valves. Install valves in the pipeline in the same manner specified for laying and jointing the pipe and in accordance with details included in Drawings.
- C. Valve Boxes. Except where specified otherwise, install valve boxes on all buried valves. Install boxes such that no stress is transmitted to the valve. Set boxes plumb and directly over the valve with the top of the box placed flush with the finished grade. Backfill and thoroughly compact around each box. Provide extended stems on valves where required such that the operating nut is not lower than two feet (2') below finished grade.

D. Debris Caps.

1. Debris caps shall be installed as close under the cast iron cover without interfering with cover operation.
2. Flexible skirt shall be trimmed to provide a smooth contact with the interior diameter of the pipe.
3. Flexible caps shall be manufactured by SW Services, Inc. Phoenix, Arizona, or equal approved by Engineer.
4. Debris caps shall be comprised of a hollow member having a cylindrical outer surface. The caps shall have a flexible skirt providing an outward seal preventing debris from getting past the cap. The cap must withstand, without slippage, a minimum vertical force of 50 pounds, at a loading rate of 1.0 inch per minute. The cap shall be molded using General Electric ABS #HIM 4500. The caps shall have retaining prongs to retain a standard locating coil.

E. Fire Hydrants. Install hydrants in accordance with the standard details on the drawings. Hydrant to be set plumb and true to grade. Contractor to bag or cover the fire hydrant that is not in operation.

F. Joint Restraint. Concrete thrust blocks shall be provided, as shown in the details included with the Drawings for all tees, elbows, plugs, reducers, valves, fire hydrants and crosses if one or more sides of the cross is plugged. The bearing area of the block shall be at least equal to that stated on the drawings. The bearing surface shall be against undisturbed earth. The block shall be placed normal to the thrust as shown on the drawings. Concrete for thrust blocks shall have three thousand (3,000) psi compressive strength. Concrete support blocks shall be placed under all valves.

1. Contractor will be required to use either plywood forms or plastic to protect the nuts and bolts on the fittings when the concrete reaction block is placed.
2. Mechanical joint retainer glands and push-on joint restraint devices to be used as shown on the Drawings and as required by the local jurisdiction. Contractor to verify prior to construction.
3. Contractor to also use joint restraint or wood blocking as a method of temporary restraint to secure fittings while concrete reaction blocks set up. (Note: Temporary restraint to be used for those cases where a tie-in is being made and the water needs to be turned back on as soon as possible).

3.06 CONNECTION TO EXISTING WATER FACILITIES

A. All main line connections between existing and proposed piping shall be made during non-business hours or at a time which is acceptable to the Owner. All shut-offs shall be planned 24 hours in advance and all persons affected by the shut-off shall be given a 24-hour notice in the local newspaper and/or local radio at the Contractor's expense. In addition, the Contractor shall personally warn those affected 1 hour before the water is shut off.

- B. The tie-ins between existing and proposed mains shall be made so that both the proposed main and existing main are in service at the same time. Only after the new main is tested, approved and in service can the individual proposed service lines tie into the existing service line on the building side of the curb valve. The affected property shall be given a minimum of one (1) hour notice before the water is shut off. The new line must have passed the pressure testing and bacteriological test prior to connecting the services to the proposed waterline.
- C. Remove existing curb boxes and locate new curb boxes on property line unless otherwise instructed by Project Engineer. Contractor is to provide all necessary fittings needed to reconnect service line on property side of curb box. Contractor shall notify Project Engineer if existing service line is leaking prior to connection. Contractor shall be responsible for repair of existing service line if it leaking after connection is made. Contractor shall keep the connection to existing pipe exposed, and notify Project Observer, and again approval from Project Observer prior to backfilling over connection to existing service line.
- D. Take all precautions to prevent contamination when making connections to existing potable water lines. No trench water, mud or other contaminating substances shall be permitted to enter the pipeline.
- E. Swab the interior of all new pipe, fittings and valves installed in the existing pipeline with a 5 percent (50,000 ppm) chlorine solution prior to installation. After the connection is completed, flush the main to remove all contaminated water.

3.07 PROTECTION OF WATER SUPPLIES

- A. Water lines shall be located a minimum of ten feet (10') horizontally from existing or proposed sewer mains. Wherever the sewer line crosses above or within eighteen inches (18") beneath the water mains, the sewer line shall be made impervious by the method listed below:
 - 1. Concrete encasement for twenty feet, centered over the waterline.
 - 2. In all cases, select granular backfill shall be used to prevent any settling of the higher pipe.

3.08 SERVICE CONNECTIONS

- A. Customer service connections shall be installed in accordance with the details set forth on the Drawings. Terminate the service with a curb stop and box and mark with a stake except where shown otherwise on the Drawings.

3.09 TRACER WIRE

- A. Tape electrical tracing wire to the top of the pipe at 5-foot intervals to prevent dislocation of the wire during backfilling. Extend wire to ground surface at all valves, fire hydrants, and other locations shown on drawings. The tracing wire shall be brought up on the outside of the valve box. When the wire is within 4" of the top of the lid, the wire shall be brought back inside the box and securely fastened. Provide sufficient slack in the wire outside of the box to compensate for

any future adjustment to the valve box. Required on all water mains.

3.10 HYDROSTATIC TESTS

A. Make pressure and leakage tests on all newly laid pipe. Furnish all necessary equipment and material, make all taps in the pipe as required, and conduct the tests. The tests shall be conducted between valved sections of the pipeline, or as approved by the Engineer. The Engineer will monitor the tests.

B. Furnish the following equipment and material for the tests:

Amount	Description
2	Approved graduated containers.
2	Pressure gauges.
1	Hydraulic force pump approved by the Engineer.
1	Additional 1/2 inch pressure tap for Engineer's test gauge. Suitable hose and suction pipe as required.

C. Conduct the tests after the trench has been partially backfilled with the joints left exposed for inspection, or when completely backfilled, as permitted by the Engineer. Where any section of pipe is provided with concrete reaction blocking, do not make the pressure test until at least 5 days have elapsed after the concrete thrust blocking is installed. If high-early cement is used for the concrete thrust blocking, the time may be cut to 2 days.

D. Conduct pressure test in the following manner, unless otherwise approved by the Engineer: after the trench has been backfilled or partially backfilled as hereinbefore specified, fill the pipe with water, expelling all air during the filling. The test pressure shall be 1 and a half times normal working pressure at the point of lowest elevation of the test gauge.

1. Duration

a) The duration of each pressure test shall be 2 hours, unless otherwise directed by the Engineer.

2. Procedure

a) Slowly fill the pipe with water and allow to stand for 24 hours. Expel all air from the pipe. Allow and maintain the specified test pressure by continuous pumping if necessary for the entire test period. The test pressure shall be calculated for the point of lowest elevation, or as specified by the Engineer. The pump suction shall be in a barrel or similar device, or metered so that the amount of water required to maintain the test pressure may be measured accurately.

b) Before the line is pressurized, the Engineer shall verify that all necessary main line valves are open or closed with regard to the section of line being tested. In addition, the Engineer shall verify that all hydrant valves are open.

3. Leakage

- a) Leakage shall be defined as the quantity of water necessary to hold the specified test pressure for the duration of the test period. No pipe installation will be accepted if the leakage is greater than the number of gallons per hour as determined by the following formula:

$$L = \frac{ND\sqrt{P}}{7400}$$

In the above formula:

- L = Allowable leakage, in gallons per hour.
N = Number of joints in the length of pipe tested.
D = Nominal diameter of pipe, in inches.
P = Average test pressure during the leakage test, in pounds per square inch gauge.

- b) The pressure testing of water service lines shall follow the same procedure as outlined in the section. In all cases, however, the corporation stop, service line and curb stop shall be visually inspected under full test pressure and any leaks fixed.

4. Correction of Excessive Leakage

- a) Should any test of pipe laid disclose leakage greater than that allowed, locate and repair the defective joints or pipe until the leakage of a subsequent test is within the specified allowance.

3.11 DISINFECTION OF POTABLE WATERLINES

- A. General. Flush and disinfect potable waterlines in accordance with the procedure set forth in AWWA C651, latest edition, Disinfecting Water Mains.
- B. Provide all temporary blow-offs, pumps, chlorination equipment, chlorine and all other necessary apparatus required.
- C. Pipe Cleaning. If the pipe contains dirt or heavy encrusted matter that, in the opinion of the Engineer, will not be removed during the flushing operation, the Contractor shall clean and swab the interior of the pipe with a five percent (50,000 ppm) chlorine solution.
- D. Preliminary Flushing. Flush pipeline prior to disinfection, except when the tablet method is used, to remove all remaining foreign material. The flushing operation shall develop a minimum velocity of 2.5 ft./sec.
- E. Chlorine Application. In general, chlorine shall be applied using the continuous

feed method. However, on large diameter lines where this would not be practical, the slug method may be used. The tablet method may be used on short extensions (up to 2500 feet) of small diameter mains (12 inches and smaller).

1. Continuous Feed Method. Introduce water into the line at a constant rate while adding chlorine at a minimum concentration of 50 mg/l. Maintain the chlorinated water in the pipeline for a minimum of 24 hours after which period the treated water shall contain no less than 10 mg/l of chlorine throughout the entire length.
 2. Slug Method. Introduce water with a minimum chlorine concentration of 100 mg/l at a constant measured rate into the pipeline. Apply column or slug of chlorinated water that will, as it passes along the line, expose all interior surfaces for a period of three hours. Check the application at the upstream end of the line.
 3. Tablet Method. This method shall not be used if trench water or foreign material has entered the line or if the water is below 5°C (41°F). Because preliminary flushing cannot be used, this method shall only be used when scrupulous cleanliness has been exercised.
 - a) Place tablets in each section of pipe in sufficient number to produce a dose of 50 mg/l initial residual with a 20 mg/l residual after 24 hours.. Refer to Table 2 of AWWA C651, latest edition, for the required minimum number of tablets. All tablets within the main must be attached at the top of the pipe. Introduce water into the pipeline at a rate no greater than 1 ft./sec. and retain the water in the pipeline for a period of 24 hours after which period the treated water shall show detectable chlorine residual at each sampling point.
- F. Final Flushing. After the applicable retention period, heavy chlorinated water should not remain in prolonged contact with pipe. In order to prevent damage to the pipe lining or to prevent corrosion damage to the pipe itself, the heavily chlorinated water shall be flushed from the main fittings, valves, and branches until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the distribution system or that is acceptable for domestic use.
1. The environment to which the chlorinated water is to be discharged shall be inspected. If there is any possibility that the chlorinated discharge will cause damage to the environment, then a neutralizing chemical shall be applied to the water to be wasted to neutralize thoroughly the residual chlorine.
- G. Bacteriologic Tests. *Standard conditions.* After final flushing and before the new water main is connected to the distribution system, two consecutive sets of acceptable samples, taken at least 24 hours apart, shall be collected from the new main. At least one set of samples shall be collected from every 1,200 feet of the new water main, plus one set from the end of the line and at least one set from

each branch. A minimum of two sampling points are required for any segment over 500 feet in length. All samples shall be tested for bacteriological (chemical and physical) quality in accordance with *Standard Methods for the Examination of Water and Wastewater*, and shall show absence of coliform organisms.

1. Collect samples in sterile bottles from sampling points furnished and installed by the Contractor in the main.
- H. Final Connections to Existing Mains. When connections to existing mains are made without a new valve at the connection point, new water main and appurtenances shall be installed, flushed, disinfected and satisfactory bacteriological sample results received prior to permanent connections being made to the active, existing system.
1. Final connections or those portions of the new system installed that have not been disinfected as part of a previous disinfection procedure, shall be disinfected in accordance with Section 4.6 of AWWA C651.

END OF SECTION

SECTION 02700

FINISHED GRADING AND RESTORATION

PART 1 GENERAL

1.01 SUMMARY

- A. This Work shall consist of finish grading, restoration of grounds and cleanup. This shall be a continuous process from project start-up to final acceptance of the Work by the Engineer.

PART 2 PRODUCTS

2.01 GENERAL CLEANUP

- A. Cleanup shall include the regrading, resurfacing, rebuilding and replacing of all surfaces on which construction took place, and rebuilding or replacing any areas disturbed by the construction. The streets or roads where disturbed shall be resurfaced by the Contractor, including both gravel and oil roads, and shall be replaced in as good or better condition than that at the start of construction. The Engineer shall be the sole judge as to whether streets, roads or property have been restored to a condition as good or better than at the start of construction.
- B. The Contractor shall, at all times, keep property on which Work is in progress free from accumulation of waste material or rubbish caused by employees or caused by the Work, and he shall carry on a constant program to maintain Work area, structure sites, right-of-ways and the surface of streets and roads in a condition satisfactory to the appropriate authority, grantor of the right-of-way, and the Engineer.
- C. Preliminary cleanup shall commence as soon as the construction site is occupied by the Contractor (including his employees, supplies, materials or equipment) and shall be a continuous process, if necessary, in order that the site of the Work shall have an appearance and/or utility equal to or better than the start of the Work.
- D. Upon completion of the Work, the Contractor shall remove all remaining rubbish, tools, equipment, scaffolds and surplus materials from the job and leave the Work area clean and free of debris.

PART 3 EXECUTION

3.01 GENERAL

- A. All driveways, retaining walls, concrete flatwork, drainage ditches, trees, shrubs, and other miscellaneous items shall be returned to as good as or better than original conditions, if they are damaged by Work.

3.02 LANDSCAPING

- A. See appropriate sections for reseeding requirements. Decorative Landscaping is not applicable.

END OF SECTION

SECTION 02822

TEMPORARY EROSION CONTROL

PART 1 GENERAL

1.01 SUMMARY

- A. This work consists of furnishing and applying soil binding slurry over disturbed slopes as a temporary soil erosion inhibitor. Disturbed slopes that will not be re-worked and finished slopes that are not scheduled revegetation for a period 21 days or more shall be treated as construction progresses. As construction progresses into the Fall season, all disturbed slopes that will not be re-worked before spring and finished slopes that are not scheduled for revegetation until spring shall be treated before the onset of winter and far enough in advance, in order for the treatment to be applied in accordance of the climatic requirements of this specification. Contractor shall furnish the equipment and labor necessary for performing the work.
- B. Soil binding agent shall be applied to all disturbed open slopes using standard mechanized hydraulic equipment used for broadcasting water based slurry products.
- C. The soil-binding agent shall be added to the proportionate quantity of water and thoroughly mixed per manufacturer's recommendations.
- D. This specification shall apply to all disturbed areas outside CDOT right-of-way.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Soil binder shall be Soil Master WR or approved equal. Soil binder shall be non-toxic, non-flammable and conform to the following properties:

Copolymer of methacrylates/acrylates/acrylics/tripolycate	60%
Extgoxylated surfactants	2%
Silicates	2%
Inert ingredients	36%
pH	4 - 5.1
Color	Milky white
Lbs. per U.S. gallon	9 - 10 lbs.

- B. Wood cellulose fiber mulch shall be Mat-Fiber, or approved equal. Wood cellulose fiber mulch shall conform to the following requirements:

Moisture content (total weight basis)	12.0% ± 3%
Organic matter (oven-dried weight basis, min.)	99.3%
Inorganic content (oven-dried weight basis, max.)	0.7%

pH at 3% consistency in water slurry (avg.)	4.9
Water holding capacity (min.)	1.2 gal/lb.
Color	Green

- C. Water used for establishing the proper dilution ratio shall be clean, free of sediment and other debris and pollutants.

2.02 OTHER ACCEPTED DUST SUPPRESSION ADDATIVES

A. Starch-Based or other 100% Natural Polymer

- 1. Accepted Product – DustStar by Chemstar or approved equal.

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

- A. Liquefied soil binder (Soil Master WR) shall be thoroughly mixed with water and wood cellulose fiber mulch (Mat-Fiber) into a homogeneous mix and applied to the disturbed ground at the following rate per acre:

<u>Soil Binder/Acre</u>	<u>Cellulose Fiber/Acre</u>	<u>Water/Acre</u>
165 gallons	200 pounds	2,000 gallons

- B. The soil-binding product and cellulose fiber mulch shall be slowly poured into the slurry tank with agitators activated until a homogeneous slurry is formed. The soil binding slurry shall be applied when the ground temperature is fifty degrees F. or greater at time of application and sustained while the slurry solidifies and stabilizes for a forty-eight hour period.
- C. The soil binding slurry shall be sprayed uniformly over the disturbed areas. Application shall be in the form of a mist and avoid over saturation that results in the slurry running off the slope. Contractor may need to spray areas more than once to achieve the proper coverage and avoid over-saturation. The slurry shall be applied to a moistened ground, but not in the presence of freestanding surface water. Any areas not sealed with the soil binder properly or areas damaged due to the negligence of the Contractor shall be repair and retreated.
- D. The Engineer may order test sections be established for adjusting the equipment and assure proper application and conformance to the specification.

END OF SECTION

Beta[®] b Series

Energy efficient and NSF approved



The **ProMinent[®] Beta[®]** is a microprocessor-based diaphragm solenoid metering pump capable of flows from **0.16 to 8.45 gph (0.59 to 32 l/h)** and pressures to **363 psi (25 bar)**. Feed rate is determined by stroke length and stroke frequency. Stroke length is adjusted from 0% to 100% with a 10:1 turndown. Stroke frequency is adjusted in 10% increments from 10-100. (Optional) External control via a standard 4-20 mA or pulse contact signal.

Features & Benefits

- Certified to NSF/ANSI 61 (acrylic or PVDF liquid ends)
- Auto-degassing liquid ends for off-gassing chemicals such as bleach & ammonia
- Capable of handling up to 3000 cps of viscous media such as polymers
- Integral bleed valve eliminates priming issues
- Continual monitoring of chemical supply with optional dual stage level switch
- Adjustable stroke length and stroke frequency
- Fault and pacing relays optional
- Standard external control via potential-free contacts with pulse step-up and step-down to adapt to existing signal transducers of 64:1 to 1:64
- (Optional) external control via standard 4-20 mA and potential-free contacts with pulse step-up and step-down of 32:1 to 1:32

Applications

- Water and wastewater treatment
- Cooling tower and boiler water treatment
- Low flow chemical feed
- Industrial Processes

Beta[®] b Series

Technical data

Capacity Data																
Pump Version	Capacity at Maximum Back Pressure				mL/stroke	Capacity at 1/2 Maximum Back Pressure				mL/stroke	Pre-Primed Suction Lift		Max. Stroking Rate spm	Tubing Connectors ² O.D. x I.D.	Shipping Weight (approx.)	
	psig	(bar)	GPH	(L/h)		psig	(bar)	GPH	(L/h)		ft.	(m)			lbs.	(kg)
BT4b																
1000	145	(10)	0.2	(0.74)	0.07	73	(5)	0.22	(0.82)	0.08	19.6	(6.0)	180	1/4 x 3/16	6.4-7.9	(2.9-3.6)
2001 ³	290	(20)	0.25	(0.96)	0.10	145	(10)	0.4	(1.50)	0.13	19.6	(6.0)	180	1/4 x 3/16	6.4-7.9	(2.9-3.6)
1601	232	(16)	0.29	(1.10)	0.10	116	(8)	0.37	(1.40)	0.13	19.6	(6.0)	180	1/4 x 3/16	6.4-7.9	(2.9-3.6)
2002 ³	290	(20)	0.45	(1.70)	0.19	145	(10)	0.74	(2.80)	0.24	19.6	(6.0)	180	1/4 x 3/16	6.4-7.9	(2.9-3.6)
1602	232	(16)	0.58	(2.20)	0.19	116	(8)	0.66	(2.50)	0.24	19.6	(6.0)	180	1/4 x 3/16	6.4-7.9	(2.9-3.6)
1604	232	(16)	0.95	(3.60)	0.33	116	(8)	1.14	(4.30)	0.40	19.6	(6.0)	180	1/4 x 3/16	6.8-8.6	(3.1-3.9)
0708	101	(7)	1.88	(7.10)	0.66	50.5	(4)	2.22	(8.40)	0.78	19.6	(6.0)	180	1/2 x 3/8	6.8-8.6	(3.1-3.9)
0413	58	(4)	3.25	(12.30)	1.14	29	(2)	3.75	(14.20)	1.31	9.8	(3.0)	180	1/2 x 3/8	6.8-8.6	(3.1-3.9)
0220	29	(2)	5.02	(19.00)	1.76	14.5	(1)	5.52	(20.90)	1.94	6.5	(2.0)	180	1/2 x 3/8	7.3-9.7	(3.3-4.4)
BT5b																
2504 ³	363	(25)	0.77	(2.90)	0.27	181	(13)	0.98	(3.70)	0.34	19.6	(6.0)	180	(8 x 4mm)	9.9-11.7	(4.5-5.3)
1008	145	(10)	1.80	(6.80)	0.63	73	(5)	2.19	(8.30)	0.76	19.6	(6.0)	180	1/2 x 3/8	9.9-11.7	(4.5-5.3)
0713	101	(7)	2.91	(11.00)	1.02	50.5	(4)	3.46	(13.10)	1.21	13.1	(4.0)	180	1/2 x 3/8	9.9-11.7	(4.5-5.3)
0420	58	(4)	4.52	(17.10)	1.58	29	(2)	5.05	(19.10)	1.77	9.8	(3.0)	180	1/2 x 3/8	10.4-12.8	(4.7-5.8)
0232 ¹	29	(2)	8.45	(32.00)	2.96	14.5	(1)	9.56	(36.20)	3.35	6.5	(2.0)	180	1/2 x 3/8	11.2-14.6	(5.1-6.6)
With auto-degassing liquid ends																
BT4b																
1601	232	(16)	0.16	(0.59)	0.06	116	(8)	0.21	(0.80)	0.07	5.9	(1.8)	180	1/4 x 3/16	6.4	(2.9)
1602	232	(16)	0.37	(1.40)	0.13	116	(8)	0.46	(1.74)	0.174	6.9	(2.1)	180	1/4 x 3/16	6.4	(2.9)
1604	232	(16)	0.71	(2.70)	0.25	116	(8)	0.95	(3.60)	0.33	8.8	(2.7)	180	1/4 x 3/16	6.8	(3.1)
0708	101	(7)	1.74	(6.60)	0.61	50.8	(4)	1.98	(7.50)	0.69	6.5	(2.0)	180	1/2 x 3/8	6.8	(3.1)
0413	58	(4)	2.85	(10.80)	1.00	29	(2)	3.33	(12.60)	1.17	6.5	(2.0)	180	1/2 x 3/8	6.8	(3.1)
0220	29	(2)	4.28	(16.20)	1.50	14.5	(1)	4.76	(18.00)	1.67	6.5	(2.0)	180	1/2 x 3/8	7.3	(3.3)
BT5b																
1008	145	(10)	1.66	(6.30)	0.58	73	(5)	1.98	(7.50)	0.69	9.8	(3.0)	180	1/2 x 3/8	9.9	(4.5)
0713	101	(7)	2.60	(10.50)	0.911	51	(4)	3.25	(12.30)	1.14	8.2	(2.5)	180	1/2 x 3/8	9.9	(4.5)
0420	58	(4)	4.12	(15.60)	1.44	29	(2)	4.6	(17.40)	1.61	8.2	(2.5)	180	1/2 x 3/8	10.4	(4.7)

Above capacities and suction lift refer to pumps tested on water at 115 VAC, 60 Hz, and an ambient temperature of 70°F (21°C).

Higher specific gravity fluids will reduce suction lift. Higher viscosity fluids will reduce capacity.

Liquid ends for highly viscous media have 10-20% less metering capacity and are not self-priming. Standard connectors are 1/2" MNPT or 5/8" hose barb. Positive suction recommended.

¹ Not available with bleed valve.

² SS versions use 1/4" female threads except models 0220, 0420, and 0232 which use 3/8" female threads.

³ Only available in SS and Acrylic liquid ends

Liquid end materials in contact with media					
Version	Liquid End	Suction/Discharge valves	Seals	Valve balls	Diaphragm*
*PVT	*PVDF	*PVDF	PTFE	Ceramic	PTFE
PPT	Polypropylene	*PVDF	PTFE	Ceramic	PTFE
NPT	Acrylic	*PVDF	PTFE	Ceramic	PTFE
TTT	PTFE with Carbon	PTFE with Carbon	PTFE	Ceramic	PTFE
SST	316 Stainless Steel	316 Stainless Steel	PTFE	Ceramic	PTFE

*Highly compatible material suitable for most fluids.

PULSAFEEDER®

The Five Function Valve is easily installed and allows simple, one-handed operation. The valve upgrades CHEM-TECH Series 100 and Series 200 metering pumps, plus all PULSAtron models up to 240 GPD. The Five Function Valve is packed with features that increase safety, enhance performance and generally improves the convenience of operation.

The functions are selected by setting two dual position selector knobs. The label on the back panel of the valve identifies each function with selector knob positions.

The Five Function Valve is compatible with most PULSAtron, and CHEM-TECH Series pumps. Connected to the existing discharge valve the Five Function Valve is capable of handling a large output flow as well as viscous liquids. A return port located on the side body provides flow of chemical back to the solution tank when in the air bleed or drain discharge mode.

Features

- Pressure Relief
- Back Pressure – Maintains output reproducibility and allows metering into atmospheric discharge.
- Anti-Siphon – Prevents siphoning through the pump when point of injection is lower than the pump or into the suction line of another pump. Rated at total vacuum.
- Air Bleed – Used during priming to manually remove air from the pump head.
- Discharge Drain – Depressurize pump discharge line without loosening tubing or fittings.

Operating Benefits

- Relieve excessive pressure in discharge line to protect connections and tubing.
- Maintain output reproducibility.
- Prevents siphoning.



Aftermarket

- Water Meters
- Gauges
- Dampeners
- Pressure Relief Valves
- KOPkits
- Tanks
- Pre-Engineered Systems



Five Function Valve

Five Function Valve

Specifications and Model Selection

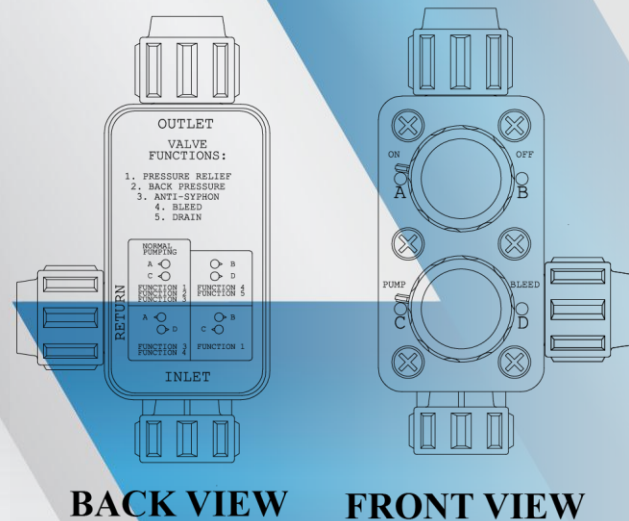
Five Function Valve Selection Guide		L380
Five Function Valve	L380 = Five Function Valve	
Max Pressure Rating	B = 50 PSI D = 100 PSI F = 150 PSI K = 250 PSI	
O-Ring Material	T = TFE	
Connection Size	01 = 3/8" (0.95 cm) OD Tubing Connection 02 = 1/4" (0.635 cm) Male MNPT Connection 03 = 1/2" (1.27 cm) OD Tubing Connection 0P = 4 x 6 mm 0N = 4 x 10 mm 0S = 6 x 10 mm 0Y = 6 x 12 mm 0Q = 10 x 14 mm	
Body Materials	PVD = Polyvinylidene Fluoride (PVDF or Kynar)	

Engineering Data

Materials of Construction:

Valve Body:	GFPPPL
Diaphragm:	PVDF
O-Rings:	PTFE-faced CSPE
Hardware:	PTFE
Maximum Flow:	188 SS
Maximum Viscosity:	240 GPD (37.85 LPH)
Maximum Operating Pressure:	1000 CPS
Pressure Relief Settings: (nominal cracking pressure)	250 PSI (17 BAR)
Note:	275 PSI (19 BAR) – red
	175 PSI (12 BAR) – green
	125 PSI (8.6 BAR) – blue
	Pressure relief will occur within 50% of maximum rating of pump.

Important: Material Code - GFPPPL=Glass-filled Polypropylene, PVC=Polyvinyl Chloride, PE=Polyethylene, PVDF=Polyvinylidene Fluoride, CSPE=Generic formulation of Hypalon, a registered trademark of E.I. DuPont Company. Viton is a registered trademark of E.I. DuPont Company. PVC wetted end recommended for sodium hypochlorite.



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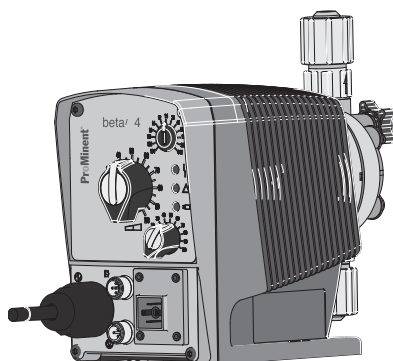
An ISO 9001 Certified Company

FFV001 I14



ProMinent® Beta® b Solenoid Diaphragm Metering Pumps

Overview: Beta® b



Ideal for basic chemical feed applications

(see [page 121](#) for spare parts and [page 134](#) for control cables)

- Capacity range 8.4 gph (32 l/h) max, 363 psi (25 bar) max
- External contact input for pulse control with a range of 1:64-64:1
- Continuous stroke length adjustment from 0-100% (recommended 30-100%)
- Supplied in PP, Acrylic/PVC, PTFE, PVDF, SS
- Patented coarse/fine deaeration for PP, and Acrylic/PVC
- Auto-degassing liquid end in Acrylic/PVC
- HV liquid end for highly viscous media (suitable for viscosities to 3000 cPs)
- 10-setting stroke frequency adjustment from 10-100%
- External control via voltage-free contacts
- Connector for two-stage level switch
- 12-24 V DC, 24 V AC low voltage version
- LED's for operation status
- NSF/ANSI 61 approved

ProMinent® solenoid-driven metering pumps consist of two main components: the pump drive unit and the liquid end. The Beta series offers two drive (solenoid) sizes: Beta/4 (BT4b) and Beta/5 (BT5b). Operating principles and options are identical, and both units offer maximum backpressure up to 363 psig (17.5 bar). Capacity range for the Beta/4 is 0.19 to 5 gph (0.74 to 19 l/h); Beta/5 is 0.80 to 8.4 gph (2.9 to 32 l/h).

Feed rate is determined by stroke length and stroking rate: stroke length can be varied from 0 to 100% with an adjustment ratio of 10:1. The stroke length is set manually by the adjustment knob on the front of the pump.

Stroke rate can be adjusted in 10% increments between 10 and 100% via the multifunction switch. This switch is also used to select voltage-free On/Off external pulse contact, pump stop, or test (for priming).

Specifications

Drive Unit

The pump housing is constructed of fiberglass-reinforced PPE plastic to protect against corrosion, dust, and water.

The solenoid drive unit houses a short-stroke solenoid with a maximum stroke length of 0.05" (1.25 mm). It is equipped with a noise suppressing mechanism for quiet operation and the armature is the only moving part.

Operating on pulse action, each pulse generates a magnetic field in the solenoid coil. This magnetic field moves the armature, which in turn moves the diaphragm. The diaphragm pushes into the dosing head and cavity forces chemical out of the discharge valve. When the magnetic field is de-energized, a spring returns the armature and diaphragm to their original position. This return movement draws chemical into the dosing head cavity through the suction valve.

In the event of a diaphragm rupture, the liquid end has a weep hole on the bottom of the backplate to direct chemical out of the pump and away from the solenoid. An optional diaphragm failure detector can be used to stop the pump and indicate a fault.

The stroke-length adjusting mechanism is connected directly to the solenoid. Adjustment results in an accurate self-locking stroke-length setting.

Diaphragm

The diaphragm is constructed of fabric-reinforced EPDM elastomer with a plastic core and PTFE-facing. It is chemically resistant to virtually all process fluids and can be used over a wide temperature range. The Beta pump is designed with a convex diaphragm. The curved shape provides precise metering and alleviates stress placed on the diaphragm by reducing liquid end dead volume.

ProMinent® Beta® b Solenoid Diaphragm Metering Pumps

Specifications (Cont.)

The Liquid End

The Beta metering pump liquid ends are available in five material versions: Polypropylene (PP), Kynar (PVDF), Acrylic/PVC (NP), PTFE (TT), and 316 Stainless steel (SS).

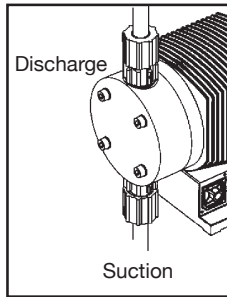
Some liquid ends are interchangeable between the BT4a and BT5a.

Options include a manual bleed valve with needle valve for easy priming, and continuous bleed of fluids that tend to off-gas (available with versions PP, PVT, and NP liquid ends).

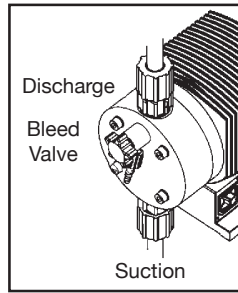
Automatic degassing liquid ends are available for PP and NP versions (except 1000 and 0232). This style liquid end discharges from the center and degasses from the top to prevent air build-up in the chamber.

High viscosity PVDF liquid ends are available for pump versions 1005, 0708, 0413, 0220, 1008, 0713, and 0420. Their metering capacity is 10-20% less than standard pump versions and recommended viscosity is up to 3000 cPs. The HV liquid ends are not self-priming; flooded suction is recommended.

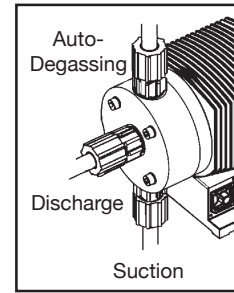
Suction and discharge ports are equipped with double-ball check valves for superior repeatability.



Liquid end without bleed valve



Liquid end with bleed valve



Auto-degassing liquid end

Power Supply

The Beta metering pumps accept a universal 100-230 volt power supply (+/- 10%), single phase, 50/60 Hz, with a 1.15 service factor. Performance is identical whether operated on 50 Hz or 60 Hz power. The power cord is detachable.

Fault Indicators

Three LED lights indicate operational status. A green light flashes during normal operation; a yellow light warns of low chemical; and a red light indicates lack of chemical or an operational error.

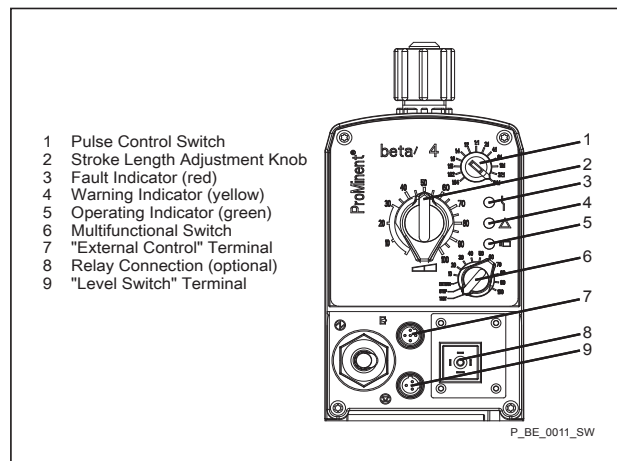
Relay Outputs

Fault annunciating relay

For low tank level (level switch), processor fault, and fuse/power supply failure.

Pacing relay

A contact closure is issued with every pump stroke (contact duration 150 ms). This allows a second ProMinent metering pump to be paced synchronously, or to totalize flow with an external stroke counter.



ProMinent® Beta® b Solenoid Diaphragm Metering Pumps

Specifications (Cont.)

<i>Maximum stroke length:</i>	0.05" (1.25 mm)		
<i>Materials of construction</i>			
<i>Housing:</i>	Fiberglass reinforced PPE		
<i>Diaphragm:</i>	PTFE-faced EPDM with plastic core		
<i>Liquid end options:</i>	Polypropylene, PVDF, Acrylic/PVC, PTFE, 316 SS		
<i>Enclosure rating:</i>	IP 65		
<i>Motor insulation class:</i>	F		
<i>Power supply:</i>	100-230 VAC, 1 phase, 50/60 Hz, +/- 10%; 12-24 VDC or 24VDC (+/- 10%)		
<i>Check valves:</i>	Double ball		
<i>Metering repeatability:</i>	When used according to operating instructions, ±2% under constant conditions and at minimum 30% stroke length		
<i>Power cord:</i>	6 ft (2 m)		
<i>Relay cable (optional):</i>	6 ft (2 m)		
<i>Relay load</i>			
<i>Fault relay only (options 1 & 3):</i>	Contact load: 250 VAC, 2 A, 50/60 Hz Operating life: > 200,000 switch functions		
<i>Fault and pacing relay (options 4 & 5):</i>	Contact load: 250 VAC/DC, 2 A, 50/60 Hz Operating life: > 200,000 switch functions Residual impedance in ON-position (R_{DSON}): < 8 Ω Residual current in OFF-position: < 1 μ A Maximum current: < 100 mA Maximum voltage: 24 VDC Switch functions: 15x10 ⁹ Contact closure: 100 μ s (for pacing relay)		
<i>Ambient temperature range:</i>	14°F (-10°C) to 113°F (45°C)		
<i>Max. fluid operating temperatures:</i>	Material	Constant	Short Term
	Acrylic/PVC	113°F (45°C)	140°F (60°C)
	Polypropylene	122°F (50°C)	212°F (100°C)
	PTFE	122°F (50°C)	248°F (120°C)
	316 SS	122°F (50°C)	248°F (120°C)
	PVDF	149°F (65°C)	212°F (100°C)
<i>Average power drain at maximum stroking rate (Watts) / current drain at pump stroke (Amps)</i>			
BT4a:	17W / 0.7 A or 15 A (peak current for approx. 1 μ s)		
BT5a:	22W / 1.0 A or 15 A (peak current for approx. 1 μ s)		
<i>Service factor:</i>	1.15		
<i>Warranty:</i>	2 years on drive, 1 year on liquid end (extended warranties available)		
<i>Industry standards:</i>	UL recognized, CE available for U.S.A. and Canada, NSF/ANSI 61		
<i>Valve threads:</i>	Metric thread for PP, NP, PVT, and TT versions. 1/2" MNPT connections are available in all materials.		
<i>Standard Production Test:</i>	All pumps are tested for capacity at maximum pressure prior to shipment.		
<i>Max. solids size in fluid:</i>	Pumps with 1/4" valves: 15 μ - Pumps with 1/2" valves: 50 μ		
<i>Controlling contact (pulse):</i>	With voltage free contact, or with semiconductor sink logic control (NPN), not source logic (PNP). With a residual voltage of <700 mV, the contact load is approximately 0.5 mA at +5 VDC. (Note: Semiconductor contacts that require >700 mV across a closed contact should not be used.) Pump ignores contacts exceeding maximum input rate.		
<i>Necessary contact duration:</i>	20 μ s		
<i>Recommended Viscosity:</i>	max. 200 cPs for standard liquid end max. 500 cPs for valve with springs max. 50 cPs for auto-degassing metering pumps max. 3000 cPs for high viscosity		

ProMinent® Beta® b Solenoid Diaphragm Metering Pumps

Capacity Data

Pump Version	Capacity at Max Backpressure			Capacity at 1/2 Max Backpressure			Pre-Primed Suction Lift		Max. Stroke Rate spm	Tubing Connectors ² O.D. x I.D. inches	Shipping Weight (higher weights are for SS) lbs (kg)
	psig (bar)	U.S. GPH (l/h)	ml/stroke	psig (bar)	U.S. GPH (l/h)	mL/stroke	ft (m)				
BT4b											
1000	145 (10)	0.19 (0.74)	0.07	73 (5)	0.21 (0.82)	0.08	19.6 (6)	180	1/4 x 3/16	6.4-7.9 (2.9-3.6)	
2001 ³	290 (20)	0.29 (1.1)	0.10	145 (10)	0.37 (1.40)	0.13	19.6 (6)	180	1/4 x 3/16	6.4-7.9 (2.9-3.6)	
1601	232 (16)	0.29 (1.1)	0.10	116 (8)	0.37 (1.40)	0.13	19.6 (6)	180	1/4 x 3/16	6.4-7.9 (2.9-3.6)	
2002 ³	290 (20)	0.58 (2.2)	0.19	145 (10)	0.66 (2.5)	0.24	19.6 (6)	180	1/4 x 3/16	6.4-7.9 (2.9-3.6)	
1602	232 (16)	0.58 (2.2)	0.19	116 (8)	0.66 (2.5)	0.24	19.6 (6)	180	1/4 x 3/16	6.4-7.9 (2.9-3.6)	
1604	232 (16)	0.95 (3.6)	0.33	116 (8)	1.13 (4.3)	0.40	19.6 (6)	180	1/4 x 3/16	6.8-8.6 (3.1-3.9)	
0708	101 (7)	1.9 (7.1)	0.66	50.5 (3.5)	2.22 (8.4)	0.78	19.6 (6)	180	1/2 x 3/8	6.8-8.6 (3.1-3.9)	
0413	58 (4)	3.2 (12.3)	1.14	29 (2)	3.75 (14.2)	1.31	9.8 (3)	180	1/2 x 3/8	6.8-8.6 (3.1-3.9)	
0220	29 (2)	5.0 (19.0)	1.76	14.5 (1)	5.52 (20.9)	1.94	6.5 (2)	180	1/2 x 3/8	7.3-9.7 (3.3-4.4)	

BT5b											
2504 ³	363 (25)	0.77 (2.9)	0.27	181 (12.5)	0.97 (3.7)	0.34	19.6 (6)	180	8 x 4 mm	9.9-11.7 (4.5-5.3)	
1008	145 (10)	1.8 (6.8)	0.63	73 (5)	2.19 (8.3)	0.76	19.6 (6)	180	1/2 x 3/8	9.9-11.7 (4.5-5.3)	
0713	101 (7)	2.9 (11.0)	1.02	50.5 (3.5)	3.46 (13.1)	1.21	13.1 (4)	180	1/2 x 3/8	9.9-11.7 (4.5-5.3)	
0420	58 (4)	4.5 (17.1)	1.58	29 (2)	5.04 (19.1)	1.77	9.8 (3)	180	1/2 x 3/8	10.4-12.8 (4.7-5.8)	
0232 ¹	29 (2)	8.4 (32.0)	2.96	14.5 (1)	9.56 (36.2)	3.35	6.5 (2)	180	1/2 x 3/8	11.2-14.6 (5.1-6.6)	

With auto-degassing liquid ends

BT4b											
1601	232 (16)	0.16 (0.59)	0.06	116 (8)	0.21 (0.80)	0.07	5.9 (1.8)	180	1/4 x 3/16	6.4 (2.9)	
1602	232 (16)	0.37 (1.4)	0.13	116 (8)	0.46 (1.74)	0.174	6.9 (2.1)	180	1/4 x 3/16	6.4 (2.9)	
1604	232 (16)	0.71 (2.7)	0.25	116 (8)	.95 (3.6)	0.33	8.8 (2.7)	180	1/4 x 3/16	6.8 (3.1)	
0708	101 (7)	1.74 (6.6)	0.61	50.8 (3.5)	1.98 (7.5)	0.69	6.5 (2.0)	180	1/2 x 3/8	6.8 (3.1)	
0413	58 (4)	2.8 (10.8)	1.00	29 (2)	3.3 (12.6)	1.17	6.5 (2.0)	180	1/2 x 3/8	6.8 (3.1)	
0220	29 (2)	4.3 (16.2)	1.50	14.5 (1)	4.7 (18.0)	1.67	6.5 (2.0)	180	1/2 x 3/8	7.3 (3.3)	

BT5b											
1008	145 (10)	1.66 (6.3)	0.58	73 (5)	1.98 (7.5)	0.69	9.8 (3)	180	1/2 x 3/8	9.9 (4.5)	
0713	101 (7)	2.77 (10.5)	0.97	51 (3.5)	3.2 (12.3)	1.14	8.2 (2.5)	180	1/2 x 3/8	9.9 (4.5)	
0420	58 (4)	4.12 (15.6)	1.44	29 (2)	4.6 (17.4)	1.61	8.2 (2.5)	180	1/2 x 3/8	10.4 (4.7)	

(Note: Above capacities and suction lift refer to pumps tested on water at 115 VAC, 60 Hz, and an ambient temperature of 70°F (20°C). Higher specific gravity fluids will reduce suction lift. Capacities will be slightly reduced from published ratings if pumps are skid mounted).

Higher viscosity fluids will reduce capacity. Liquid ends for highly viscous media have 10-20% less metering capacity and are not self-priming.

Standard connectors are 1/2" MNPT or 5/8" hose barb. Positive suction is recommended.

¹ Not available with bleed valve.

² SS versions use 1/4" female threads except models 0220, 0420, and 0232 which use 3/8" female threads.

³ Only available in SS and Acrylic liquid ends.

Universal control cable necessary for external Beta control. (see [page 134](#))

Materials In Contact With Chemicals

	Pump Head	Suction/Pressure Connector	O-rings	Balls
PPE ⁵	Polypropylene	Polypropylene	EPDM	ceramic
PPB ⁵	Polypropylene	Polypropylene	Viton®	ceramic
NPE ^{4,5}	Acrylic	PVC	EPDM	ceramic
NPB ^{4,5}	Acrylic	PVC	Viton®	ceramic
PVT ⁴	PVDF	PVDF	PTFE	ceramic
TTT	PTFE with carbon	PTFE with carbon	PTFE	ceramic
SST	316 stainless steel	316 stainless steel	PTFE	ceramic
NPT ⁴	Acrylic	PVDF	PTFE	ceramic
PPT	Polypropylene	Polypropylene	PTFE	ceramic

⁴ NSF/ANSI 61 approved

⁵ Only available in self de-gassing models

Note: Viton® is a registered trademark of DuPont Dow Elastomers.

ProMinent® Beta® b Solenoid Diaphragm Metering Pumps

Identcode Ordering System

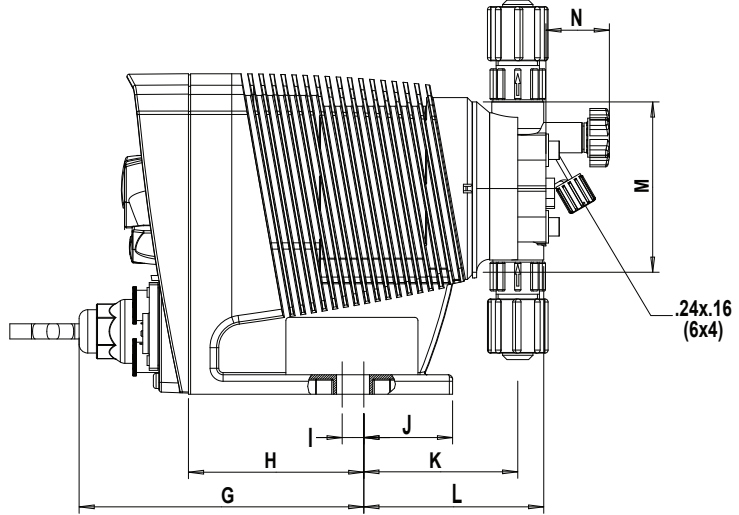
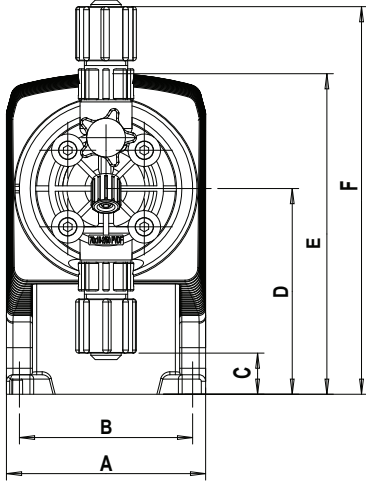
BT4b	Beta 4b										Beta 5b		
Version	Capacity					Version	Capacity					Version	Capacity
1000	0.20 gph (0.74 l/h), 145 psi (10 bar)					1604	0.95 gph (3.60 l/h), 232 psi (16 bar)					2504	0.77 gph (2.90 l/h), 363 psi (25 bar)
2001	0.25 gph (0.96 l/h), 290 psi (20 bar)					0708	1.88 gph (7.10 l/h), 102 psi (7 bar)					1008	1.80 gph (6.80 l/h), 145 psi (10 bar)
1601	0.29 gph (1.10 l/h), 232 psi (16 bar)					0413	3.25 gph (12.30 l/h), 58 psi (4 bar)					0713	2.91 gph (11.00 l/h), 102 psi (7 bar)
2002	0.45 gph (1.70 l/h), 290 psi (20 bar)					0220	5.02 gph (19.0 l/h), 29 psi (2 bar)					0420	4.52 gph (17.10 l/h), 58 psi (4 bar)
1602	0.58 gph (2.2 l/h), 232 psi (16 bar)											0232	8.45 gph (32.00 l/h), 29 psi (2 bar)
Liquid end material:													
PP Polypropylene/PVDF, for self-degassing version Polypropylene/Polypropylene													
NP Acrylic glass/PVDF, for self-degassing version Acrylic glass/PVC													
PV PVDF/PVDF													
TT PTFE/PTFE													
SS Stainless steel													
O-rings:													
E EPDM/PTFE coated, only for PP and NP self-degassing													
B FPM-B/PTFE coated, only on PP and NP self-degassing													
T PTFE/PTFE coated													
P Diaphragm and seal EPDM													
Liquid end version:													
0 Non-bleed version, no valve spring, for TT, SS and type 0232 only													
1 Non-bleed version, with valve spring, for TT, SS and type 0232 only													
2 With deaerator, no valve spring, PP, PV, NP only, not type 0232													
3 With deaerator, with valve spring, PP, PV, NP only, not type 0232													
4 Version for highly viscous media, only PVT, types 1005, 1605, 0708, 1008, 0413, 0713, 0220, 0420													
9 Self-degassing for PP, NP only, not for types 1000 and 0232													
Hydraulic connections:													
0 Standard according to technical data													
B special-connection 3/8" x 1/4"													
Logo:													
0 With ProMinent® logo													
Power supply:													
U Universal 100-240 V													
M 12-24 VDC													
Cable and plug:													
A 6 ft European													
D 6 ft USA 115 V													
U 6 ft USA 230 V													
Relay:													
0 No relay													
1 Fault indicating relay, normally energized, 1 x changeover contact 230 V - 2 A													
3 Fault indicating relay, normally de-energized, 1 x changeover contact 230 V - 2 A													
4 As 1 + pacing relay 2 x normally open contacts 24 V - 100 mA													
5 As 3 + pacing relay 2 x normally open contacts 24 V - 100 mA													
Accessories:													
0 No accessories													
1 With foot and injection valve, 5 ft PVC suction tubing, 10 ft PE discharge tubing													
Control type:													
0 No lock													
1 With lock: manual operation locked when external cable plugged in													
Control variants:													
0 Standard													
BT4b	1000	PP	E	0	0	0	U	A	0	0	0	0	

ProMinent® Beta® b Solenoid Diaphragm Metering Pumps

Dimensional Drawings

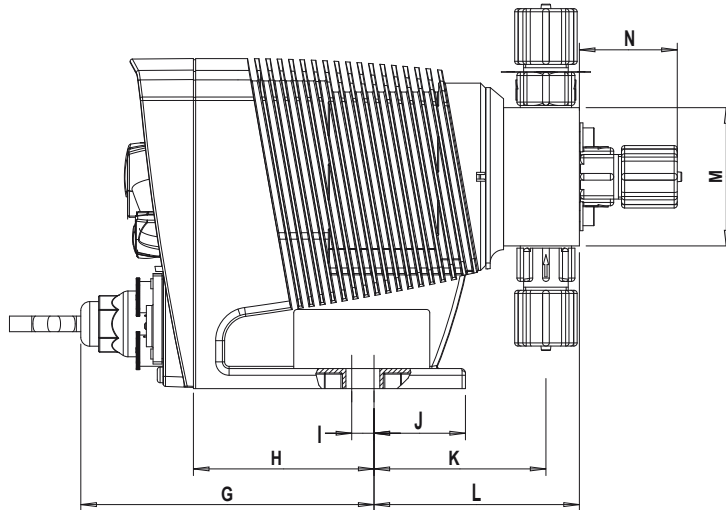
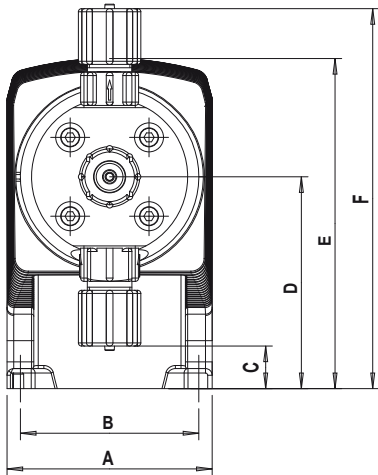
Dimensions in inches (mm).

Ranges given, actual dimension dependent on liquid end material.



Pump	A	B	C	D	E	F	G	H	I	J	K	L	M	N
BT4	3.6 (92)	3.1 (80)	.13-.75 (3.2-19)	3.7 (95)	5.8 (148)	7.0-7.8 (179-199)	5.2 (131.5)	3.2 (81)	.39 (10)	1.4 (36)	2.8-3.0 (71-76)	3.2-3.7 (83-93)	2.8-4.3 (Ø 90-Ø 110)	1.1 29.3
BT5	4.0 (102)	3.1 (80)	.13-.75 (3.2-19)	4.0 (101)	6.0 (153)	7.0-7.8 (179-199)	5.3 (135.5)	3.3 (85)	.59 (15)	1.6 (41)	2.8-3.0 (71-76)	3.2-3.7 (83-93)	2.8-4.3 (Ø 90-Ø 110)	1.1 29.3

With Auto-Degassing Liquid Ends



Pump	A	B	C	D	E	F	G	H	I	J	K	L	M	N
BT4	3.6 (92)	3.1 (80)	.30-.75 (7.5-19)	3.7 (95)	5.8 (148)	6.7-7.42 (170.5-188.5)	5.2 (131.5)	3.2 (81)	.39 (10)	1.4 (36)	2.9-3.0 (74-77)	3.5-4.2 (89-105.5)	2.8-3.5 (Ø 90-Ø 70)	1.73 43.9
BT5	4.0 (102)	3.1 (80)	.30-.75 (7.5-19)	4.0 (101)	6.0 (153)	6.7-7.42 (170.5-188.5)	5.3 (135.5)	3.3 (85)	.59 (15)	1.6 (41)	2.9-3.0 (74-77)	3.5-4.2 (89-105.5)	2.8-3.5 (Ø 90-Ø 70)	1.73 43.9



FEATURES

Powered for Continuous Operation: All ratings are within the working limits of the motor as recommended by the motor manufacturer. Pump can be operated continuously without damage to the motor.

Field Serviceable: Units have left hand threads and are field serviceable with common tools and readily available repair parts.

Sand Handling Design: Our face clearance, floating impeller stack has proven itself for over 50 years as a superior sand handling, durable pump design.

FDA Compliant Non-Metallic Parts: Impellers, diffusers and bearing spiders are constructed of glass filled engineered composites. They are corrosion resistant and non-toxic.

Discharge Head/Check Valve: Cast 303 stainless steel for strength and durability. Two cast-in safety line loops for installer convenience. The built-in check valve is constructed of stainless steel and FDA compliant BUNA rubber for abrasion resistance and quiet operation.

Motor Adapter: Cast 303 stainless steel for rigid, accurate alignment of pump and motor. Easy access to motor mounting nuts using standard open end wrench.

Stainless Steel Casing: Polished stainless steel is strong and corrosion resistant.

Hex Shaft Design: Six sided shafts for positive impeller drive.

Engineered Polymer Bearings: The proprietary, engineered polymer bearing material is strong and resistant to abrasion and wear. The enclosed upper bearing is mounted in a durable Noryl® bearing spider for excellent abrasion resistance.

e-GS

35GS, 45GS, 65GS & 85GS

35-85 GPM 1-10HP, 60 HZ, SUBMERSIBLE PUMPS

WATER END DATA

Series	Model	Required HP	Stages	Water End	
				Length (in)	Weight (lbs)
35GS	35GS10	1	6	14.2	8
	35GS15	1.5	8	16.6	9
	35GS20	2	10	19.1	10
	35GS30	3	14	24.0	13
	35GS50	5	23	36.4	20
	35GS75	7.5	36	53.0	28
	35GS100	10	46	65.2	34
45GS	45GS15	1.5	5	12.9	8
	45GS20	2	7	15.4	9
	45GS30	3	10	19.0	10
	45GS50	5	17	27.7	15
	45GS75	7.5	25	38.9	21
	45GS100	10	34	50.6	27
65GS	65GS15	1.5	6	19.1	10
	65GS20	2	7	21.2	11
	65GS30	3	10	27.4	12
	65GS50	5	16	41.2	18
	65GS75	7.5	26	62.3	35
	65GS100	10	33	76.8	42
85GS	85GS30	3	8	29.4	13
	85GS50	5	14	42.8	18
	85GS75	7.5	21	63.8	35
	85GS100	10	27	79.9	41

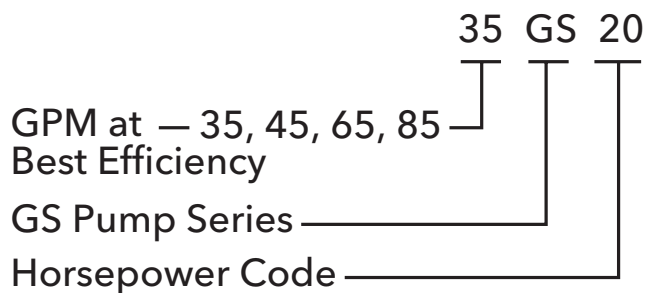
SPECIFICATIONS

Model	Flow Range GPM	Horse-Power Range	Best Efficiency GPM	Discharge Connection	Minimum Well Size	Rotation
35GS	10-50	1.0 - 10	35	2"	4"	CCW
45GS	20 - 65	1.5 - 10	45	2"	4"	CCW
65GS	30 - 80	1.5 - 10	65	2"	4"	CCW
85GS	40 - 120	3.0 - 10	85	2"	4"	CCW

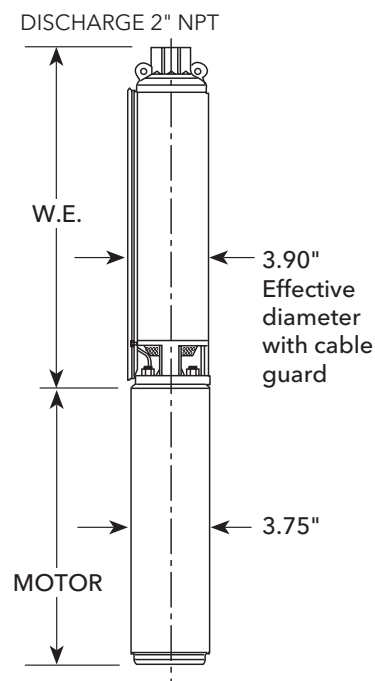
"GS" SERIES MATERIALS OF CONSTRUCTION

Part Name	Material
Discharge Head	AISI 303 SS
Check Valve Poppet	AISI 303 SS
Check Valve Seal	BUNA, FDA Compliant
Check Valve Seat	AISI 304 SS
Check Valve Retaining Ring	AISI 302 SS
Bearing Spider - Upper	Noryl
Bearing	Proprietary Engineered Polymer
Klipring	AISI 301 SS
Diffuser	Noryl
Impeller	Noryl
Bowl	AISI 304 SS
Intermediate Sleeve*	AISI 304 SS, Powder Metal
Intermediate Shaft Coupling*	AISI 304 SS, Powder Metal
Intermediate Bearing Spider*	Noryl
Intermediate Bearing Spider*	AISI 303 SS
Shim	AISI 304 SS
Screws - Cable Guard	AISI 304 SS
Motor Adapter	AISI 303 SS
Casing	AISI 304 SS
Shaft	17-4 PH Stainless Steel
Coupling	AISI 304 SS, Powder Metal
Cable Guard	AISI 304 SS
Suction Screen	AISI 304 SS

NOMENCLATURE - SOLD AS WATER ENDS ONLY



10 = 1	50 = 5
15 = 1½	75 = 7½
20 = 2	100 = 10
30 = 3	



CENTRIPRO 4" SINGLE-PHASE MOTORS

Order No.	Type	HP	Volts	Length in. (mm)	Weight lb. (kg.)
M10422	2-wire PSC	1	230	13.3 (337)	24.5 (11.1)
M15422		1.5		14.9 (378)	28.9 (13.1)
M10412	3-wire	1	230	11.7 (297)	23.1 (10.5)
M15412		1.5		13.6 (345)	27.4 (12.4)
M20412		2		15.1 (383)	31.0 (14.1)
M30412		3		18.3 (466)	40.0 (18.1)
M50412		5		27.7 (703)	70.0 (31.8)

CENTRIPRO 4" THREE-PHASE MOTORS

Order No.	HP	Volts	Length in. (mm)	Weight lb. (kg.)
M10430	1	200	11.7 (297)	22 (10.4)
M15430	1.5		11.7 (297)	22 (10.4)
M20430	2		13.8 (351)	28 (12.7)
M30430	3		15.3 (389)	32 (14.5)
M50430	5		21.7 (550)	55 (24.9)
M75430	7.5		27.7 (703)	70 (31.8)
M10432	1	230	11.7 (297)	23 (10.4)
M15432	1.5		11.7 (297)	23 (10.4)
M20432	2		13.8 (351)	28 (12.7)
M30432	3		15.3 (389)	32 (14.5)
M50432	5		21.7 (550)	55 (24.9)
M75432	7.5		27.7 (703)	70 (31.8)
M10434	1	460	11.7 (297)	23 (10.4)
M15434	1.5		11.7 (297)	23 (10.4)
M20434	2		13.8 (351)	28 (12.7)
M30434	3		15.3 (389)	32 (14.5)
M50434	5		21.7 (550)	55 (24.9)
M75434	7.5		27.7 (703)	70 (31.8)
M100434	10		-	-
M15437	1.5	575	11.7 (297)	23 (10.4)
M20437	2		15.3 (389)	32 (14.5)
M30437	3		15.3 (389)	32 (14.5)
M50437	5		27.7 (703)	70 (31.8)
M75437	7.5		27.7 (703)	70 (31.8)

NEMA MOTOR

- Corrosion resistant stainless steel construction.
- Built-in surge arrestor is provided on single phase motors through 5 HP.
- Stainless steel splined shaft.
- Hermetically sealed windings.
- Replaceable motor lead assembly.
- NEMA mounting dimensions.
- Control box is required with 3 wire single phase units.
- Three phase units require a magnetic starter with three leg Class 10 overload protection.

AGENCY LISTINGS



CentriPro Motor - tested to UL778 and CAN 22.2 by CSA International (Canadian Standards Association)



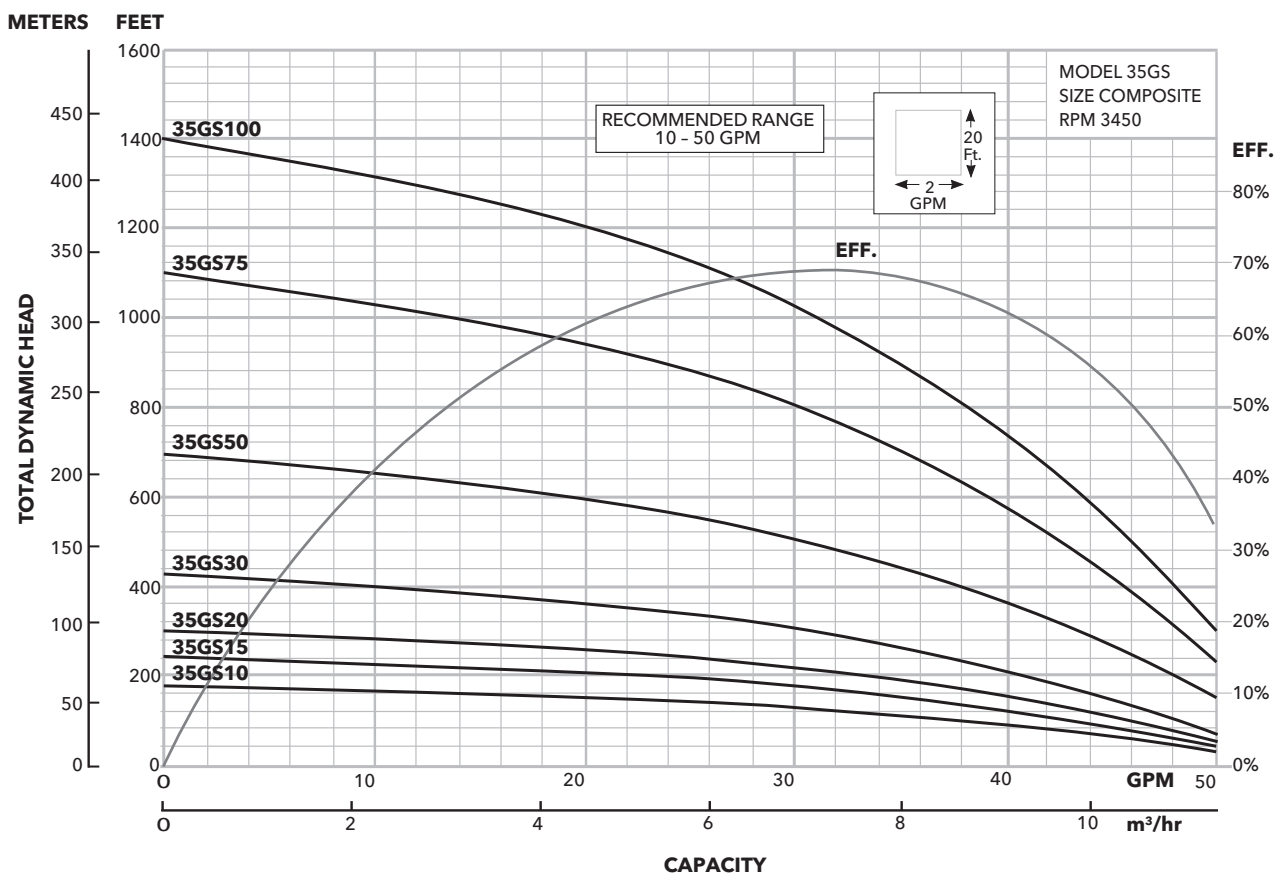
CentriPro Motor - Certified to NSF/ANSI 61, Annex G, Drinking Water System Components 4P49



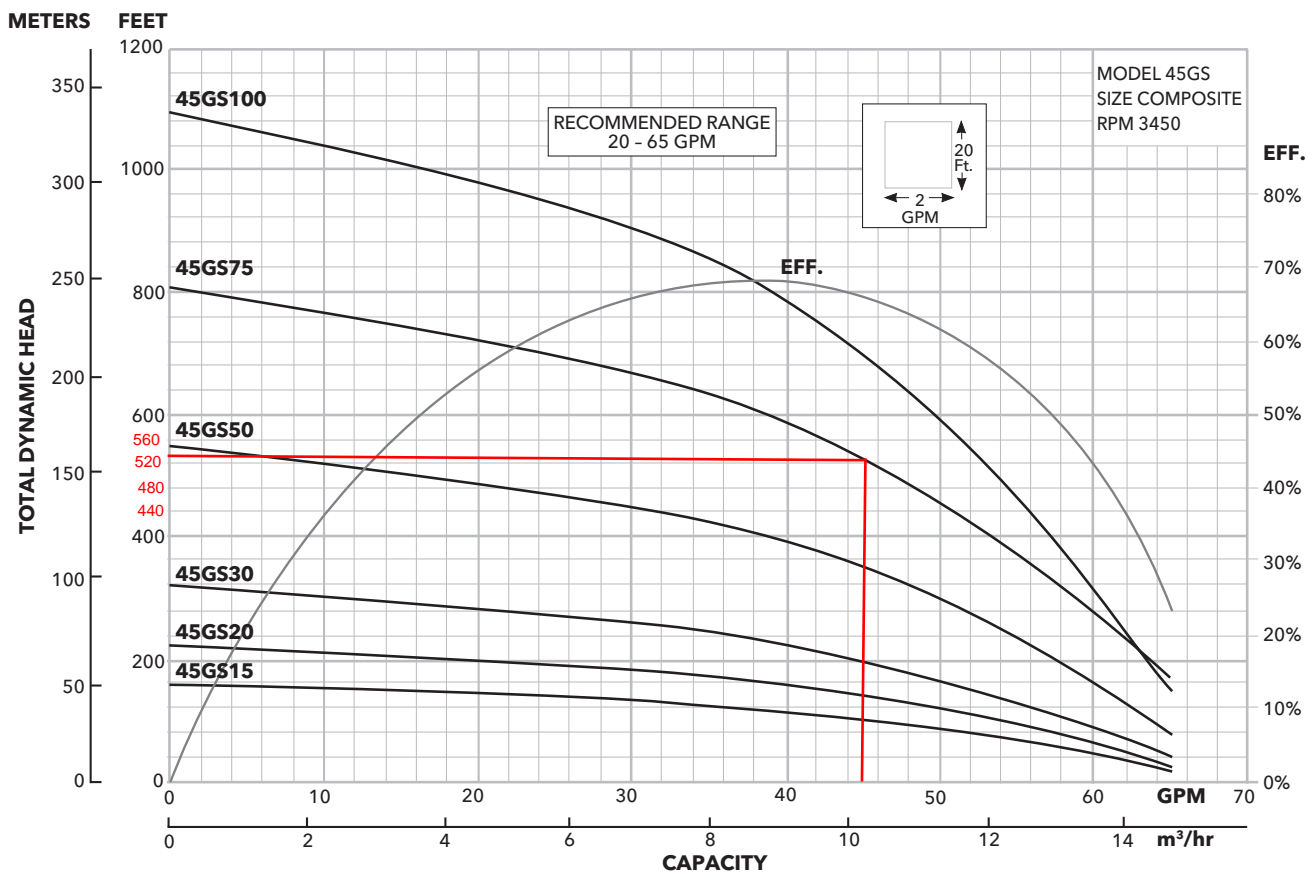
NSF/ANSI 372 - Drinking Water System Components - Lead Content

CLASS 6853 01 - Low Lead Content Certification Program - - Plumbing Products

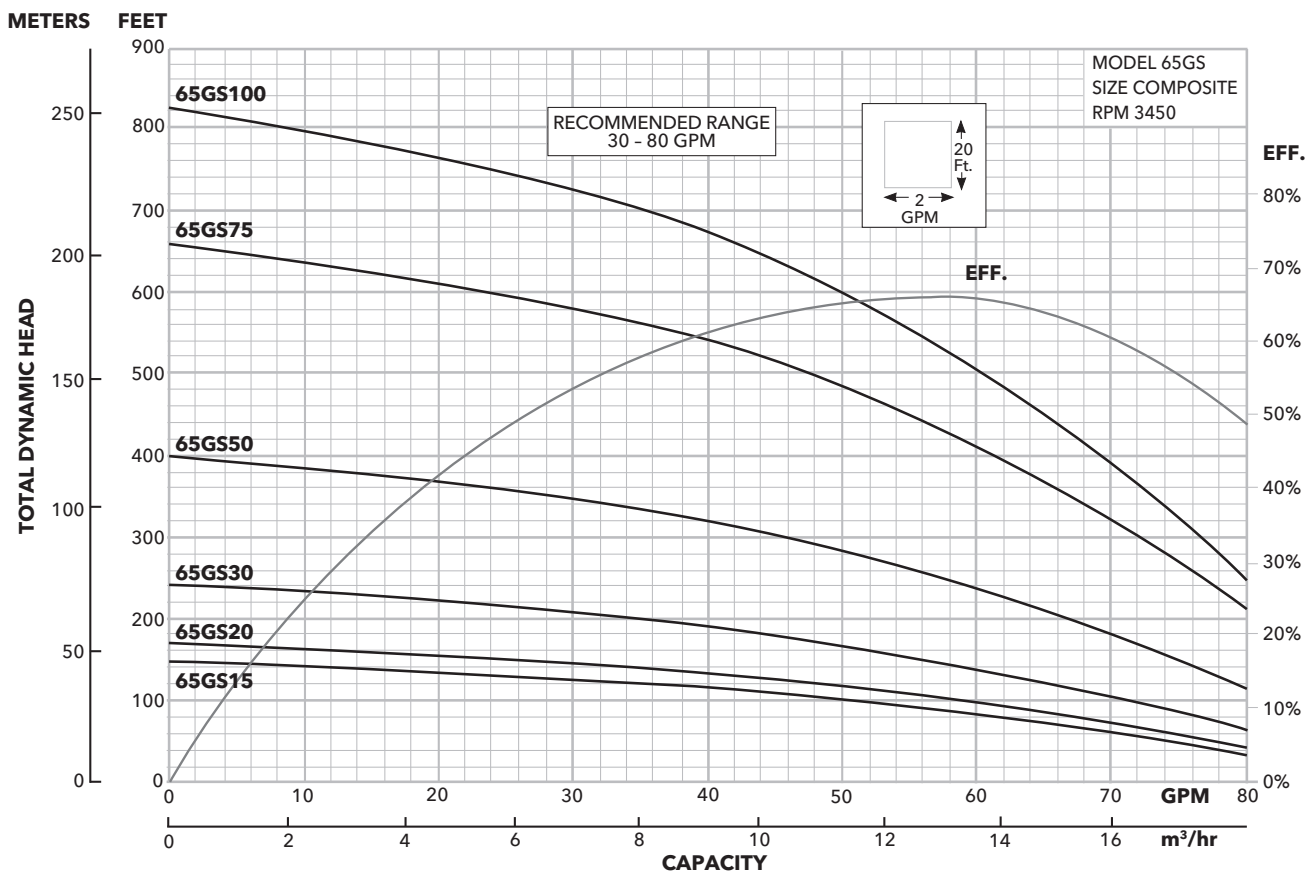
Model 35GS



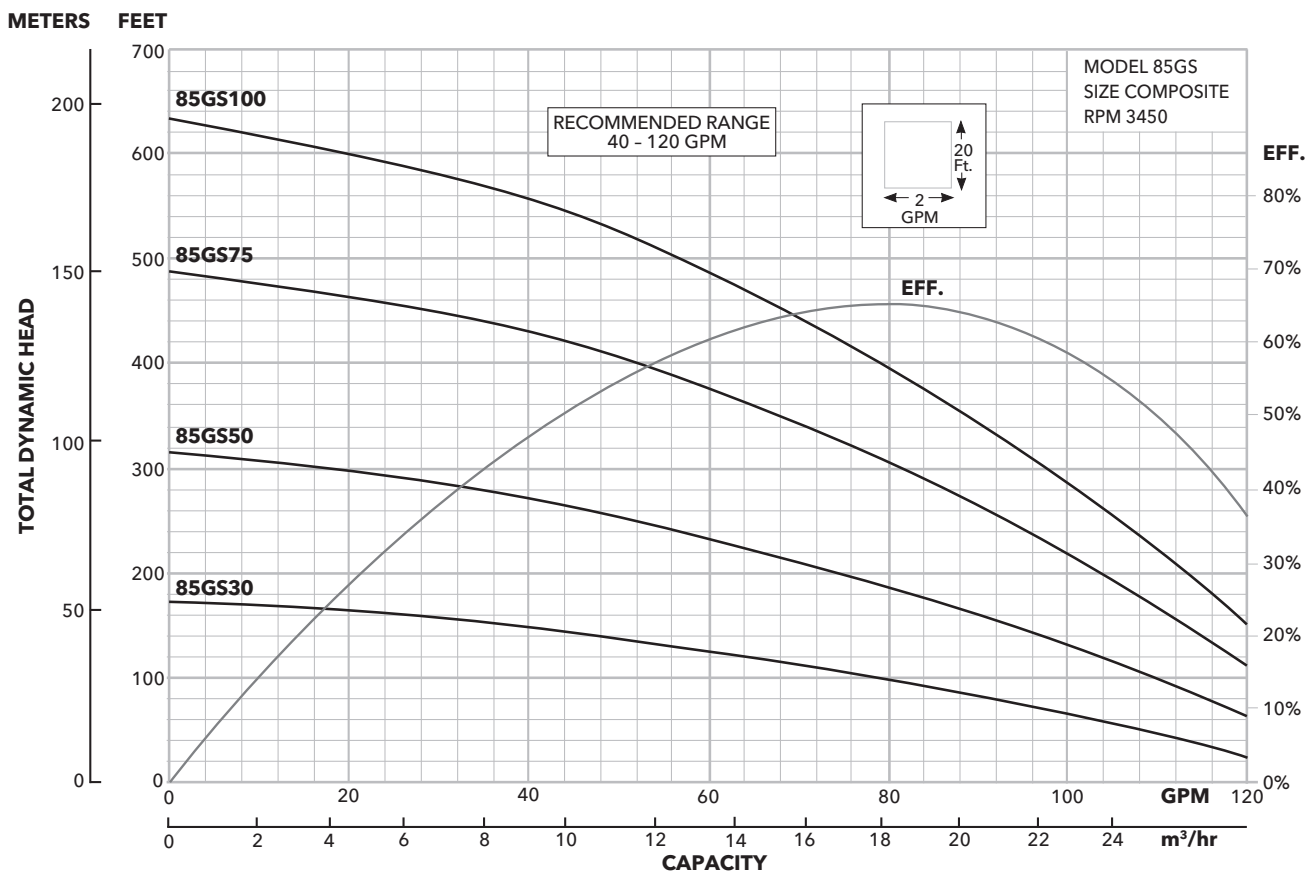
Model 45GS



Model 65GS



Model 85GS



MODEL 35GS

SELECTION CHART

Horsepower Range 1 - 3, Recommended Range 10 - 50 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																												
			20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	520	560	600		
35GS10	1	0		49	46	42	38	33	26	15																					
		20	44	40	36	31	23	11																							
		30	40	36	30	22																									
		40	35	29	20																										
		50	28	18																											
		60	16																												
Shut-off PSI			69	60	52	43	34	26	17	8																					
35GS15	1½	0			48	46	43	40	37	33	29	23	14																		
		20	47	45	43	39	36	32	28	21	10																				
		30	45	42	39	35	32	27	19																						
		40	42	38	35	31	26	18																							
		50	38	34	30	25	16																								
		60	34	29	24	15																									
Shut-off PSI			97	88	79	71	62	53	45	36	27	19	10																		
35GS20	2	0			50	48	46	44	42	39	37	34	30	26	20	12															
		20	49	47	45	43	41	38	36	33	29	24	17																		
		30	47	45	43	40	38	35	32	28	23	16																			
		40	44	42	40	38	35	32	27	22	15																				
		50	42	40	37	34	31	27	21	14																					
		60	39	37	34	30	26	20	12																						
Shut-off PSI			123	114	105	97	88	79	71	62	53	45	36	27	19	10															
35GS30	3	0				50	48	47	45	44	42	41	39	38	36	34	31	28	25	21	16	10									
		20		49	48	46	45	43	42	40	39	37	35	33	30	27	24	19	14												
		30	49	47	46	45	43	42	40	39	37	35	33	30	27	23	18	13													
		40	47	46	44	43	41	40	38	37	35	32	30	26	22	18	12														
		50	46	44	43	41	40	38	36	34	32	29	26	22	17	11															
		60	44	42	41	39	38	36	34	31	29	25	21	16	10																
Shut-off PSI			176	168	159	150	142	133	124	116	107	98	90	81	72	64	55	46	38	29	20	12									

Horsepower Range 5-10, Recommended Range 10 - 50 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																												
			50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350		
35GS50	5	0			50	48	46	43	41	38	35	31	26	19	11																
		20		50	48	46	44	41	38	35	31	26	20	12																	
		30		49	47	45	42	40	37	33	29	24	16																		
		40	50	48	46	44	41	38	35	31	27	20	12																		
		50	49	47	45	43	40	37	34	29	24	17																			
			48	46	44	41	39	35	32	27	21	13																			
Shut-off PSI			280	259	237	215	194	172	150	129	107	85	64	42																	
35GS75	7½	0				50	48	47	46	44	43	41	39	37	35	33	30	27	24	19	14										
		20			50	49	47	46	44	43	41	39	37	35	33	31	28	24	20	14											
		30			50	49	48	47	45	44	42	40	38	37	34	32	29	26	22	17	12										
		40			50	49	47	46	44	43	41	39	38	36	33	31	28	24	20	15											
		50		50	49	48	47	45	44	42	40	39	37	35	32	30	26	22	18	12											
				50	49	47	46	45	43	41	40	38	36	34	31	28	25	20	15												
Shut-off PSI			453	431	410	388	366	345	323	301	280	258	236	215	193	171	150	128	106	85	63	42									
35GS100	10	0						49	48	47	46	45	44	42	41	40	38	37	35	33	31	29	26	24	20	16	11				
		20						49	48	47	46	45	44	42	41	40	38	37	35	33	31	29	27	24	20	16	12				
		30						49	48	47	45	44	43	42	40	39	38	36	34	32	30	28	25	22	19	14					
		40					49	48	47	46	45	44	43	41	40	38	37	35	34	32	29	27	24	21	17	12					
		50					49	48	47	46	44	43	42	41	39	38	36	34	33	31	28	26	23	19	15	10					
						49	48	47	46	45	44	43	41	40	39	37	35	34	32	30	27	24	21	17	13						
Shut-off PSI			583	561	540	518	496	475	453	431	410	388	366	345	323	302	280	258	237	215	193	172	150	128	107	85	63	42			

MODEL 45GS

SELECTION CHART

Horsepower Range 1½ - 5, Recommended Range 20 - 65 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																												
			20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	440	480	520	560	600	640			
45GS15	1½	0	64	61	57	52	46	37	23																						
		20	55	50	44	34																									
		30	49	43	32																										
		40	41	30																											
		50	27																												
		60																													
Shut-off PSI			61	52	44	35	26	18	9																						
45GS20	2	0		62	60	57	53	49	45	40	32																				
		20	59	56	52	48	43	38	28																						
		30	55	51	47	43	36	26																							
		40	51	47	42	35	25																								
		50	46	41	34	22																									
		60	40	46	37	38	28	29																							
Shut-off PSI			88	80	71	63	54	45	37	28	19																				
45GS30	3	0		65	62	60	59	56	53	50	47	45	41	37	30	21															
		20	62	60	58	55	52	49	47	44	40	35	28																		
		30	60	58	55	52	49	46	43	39	34	26																			
		40	57	54	51	49	46	42	38	33	25																				
		50	54	51	48	45	42	38	32	23																					
		60	51	48	45	41	37	31	22																						
Shut-off PSI			130	121	113	104	95	87	78	69	61	52	43	35	26	17															
45GS50	5	0				65	63	62	61	60	59	58	56	55	53	51	50	48	46	44	42	39	32	22							
		20		64	63	61	60	59	58	57	56	54	53	51	49	47	46	43	41	38	35	31	20								
		30	64	62	61	60	59	58	57	55	54	52	51	49	47	45	43	41	38	34	30	25									
		40	62	61	60	59	58	57	55	54	52	50	49	47	45	43	40	37	33	29	24										
		50	61	60	59	58	56	55	53	52	50	48	47	45	42	40	37	33	28	23											
		60	60	59	58	56	55	53	52	50	48	46	44	42	39	36	32	28	22												
Shut-off PSI			228	220	211	202	194	185	176	168	159	150	142	133	124	116	107	98	90	81	72	64	46	29							

Horsepower Range 7½ - 10, Recommended Range 20-65 GPM, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																												
			40	80	120	160	200	240	280	320	360	400	440	480	520	560	600	640	680	720	760	800	840	880	920	960	1000	1040			
45GS75	7½	0					63	62	60	58	56	53	51	48	46	43	39	34	28	21											
		20				63	61	60	57	55	53	50	48	45	42	38	33	27	19												
		30			64	62	60	58	56	54	51	49	46	43	40	35	30	23													
		40		65	63	61	59	57	55	52	50	47	45	41	37	32	26														
		50		64	62	60	58	56	54	51	49	46	43	39	35	29	21														
		60	65	63	61	59	57	55	52	50	47	44	41	37	31	25															
Shut-off PSI			332	315	298	280	263	246	228	211	194	177	159	142	125	107	90	73	55	38											
45GS100	10	0				65	64	63	61	60	58	57	55	54	53	51	50	48	46	44	42	39	36	32	28	23					
		20			65	64	63	61	60	58	57	55	54	52	51	49	48	46	44	42	39	36	32	27	22						
		30		65	64	63	62	60	59	57	56	54	53	52	50	49	47	45	43	40	37	33	29	24							
		40		65	64	62	61	60	58	56	55	54	52	51	49	48	46	44	41	38	35	31	26	21							
		50	65	64	63	62	60	59	57	56	54	53	51	50	48	47	45	42	40	36	33	28	23								
		60	65	64	62	61	59	58	56	55	53	52	50	49	47	45	43	41	38	34	30	26	20								
Shut-off PSI			456	439	422	404	387	370	353	335	318	301	283	266	249	231	214	197	179	162	145	127	110	93	75	58					

MODEL 65GS

SELECTION CHART

Horsepower Range 1½ - 5, Recommended Range 30 - 80 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																					
			20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	440	480
65GS15	1½	0		78	70	61	51	36																
		20	68	58	47	30																		
		30	57	45																				
		40	42																					
		50																						
		60																						
Shut-off PSI			55	46	38	29	20	12																
65GS20	2	0		81	74	67	59	48	35															
		20	72	64	56	45	30																	
		30	63	54	43																			
		40	53	41																				
		50	39																					
		60																						
Shut-off PSI			65	56	48	39	30	22	13															
65GS30	3	0			81	76	71	66	59	53	45	35												
		20	80	75	69	64	57	51	42	32														
		30	74	69	63	56	49	41	30															
		40	68	62	55	48	39																	
		50	61	54	47	38																		
		60	53	46	36																			
Shut-off PSI			96	87	79	70	61	53	44	35	27	18												
65GS50	5	0						80	77	73	70	67	63	59	55	50	45	39	32					
		20					79	76	72	69	66	62	58	54	49	44	37	30						
		30				78	75	72	69	65	61	57	53	48	43	36								
		40		78	75	71	68	64	61	57	52	47	42	35										
		50	77	74	71	67	64	60	56	52	47	41	34											
		60	74	70	67	63	59	55	51	46	40	33												
Shut-off PSI			164	155	147	138	129	121	112	103	95	86	77	69	60	51	43	34	26					

Horsepower Range 7½ - 10, Recommended Range 30 - 80 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																					
			40	80	120	160	200	240	280	320	360	400	440	480	520	560	600	640	680	720	760	800	840	880
65GS75	7½	0						78	74	70	66	61	56	50	44	35								
		20					80	77	73	69	65	60	55	50	42	33								
		30					79	75	71	67	62	57	52	46	38									
		40				80	77	73	69	64	60	54	49	41	32									
		50				78	75	70	66	62	57	51	45	36										
		60		79	76	72	68	64	59	54	48	40	30											
Shut-off PSI			268	251	233	216	199	181	164	147	129	112	95	77	60	43								
65GS100	10	0						80	78	75	72	69	66	62	58	54	50	45	39	31				
		20						80	78	75	72	69	65	62	58	54	49	44	37	30				
		30						79	76	73	70	67	63	59	55	51	46	40	33					
		40					80	77	74	71	68	65	61	57	53	48	43	36						
		50					78	76	73	69	66	63	59	55	50	45	39	32						
		60					79	77	74	71	68	64	60	57	52	48	42	35						
Shut-off PSI			339	322	305	288	270	253	236	218	201	184	166	149	132	114	97	80	62	45				

MODEL 85GS

SELECTION CHART

Horsepower Range 3 - 10, Recommended Range 40 - 120 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																									
			20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	440	480	520			
85GS30	3	0		112	103	92	79	64	48																			
		20	100	88	74	59	42																					
		30	86	72	57	39																						
		40	70	54																								
		50	52																									
		60																										
Shut-off PSI			66	58	49	40	32																					
85GS50	5	0				114	109	103	97	90	83	74	66	57	47													
		20	119	113	107	101	95	88	80	72	63	54	43															
		30	112	106	101	94	87	79	70	62	52	41																
		40	105	100	93	85	77	69	60	51	40																	
		50	99	92	84	76	68	59	49																			
		60	91	83	75	66	58	48																				
Shut-off PSI			128	119	111	102	93	85	76	67	59	50	41	33	24													
85GS75	7½	0					119	115	111	108	104	100	95	91	86	81	76	71	65	59	52							
		20				118	114	110	106	102	98	94	89	84	80	74	69	63	57	50	41							
		30				117	113	110	106	102	98	93	88	84	79	74	68	62	56	48	40							
		40	120	116	113	109	105	101	97	92	88	83	78	73	67	61	55	47										
		50	116	112	109	105	101	96	92	87	82	77	72	66	60	54	46											
		60	112	108	104	100	95	91	86	81	76	71	66	59	53	45												
Shut-off PSI			203	194	185	177	168	159	151	142	133	125	116	107	99	90	81	73	64	55	47	38						
85GS100	10	0							119	116	114	111	108	104	101	97	94	90	87	83	79	71	62	52				
		20						118	116	113	110	107	103	100	96	93	89	85	82	78	74	70	61	50				
		30				120	118	115	112	109	106	103	99	96	92	89	85	81	77	73	69	65	55	42				
		40			120	117	115	112	109	106	102	99	95	92	88	84	81	77	73	68	64	59	48					
		50		120	117	114	111	108	105	102	98	95	91	87	84	80	76	72	68	63	58	53	40					
		60	119	117	114	111	108	105	101	98	94	91	87	83	79	75	71	67	63	58	52	46						
Shut-off PSI			265	257	248	239	231	222	213	205	196	188	179	170	162	153	144	136	127	118	110	101	84	66	49			

PART NUMBER CROSS REFERENCE

Old GS Hi Cap Part Number	NEW eGS Hi Cap Part Number
33GS10	35GS10
33GS15	35GS15
33GS20	35GS20
33GS30	35GS30
33GS50	35GS50
33GS75	35GS75
33GS100	35GS100
40GS15	45GS15
40GS20	45GS20
40GS30	45GS30
40GS50	45GS50
40GS75	45GS75
-	45GS100
55GS15	65GS15
55GS20	65GS20
55GS30	65GS30
55GS50	65GS50
55GS75	65GS75
55GS100	65GS100
60GS15	65GS15
60GS20	65GS20
60GS30	65GS30
60GS50	65GS50
60GS75	65GS75
75GS30	85GS30
75GS50	85GS50
75GS75	85GS75
75GS100	85GS100
80GS30	85GS30
80GS50	85GS50
80GS75	85GS75

* Determined using best efficiency point, see curves for more detail

NOTES

Xylem |'zīləm|

- 1) The tissue in plants that brings water upward from the roots;
- 2) a leading global water technology company.

We're a global team unified in a common purpose: creating innovative solutions to meet our world's water needs. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. We move, treat, analyze, and return water to the environment, and we help people use water efficiently, in their homes, buildings, factories and farms. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise, backed by a legacy of innovation.

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Material Safety Data Sheet

Provided by:
 DPC Industries, Inc. DX Systems Company
 DPC Enterprises, LP DX Terminals
 DXI Industries, Inc.

PO Box 24600
 Houston, Tx 77229-4600
 281-457-4888
 888-647-7717
 www.dxgroup.com

SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name DIXICHLOR
Synonyms BLEACH
Chemical Name SODIUM HYPOCHLORITE 10% **Date of Issue:** 1/8/2001
Emergency phone: 281-457-4888 **Reviewed / Revision Date:** 08/28/2006
Chemtrec: 800-424-9300

SECTION 2 - COMPOSITION/INFORMATION ON INGREDIENTS

COMPONENTS	PERCENT	CAS NO.
SODIUM HYPOCHLORITE	10	7681-52-9
SODIUM CHLORIDE	7 - 8	7647-14-5
SODIUM HYDROXIDE	0.5 - 2	1310-73-2
WATER	REMAINDER	7732-18-5

SECTION 3 - HAZARDS IDENTIFICATION

Potential Health Effects

ACGIH - TLV: NOT ESTABLISHED; 1 ppm AS CHLORINE
Eye Contact MAY CAUSE SEVERE PAIN, BLURRED VISION, TEARING AND SWELLING. CONCENTRATED SOLUTIONS MAY CAUSE BURNING.
Skin Contact MAY CAUSE MODERATE SKIN IRRITATION. CONTACT WITH CONCENTRATED SOLUTIONS MAY BLEACH THE SKIN AND CAUSE REDNESS, PAIN, BLISTERING, ITCHY ECZEMA AND POSSIBLE CHEMICAL BURNS.
Ingestion MAY CAUSE PAIN AND INFLAMMATION OF THE MOUTH, THROAT, ESOPHAGUS, AND STOMACH. CAN CAUSE EROSION OF MUCOUS MEMBRANES, ESPECIALLY IN THE STOMACH.
Inhalation VAPORS MAY CAUSE SLIGHT TO SEVERE IRRITATION OF THE RESPIRATORY TRACT. HIGH CONCENTRATIONS MAY CAUSE SORE THROAT, BLISTERING, DELAYED PULMONARY EDEMA (SWELLING OF LUNG TISSUE) AND SHORTNESS OF BREATH.
Carcinogenicity: *NTP* NO *IARC* NO *OSHA* NO

SECTION 4 - FIRST AID PROCEDURES

Eye Contact: IMMEDIATELY FLUSH EYES WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES WHILE HOLDING EYELIDS OPEN. GET MEDICAL ATTENTION.
Skin Contact: IMMEDIATELY REMOVE CONTAMINATED CLOTHING OR SHOES, WIPE EXCESS FROM SKIN AND FLUSH WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. USE SOAP IF AVAILABLE OR FOLLOW BY WASHING WITH SOAP AND WATER. DO NOT REUSE CLOTHING UNTIL THOROUGHLY CLEANED. GET MEDICAL ATTENTION.
Inhalation: REMOVE VICTIM TO FRESH AIR AND PROVIDE OXYGEN IF BREATHING IS DIFFICULT. GIVE ARTIFICIAL RESPIRATION IF NOT BREATHING. GET MEDICAL ATTENTION.
Ingestion: DO NOT INDUCE VOMITING. RINSE MOUTH WITH WATER. IF CONSCIOUS, GIVE LARGE QUANTITIES OF WATER OR MILK AND GET IMMEDIATE MEDICAL ATTENTION. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON!

SECTION 5 - FIRE FIGHTING MEASURES

Flash Point (°F)	NONFLAMMABLE.
Extinguishing Media	USE MEDIA APPROPRIATE FOR SURROUNDING AREA.
Special Firefighting Procedures/Precuations	WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE GEAR. STAY UPWIND AND KEEP OUT OF LOW AREAS.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

For Spill:	CLEAN-UP PERSONNEL SHOULD USE PROTECTIVE EQUIPMENT TO PREVENT CONTACT. CONTAIN MATERIAL. PLACE COLLECTED MATERIAL IN A DISPOSAL CONTAINER. PREVENT LIQUID FROM ENTERING SEWERS OR WATERWAYS. DO NOT USE COMBUSTIBLE ABSORBENTS.
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SECTION 7 - HANDLING AND STORAGE

Keep container tightly closed when not in use. Store in a cool, dry, well-ventilated area, away from heat and incompatible materials. Protect containers from physical damage.

AVOID CONTACT WITH EYES AND SKIN AND INHALATION OF VAPORS, MISTS, AND FUMES.

SECTION 8 - EXPOSURE CONTROLS/PERSONAL PROTECTION

Respiratory Protection	NOT NECESSARY UNDER NORMAL USE AND CONDITIONS. FOR AREAS WITH HIGH VAPOR CONCENTRATIONS, USE NIOSH APPROVED RESPIRATOR PROTECTION. FOR CANISTER TYPE RESPIRATORS, USE CHLORINE FILTERS. IN CASE OF FIRE, WEAR SELF-CONTAINED BREATHING APPARATUS.
Ventilation	LOCAL AND MECHANICAL RECOMMENDED.
Protective Gloves	CHEMICAL IMPERVIOUS GLOVES.
Eye/Face Protection	CHEMICAL SAFETY GOGGLES AND/OR FULL-FACE SHIELD.
Other Protection	CHEMICAL RESISTANT CLOTHING SUCH AS COVERALLS/APRON, BOOTS, ETC.
Work Practices	USE GOOD PERSONAL HYGIENE PRACTICES. WASH HANDS BEFORE EATING, DRINKING, SMOKING, OR USING TOILET FACILITIES. PROMPTLY REMOVE SOILED CLOTHING AND WASH THOROUGHLY BEFORE REUSE. SHOWER AFTER WORK USING PLENTY OF SOAP AND WATER.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Boiling Point (°F):	DECOMPOSES	Vapor Pressure (mmHg):	17.5 (@ 20 C)
Freezing Point (°F):	7 - 10	Vapor Density (Air=1):	NOT ESTABLISHED.
Solubility (H2O):	COMPLETE	Specific Gravity (H2O=1):	1.20 - 1.40
pH	12 - 13	Evaporation Rate:	NOT ESTABLISHED.
Appearance/Odor:	CLEAR, PALE YELLOW OR GREENISH LIQUID WITH A CHLORINE ODOR.		

SECTION 10 - STABILITY AND REACTIVITY

Chemical Stability:	YES
Incompatible Material:	ANY ACIDIC MATERIAL, AMMONIA, UREA, OXIDIZABLE MATERIALS AND METALS, SUCH AS NICKEL, COPPER, TIN, ALUMINUM AND IRON.
Hazardous Polymerization:	WILL NOT OCCUR.
Decomposition Products:	CHLORINE GAS RATE OF DECOMPOSITION INCREASES WITH THE CONCENTRATION WITH TEMPERATURES ABOVE 85 DEGREES F.

SECTION 11 - TOXICITY INFORMATION

Oral = > 8000 mg/kg (Rat) Dermal LD50 = N.E. Inhalation LC50 = > 10.5 mg/l (Rat)

SECTION 12 - ECOLOGICAL INFORMATION

DAPHNIA MAGNA 24 HR. LC50 = > 500 MG/L ZEBRA FISH STATIC 24 HR. LC50 = > 500 MG/L

SECTION 13 - DISPOSAL CONSIDERATIONS

DO NOT DISCHARGE INTO WATERWAYS OR SEWER SYSTEMS WITHOUT PRIOR APPROVAL. EMPTY DRUMS, AS DEFINED BY RCRA, MAY BE SENT TO LICENSED DRUM RECONDITIONED FOR REUSE.
DISPOSE OF WASTE MATERIALS ACCORDING TO ALL FEDERAL, STATE AND LOCAL REGULATIONS.

SECTION 14 - TRANSPORT INFORMATION

USA DOT Shipping Name: HYPOCHLORITE SOLUTION

Hazard Class: 8

UN/NA Number: UN1791

Packing Group: III

Subsidiary Hazard:

Marine Pollutant: NO

SECTION 15 - REGULATORY INFORMATION

CERCLA RQ (lbs): 100

SARA Title III Section 312:

Acute **Chronic** **Flammable** **Sudden Release of Pressure** **Reactive**

SARA Title III Section 313: No

SARA Extremely Hazardous Substance: No

HMIS HAZARD RATING

Health: 2 **Fire:** 0 **Reactivity:** 1

0 - Least 1 - Slight 2 - Moderate 3 - High 4 - Extreme

SECTION 16 - OTHER INFORMATION

EPA Pesticide Registration Number: 813-16

NSF Maximum Use Level for Potable Water (Standard 60): CHECK PRODUCT LABEL, RANGES 46 mg/l TO 105 mg/l

TSCA (Toxic Substance Control Act), 40 CFR 710:

Sources of the raw materials used in this mixture assure that all chemical ingredients present are in compliance with Section 8(b) Chemical Substance Inventory, or are otherwise in compliance with TSCA.

DISCLAIMER

THE DATA PRESENTED IS TRUE AND CORRECT TO THE BEST OF OUR KNOWLEDGE AND BELIEF; HOWEVER, NEITHER SELLER NOR PREPARER MAKES ANY WARRANTIES, EXPRESSED OR IMPLIED, CONCERNING THE INFORMATION PRESENTED. THE USER IS CAUTIONED TO PERFORM HIS OWN HAZARD EVALUATION AND TO RELY UPON HIS OWN DETERMINATIONS.



FEATURES

- Dry top multi-jet design
- Tolerates low quality water
- Simple pulse output
- Cold or hot water models

APPLICATIONS

- Cooling tower chemical control
- Industrial water treatment
- Deduct metering



Hot Water Model

GENERAL INFORMATION

MJ-Series meters use the multi-jet principle, which has been an internationally-accepted standard for many years. This type of meter is known for its wide range, simplicity, and accuracy in low-quality water. Seametrics offers cold or hot water models. The impeller is centered in a ring of jets, with inlet jets on one level and outlet jets on another. A gear train drives the register totalizer dials. For pulse output, one of the pointers is replaced by a magnet, which is detected by an encapsulated sensor attached to the outside of the lens. Pulse rate is determined by the dial on which the magnet is placed, and by the number of sensors (single or double).

Changing the pulse rate requires no special tools and can be done in the field.

Mechanically, all MJ-Series meters are the same. The difference among *MJE/MJHE, *MJR/MJHR and *MJT/MJHT meters is in the sensor. MJE/MJHE meters use a solid-state, long-lasting Hall-effect sensor, which requires power. It is suited for use with Seametrics controls and metering pumps (LMI for instance) that have sensor power. MJR/MJHR meters use a two-wire reed switch. They provide a dry contact closure and do not require power. MJT/MJHT meters totalize only and do not have a sensor.

***Note on Nomenclature:** Meter names that include "H" are hot water models. Without the "H" = cold water models.

FEATURES

Available in cold or hot water models

Either MJE/MJHE or MJR/MJHR sensor fastens to lens without removing top

Calibration plug seal wire for tamper evidence

Cast bronze body

Union end couplings for easy service

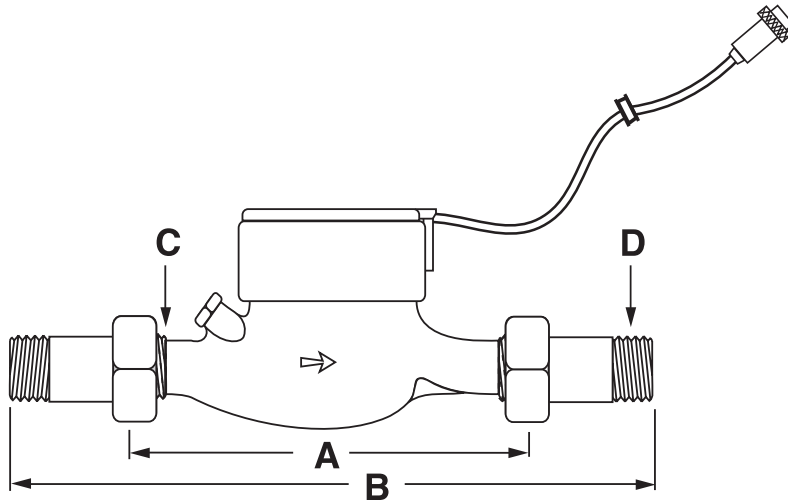


SPECIFICATIONS*

Power	6 mA at 12 Vdc (MJE/MJHE only)				
Temperature	Cold Water Model	105° F (40° C) max			
	Hot Water Model	194° F (90° C) max			
Pressure	150 psi operating				
Materials	Body	Cast bronze, epoxy powder coated inside and out			
	Internals	Engineered thermoplastic			
	Magnet	Alnico			
Accuracy	+/- 1.5% of reading				
Pulse Output		MJE/MJHE	MJR/MJHR	MJT/MJHT	
	Sensor	Hall-effect device	Reed switch	Totalizer only	
	Max Current	20 mA	20mA	n/a	
	Max Voltage	24 Vdc	24 Vdc or Vac	n/a	
Cable Length	12' (4 m) standard (2000' maximum run)				
Flow Rates (GPM)		3/4"	1"	1-1/2"	2"
	Minimum	0.22	0.44	0.88	1.98
	Maximum	22	52	88	132

*Specifications subject to change • Please consult our website for current data (www.seametrics.com).

DIMENSIONS



	3/4"	1"	1-1/2"	2"
A (body)	7-1/2"	10-1/4"	11-3/4"	11-3/4"
B (w/couplings)	12-5/8"	15-5/8"	17-5/8"	17-5/8"
C (IPS thread)	1"	1-1/4"	2"	2-1/2"
D (NPT thread)	3/4"	1"	1-1/2"	2"

PULSE RATES

	3/4"	1"	1-1/2"	2"
Pulses per Gallon	20*			
	10			
	4†	4†	4†	4†
	2*	2*	2*	2*
	1	1	1	1
Gallons per Pulse	1	1	1	1
	5*	5*	5*	5*
	10	10	10	10
	50*	50*	50*	50*
	100	100	100	100
Cubic Feet per Pulse	1	1	1	1
	5*	5*	5*	5*
	10	10	10	10

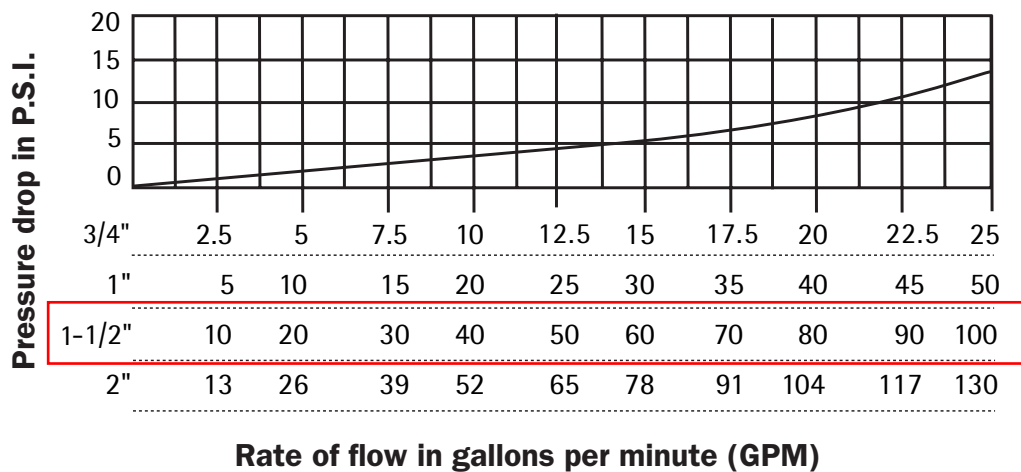
*These pulse rates available in MJR and MJHR dual reed switch meters only.

†This pulse rate available in MJR and MJHR single reed switch meters only.

FLOW RATES (GPM)

	3/4"	1"	1-1/2"	2"
Minimum	0.22	0.44	0.88	1.98
Maximum	22	52	88	132

PRESSURE DROP CURVE



HOW TO ORDER

MODEL	SIZE	PULSE RATE	OPTIONS
Cold water, Reed switch = MJR Cold water, Hall-effect sensor = MJE Cold water, Totalizer only = MJT Hot water, Reed switch = MJHR Hot water, Hall-effect sensor = MJHE Hot water, Totalizer only = MJHT	3/4" = -075 1" = -100 1-1/2" = -150 2" = -200	†*20 Pulse/Gal = 20P †10 Pulse/Gal = 10P *4 Pulse/Gal = 4P *2 Pulse/Gal = 2P 1 Gal/Pulse = 1G *5 Gal/Pulse = 5G 10 Gal/Pulse = 10G *50 Gal/Pulse = 50G 100 Gal/Pulse = 100G 1 CF/Pulse = 1CF *5 CF/P = 5CF 10 CF/P = 10CF	LMI pump connector = -06 Seametrics control connector = -07
		†3/4" Only *MJR and MJHR Meters Only	
ACCESSORIES Pulse divider = PD10 Pulse splitter = PS40 Pulse timer = PT35			

CONTACT YOUR SUPPLIER