




WACO Products, Inc.

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WACO Products, Inc. continues a tradition of more than 50 years of designing and fabricating engineered products and systems for industry and government. Born from expertise in design and construction with structural aluminum, the tradition continues with added capability for all types of high quality custom metal fabrication. WACO Products, Inc. serves a broad range of clients across the globe with its expertise in design and construction of aluminum and stainless steel structures and fabricated equipment. Our equipment lines meet the needs of customers requiring products exhibiting high strength, light weight, and corrosion resistance with economical construction design and top quality. See our website at www.wacoproducts.com for photos, updated drawings and specifications of many of our products.

WACO Environmental

WACO Environmental Products are typically installed in municipal or industrial water and wastewater systems. WACO Products can supply all of the gates for your plants or pump stations including fabricated alternatives for cast iron constructions. Many owners and engineers are realizing the superior performance, maintenance, and cost advantages of WACO Products fabricated gates throughout a water system.

Slide Gates



Weir Gates

Slide gates are typically used isolate plant process sections for treatment control and to isolate specific plant and pump station areas and equipment for maintenance. Weir gates enable operators to balance water flow and levels throughout a treatment facility. Slide and weir gates can be manually, electrically, or hydraulically (water or synthetic fluid) operated as required by the gate dimensions or frequency of operation. Gates are designed to meet

● Page 2

or exceed all applicable AWWA specifications such as the new C561-04 for fabricated stainless slide gates. With over 50 years of experience and design firsts, feel free to call WACO Products for design and selection assistance on your next project.

WACO Slide Gates in a dam application



Hand pull stop gates or stop logs are economical ways to stop or divert flows where control requirements are less frequent. Waco flap gates and canal gates add to our full line of flow control products. Other WACO fabrications such as debris baskets, bar screens, baffle walls, vertical ladders, and bar or plank grating assemblies are utilized in CSO/SSO structures and pump stations as well as treatment plants.

Debris Baskets



Barscreens



Aluminum is a natural material for use around water. All WACO Environmental products are available in aluminum. It is resistant to corrosion, lightweight and strong, and uniquely versatile in extruded shapes. Requiring little maintenance, WACO aluminum environmental products can be used throughout your treatment system safely and economically.

Stainless steel alloys should be chosen when the higher cost is justified by the severity of the water or atmospheric conditions. Stainless steel construction is available for all WACO equipment, and is usually recommended where corrosion potential is particularly high. Highly abrasive conditions or requirements for high purity applications may also indicate stainless steel as the material of choice.

The WACO Environmental Products Advantage

Experience – Over 50 years of value engineering products designed specifically for water and wastewater treatment and flow control. Treatment facilities small and large, pump and lift stations, CSO/SSO structures and screens, irrigation, pipelines, dams and fishways; if it involves water level regulation, flow control or diversion, WACO is there.

Expertise – Our sales and engineering personnel have probably solved problems similar to yours under similar conditions. Because we have wide ranging experience with mechanical and structural fabrications, we can combine these areas effectively to create new solutions to meet your specifications. Our network of knowledgeable Sales Representative Firms add to our experience, and advise and support our customers before, during and after the sale.



WACO Products fabrication employees are AWS certified yearly by an independent testing facility. Our continuing education programs and 100% employee quality control empowerment means that our techniques stay sharp, and our products maintain their reputation for reliability and performance. State of the art welding, cutting and forming equipment, maintained using our in-house machine shop, help WACO fabricators cost-effectively support our quality benchmarks.

Responsiveness – Speed means different things to different people. Contractors want accurate scopes of supply provided quickly and competitively on bid day. Engineers need answers to application questions and confirmation on custom design practicality before they proceed with their plans and specifications. Owners need fast turnaround on parts or rapid development projects. WACO Products' size means we can turn out large jobs at a good value, but still maintain first name relationships with our customers like a smaller fab shop.

We specialize in servicing design-build projects which require in-depth engineering assistance combined with quick completion of submittals and fabrication to keep demanding customers on time and on budget. Standard bid projects find WACO Products giving contractors the edge with creative solutions to meet complex scopes of supply coupled with storage, billing, delivery and site service challenges.

The WACO Value Equation

Everyone wants good products at the best price. WACO Products goes three steps further to add value by:

- 1) Providing every project with the **Experience** required to select and design the best equipment for the job at hand
- 2) Using our **Expertise** to fabricate equipment to our customers' high quality standards and custom requirements
- 3) Adding to our customers' bottom lines with **Responsiveness** that yields savings in time and money during design, at time of purchase, during installation and over the life of our products.



About WACO Products

WACO Products, Inc. located in Baltimore, Maryland, will fulfill your equipment needs with our Environmental, Marine, and Industrial product lines. WACO Products will also custom build to your drawings and specifications in our 65,000 square foot manufacturing facility.

Our Environmental Products help owners and engineers outfit pump stations, water treatment and wastewater treatment plants with long lasting and dependable slide gates, weir gates, ladders, debris baskets, and related equipment developed over the past 50 years. We offer standard designs or fabrication to custom specifications in aluminum or your specified grade of stainless steel.

WACO Marine Products meet the needs of Navy and commercial ships, shipyards and suppliers. From accommodation and vertical ladders, brows, gangways and storage battens, to deck or overhead gratings and oil-tight hatch covers, check out what WACO Products can offer.



WACO Industrial Products offers custom products for industrial and commercial applications such as ladders and support structures, as well as standard enclosures for gas line equipment and reducing valves. Other WACO products find their application in defense and military service. Our Waterjet cutting capabilities give us a unique ability to cut the most complex parts from almost any material. We also manufacture critical components for original equipment manufacturers (OEM's) to incorporate in their finished products.

WACO Products helps customers around the world with its specialization in high quality aluminum and stainless steel equipment and structures. Whether it is a complete product made to your specifications, or a component to be integrated with other equipment, WACO Products can help take your ideas from drawings to reality.



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Environmental Products

Fabricated per plans and specifications

Slide, Weir & Sluice Gates

AWWA C561, C513 standard designs and performance

High head and low leakage designs available

Mounting to order: End-of-Wall, Channel Wall, Embedded,

Wall Thimble, End of Pipe, combinations and specials

6061 Aluminum, 304 or 316 Stainless Steel with special stainless
grades available, FRP, and combinations

Manual, electric and hydraulic operators; limit switches, cycle control systems

Self-contained and Non-self-contained frames

Self-adjusting UHMW seal and Neoprene P-Seal styles

Weir cut-outs, bar and screen insert plates

Hand Pull Stop Gates

Mounting to order: End-of-Wall, Channel Wall, Embedded,
combinations and specials

6061 Aluminum, 304 or 316 Stainless Steel with special stainless
grades available, FRP and combinations

Handles, hand slots, hoist lift eyes or custom lift points

Weir cut outs, bar and screen insert plates

Low leakage designs available

Other Flow Control Products – available in all materials

♦ **Stop Logs and Frames**

♦ **Flap Gates**

♦ **Bulkheads: temporary, permanent, or removable with permanent frame**

♦ **Telescopic Valves**

♦ **Baffles and Stilling Boxes**

Miscellaneous Metals - available in all materials

♦ **Vertical ladders (incl. WSSC standard); fall prevention systems & cages**

♦ **Static Bar Screens**

♦ **Static Wire Screens**

♦ **Debris Baskets; coarse & fine**

♦ **Gratings & Railings**

♦ **Platforms, stairs and structural support systems; grating and solid surface**

♦ **Access hatches: Non-standard sizes, H2O and extra-heavy loadings**



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WACO Series 1000 Stop Logs and Frames-Sample Specification

General

The fabricated 6061-T6 aluminum stop logs and frames shall be manufactured by WACO Products, Inc., Baltimore, Maryland or equal. Stop logs and frames shall be furnished with all necessary accessories and hardware for a complete installation and shall be the latest standard product of a manufacturer regularly engaged in the production of equipment of this type. All stop logs and frames shall be furnished by the same manufacturer.

Design

Except as otherwise indicated by this specification, all stop logs and frames will be designed and manufactured to meet or exceed all design criteria of AWWA Standard C513, most current edition, defining head and loading calculations, structural strength, deflection requirements, and material specifications including minimum dimensions.

Structural components shall have a minimum design safety factor of 4 with regard to ultimate tensile, compressive, and shear strength and a minimum safety factor of 2 with regard to tensile, compressive, and shear yield strength.

Stop Logs

The stop logs are to be fabricated from minimum 1/4" thickness 6061-T6 aluminum plate and shapes, reinforced as required to meet the engineer's specified design head. Deflection under full design head will be no more than 1/360 of the span width of the gate. Stop logs will be fabricated so that logs will be interchangeable for all channels of

equal width. Log heights will be such that a multiple number of logs shall stack as required to meet the elevation specified. Unequal stop log heights will not be permitted.

Stop logs shall have bottom and face seals as required to meet the leakage requirements specified. Logs shall have face seals mounted for seating head service alone or for both seating and unseating head service as specified. Seals mounted on the frame shall not be permitted. Each stop log shall have integral attachment points for secure engagement with a stop log lifter to be provided by the log manufacturer.

Stop Log Guide Frames

The guide frame is to be fabricated from minimum 1/4" thickness 6061-T6 aluminum extrusions and structural members to resist loads imposed by the design head upon the stop logs and frame. The frame is to be fabricated to accommodate the full height of all logs stacked as required to fully close the channel up to the water elevation as shown in the plans. Additionally, the frame will extend above the top log elevation to the installation floor elevation as required to allow for proper installation and alignment of logs.

Frames will be for embedded installation flush with channel side walls and invert or for surface mounting using anchor bolts. Surface mounted frames will be sealed to the wall with frame mounted gaskets or grouted in place after securing with anchor bolts. Gasket-type frames require that Contractor/Installer field verify channel dimensions and wall surface

conditions for suitability with gasket use prior to start of submittal drawings.

Invert Frames

Invert frames shall be supplied to form a seating surface for the stop logs. Formed concrete seating surfaces shall not be permitted. The invert frame member shall be a one-piece 6061-T6 aluminum extrusion or plate which forms a seating surface for the bottom seal of a stop log. Inverts will be for embedded installation flush with channel bottom or for surface mounting using anchor bolts.

Surface mounted inverts will be sealed to the channel bottom with invert mounted gaskets or grouted in place after securing with anchor bolts. Gasket-type inverts require that Contractor field verify channel dimensions and channel bottom surface conditions for suitability with gasket use prior to start of submittal drawings.

Embedded inverts shall be a flush-bottom design formed by a 6061-T6 aluminum shape welded to the side frames and forming a structural cross-member for the frame. The embedded invert shall be installed so that the seating surface shall be flush with the channel invert in order to maximize flow and prevent fouling.

Seals

Stop log seals shall be minimum ¼" thick closed cell type neoprene bonded to the side faces and bottoms of the stop logs. Seal faces shall have a bonded layer of UHMW polyethylene to reduce friction with seating surfaces under head load and during installation of logs in the frames, and to prevent seals from binding with frame during prolonged installations. Seals shall not permanently deform or compress under design head loads. Minimum seal seating surface width shall be one (1) inch.

Optional P-seal (J-bulb) type seals are also available for seating and/or unseating faces.

Stop log width and depth fit tolerances within the frame shall maintain full contact of the seals against the side and invert frame seating surfaces at all times. Seals shall be replaceable without special tools.

Stop Log Lifter

A stop log lifter shall be provided for installation and removal of logs within the stop log frames. Stop log lifter shall be made of fabricated aluminum bars, plates and shapes except for actuation and lifting cables. The lifter shall engage each log securely at the attachment points without need for additional tools. Lifter shall incorporate a guide bar equal to or adjustable to each frame width. Polymer bearing bars shall allow for free and easy entry and removal of lifter in and out of the guide frame, and for gravity engagement to logs within the frame for removal purposes. An actuation cable shall permit disengagement of the lifter after lowering logs into the frame.

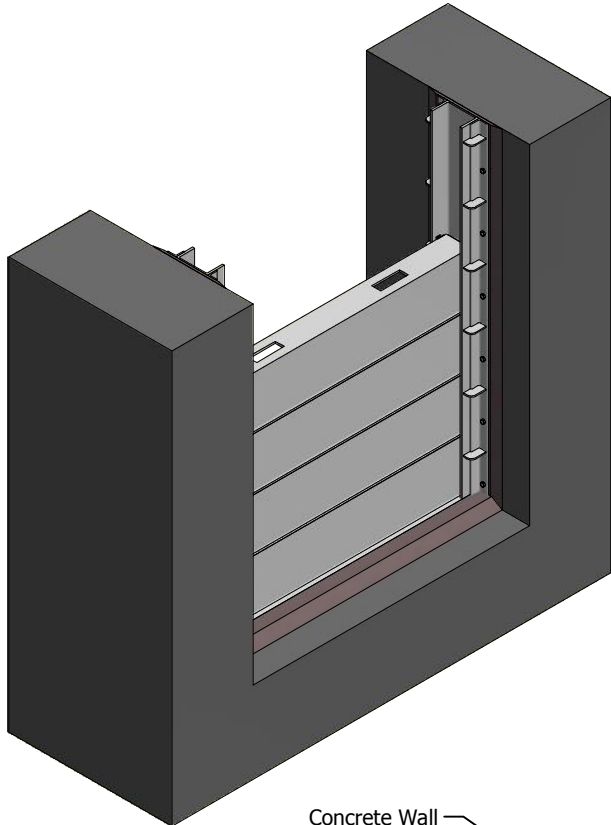
Other Features:

All WACO Products stop logs are made to order from approved drawings and our standard designs can be customized to fit virtually any specific head, mounting, or operating condition. Combinations of frame types (i.e. surface mount invert with embedded sides) are available to suit specific new construction or retrofit requirements. Call WACO Products Engineering Department for assistance and recommendations on mounting arrangements.

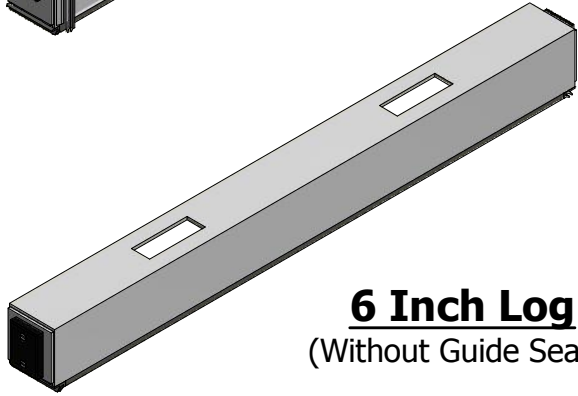
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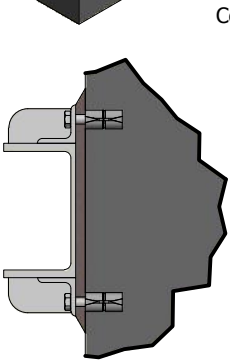
WACO Series 1000 Stop Logs



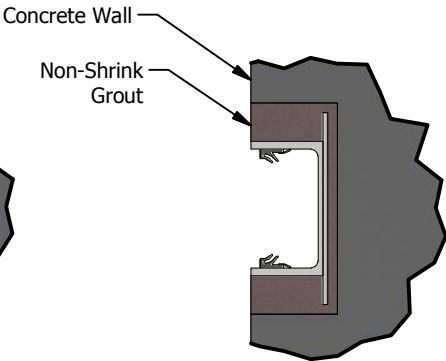
12 Inch Log
(With Guide Seals)



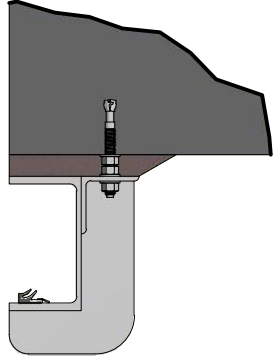
6 Inch Log
(Without Guide Seals)



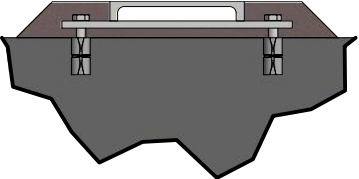
Surface Mounted
Guide Frame
(For use with log mounted guide seals)



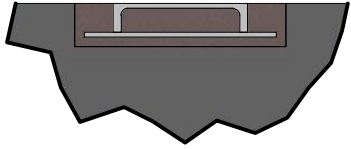
Embedded
Guide Frame
(Shown with frame mounted
dual seated seals)



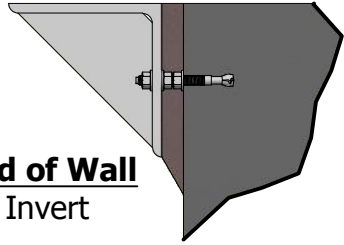
End of Wall
Guide Frame
(Shown with frame mounted
single seated seal)



Surface Mounted
Invert



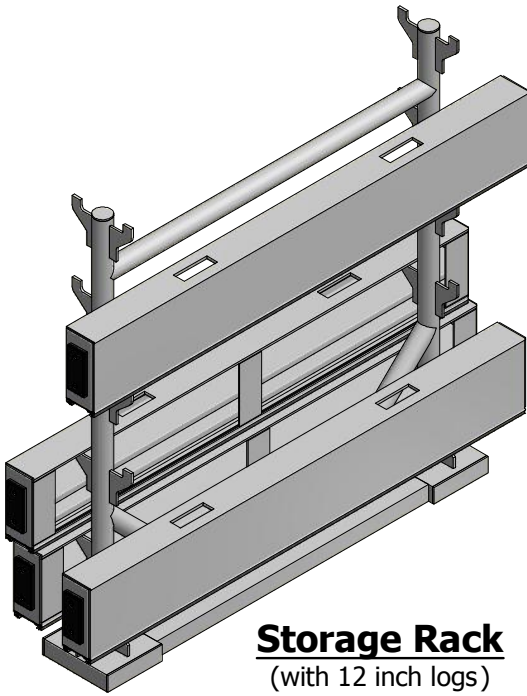
Embedded
Invert



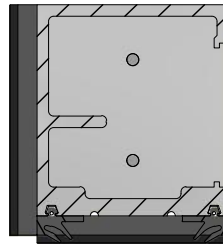
End of Wall
Invert

WACO Series 1000 Stop Logs

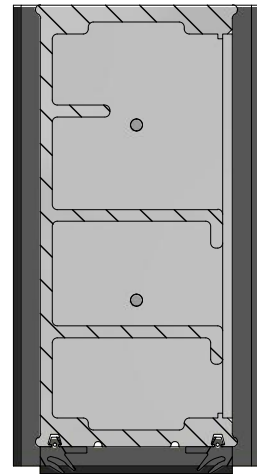
NOTE: Seal types can be arranged to suit project requirements



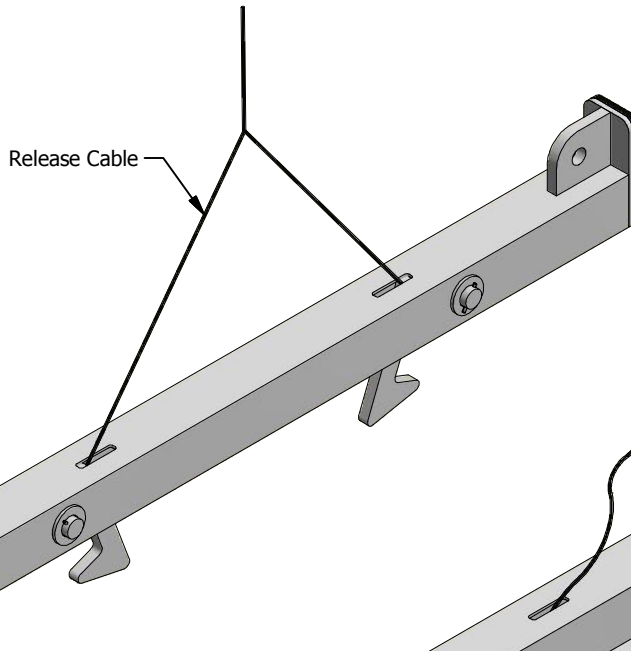
Storage Rack
(with 12 inch logs)



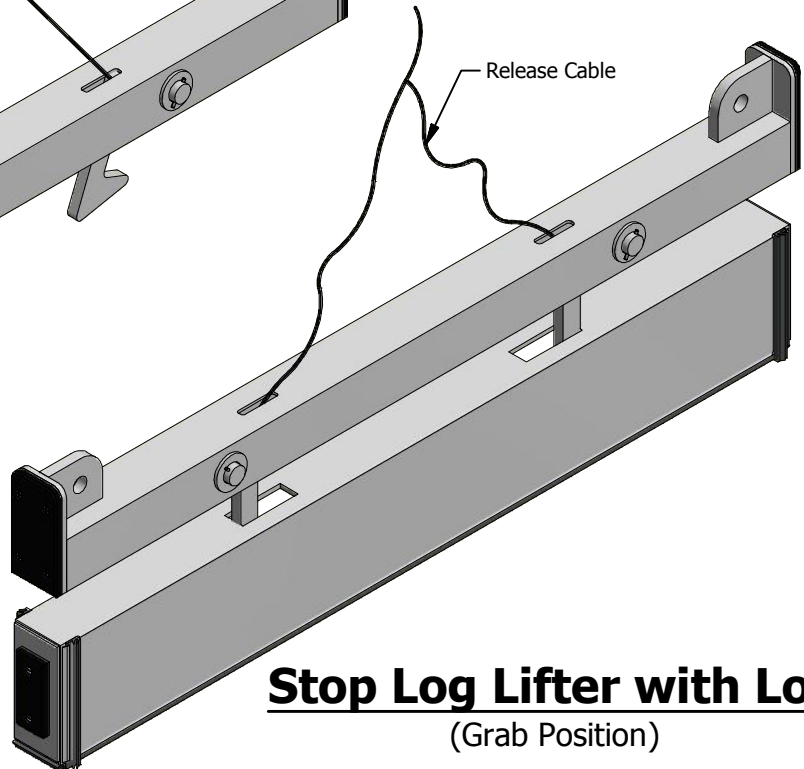
6 In. Log - Section View
(With single seated seal)



12 In. Log - Section View
(With dual seated seals)



Stop Log Lifter
(Release Position)



Stop Log Lifter with Log
(Grab Position)



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WACO Series 2000 Telescopic Valves - Sample Specification

General

The fabricated 304L or 316L stainless steel telescopic valves shall be Series 2000 type as manufactured by WACO Products, Inc., Baltimore, Maryland or equal. Valves and appurtenances shall be furnished with all necessary accessories and parts for a complete installation and shall be the latest standard product of a manufacturer regularly engaged in the production of equipment of this type. All telescopic valves and their operators shall be furnished by the same manufacturer.

Design

Except as otherwise indicated by this specification, all telescopic valves will be designed and manufactured to meet or exceed all specified criteria defining loading calculations, structural strength, deflection requirements, and material specifications including minimum dimensions.

Structural components shall have a minimum design safety factor of 4 with regard to ultimate tensile, compressive, and shear strength and a minimum safety factor of 2 with regard to tensile, compressive, and shear yield strength.

Telescopic Tubes

The telescopic tubes are to be fabricated from minimum 16 gage thickness tube, plate and shapes, reinforced as required to meet the operating loads. The tube shall be accurately formed and finished to assure a smooth leak resistant fit with the valve gasket. The tube shall have a flush upper edge or two opposing v-notch weir cut-outs as specified. The tube shall be attached to the operator stem by means of a stainless steel yoke of the same alloy as the tube, minimum ¼" thickness, bolted to the outer tube wall such that the operator stem may be

removed without disengaging the tube from the seal and drain pipe assembly.

The outer tube wall shall have a guide bar along the entire telescoping length to prevent rotation of the tube within the seal assembly during operation.

Seal and Drain Pipe

The seal gasket shall be minimum ½" thick neoprene or EPDM rubber, with accurately cut tube center hole and bolt holes to match drain pipe and telescopic valve flanges. The telescopic valve shall include a lower seal flange of the same alloy as the tube, machined to match the drain pipe bolt hole pattern and tube/gasket center holes. The valve seal gasket and valve flange shall have guide grooves to match the tube anti-rotation guide bar.

The tube center hole on the seal flange shall be sized to assure that compression of the seal against the outer tube wall shall occur when the seal and pipe assembly is properly secured to the drain pipe flange. Stainless steel flange mounting bolts of the same alloy as the tube shall be supplied by the telescopic valve manufacturer. The drain pipe and integral mounting flange shall be supplied by others.

Manual Operator

The standard telescopic valve operator will be a BS-1015 horizontal handwheel type mounted on a pedestal unless otherwise specified. The bronze operating nut of the operator will be accurately machined to match the thread of the rising stem. Non-rising stems shall not be acceptable. The operating nut shall be supported by regreasable ball or roller thrust bearings top and bottom, secured in an

accurately machined cast aluminum or iron housing bolted to operator support pedestal.

Where torque, operation or space requirements dictate, bevel gear boxes with either a handcrank or handwheel shall be supplied in lieu of the standard operator. Bevel gear boxes shall have stainless steel input and/or output shafts, accurately machined gears supported by ball or roller bearings secured in an accurately machined cast aluminum or iron housing bolted to the operator support pedestal.

Regardless of the manual operator used to meet the specification, the required effort on the handwheel or crank is to be limited to a maximum 40 lb. pull. The lift mechanism will be capable of withstanding an effort of up to 200 lbs. without damage to the operator, stem or telescopic valve. Manually operated telescopic valves are to be supplied with adjustable stop collars as required to set the valve opening range. Where the size of the telescopic valve requires lift assist, but the frequency of operation does not indicate use of a permanent electric operator, a portable electric or hydraulic motor operator will be supplied as specified.

Electric Operator Option

The telescopic valve will be provided with an electric multi-turn operator incorporating integral limit switches to stop the telescopic tube in the desired full open and closed positions. The operator will also have a torque limit switch to prevent damage to an obstructed telescopic valve. Operators can be specified for modulating function where required to maximize level or flow control. Electric operators shall be in accordance with ANSI/AWWA C540 "Standard for Power-Actuating Devices for Valves and Slide Gates".

Operator Support

A fabricated pedestal of the same alloy as the tube shall be mounted on the operating floor or over-hung off of a wall at the operating level by means of an offset wall bracket. The pedestal shall be capable of supporting all loads imparted by the operator.

Operator Stems

Stem shall be of 1½" diameter stainless steel rod with accurately machined Acme stub threads. Stem shall be designed for a safety factor of 2 based on a critical buckling compressive load calculated by the Euler Column formula where C=2 and assuming a 50 lb torque on the AWWA nut. The stem shall be welded to the tube lifting yoke.

Stem guides will be supplied to support the stem as required to meet the stem design criteria and shall be fabricated of the same alloy material as the tube. Stem guides shall have bronze or UHMW bushings to reduce stem friction and wear if specified. Stem guides shall be adjustable in multiple dimensions to allow for alignment with operator and gate stem nut. Guides will be mounted on the installation wall as required to support and align the stem(s) properly. All stems shall be supplied with protective clear UV resistant stem covers with vent holes and mylar indicator tapes for quick visual valve position reference.

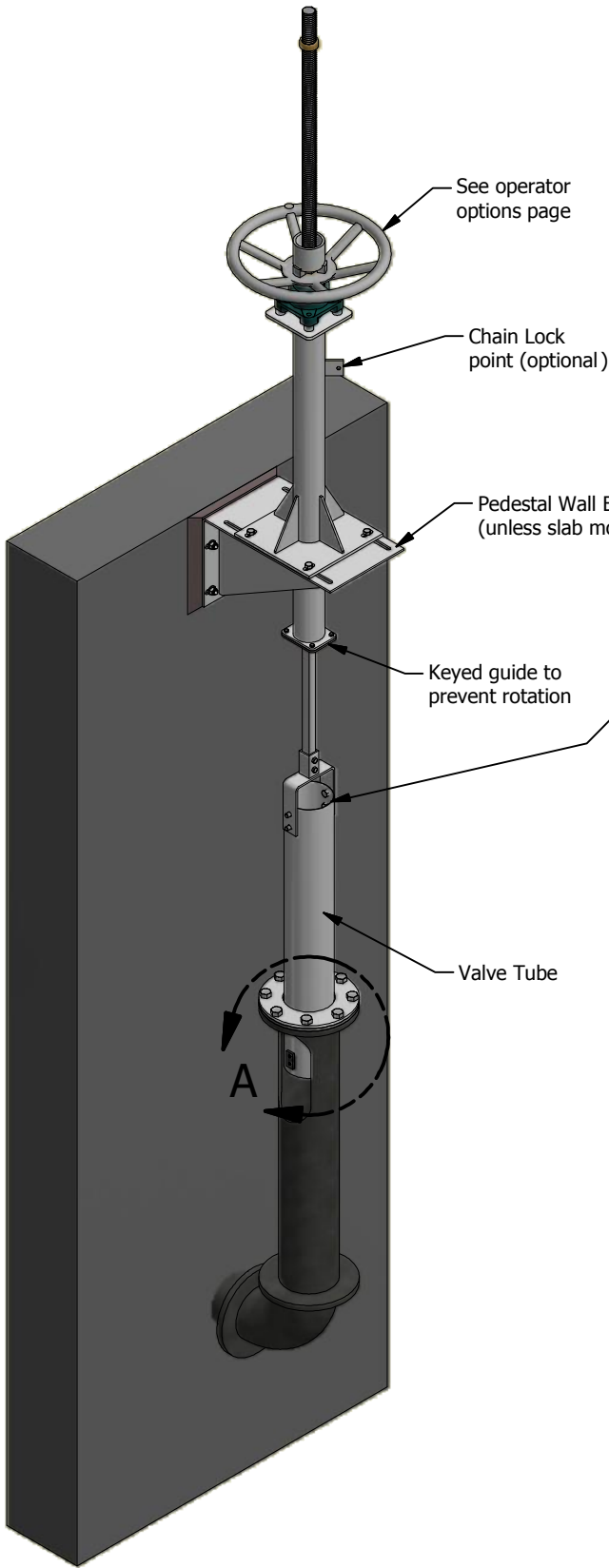
Specifying Style:

To specify 2000 series models, designate the stainless steel alloy, drain pipe inside diameter (including any reductions for pipe linings or coatings), the total length of tube travel (not the overall tube height), and the drain pipe flange and operating floor elevations.

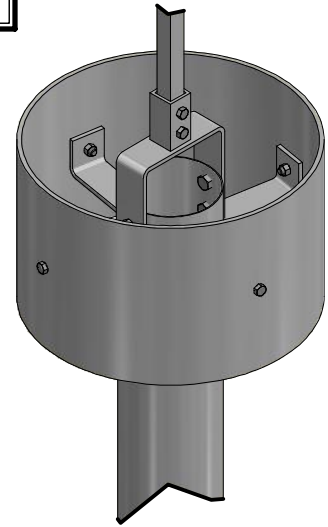
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WACO Series 2000 Telescopic Valve

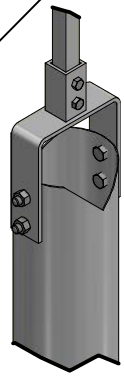


Flat Top

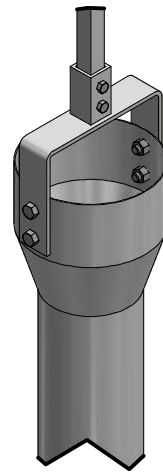


Baffle Top

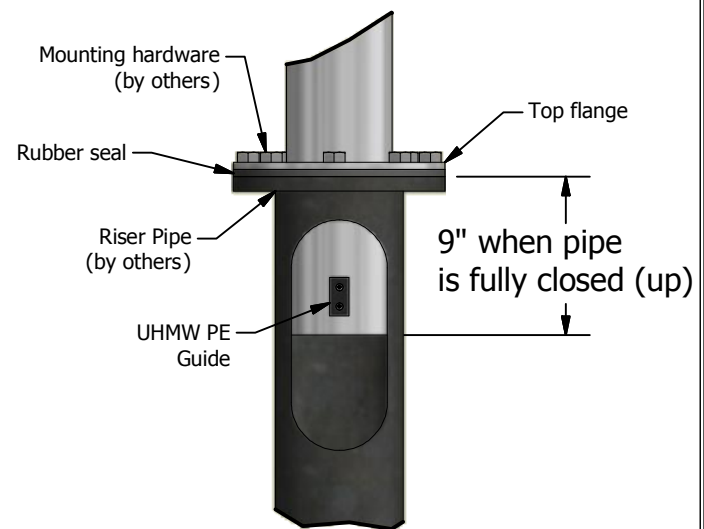
Top Options



V-Notch

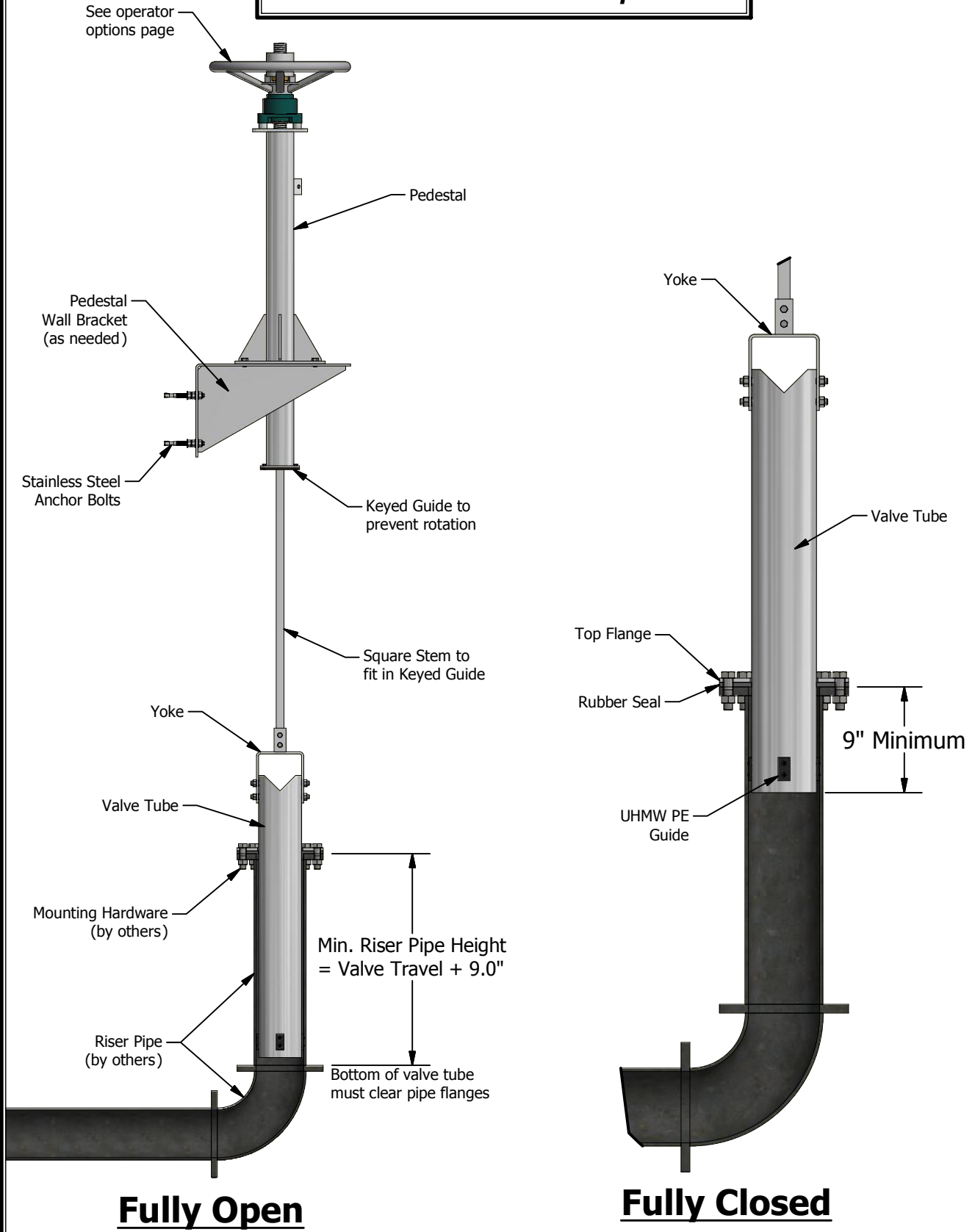


Wide Mouth



Telescopic Valve Flange
Detail A

WACO Series 2000 Telescopic Valve





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WACO Series 3000 Flap Gates and Frames- Sample Specification

General

The fabricated 6061-T6 aluminum or 300 series alloy stainless steel flap gates and frames shall be Series 3000 type as manufactured by WACO Products, Inc., Baltimore, Maryland or equal. Flap gates with rubber flap plates reinforced with stiffeners of the same alloy as the frame are also available. Flap gates and frames shall be furnished with all necessary accessories and parts for a complete installation and shall be the latest standard product of a manufacturer regularly engaged in the production of equipment of this type. All flap gates and frames shall be furnished by the same manufacturer.

Design

WACO Series 3000 flap gates are designed to prevent backflows into pipes and square or rectangular wall openings. The flap gates require minimal water pressure in the unseating direction to allow flow through the gate and out of the pipe, channel or basin. Under a backflow condition, a seating head is exerted upon the gate plate, closing it against the frame seals and effectively preventing backflow into the controlled opening. Double pin hinges shall maintain proper seating position between the gate plate and frame seals and do not require field adjustments. The gate may be manually opened for pipe/opening maintenance and inspection by using the gate's lifting eye(s).

All aluminum or stainless steel flap gates and frames will be designed and manufactured to have a

minimum design safety factor of 4 with regard to ultimate tensile, compressive, and shear strength and a minimum safety factor of 2 with regard to tensile, compressive, and shear yield strength. The flap gate and frame design shall be sufficient to withstand all loads imposed on the system by the design head indicated by the flap gate schedule or as shown on the plans.

Flap Gate Plates

The aluminum and stainless steel flap gate plates are to be fabricated from minimum 1/4" thickness plate, reinforced with stiffeners made from structural shapes of the same alloy as the plate. Stiffener size and spacing shall be as required to meet the engineer's specified design head. All stiffeners shall be welded to the flap gate plate; bolted, screwed or riveted attachment shall not be allowed. Construction shall minimize deflection of the plate in order to optimize seating against the frame seal. Deflection of the flap plate under full design seating head will be no more than 1/360 of the span width of the gate.

The rubber flap plates shall be made from single piece reinforced rubber elastomer suitable for the intended water service. The rubber shall be reinforced with 2 or more plies of non-absorbent woven fabric continuously vulcanized within the elastomer. Non-reinforced rubber materials shall not be allowed. The rubber shall be reinforced with stiffeners of the same material as the frame alloy, suitably sized and spaced to resist the design head.

The stiffeners shall be bolted to the rubber plate by means of stainless steel wide head toothed bolts and requiring no sealants, so that the rubber maintains a flat seating edge around its perimeter in order to optimize fit with the frame seal. Attaching stiffeners using bearing bars with through bolts and sealants shall not be acceptable. Stiffener deflection under full design seating head will be no more than 1/360 of the span width of the gate.

All flap gate plates equal to or under 3 feet in width shall have a single lifting eye; plates over 3 feet in width shall have two lifting eyes.

Flap Gate Frames

The gate frame is to be fabricated from minimum 1/4" thickness materials of the same alloy as the metal flap gate plate or the rubber flap gate stiffeners. The frame structure shall be designed to resist all loads imposed by the design head upon the flap plate and transferred into the frame and loads directly on the frame itself. The frame shall have fully welded hinge support plates and lifting padeyes as required for rigging and installation. The frame shall be designed for mounting directly to a wall or pipe flange, unless optional wall thimbles are indicated elsewhere in the specifications. Optional WACO Products wall thimbles shall be manufactured from the same alloy as the flap gate frame.

End-of-wall mount and pipe mount frames shall be designed to allow for a flush bottom installation. Pipe mounted frames shall be gasketed and will have mounting bolt and gasket holes spaced in accordance with the pipe flange. Gaskets shall be high density closed cell neoprene with a self-adhesive backing for mounting to the pipe flange prior to flap gate installation. Field applied mastics or sealants shall not be acceptable.

End-of-wall mounted frames shall have mounting bolt holes suitably spaced for the loads and bolt sizes, and with edge clearance as required

to maximize the bolt strength in the wall. Flap gate manufacturer shall supply 300 series alloy stainless steel mounting anchors sized in accordance with loading at full design head. If mounting on a wall with an integral precast pipe or port, the Contractor shall verify the outer precast diameter so that bolt spacing can be arranged to prevent interference with flap gate frame mounting bolts. End-of-wall mounted frames shall be designed for grouted or gasketed installation as indicated. Gasket-type frames require that Installer/Contractor field verify channel dimensions, wall alignment and wall surface conditions for suitability with gasket use prior to start of submittal drawings.

Flap Gate Hinges

Flap gate plates shall be attached to the frame by means of a double pin hinge mechanism that will assure flat and even seating around the frame seal when the gate is closed. Single pin hinges, multiple single pin hinges or other hinges requiring field adjustment shall not be acceptable. Hinge pins shall be stainless steel with high density nylon or UHMW bushings to reduce friction and to prevent metal to metal contact and corrosion. Note: rubber flap plates can also be supplied with an optional clamp hinge in lieu of double pin type.

P-Seals

Flap gate p-seals (j-bulbs) shall be minimum 1/4" thick neoprene hollow bulb extrusion fastened to the flap gate frame by means of a bolted retainer of the same alloy as the frame. The p-seal and retainer shall have slotted mounting holes to allow for adjustment of the p-seal against the flap plate. The retainer and p-seal shall not intrude upon the clear opening of the pipe or port opening. Seals shall be adjustable and replaceable without special tools and without removing the frame from its installed position.

**Using this Specification and
Other Design Features:**

All WACO Products' gates are made to order from approved drawings and our standard designs can be customized to fit virtually any specific head, mounting, or operating condition. Other materials of construction for demanding applications can also be provided. Please call WACO Products for design assistance.

Specifying Style:

Use the following guide to indicate the WACO Products' Series 3000 flap gate for your requirements as:
series/alloy-flap material-opening

3000 Series/Alloy types:

**3060; 6061-T6 aluminum
3034; 304L stainless steel
3036; 316L stainless steel**

Flap Materials:

**M; metal
R; rubber**

Opening:

**XXRO; round dimension in inches
XXYY; width x height in inches**

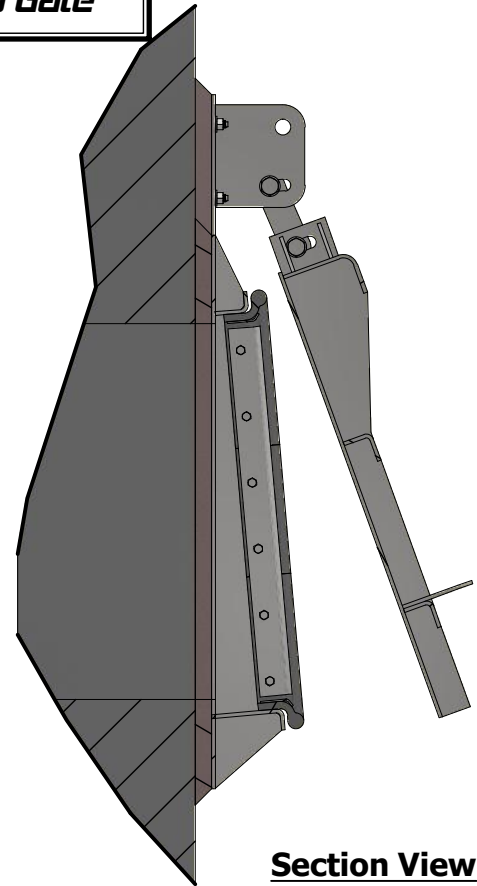
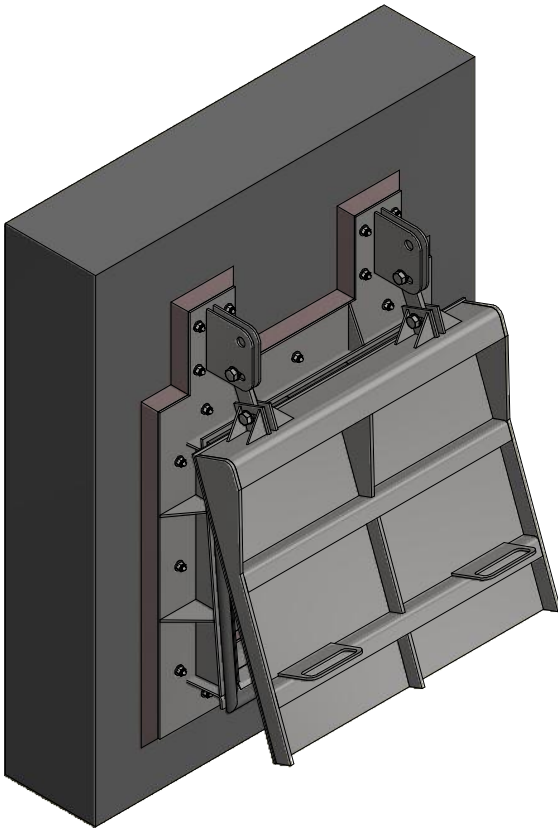
Examples:

- 1) A 48" pipe mounted flap gate in 304 stainless steel would be a 3034-M-48RO.
- 2) A 60" wide by 36" high clear rectangular opening flap gate in 6061-T6 aluminum would be a 3060-M-6036.
- 3) A 24" square clear opening flap gate with a 316 stainless steel frame and a rubber flap plate with stainless steel stiffeners would be a 3036-R-2424.

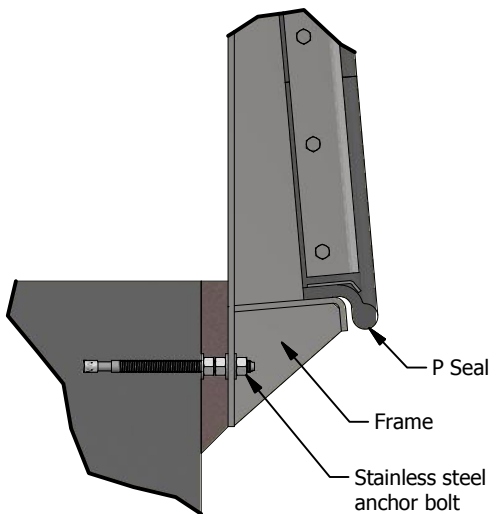
WACO Products, Inc.

1330 Knecht Avenue
Baltimore, Maryland 21229-5511

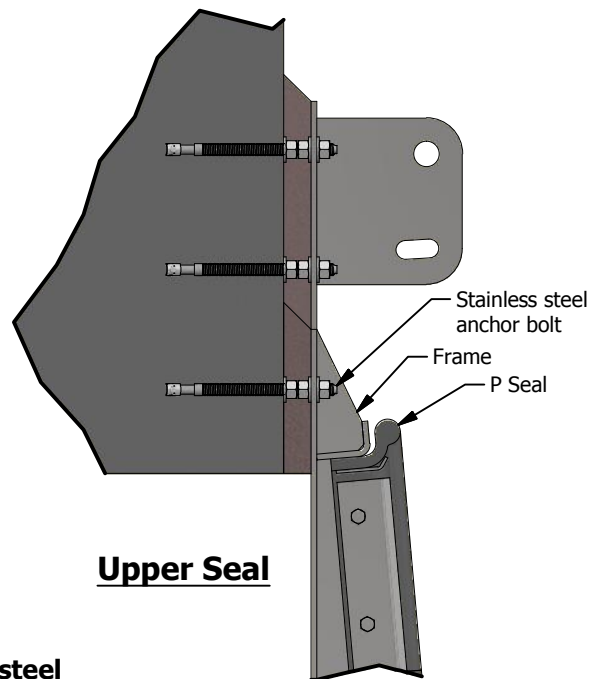
WACO Series 3000 Flap Gate



Section View



Invert Seal



Upper Seal

NOTE: Flap gate frames can be aluminum or stainless steel and flaps can be aluminum, stainless steel, or rubber. Also available in square, rectangular, and round opening configurations. Frame can be gasket back and mounted directly to wall or pipe flange.



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WACO Series 4000 Stop Gates and Frames- Sample Specification

General

The fabricated 6061-T6 aluminum hand lift stop gates and frames shall be manufactured by WACO Products, Inc., Baltimore, Maryland or equal. Stop gates and frames shall be furnished with all necessary accessories and parts for a complete installation and shall be the latest standard product of a manufacturer regularly engaged in the production of equipment of this type. All stop gates and frames shall be furnished by the same manufacturer.

Design

Except as otherwise indicated by this specification, all stop gates and frames will be designed and manufactured to meet or exceed all design criteria of AWWA Standard C513, most current edition, defining head and loading calculations, structural strength, deflection requirements, and material specifications including minimum dimensions.

Structural components shall have a minimum design safety factor of 4 with regard to ultimate tensile, compressive, and shear strength and a minimum safety factor of 2 with regard to tensile, compressive, and shear yield strength.

Stop Gate Plates

The stop plates are to be fabricated from minimum 1/4" thickness 6061-T6 aluminum plate and shapes, reinforced as required to meet the engineer's specified design head. Deflection under full design head will be no more than 1/360 of the span width of the gate. Stop gates will be fabricated so that gate plates will be interchangeable for all channels of

equal width with the same frame type.

Stop gates equal to or under 3 feet in width shall have single hand slots or handles as specified for lifting purposes. Gate plates wider than 3 feet in width shall incorporate dual slots or handles. Where drawings do not indicate otherwise, slots shall be provided. All slots shall have welded pipe handholds on the upper side of the slot for ease of lifting unless otherwise indicated.

Stop Gate Guide Frames

The guide frame is to be fabricated from minimum 1/4" thickness 6061-T6 aluminum extrusions designed to resist loads imposed by the design head upon the stop plate and into the frame. Guide frames built out of plate or structural shapes shall not be acceptable. The frame shall have factory welded mitered corners where the side and invert frames meet. Embedded and end-of-wall mount frames shall be designed to allow for a flush bottom installation. Flush bottom frames will incorporate a countersunk invert seat or flush neoprene invert seal as indicated. Formed concrete inverts and stop plate mounted seals shall not be acceptable.

Embedded frames shall be grouted in place within a blockout or embedded at the time of the channel concrete pour. Embedded frame extrusions shall have a minimum weight of 1 1/2 pounds per foot. Frames shall have a factory applied coating of bituminous paint on all surfaces to be in contact with concrete or grout.

Wall mount frame anchors are to be 300 series stainless steel and supplied by the gate manufacturer at a size, quantity and spacing sufficient for the design loads. Wall mounted frames shall have bolt holes factory drilled at the recommended locations for use as a template to locate anchors in the field. Wall mounted frames shall be designed for grouted or gasketed installation as indicated.

Gasket-type frames require that Installer/Contractor field verify channel dimensions, wall alignment and wall surface conditions for suitability with gasket use prior to start of submittal drawings. End-of-wall mount and intra-channel surface mount frames shall have a minimum extrusion weight of 2 pounds per foot. Frames shall have a factory applied coating of bituminous paint on all surfaces to be in contact with concrete or grout.

All guide frames shall incorporate ultra high molecular weight polyethylene (UHMW) bearing bars on both sides of the stop plate to reduce friction and wear between the plate and frame. Bearing bars shall be extruded from virgin UHMW ultraviolet resistant polymer and shall be held within the guide frame by integral dovetail retaining slots in the guide extrusion. Bearing bars glued or mechanically fastened to the frame or plate shall not be acceptable.

Optional P-Seals

Stop gate p-seals (j-bulbs) shall be minimum 1/4" thick neoprene hollow bulb extrusions fastened to the gate side frames by means of an adjustable bolted retainer. The p-seal and retainer shall have slotted mounting holes to allow for adjustment of the compression of the p-seal against the stop plate. The retainer and p-seal assembly support shall be welded to the gate frame extrusion on the upstream side of the gate unless otherwise indicated. Minimum seal seating surface width shall be 3/4 inches. Seals shall be replaceable without special tools and

without removing the frame from its installed position.

Using this Specification and Other Design Features:

All WACO Products' gates are made to order from approved drawings and our standard designs can be customized to fit virtually any specific head, mounting, or operating condition. Special lifting padeyes and hoists are available for stop gate applications where size/head makes manual operation impractical, but where slide gates with operators are not desirable. Please call WACO Products for design assistance.

Specifying Style:

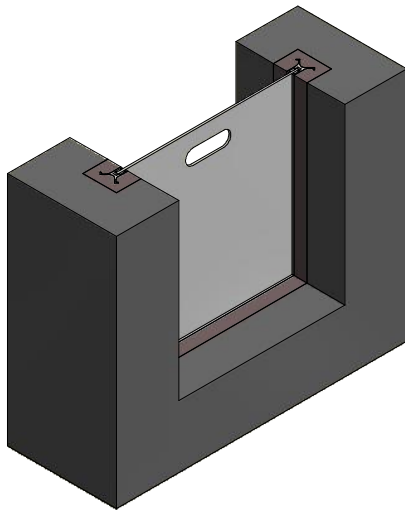
To specify 4000 series models, use the specifying grid below by selecting the opening type and mounting style required. Indicate the gate type, height and width dimensions for both the frame and stop plate (if different from the frame, and relevant elevations in the schedule or specification. Where the installation may require a combination of frame types (i.e. embedded side frame with channel mounted invert frame) please call WACO Products Engineering Department for recommendations and model designation.

4000 Series Stop Gates	
Type	Mounting
4001	channel embedded
T-1	channel embedded-no UHMW
4101	intra-channel bolted
4201	end-of-wall bolted
W-1	end-of-wall bolted-no UHMW

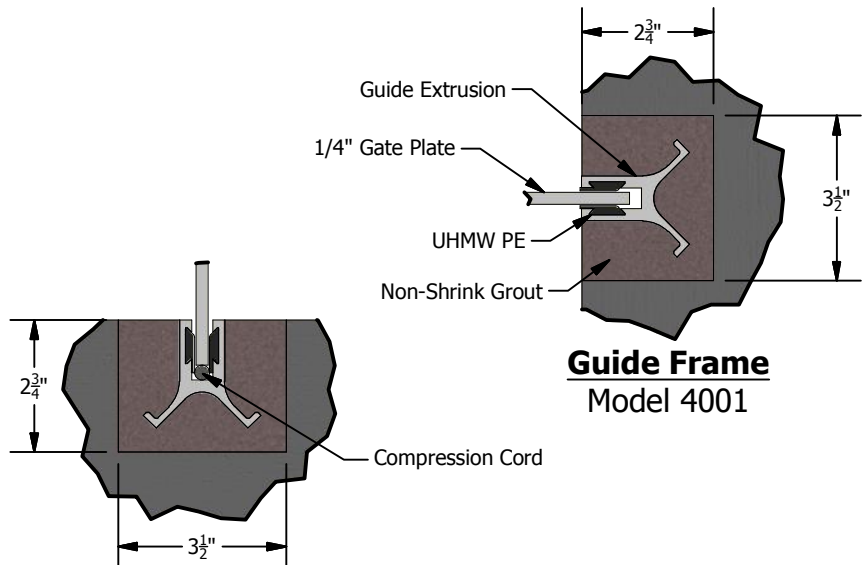
WACO Products, Inc.

1330 Knecht Avenue
 Baltimore, Maryland 21229-5511
 410-242-1000 Fax 410-247-4890
 Sales@WACOProducts.com

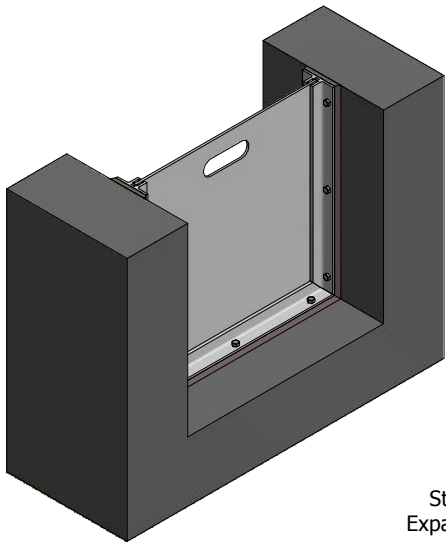
WACO Series 4000 Stop Gates



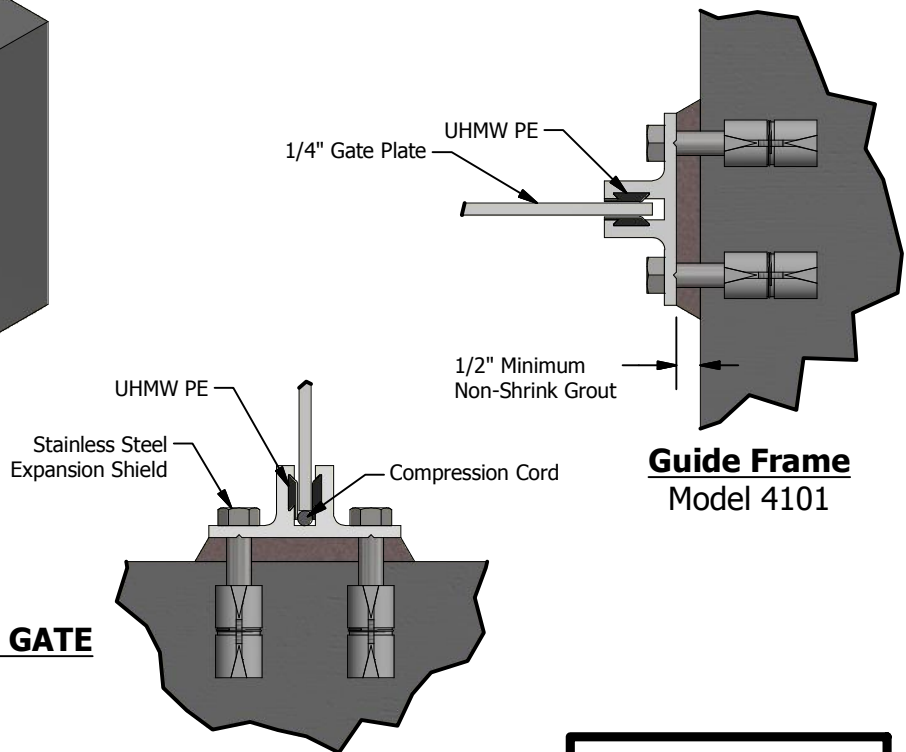
EMBEDDED STOP GATE
Model 4001



Invert Frame
Model 4001



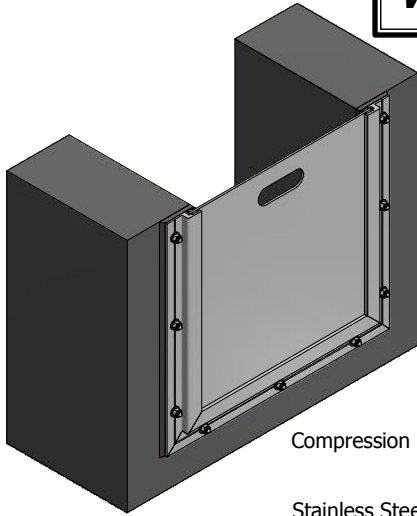
INTRA-CHANNEL STOP GATE
Model 4101



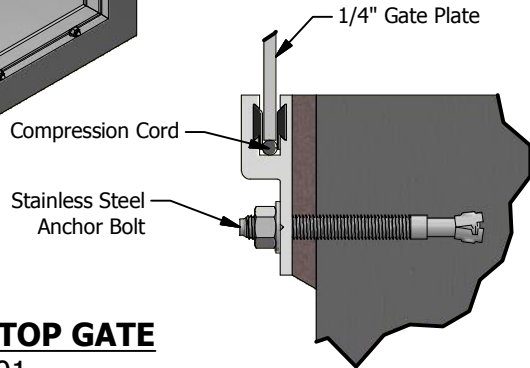
Invert Frame
Model 4101

NOTE: 4001, 4201, and 4201 frame sections can be combined to suit mounting requirements

WACO Series 4000 Stop Gates



END-OF-WALL STOP GATE
Model 4201



Invert Frame
Model 4201

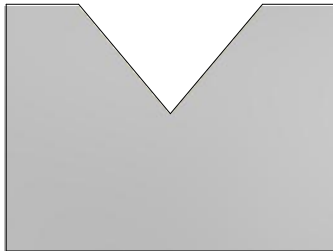
1/2" Minimum
Non-Shrink Grout

UHMW PE
Guide Extrusion

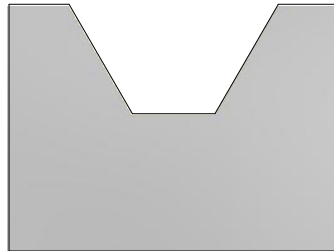
Guide Frame
Model 4201

NOTE: 4001, 4201, and
4201 frame sections
can be combined to suit
mounting requirements

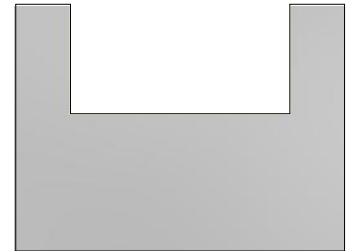
Gate Plate Options



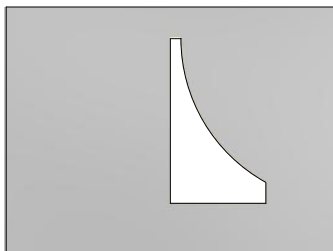
V-NOTCH WEIR PLATE



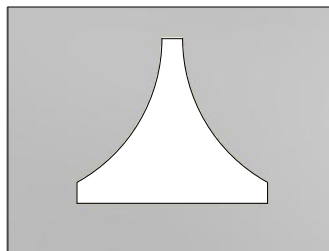
CIPOLLETTI WEIR PLATE



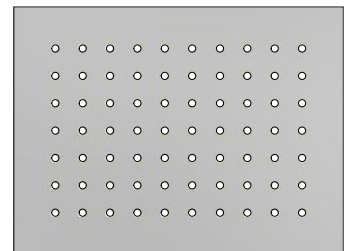
RECTANGULAR WEIR PLATE



SUTRO WEIR PLATE

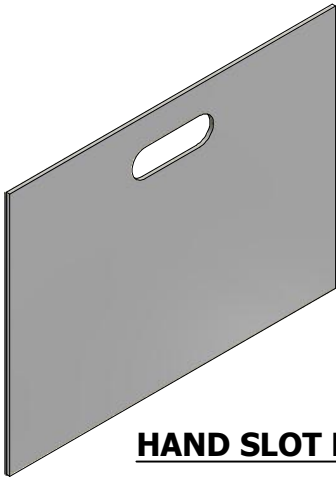


PROPORTIONAL WEIR PLATE

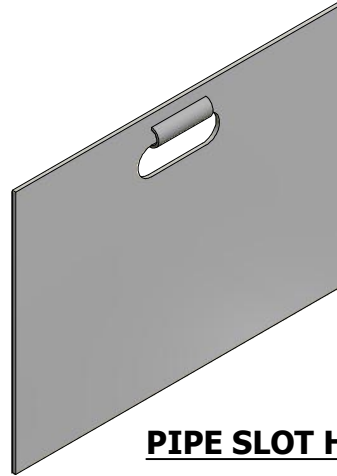


Perforated Baffle

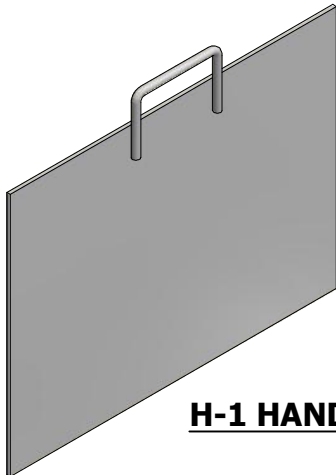
WACO Series 4000 Lifting Options



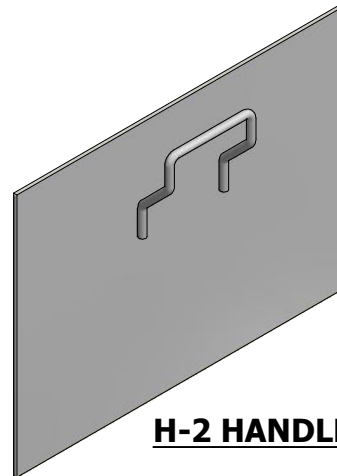
HAND SLOT HANDLE



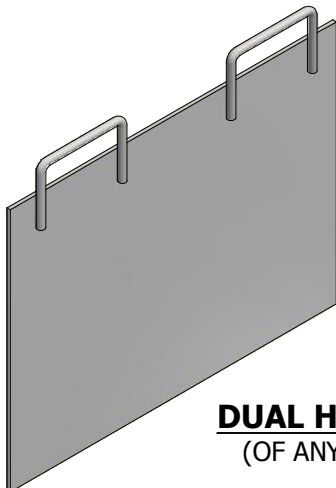
PIPE SLOT HANDLE



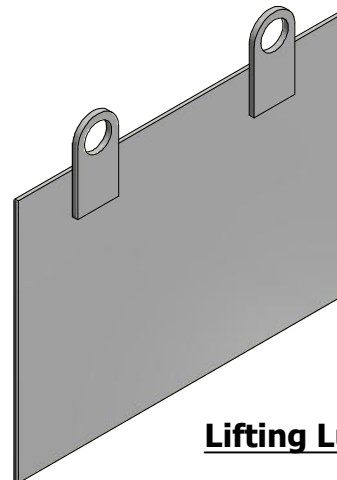
H-1 HANDLE



H-2 HANDLE



DUAL HANDLE
(OF ANY TYPE)



Lifting Lugs



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Fabricated vs. Cast Iron Slide Gates

Fabricated

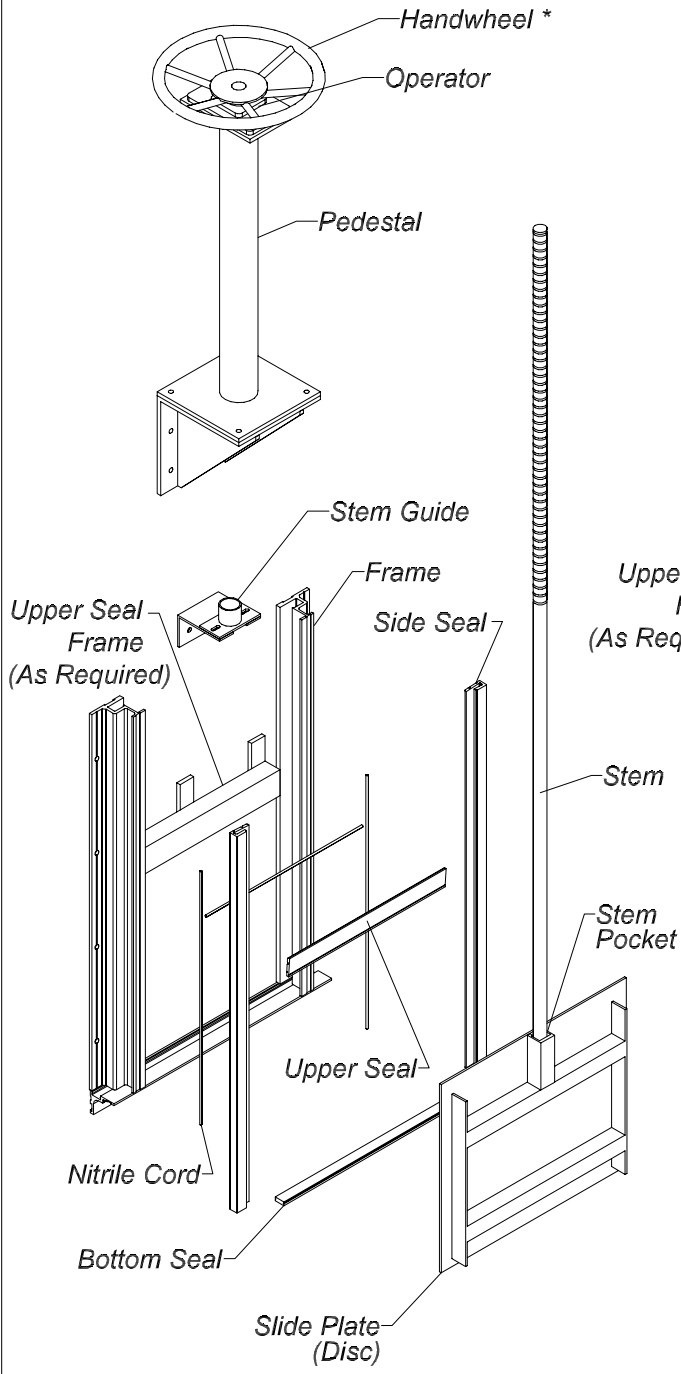
- 1) Aluminum or Stainless
- 2) Sizing to ANY requirement
- 3) AWWA C513 & C561 current standards allow 0.1 seated X 0.1 unseated GPM per WFP
- 4) Seats are polymer and/or elastomer; can be adjusted, repaired or replaced in the field.
- 5) New seats/seals are self-adjusting
- 6) Lighter weight
 - a-smaller hoists for mounting
 - b-no thimbles required
 - c-smaller operators/actuators
- 7) Lower overall costs to buy
 - a-lower equipment cost
 - b-no thimbles required
 - c-installation faster
 - d-tools/equipment cheaper
 - e-smaller operators/actuators
 - f-shorter lead times
- 8) Lower costs for O&M
 - a-field maintenance of seals and/or seats
 - b-smaller electric requirement
 - c-parts perform for life of gate & less susceptible to corrosion with proper material selection

Cast Iron

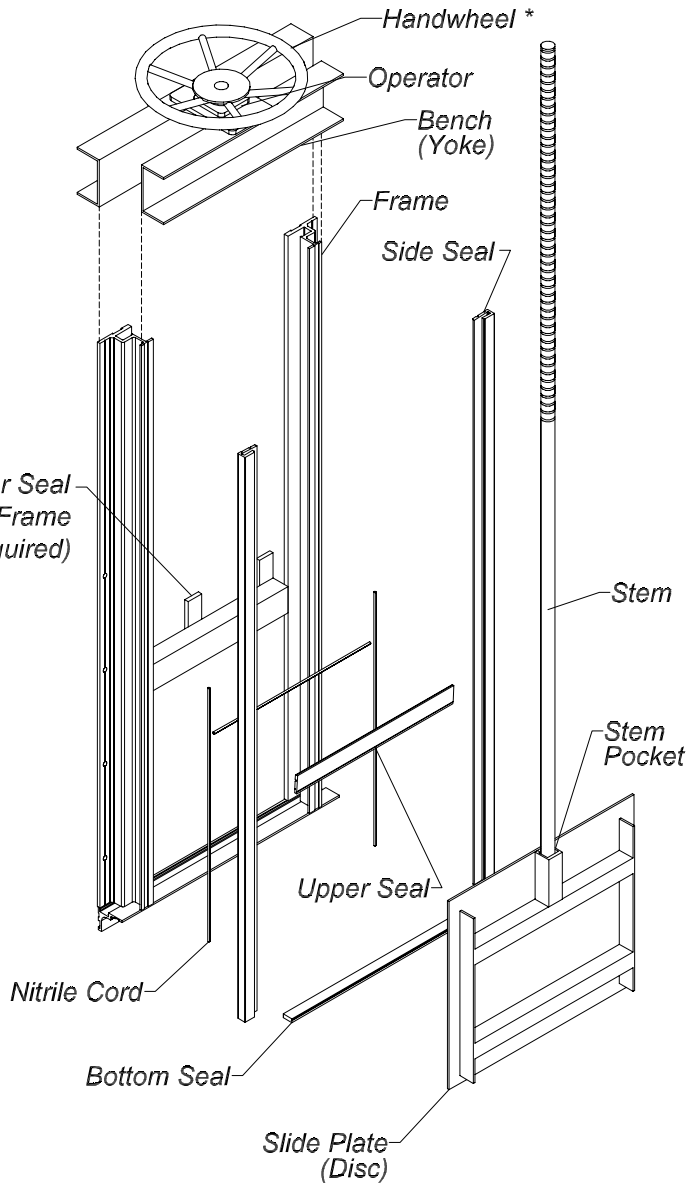
- 1) AWWA C560 specifies as Slide ***not*** Sluice Gates; shows that it is a construction NOT a performance difference. (AWWA C560 supersedes C501)
- 2) Sizing to patterns only
- 3) C560 current standard allows 0.1 seated X 0.2 unseated GPM per WFP.
- 4) Seats are cast bronze or stainless; require foundry pour and factory grinding for rework.
- 5) Seats/seals require wedge adjustments
- 6) Heavy weight
 - a-larger cranes for mounting
 - b-thimbles for support
 - c-larger operators/actuators
- 7) Higher overall cost to buy
 - a-higher equipment cost
 - b-thimbles usually required
 - c-installation longer
 - d-tools/equipment pricier
 - e-larger operators/actuators
 - f-longer lead times
- 8) Higher cost for O&M
 - a-no field maintenance of seals and/or seats
 - b-larger electric requirement
 - c-ground seal surfaces less tolerant to wear and tear, bronze particularly susceptible to corrosion



WACO Aluminum Slide Gate Components

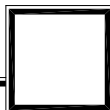


NON-SELF-CONTAINED GATE
WITH FABRICATED PEDESTAL



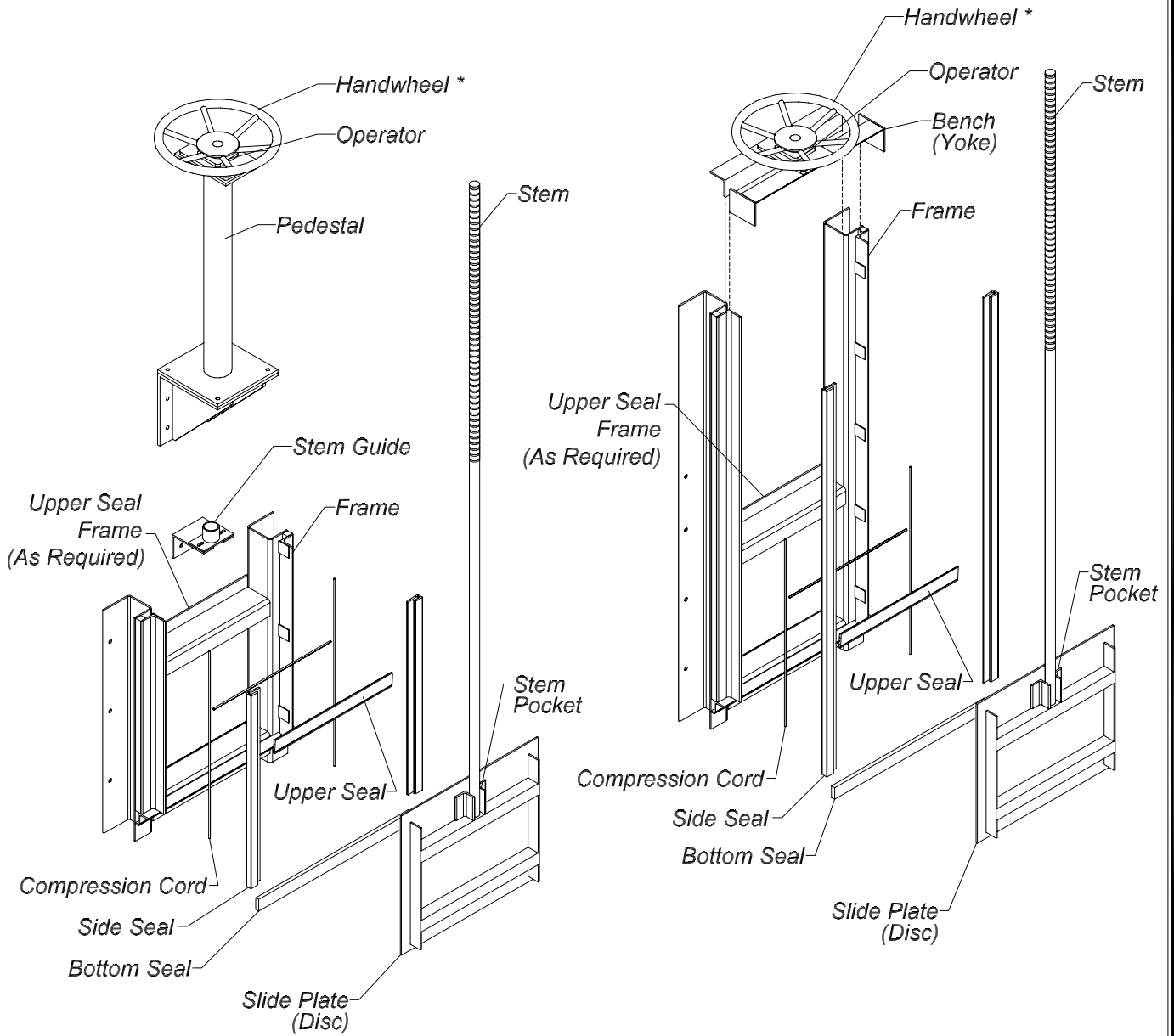
SELF-CONTAINED GATE
WITH BENCH (YOKE)

* See "Manual Operators" and "Power Operators" for additional operator types





WACO Stainless Steel Slide Gate Components



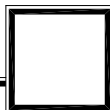
NON-SELF-CONTAINED GATE

WITH FABRICATED PEDESTAL

SELF-CONTAINED GATE

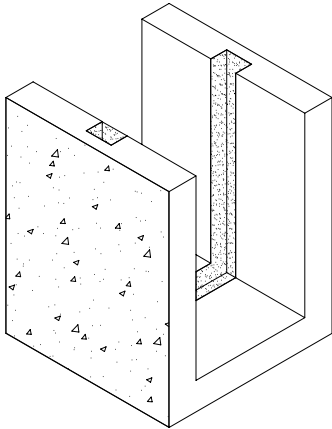
WITH BENCH (YOKE)

* See "Manual Operators" and "Power Operators" for additional operator types

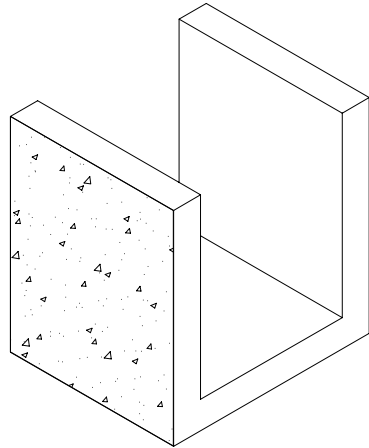




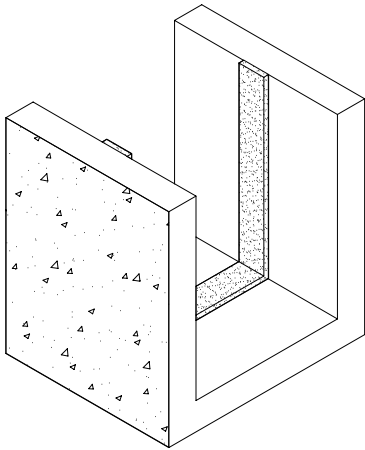
MOUNTING SURFACE TYPES



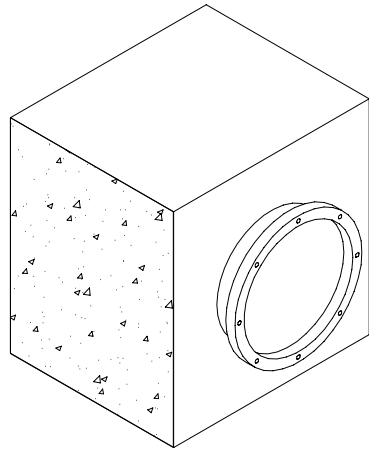
CHANNEL: EMBEDDED



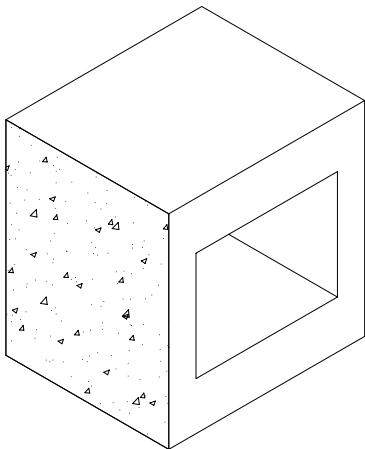
END-OF-WALL



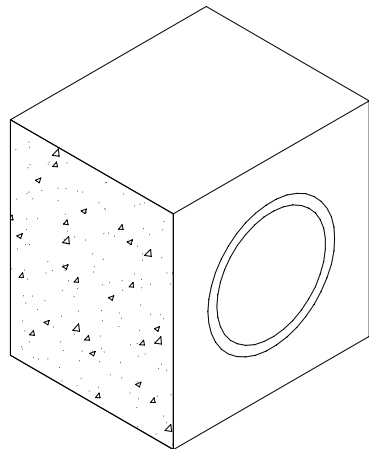
CHANNEL: SURFACE



PIPE OPENING FLANGE



PORT OPENING END-OF-WALL

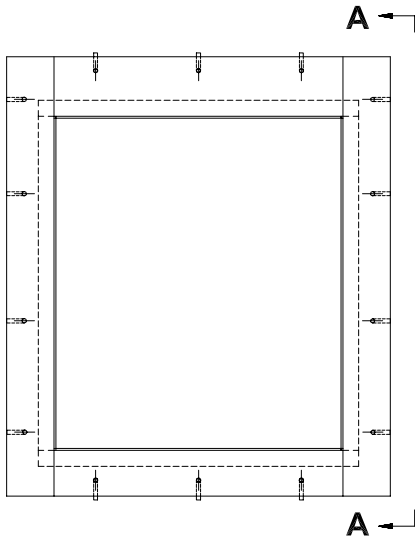


PIPE OPENING END-OF-WALL

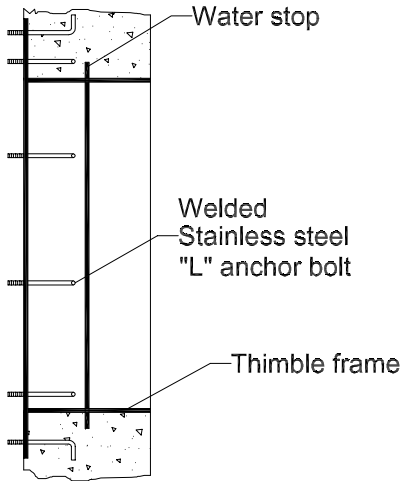




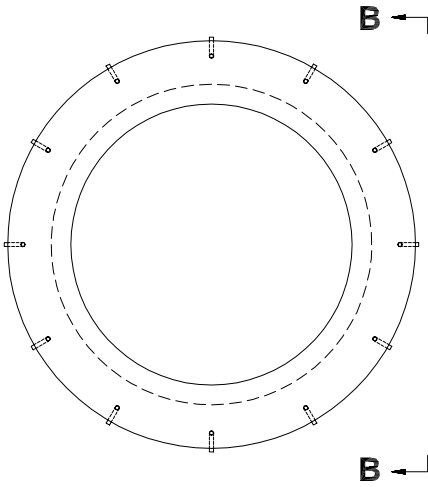
WACO Wall Thimbles



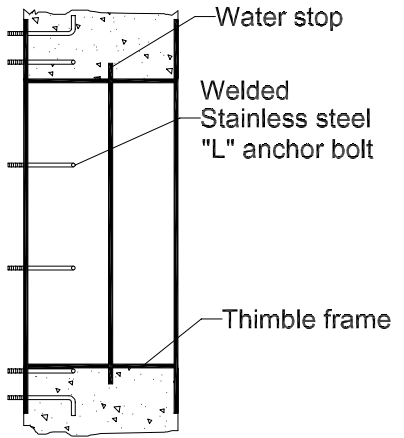
SQUARE OR RECTANGULAR THIMBLE
F-Type (Also Available in E-Type)



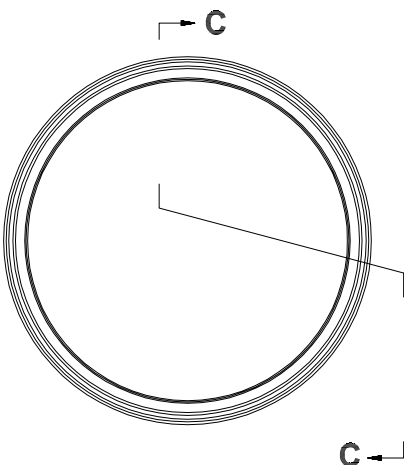
VIEW A-A



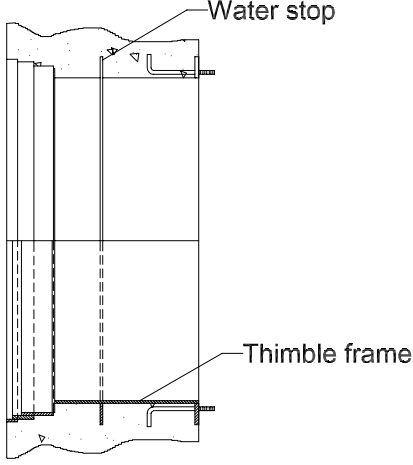
ROUND THIMBLE
E-Type (Also Available in F-Type)



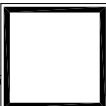
VIEW B-B



ROUND THIMBLE
Flange x MJ-Type



SECTION C-C



Slide & Weir Gate Selection Grid

	<i>Seal</i>	<i>Gate</i>			
<i>Material</i>	<i>Type</i>	<i>Type</i>	<i>Opening</i>	<i>Mounting</i>	<i>Series #</i>
Aluminum	P-Seal	weir	channel	end-of-wall bolted	5564
		slide	channel	end-of-wall bolted	5544
				intra-channel bolted	5534
				embedded	5524
			pipe	end-of-wall bolted	5584
			port	end-of-wall bolted	5574
Aluminum	UHMW	weir	channel	end-of-wall bolted	6564
		slide	channel	end-of-wall bolted	6544
				intra-channel bolted	6534
				embedded	6524
			pipe	end-of-wall bolted	6584
			port	end-of-wall bolted	6574
Stainless (304 SS ends in 4 316 SS ends in 6)	UHMW	weir	channel	end-of-wall bolted	7564/6
		slide	channel	end-of-wall bolted	7544/6
				intra-channel bolted	7534/6
				embedded	7524/6
			pipe	end-of-wall bolted	7584/6
			port	end-of-wall bolted	7574/6
Stainless (304 SS ends in 4 316 SS ends in 6)	P-Seal	weir	channel	end-of-wall bolted	8564/6
		slide	channel	end-of-wall bolted	8544/6
				intra-channel bolted	8534/6
				embedded	8524/6
			pipe	end-of-wall bolted	8584/6
			port	end-of-wall bolted	8574/6

Note: Custom combinations of any frame sections are available to suit specific applications. Please call WACO Products to discuss non-standard options.

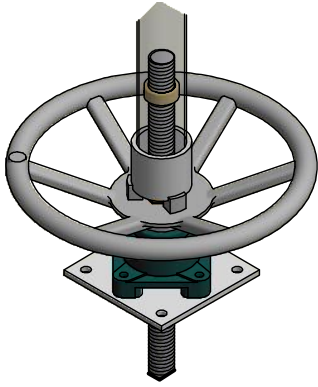
Selection Procedure:

To select a gate, work the grid column categories from left to right until you reach the gate model number.

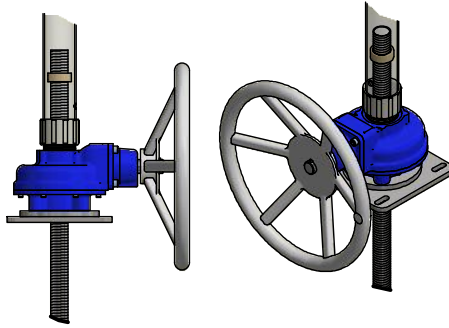
Example :

- 1) Choose your material. For instance, you may need a gate for an ultraviolet treatment channel. This means little or no corrosives, so aluminum is an economical choice.
- 2) Choose your seal type. You want seal technology that is the most current, the easiest to maintain and the most durable. UHMW is your best choice.
- 3) Choose your gate type; Slide or Weir? You are trying to regulate the water level in the UV channel; a weir gate at the effluent end will allow you to raise or lower your water level and, when fully lowered, can allow for full channel drainage.
- 4) Confirm your mounting arrangement. Weir gates open downward, so they are usually at the end of the channel wall. This means they cannot be embedded and are always bolted to the wall face.
- 5) Reading the example choices from left to right in the selection grid will select a 6564 gate.

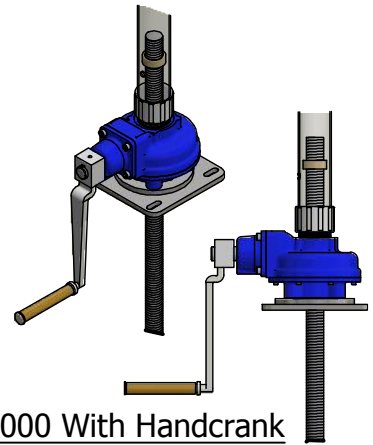
WACO Manual Operators



BS1015



BS2000 With Handwheel



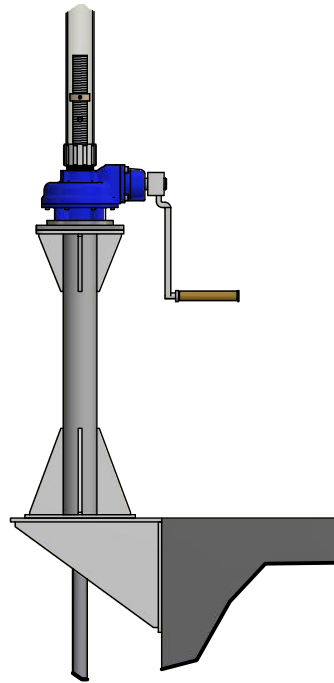
BS2000 With Handcrank



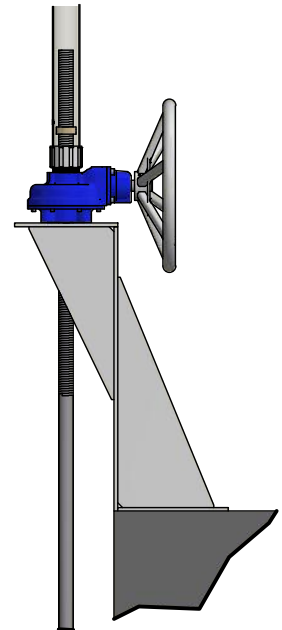
Stem Cover
(shown with BS1015)



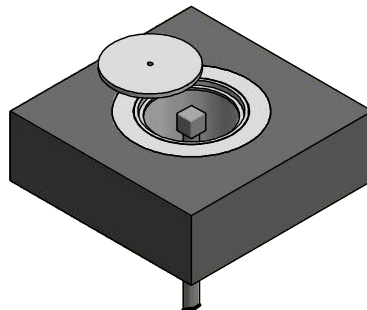
Standard Pipe Pedestal
(with BS1015)



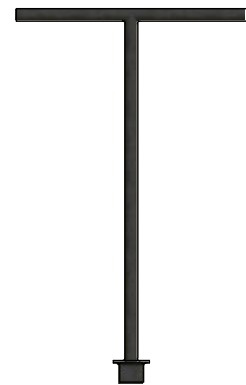
Wall Bracket
(with pipe pedestal and
BS2000 Handcrank)



Offset Pedestal
(with BS2000 Handwheel)



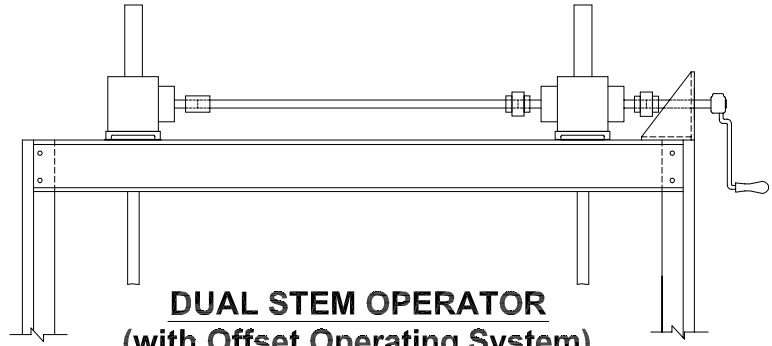
AWWA Nut Floor Box
(for non-rising stem)



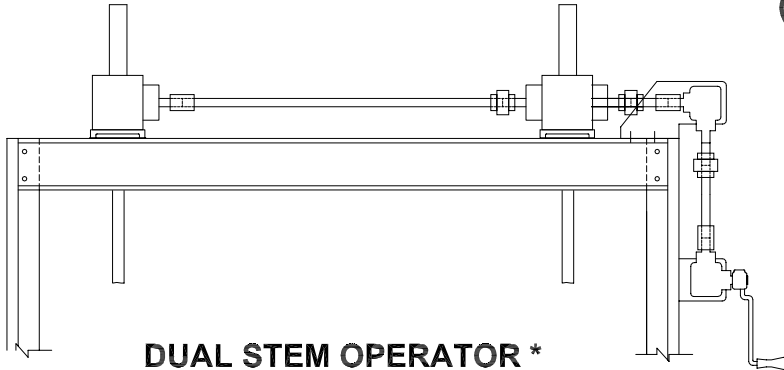
T - Wrench
(for AWWA nut operator)



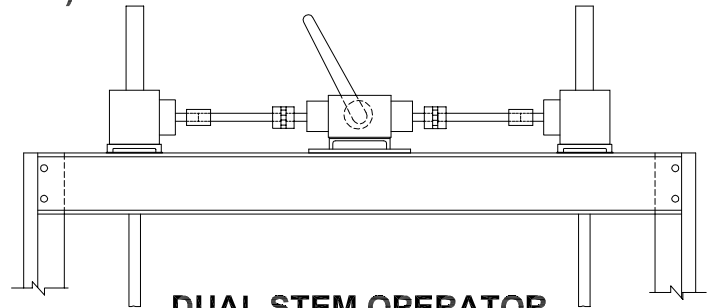
WACO Dual Stem & Offset Options



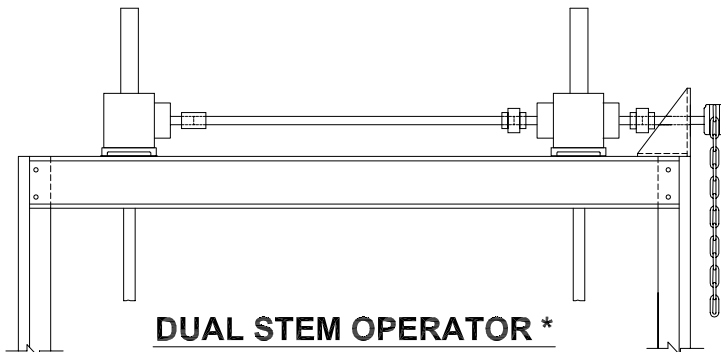
DUAL STEM OPERATOR
(with Offset Operating System)
(BS 2180 - OOS)



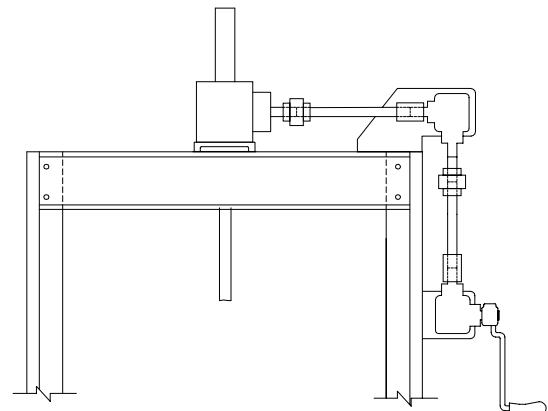
DUAL STEM OPERATOR *
(with Offset Bevel Box Operating System)
(BS 2180 - OBS)



DUAL STEM OPERATOR
(with Bevel Box Operating System)
(BS 2090)

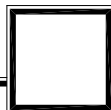


DUAL STEM OPERATOR *
(with Offset Chain & Sprocket)
(BS 2180 - OCS)

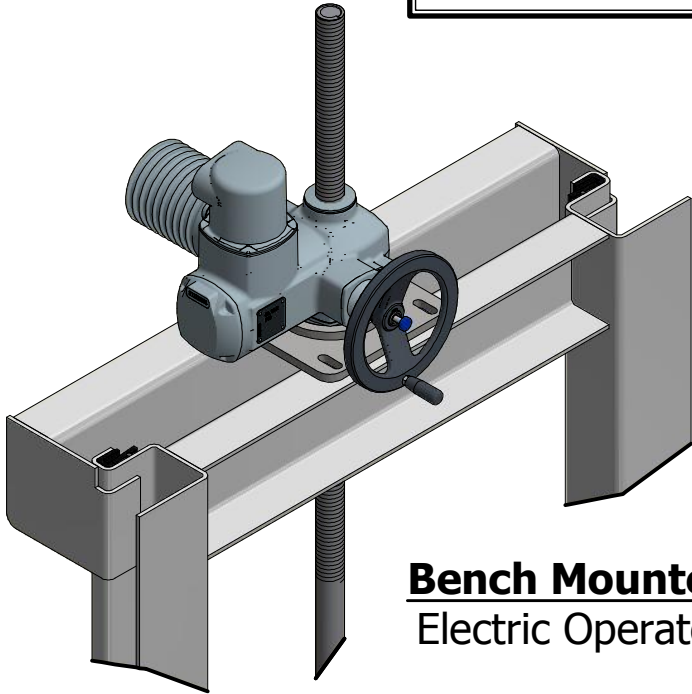


SINGLE STEM OPERATOR *
(with Offset Bevel Box Operating System)
(BS 2000 - OBS)

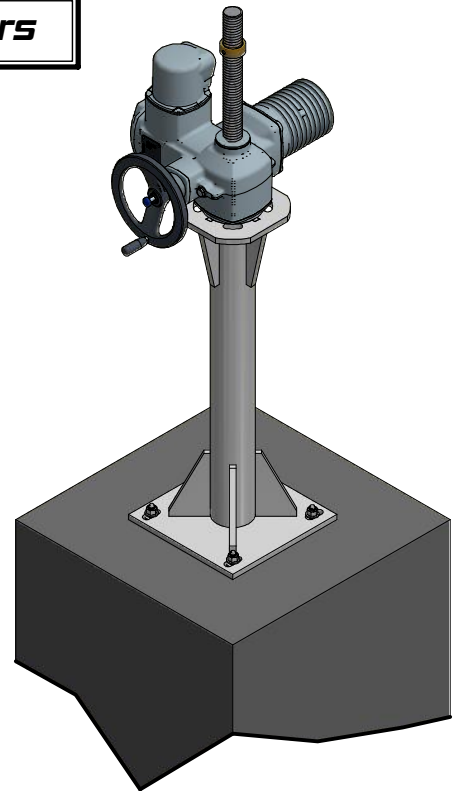
* Offset operators recommended where bench height precludes operation by person at normal standing elevation.



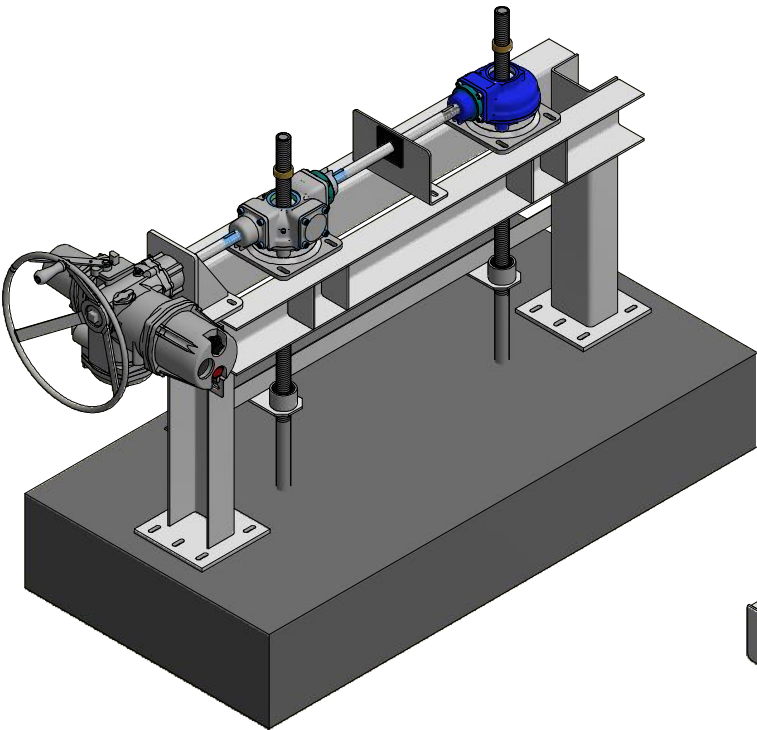
WACO Electric Operators



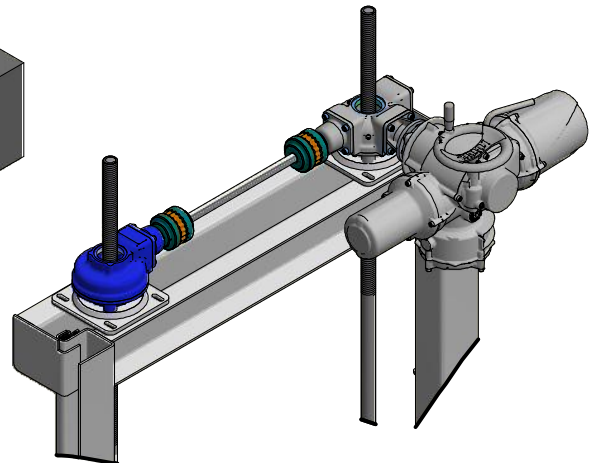
Bench Mounted
Electric Operator



Pedestal Mounted
Electric Operator



Dual Stem NSC Bench
Electric Operator



Dual Stem SC Bench
Electric Operator



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WACO 6500 Series Specification- Fabricated Aluminum Slide & Weir Gates: Sample Specification

General

The fabricated 6061-T6 aluminum gates shall be Series 6500 as manufactured by WACO Products, Inc., Baltimore, Maryland or equal. Gates shall be furnished with all necessary accessories and parts for a complete installation and shall be the latest standard product of a manufacturer regularly engaged in the production of equipment of this type. All gates shall be furnished by the same manufacturer. Upward opening gates shall be designated "slide gates" and downward opening gates shall be designated as "weir gates".

Design

Except as otherwise indicated by this specification, all gates will be designed and manufactured to meet or exceed all AWWA Standard C513, most current edition, including, but not limited to, those defining: allowable leakage, head and loading calculations, structural strength, deflection requirements, and material specifications including minimum dimensions.

Structural components shall have a minimum design safety factor of 4 with regard to ultimate tensile, compressive, and shear strength and a minimum safety factor of 2 with regard to tensile, compressive, and shear yield strength.

Slide Plate

The slide plate is to be fabricated from minimum 1/4" thickness 6061-T6 aluminum plate and shapes, reinforced as required to meet the engineer's specified design head.

Deflection under full design head will be no more than 1/360 of the span width of the gate.

Guide Frame & Bench

The guide frame is fabricated from minimum 1/4" thickness 6061-T6 aluminum extrusions and structural members to resist loads imposed by the design head. Additionally, any self-contained frame will require no additional reinforcing where it extends above the operating floor to support the operator.

The frame is fabricated to accommodate a one-piece Ultra High Molecular Weight Polyethylene (UHMW) bearing bar/seal. This bearing bar/seal is supplied mounted in the frame to reduce friction and wear between the slide/weir plate and frame faces, as well as to form the side seal seats to prevent leakage.

On self-contained frames the bench (yoke) to support the operator is formed by two back to back structural shapes, angles or channels as loading requires, which are welded or bolted to the guide frame to provide a rigid one-piece frame assembly. The bench shall be capable of supporting all loads imparted by the operator, and shall have a deflection under full design head operation of no more than 1/360 of the span width of the gate.

For non-self-contained frames, a fabricated pedestal of the same alloy as the frame is mounted on the operating floor or over-hung off of a wall at the operating level by means

of an offset wall bracket. The pedestal shall be capable of supporting all loads imparted by the operator.

Invert

Slide gate: The slide gate frame invert shall be a flush-bottom design formed by a neoprene block installed within a groove with an integral keeper. The invert frame member shall be a one-piece 6061-T6 aluminum extrusion which forms a seating surface for the edge of the plate bottom, retains the neoprene invert seal, and forms a structural cross-member for the frame. The gate shall be installed so that the gate invert shall be flush with the channel invert in order to maximize flow and prevent fouling.

Weir gate: UHMW self-adjusting seals are attached to the invert frame which is welded to the guide frame sides across the bottom to form a continuous frame and seal assembly. The frame is mounted so that the gate invert is flush with the channel or port bottom. The flush-bottom design maximizes flow to that of the channel, or port opening.

Seals

All gate side frames, slide gate upper seals, and weir gate invert seals shall prevent leakage using a UHMW bearing bar/seal that requires no adjustment. Seal pressure shall be made constant automatically by means of an integrated round section nitrile member within a continuous extruded slot in the bearing bar/seal. The cord shall exert pressure on the UHMW away from the frame face and compressing the seal against the plate face.

UHMW polymer shall be made from black virgin resins with an ultraviolet inhibiting formula. The bearing bar/seal and cord can be replaced without dismantling or loosening any portion of the frame. Bearing bar/seal shall be held in place laterally by the frame construction and requires no bolts or fastened retainers. Access to seals shall be

by means of a securing cap at the bench, allowing for service at the gate operating elevation.

Manual Operator

The standard gate operator will be a BS-1015 horizontal handwheel type mounted on a pedestal or benchstand unless otherwise specified. The bronze operating nut of the operator will be accurately machined to match the thread of the rising stem. Non-rising stems shall be used where specified, where overhead space is limited, or where mounting the operator in a floor box is required. The operating nut shall be supported by regreasable ball or roller thrust bearings top and bottom secured in an accurately machined cast aluminum or iron housing bolted to the bench or pedestal.

Where torque, operation (including dual stems) or space requirements dictate, bevel gear boxes with either a handcrank or handwheel shall be supplied in lieu of the standard operator. Bevel gear boxes shall have stainless steel input and/or output shafts, accurately machined gears supported by ball or roller bearings secured in an accurately machined cast aluminum or iron housing bolted to the bench or pedestal. An AWWA nut with or without a floor box will be supplied where t-wrench or portable actuator operation is required and may be a standalone input or an integral part of a crank, handwheel, or gear box.

Regardless of the manual operator used to meet the specification, the maximum effort on the handwheel, crank or AWWA nut is to be limited to less than a 40 lb. pull. The lift mechanism will be capable of withstanding an effort of up 200 lbs. or more without damage to the operator, stem or gate frame. Manually operated gates are to be supplied with adjustable stop collars as required to set the gate opening range. Where the size of the gate requires lift assist but the frequency of operation does not indicate use of a permanent electric operator, a

portable electric or hydraulic operator with height adjustable floor stand or bench mount will be supplied as specified.

Electric Operator Option

The slide/weir gate will be provided with an electric multi-turn operator incorporating integral limit switches to stop the gate plate in the desired open and closed positions. The operator will also have a torque limit switch to prevent damage to an obstructed gate. Operators can be specified for modulating function where required to maximize level or flow control. Electric operators shall be in accordance with ANSI/AWWA C540 "Standard for Power-Actuating Devices for Valves and Slide Gates".

Dual Operator

When the plate width exceeds twice the height or 60 inches, interconnected operators and stems are to be used. Operators for multiple stems will be linked with stainless steel shafts and couplings and can be manually or electrically powered.

Stems

Stem shall be of 1½" diameter stainless steel rod with accurately machined Acme stub threads. Stem shall be designed for a safety factor of 2 based on a critical buckling compressive load calculated by the Euler Column formula where C=2 and assuming a 50 lb torque on the AWWA nut. A stem pocket shall be welded to the face of the stiffened side of the plate and to the uppermost stiffener. The stem shall fit within the slide plate stem pocket and be attached to the pocket by means of a stainless steel bolt capable of withstanding the full force of the operator stem under full design head.

Stem guides will be supplied to support the stem as required to meet the stem design criteria and shall be fabricated of the same alloy material as the gate and frame. Stem guides shall have bronze or UHMW bushings to reduce stem friction and wear as required by the installation. Stem guides shall be adjustable in multiple dimensions to allow for

alignment with operator and gate stem nut. Guides will be mounted on the gate frame or installation wall as required to support and align the stem(s) properly.

NOTES:

Other Features:

All WACO Products gates are made to order from approved drawings and our standard designs can be customized to fit virtually any specific head, mounting, or operating condition.

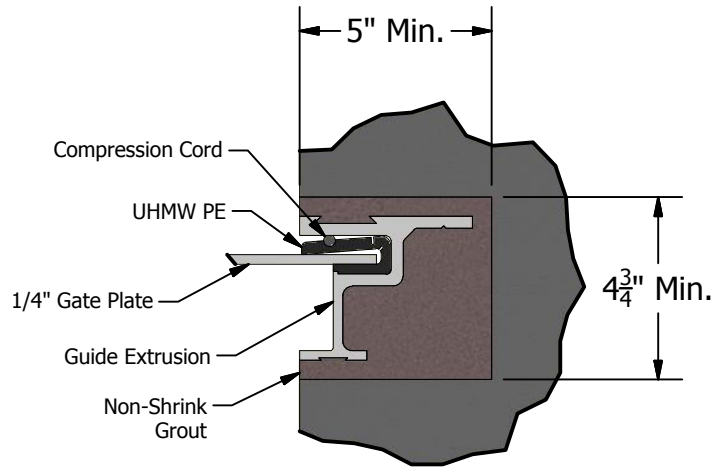
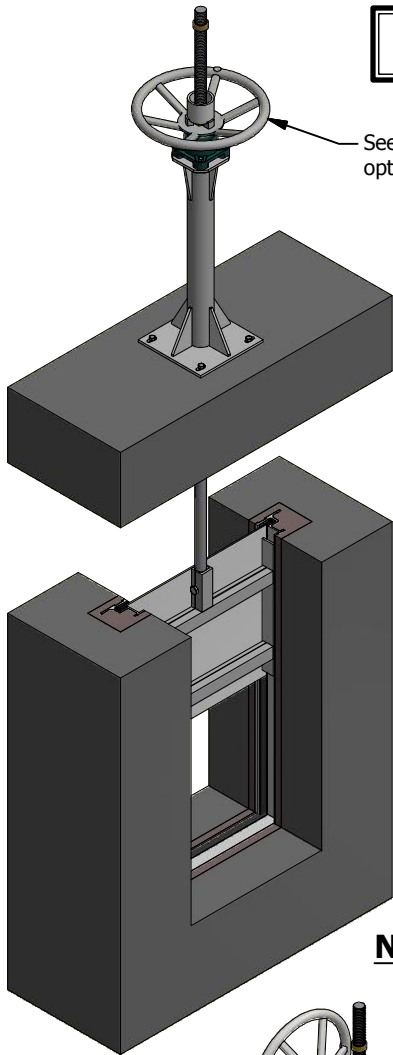
Specifying Style:

To specify Series 6500 models, use the specifying grid by selecting the opening type and mounting style required. Where the installation may require a combination of frame types (i.e. embedded side frame with channel mounted invert frame) please call WACO Products Engineering Department for recommendations and model designation.

WACO Products, Inc.

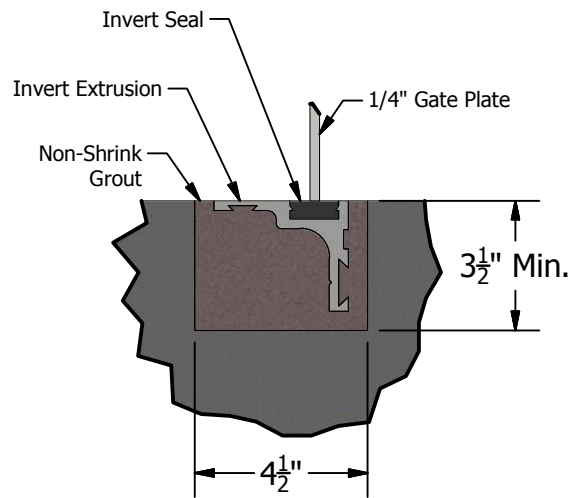
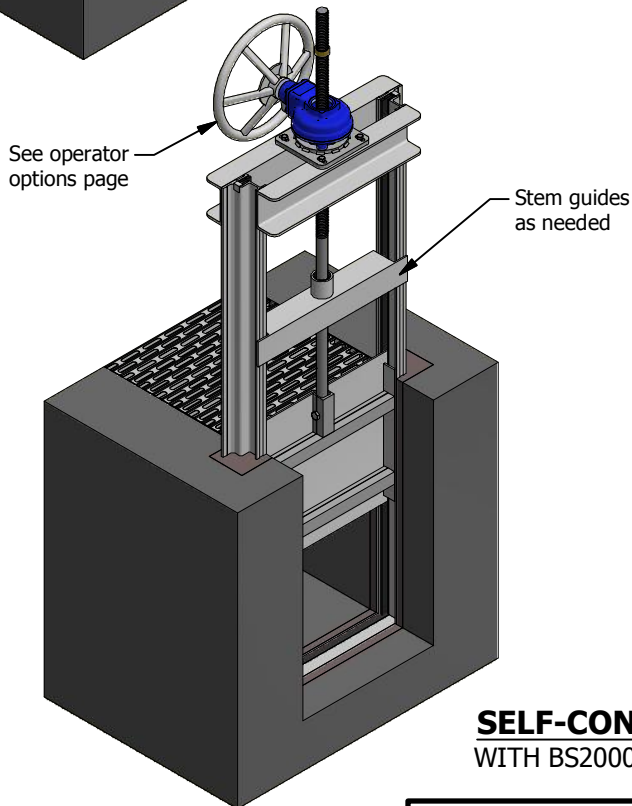
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Sales@WACOProducts.com

WACO Series 6524 Slide Gates



Guide Frame

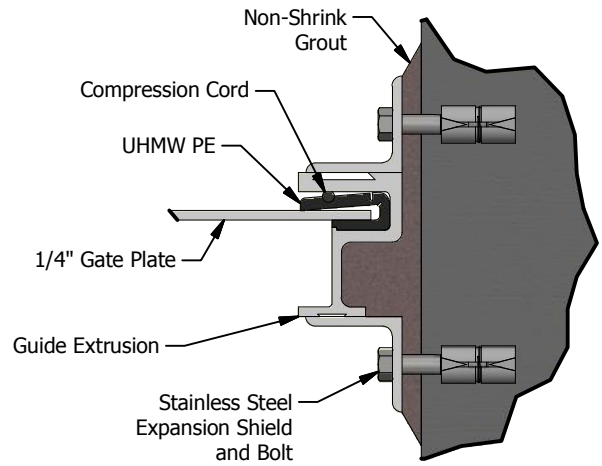
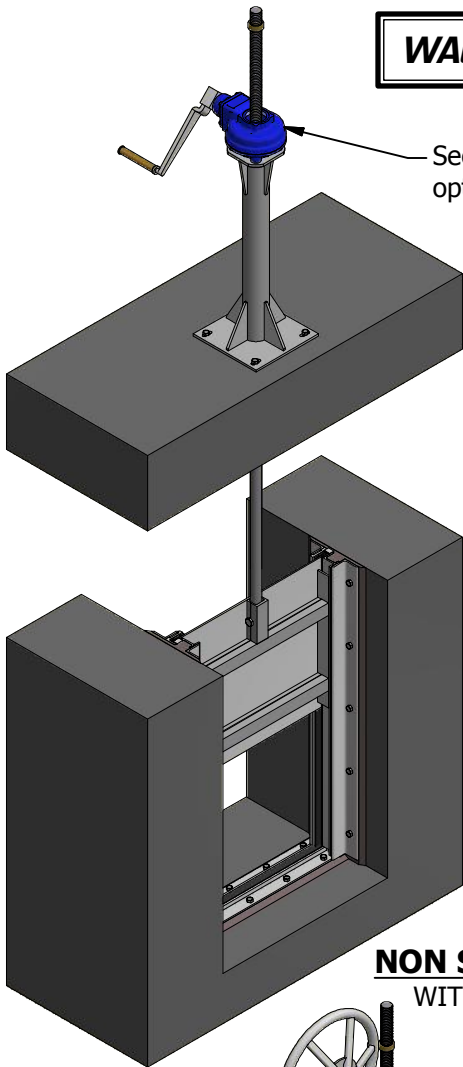
NON SELF-CONTAINED GATE WITH BS1015 AND HANDWHEEL



Flush Bottom Invert

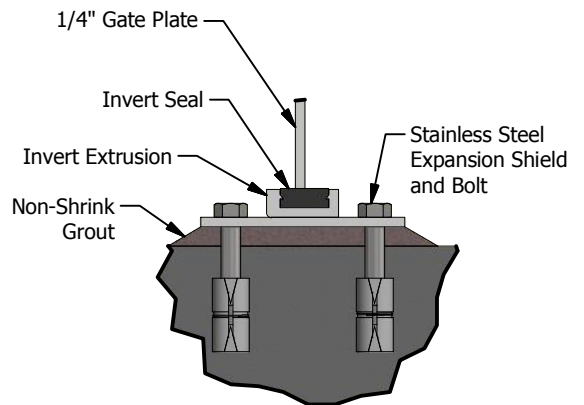
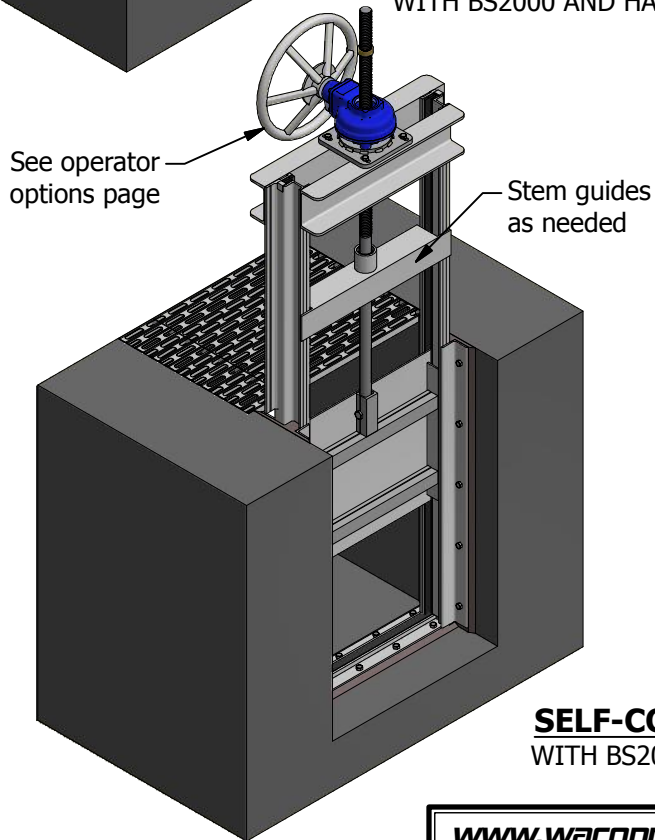
SELF-CONTAINED GATE WITH BS2000 AND HANDWHEEL

WACO Series 6534 Slide Gates



Guide Frame

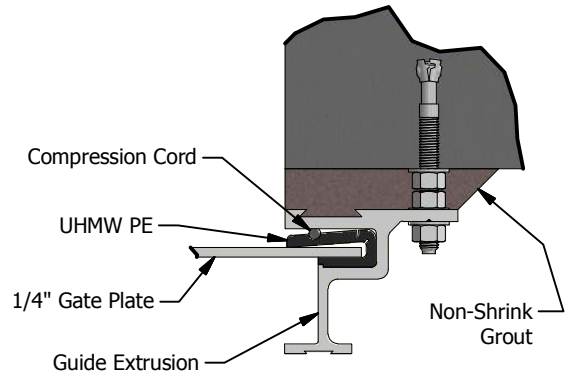
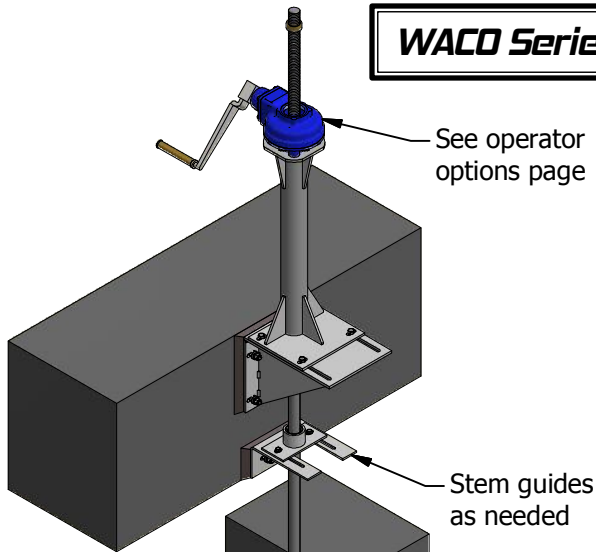
NON SELF-CONTAINED GATE WITH BS2000 AND HANDCRANK



Invert

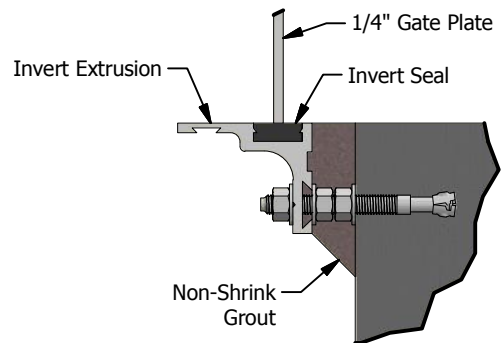
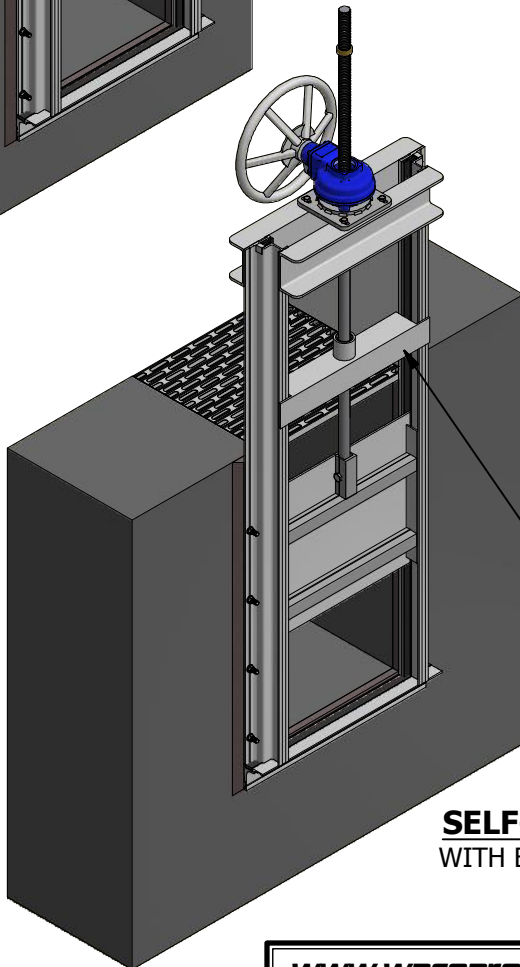
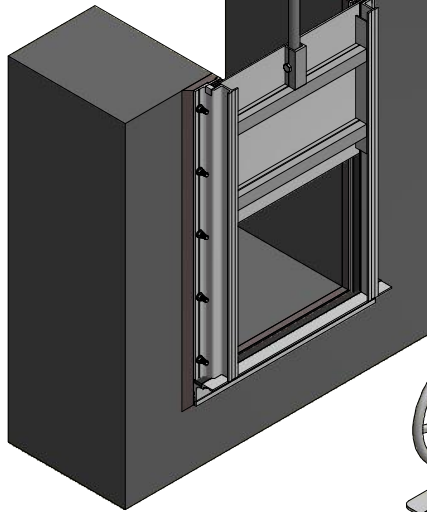
SELF-CONTAINED GATE WITH BS2000 AND HANDWHEEL

WACO Series 6544 Slide Gates



Guide Frame

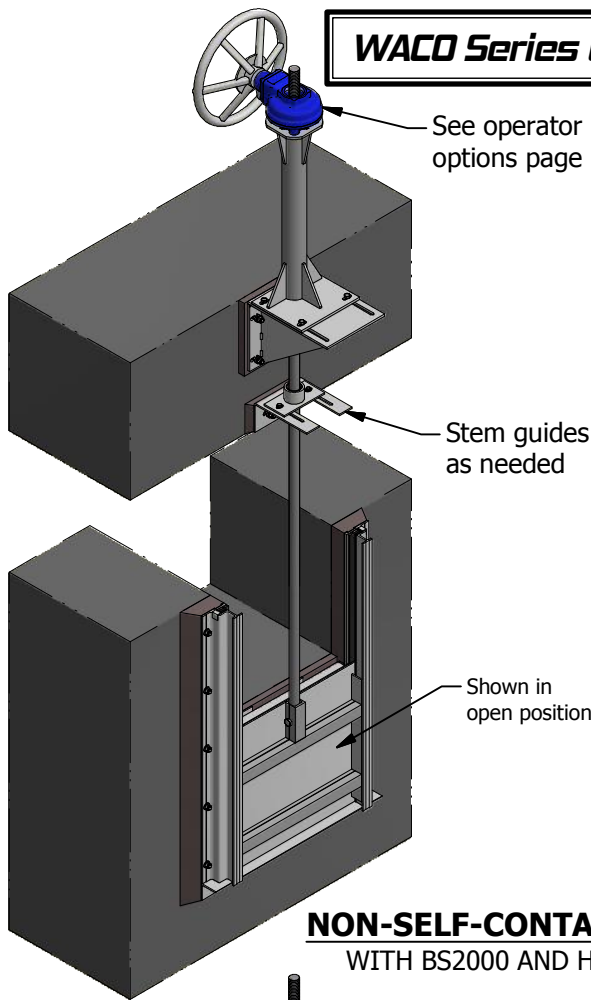
NON SELF-CONTAINED GATE WITH BS2000 AND HANDCRANK



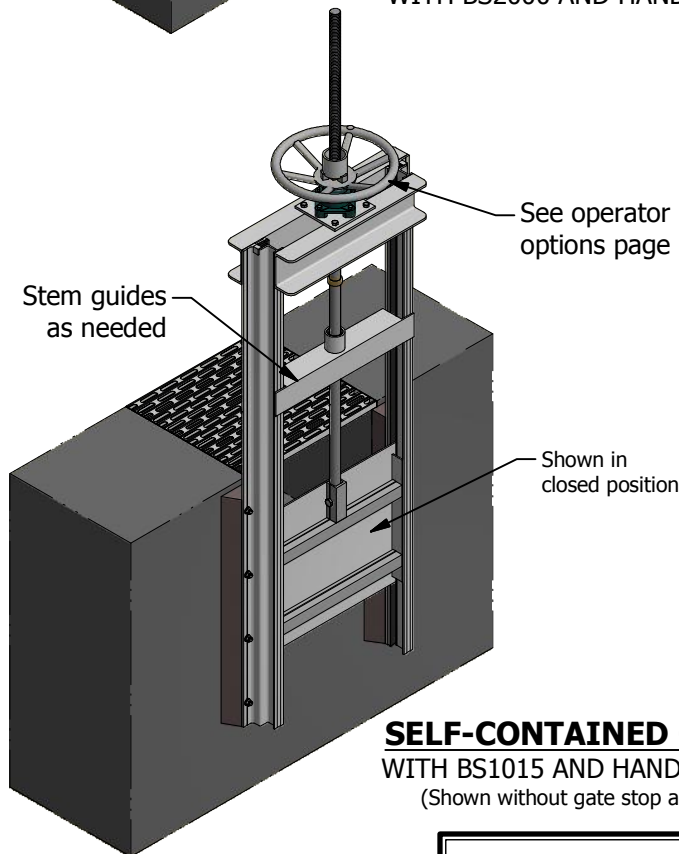
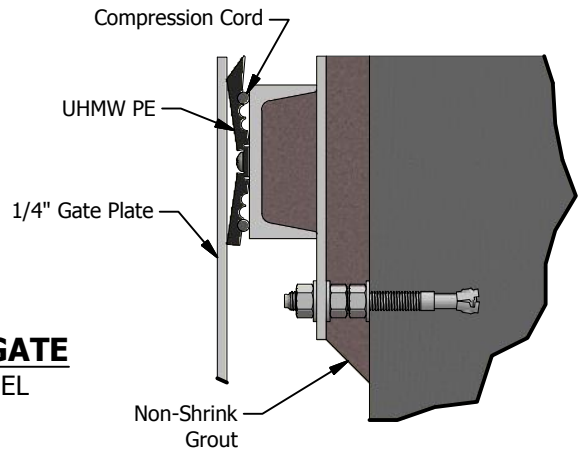
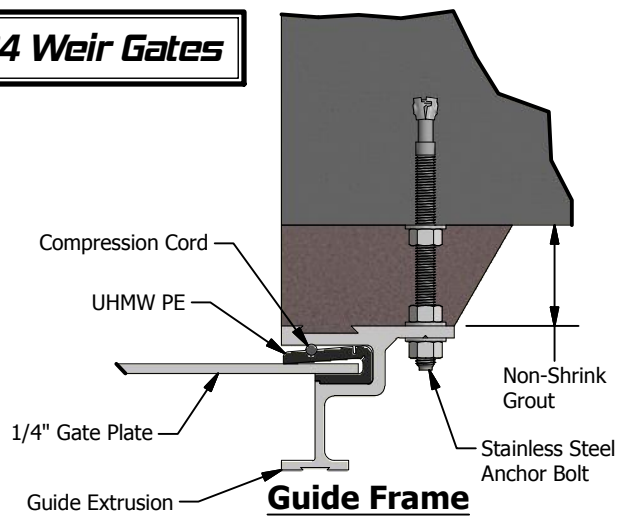
Flush Bottom Invert

SELF-CONTAINED GATE WITH BS2000 AND HANDWHEEL

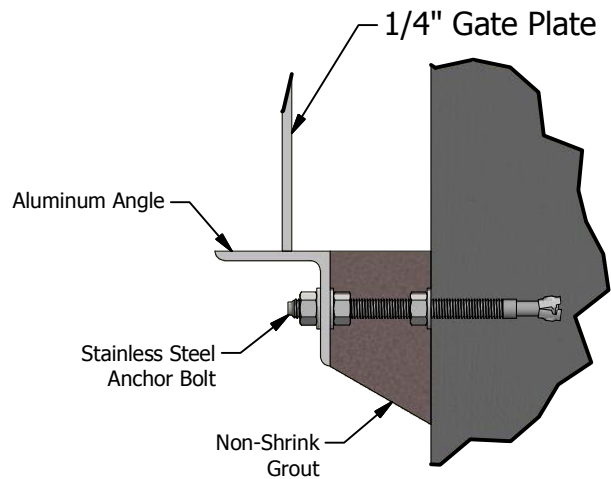
WACO Series 6564 Weir Gates



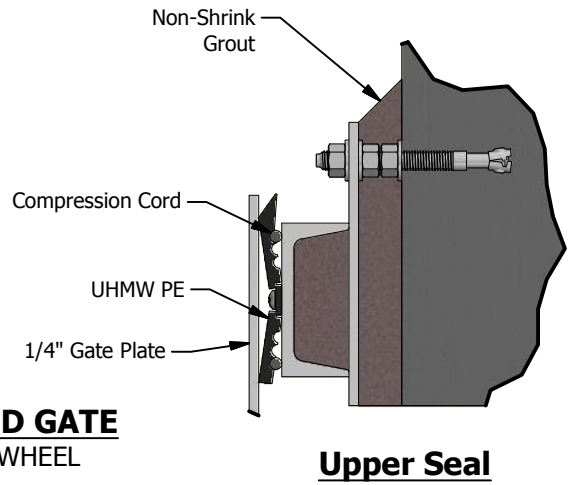
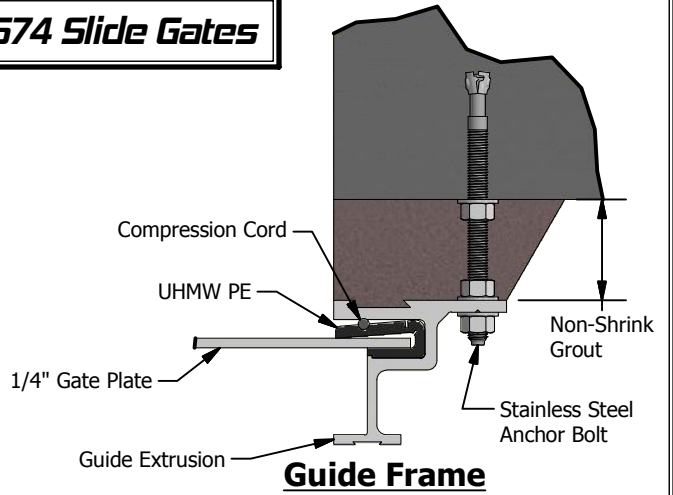
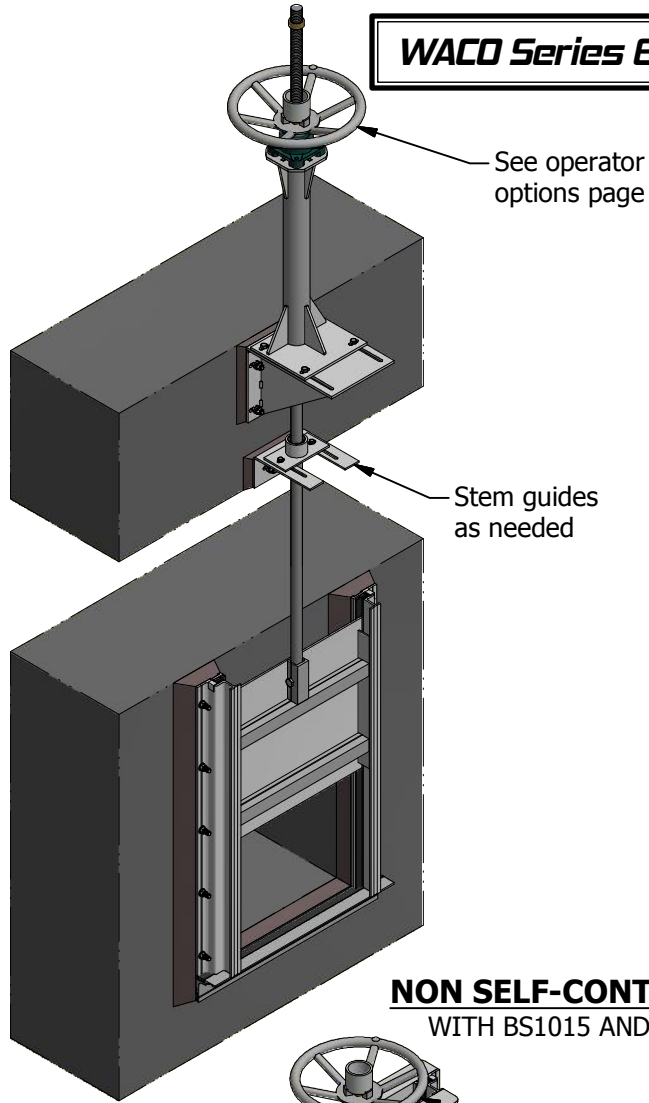
NON-SELF-CONTAINED GATE
WITH BS2000 AND HANDWHEEL



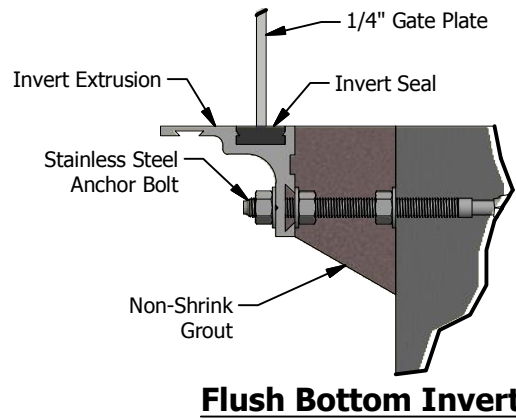
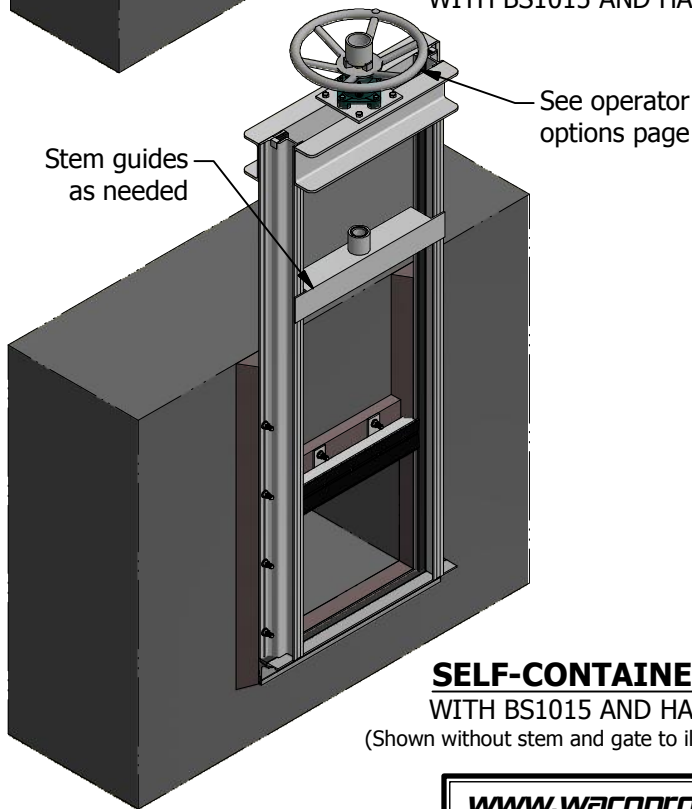
SELF-CONTAINED GATE
WITH BS1015 AND HANDWHEEL
(Shown without gate stop angle)



WACO Series 6574 Slide Gates

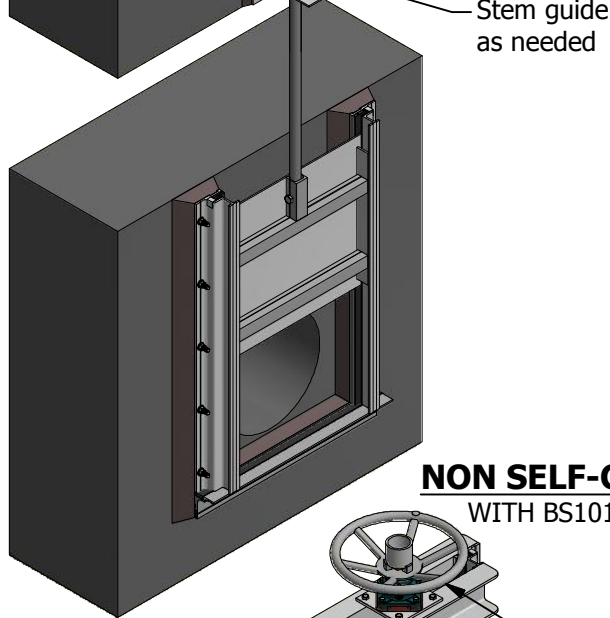
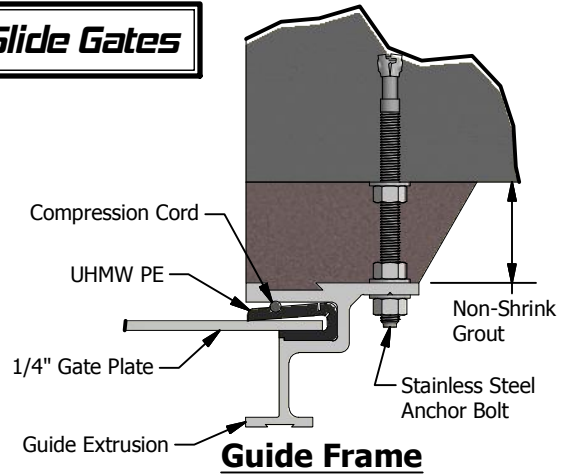
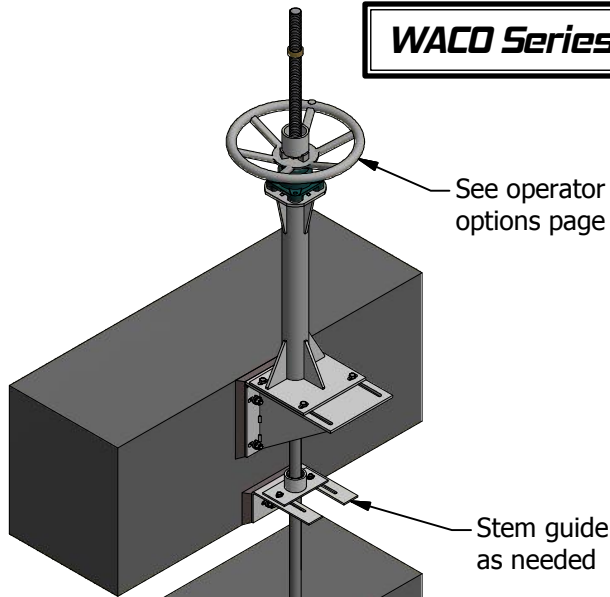


NON SELF-CONTAINED GATE
WITH BS1015 AND HANDWHEEL

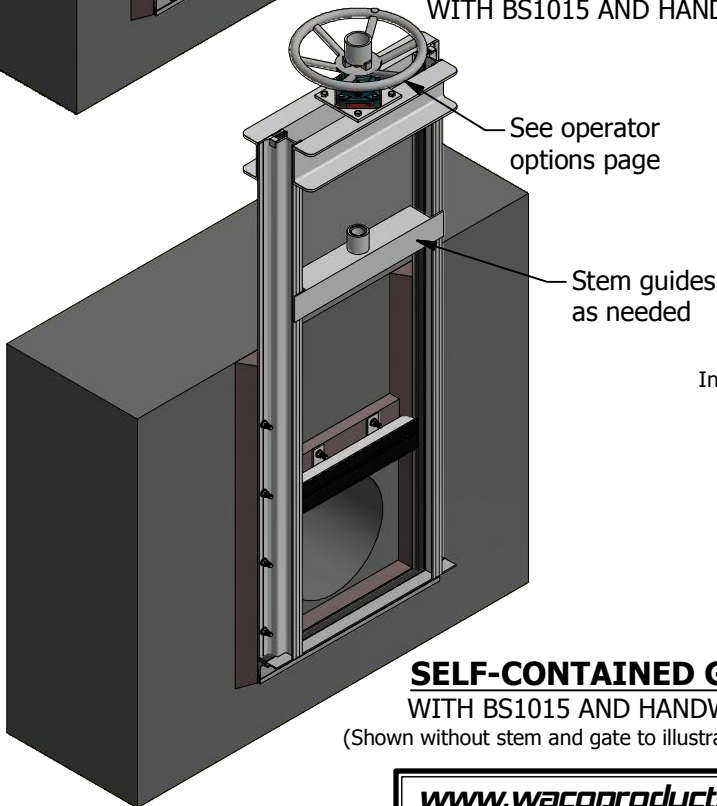
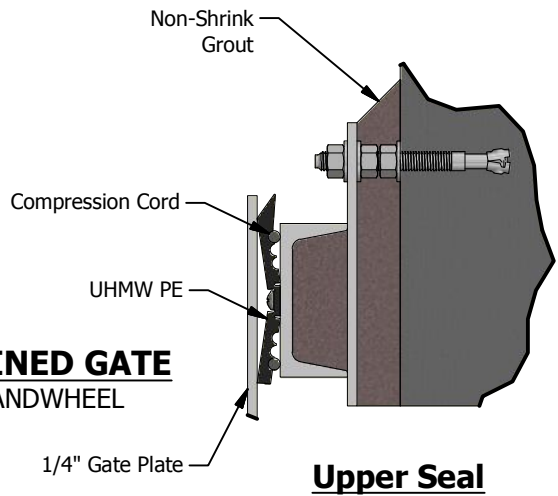


SELF-CONTAINED GATE
WITH BS1015 AND HANDWHEEL
(Shown without stem and gate to illustrate upper seal)

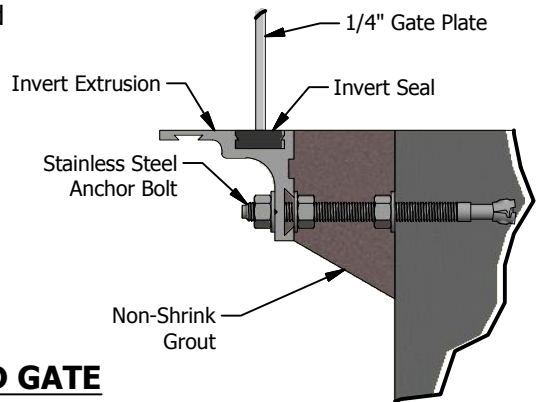
WACO Series 6584 Slide Gates



**NON SELF-CONTAINED GATE
WITH BS1015 AND HANDWHEEL**



**SELF-CONTAINED GATE
WITH BS1015 AND HANDWHEEL**
(Shown without stem and gate to illustrate upper seal)





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WACO 7500 Series Fabricated Stainless Steel Slide & Weir Gates: Sample Specification

General

The fabricated stainless steel gates shall be Series 7500 type as manufactured by WACO Products, Inc., Baltimore, Maryland or equal. Gates shall be furnished with all necessary accessories and parts for a complete installation and shall be the latest standard product of a manufacturer regularly engaged in the production of equipment of this type. All gates shall be furnished by the same manufacturer. Upward opening gates shall be designated "slide gates" and downward opening gates shall be designated as "weir gates".

Design

Gates shall be fabricated from 304 or 316 stainless steel alloys as required. All gates are to be designed and manufactured to meet or exceed all AWWA C561 "Standard for Fabricated Stainless Steel Slide Gates" specifications, including those defining allowable leakage, head and loading calculations, structural strength and deflection requirements, and material specifications and minimum dimensions.

Slide/Weir Plate

The slide/weir plate is fabricated from minimum 1/4" thickness stainless steel plate and reinforced as required. Deflection under full design head will be no more than 1/360 of the span width of the gate.

Guide Frame & Bench

The guide frame is fabricated from minimum 1/4" thickness stainless

steel structural members to resist loads imposed by the design head. Additionally, any self-contained frame will require no additional reinforcing where it extends above the operating floor to support the operator.

The frame is fabricated to accommodate a one-piece Ultra High Molecular Weight Polyethylene (UHMW) bearing bar/seal. This bearing bar/seal is supplied mounted in the frame to reduce friction and wear between the slide/weir plate and frame faces, as well as to form the side seal seats to prevent leakage.

On self-contained frames the bench (yoke) to support the operator is formed by two back to back structural shapes, angles or channels as loading requires, which are welded or bolted to the guide frame to provide a rigid one-piece frame assembly. The bench shall be capable of supporting all loads imparted by the operator, and shall have a deflection under full design head operation of no more than 1/360 of the span width of the gate.

For non-self-contained frames, a fabricated pedestal of the same alloy as the frame is mounted on the operating floor or over-hung off of a wall at the operating level by means of an offset wall bracket. The pedestal shall be capable of supporting all loads imparted by the operator.

Invert

Slide gate: The frame bottom, or invert, is a flush-bottom design formed by a neoprene block sandwiched between two structural members with a welded bottom member to form a seating surface for the edge of the plate bottom and to retain the neoprene. The flush-bottom design maximizes flow to that of the channel, port, or pipe opening.

Weir gate: UHMW self-adjusting seals are attached to the invert frame which is welded to the guide frame sides across the bottom to form a continuous frame and seal assembly. The frame is mounted so that the gate invert is flush with the channel or port bottom. The flush-bottom design maximizes flow to that of the channel, or port opening.

Seals

All gate side frames, slide gate upper seals, and weir gate invert seals shall prevent leakage using a UHMW bearing bar/seal that requires no adjustment. Seal pressure shall be made constant automatically by means of an integrated round section nitrile member within a continuous extruded slot in the bearing bar/seal. The cord shall exert pressure on the UHMW away from the frame face and compressing the seal against the plate face.

UHMW polymer shall be made from black virgin resins with an ultraviolet inhibiting formula. The bearing bar/seal and cord can be replaced without dismantling or loosening any portion of the frame. Bearing bar/seal shall be held in place laterally by the frame construction and requires no bolts or fastened retainers. Access to seals shall be by means of a securing cap at the bench, allowing for service at the gate operating elevation.

Manual Operator

The standard gate operator will be a BS-1015 horizontal handwheel type mounted on a pedestal or benchstand unless otherwise specified. The bronze operating nut of the operator will be accurately machined to match the thread of the

rising stem. Non-rising stems shall be used where specified, where overhead space is limited, or where mounting the operator in a floor box is required. The operating nut shall be supported by regreasable ball or roller thrust bearings top and bottom secured in an accurately machined cast aluminum or iron housing bolted to the bench or pedestal.

Where torque, operation (including dual stems) or space requirements dictate, BS-2000 type bevel gear boxes with either a handcrank or handwheel shall be supplied in lieu of the standard operator. Bevel gear boxes shall have stainless steel input and/or output shafts, accurately machined gears supported by ball or roller bearings secured in an accurately machined cast aluminum or iron housing bolted to the bench or pedestal. An AWWA nut with or without a floor box will be supplied where t-wrench or portable actuator operation is required and may be a standalone input or an integral part of a crank, handwheel, or gear box.

Regardless of the manual operator used to meet the specification, the maximum effort on the handwheel, crank or AWWA nut is to be limited to less than a 40 lb. pull. The lift mechanism will be capable of withstanding an effort of up 200 lbs. or more without damage to the operator, stem or gate frame. Manually operated gates are to be supplied with adjustable stop collars as required to set the gate opening range. Where the size of the gate requires lift assist but the frequency of operation does not indicate use of a permanent electric operator, a portable electric or hydraulic operator with height adjustable floor stand or bench mount will be supplied as specified.

Electric Operator Option

The slide/weir gate will be provided with an electric multi-turn operator incorporating integral limit switches to stop the gate plate in the desired open and closed positions. The operator will also have a torque limit switch to prevent damage to an obstructed gate. Operators can be

specified for modulating function where required to maximize level or flow control. Electric operators shall be in accordance with ANSI/AWWA C540 "Standard for Power-Actuating Devices for Valves and Slide Gates".

Dual Operator

When the plate width exceeds twice the height or 60 inches, interconnected operators and stems are to be used. Operators for multiple stems will be linked with stainless steel shafts and couplings and can be manually or electrically powered.

Stems

Stem shall be of 1½" diameter stainless steel rod with accurately machined Acme stub threads. Stem shall be designed for a safety factor of 2 based on a critical buckling compressive load calculated by the Euler Column formula where C=2 and assuming a 50 lb torque on the AWWA nut. A stem pocket shall be welded to the face of the stiffened side of the plate and to the uppermost stiffener. The stem shall fit within the slide plate stem pocket and be attached to the pocket by means of a stainless steel bolt capable of withstanding the full force of the operator stem under full design head.

Stem guides will be supplied to support the stem as required to meet the stem design criteria and shall be fabricated of the same alloy material as the gate and frame. Stem guides shall have bronze or UHMW bushings to reduce stem friction and wear as required by the installation. Stem guides shall be adjustable in multiple dimensions to allow for alignment with operator and gate stem nut. Guides will be mounted on the gate frame or installation wall as required to support and align the stem(s) properly.

NOTES:

Other Features:

All WACO Products gates are made to order from approved drawings and our standard designs can be customized to fit virtually any specific head, mounting, or operating condition.

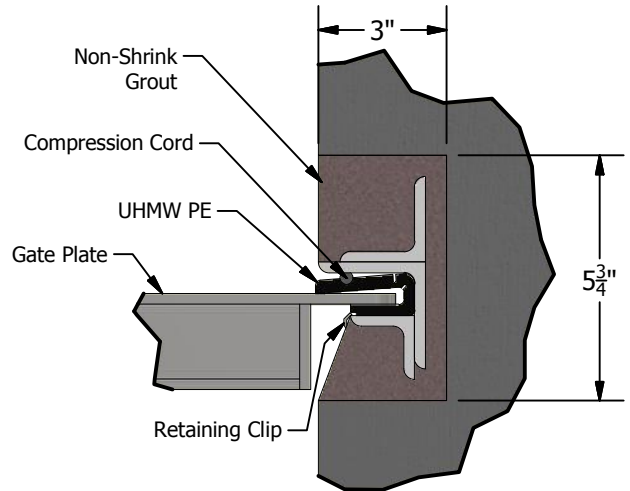
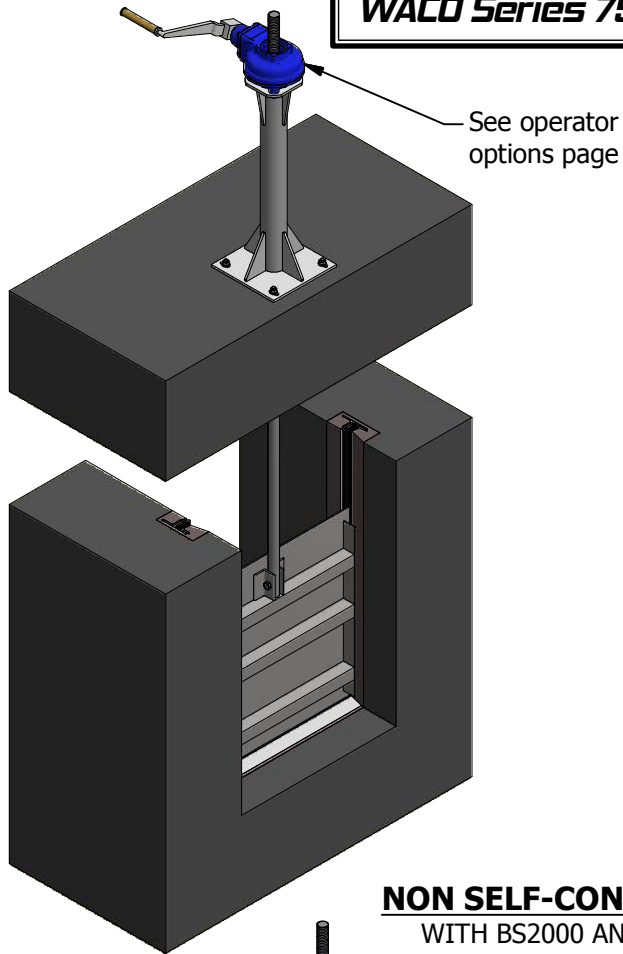
Specifying Style:

To specify Series 7500 models, use the specifying grid by selecting the opening type and mounting style required. Where the installation may require a combination of frame types (i.e. embedded side frame with channel mounted invert frame) please call WACO Products Engineering Department for recommendations and model designation.

WACO Products, Inc.

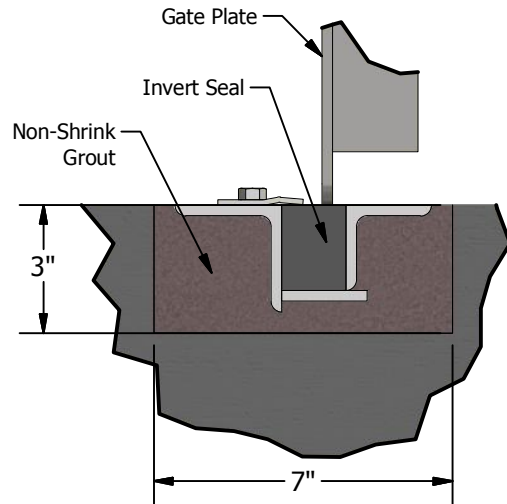
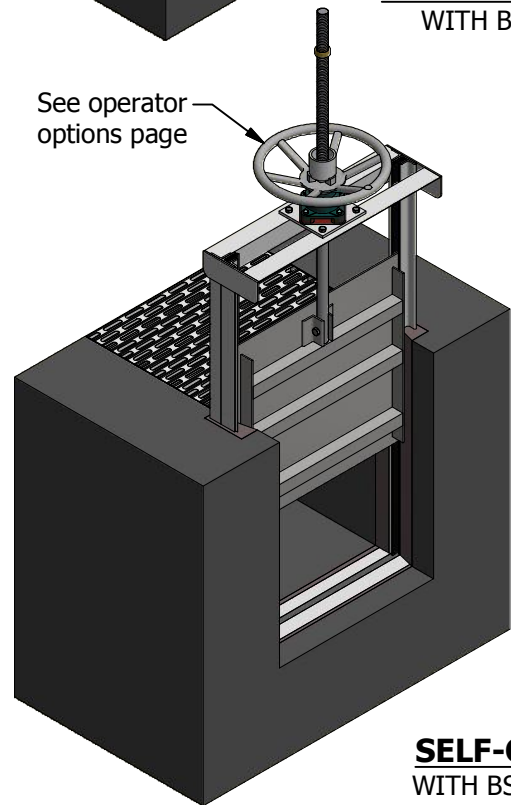
1330 Knecht Avenue
Baltimore, Maryland 21229-5511
410-242-1000 Fax 410-247-4890
Sales@WACOProducts.com

WACO Series 7524/6 Slide Gates



Guide Frame

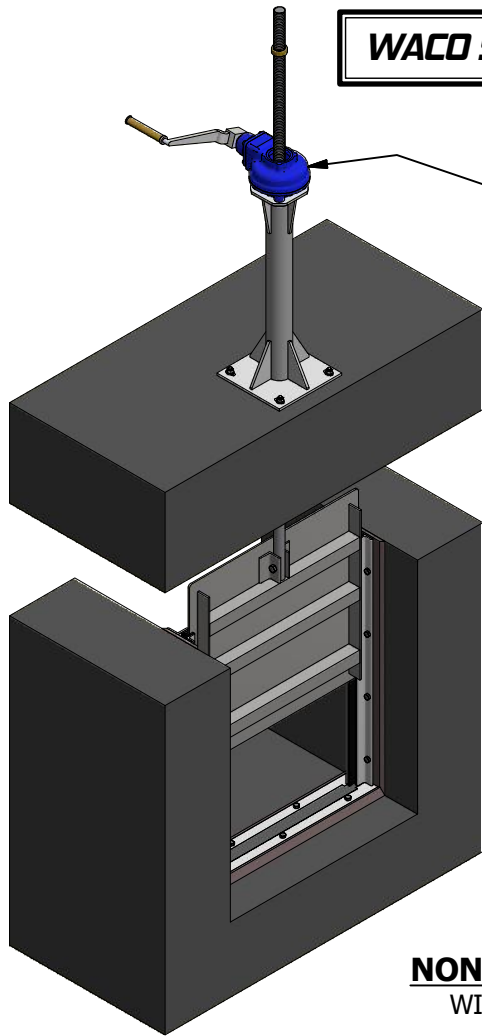
**NON SELF-CONTAINED GATE
WITH BS2000 AND HANDCRANK**



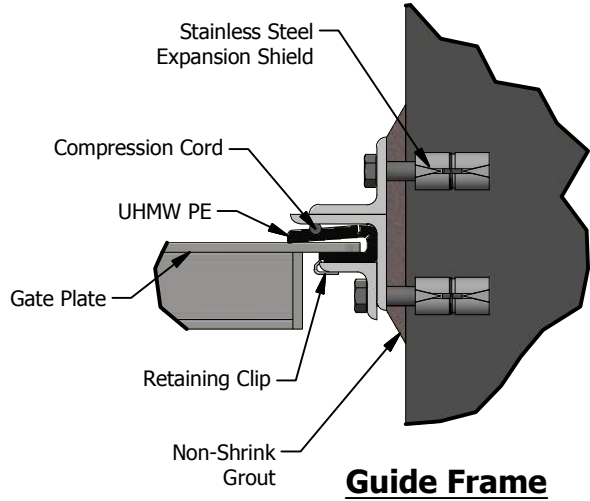
Invert Frame

**SELF-CONTAINED GATE
WITH BS1015 AND HANDWHEEL**

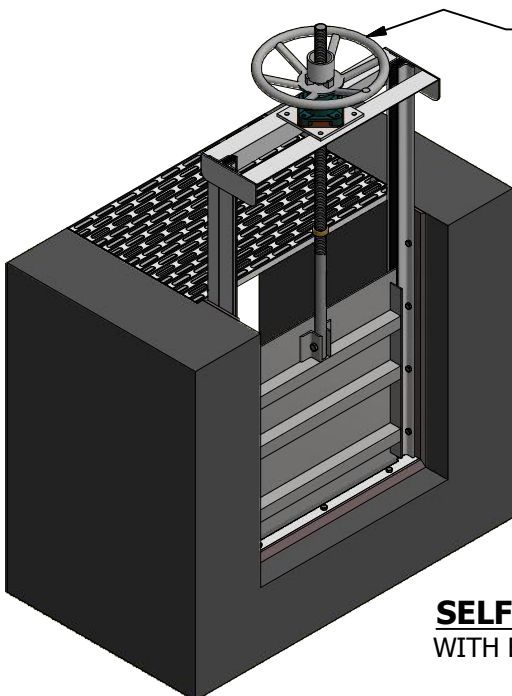
WACO Series 7534/6 Slide Gates



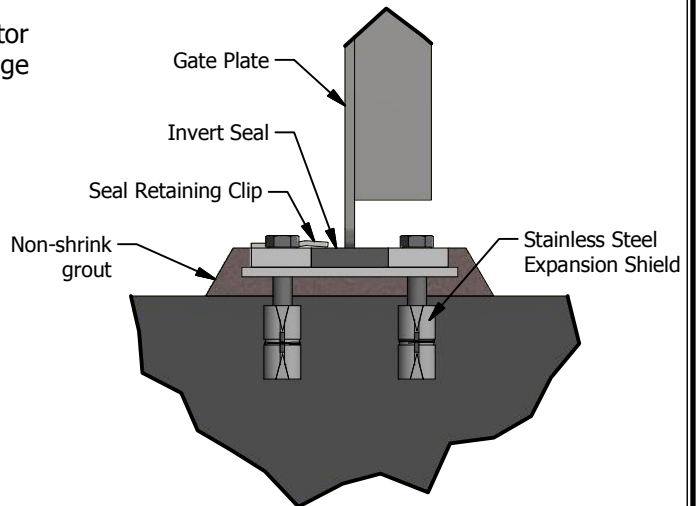
See operator options page



NON SELF-CONTAINED GATE
WITH BS2000 AND HANDCRANK



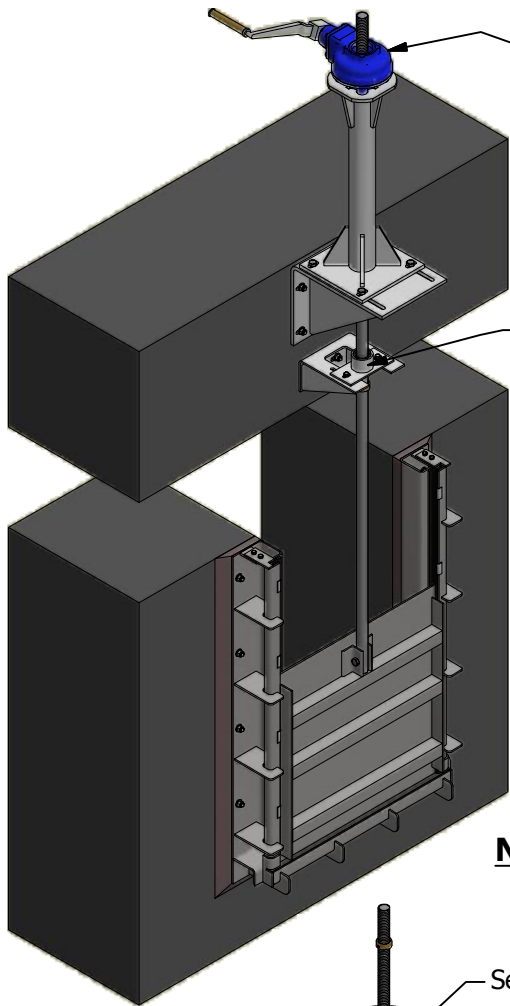
See operator options page



Invert Frame

SELF-CONTAINED GATE
WITH BS1015 AND HANDWHEEL

WACO Series 7544/6 Slide Gates



See operator options page

Stem guides as needed

Non-Shrink Grout

Single Piece Frame

Compression Cord

UHMW PE

Gate Plate

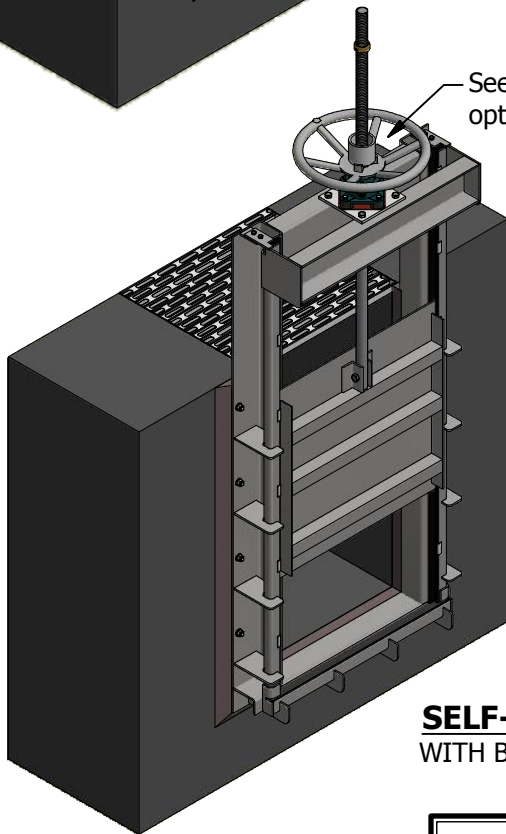
Stainless Steel Anchor Bolt

Gusset

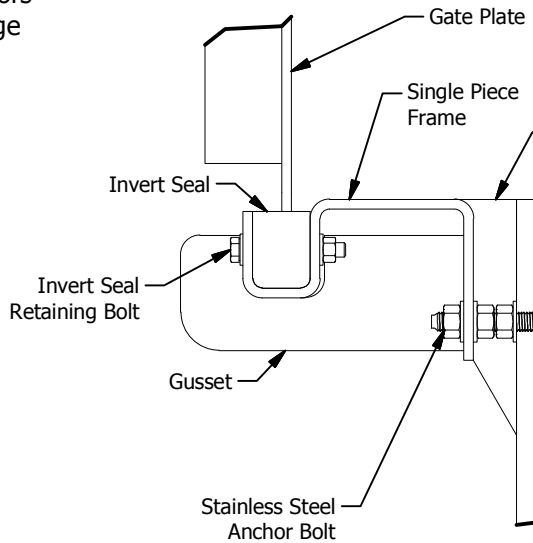
Retaining Clip

Guide Frame

NON SELF-CONTAINED GATE
WITH BS2000 AND HANDCRANK



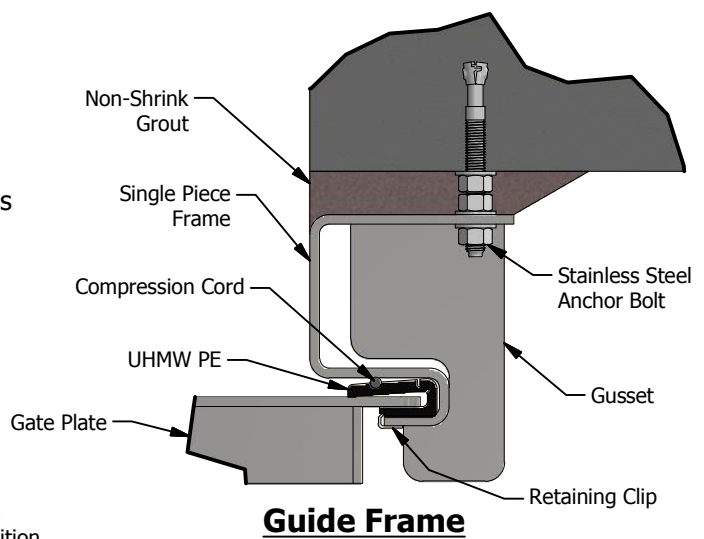
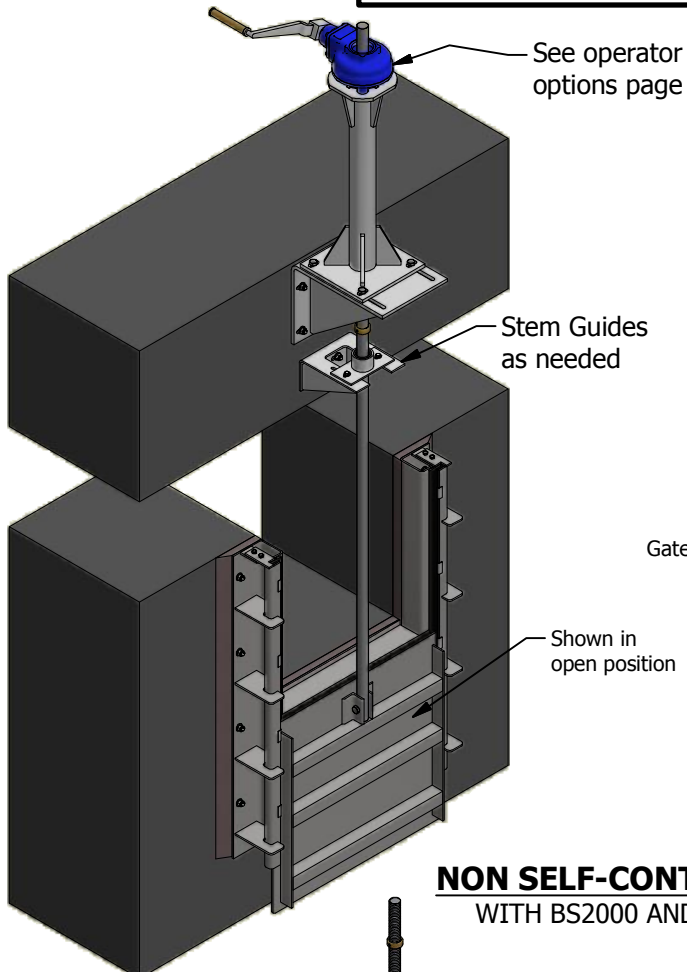
See operators options page



Invert Frame

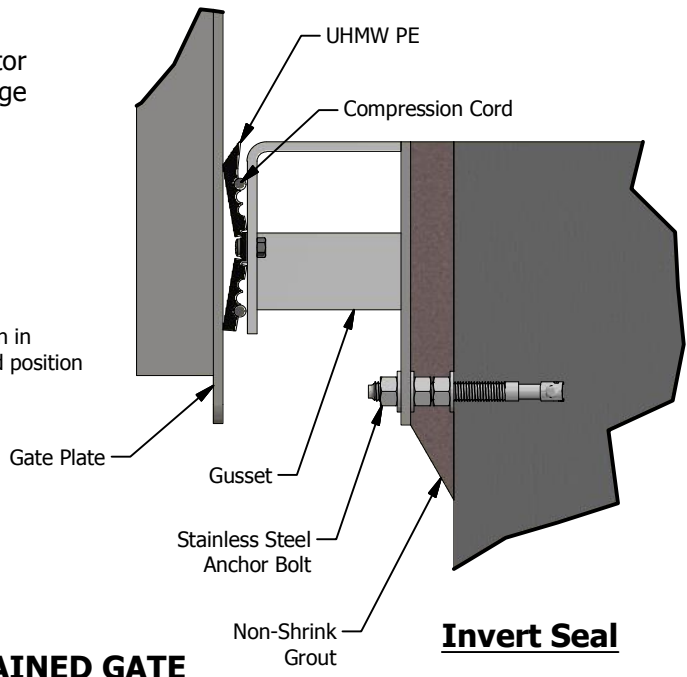
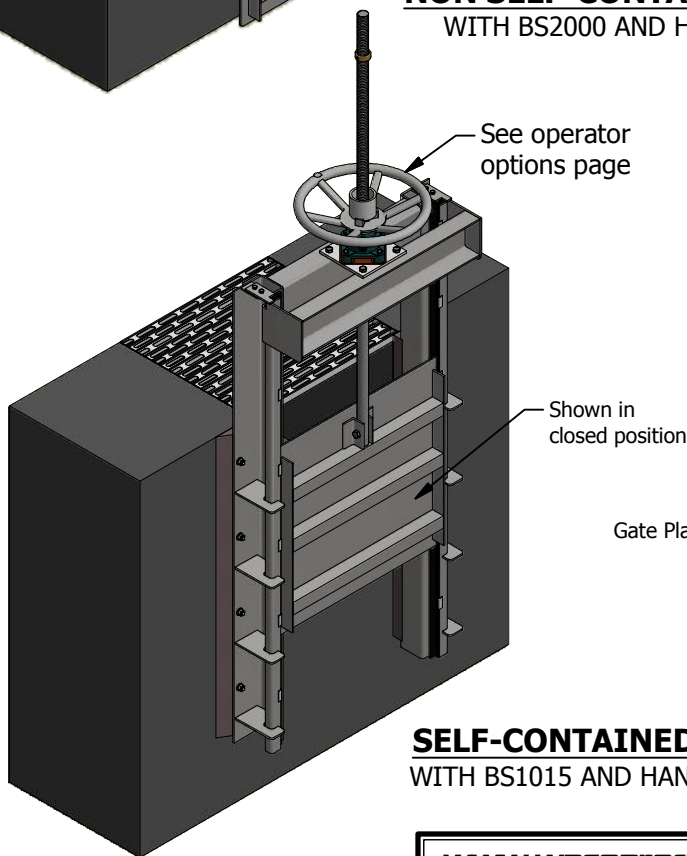
SELF-CONTAINED GATE
WITH BS1015 AND HANDWHEEL

WACO Series 7564/6 Weir Gates



Guide Frame

**NON SELF-CONTAINED GATE
WITH BS2000 AND HANDCRANK**

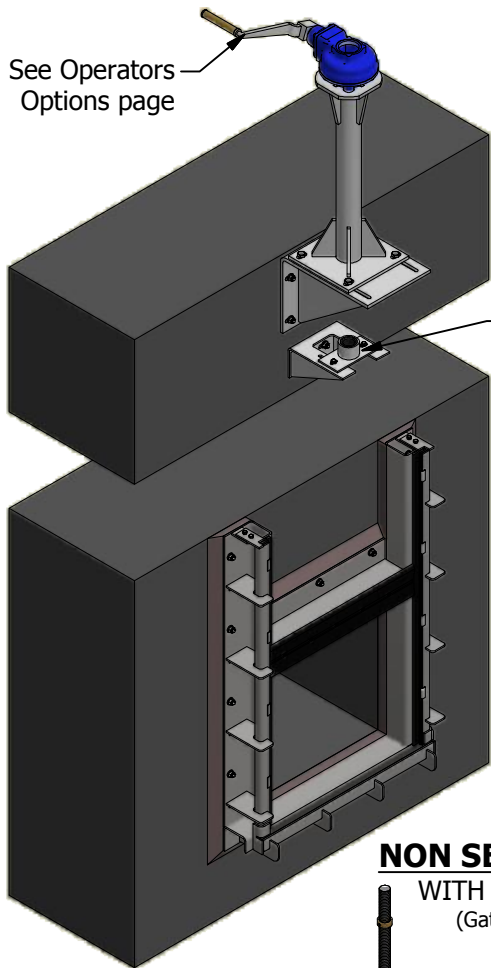


Invert Seal

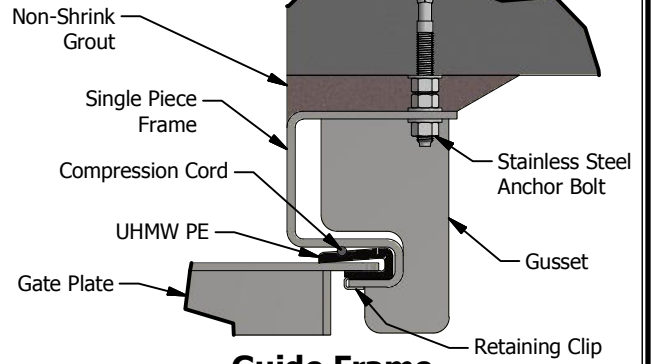
**SELF-CONTAINED GATE
WITH BS1015 AND HANDWHEEL**

WACO Series 7574/6 Slide Gates

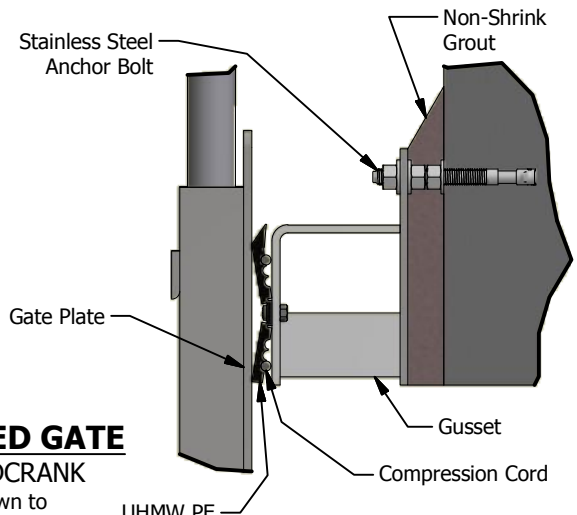
See Operators Options page



Stem guides as needed



Guide Frame

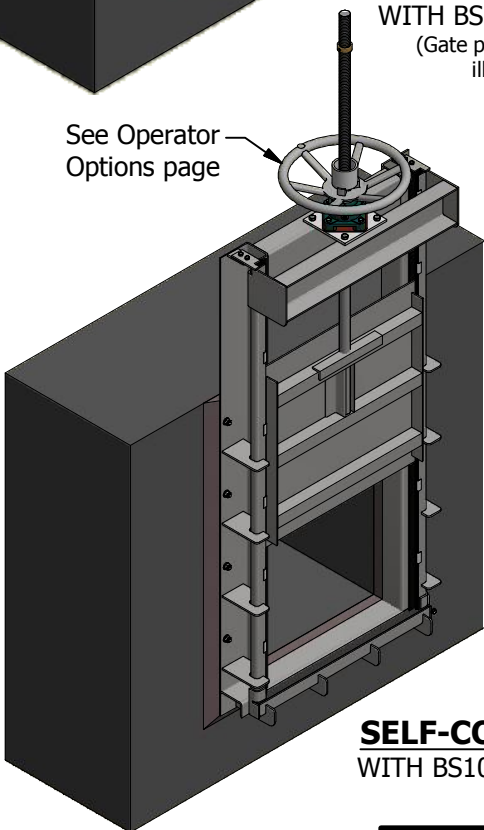


Upper Seal Frame

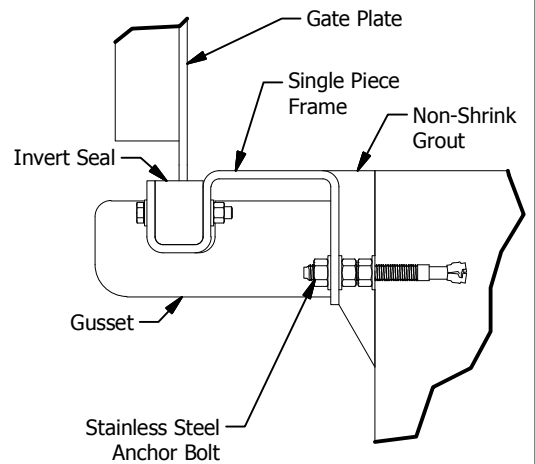
NON SELF-CONTAINED GATE

WITH BS2000 AND HANDCRANK
(Gate plate & stem not shown to illustrate upper seal)

See Operator Options page

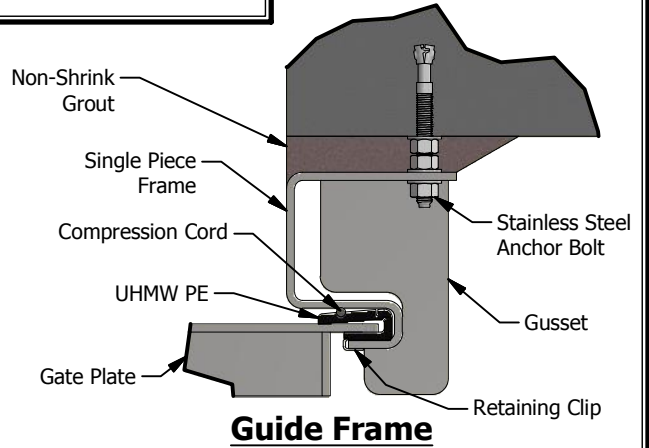
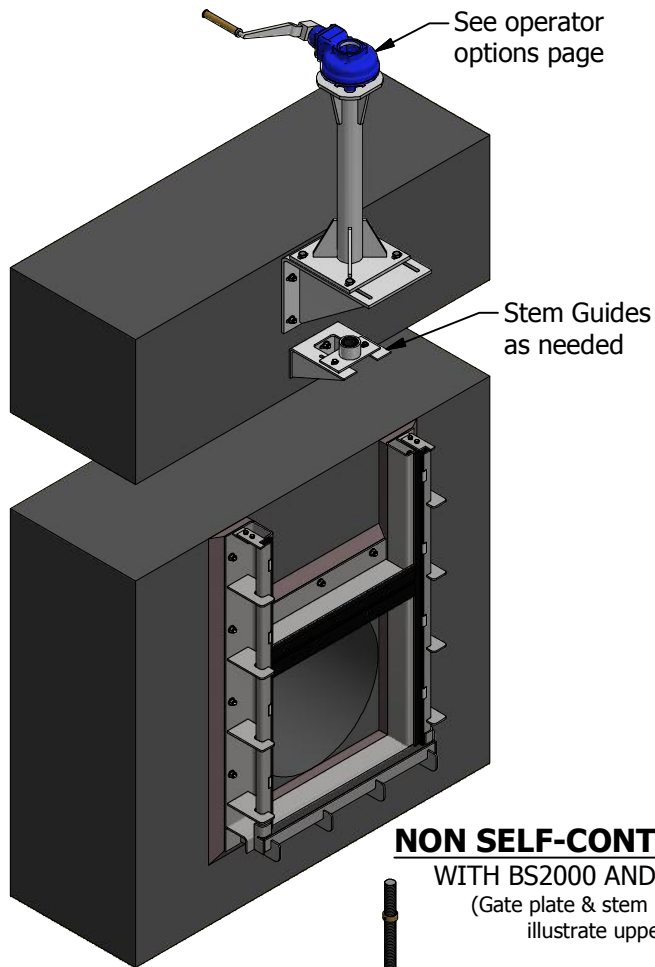


SELF-CONTAINED GATE
WITH BS1015 AND HANDWHEEL

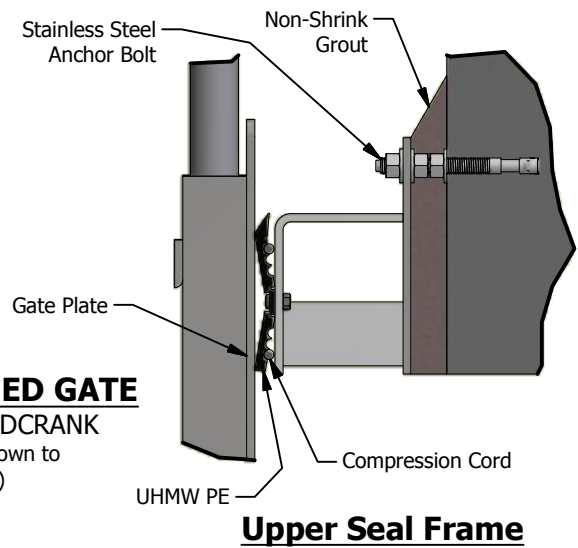


Invert Frame

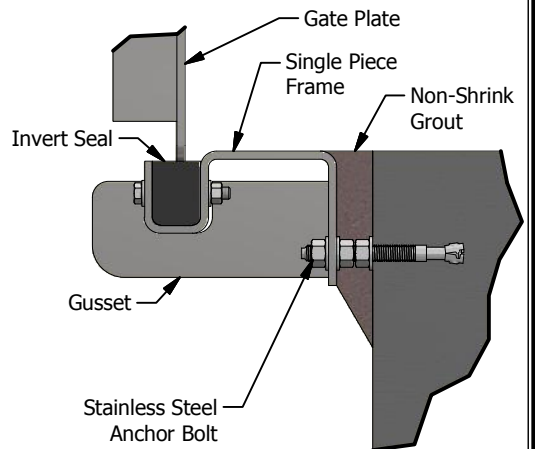
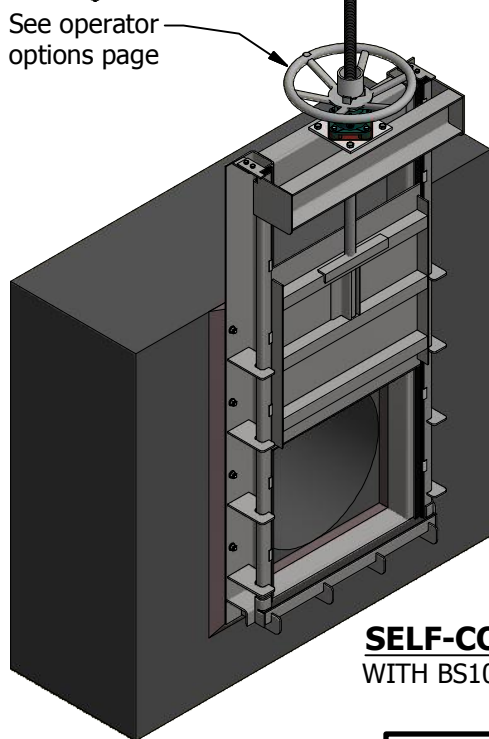
WACO Series 7584/6 Slide Gates



NON SELF-CONTAINED GATE
 WITH BS2000 AND HANDCRANK
 (Gate plate & stem not shown to illustrate upper seal)



Upper Seal Frame



SELF-CONTAINED GATE
 WITH BS1015 AND HANDWHEEL

Invert Frame

Appendix

This is to provide a guide for designing five different types of weirs which are commonly used for flow measurement and control.

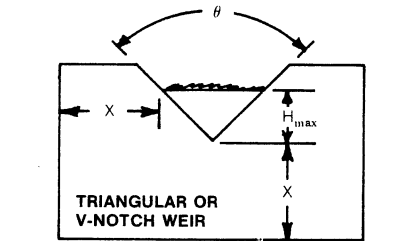
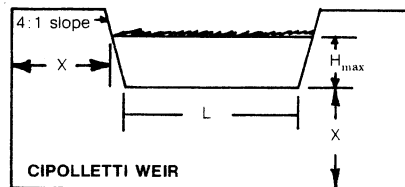
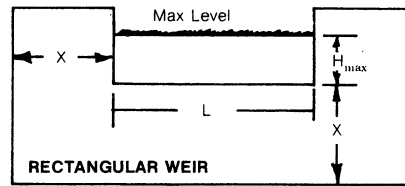
The first three weirs—the rectangular weir, the Cipolletti weir, and triangular or V-notched weir—have been presented very thoroughly in the "Handbook for Monitoring Industrial Wastewater" as prepared for the U.S. Environmental Protection Agency Office of Technology Transfer, by Associated Water and Air Resources Engineers, Inc., Nashville, Tennessee. These are the commonly used weirs for measuring waste flows.

Two other types of weirs, the proportional and the Sutro weir can be used for the control of velocity. "Sewage Treatment Plant Design—ASCE Manual No. 36" prepared by a Joint Committee of the American Society of Civil Engineers and the Water Pollution Control Federation contains the essential principles for the design of these two weirs.

Once you have selected a weir to design into your project, simply insert a layout of the 1/4 inch plate in your contract drawings or describe your requirement in writing within your mechanical specifications for WACO manual lift gates or WACO handwheel and handcrank lift slide gates. WACO will design the proper stiffening for the 1/4" plate and the mechanical lift system for the plate. Consult our factory applications engineers or our local representative for assistance with your specific lift system requirement.

Weirs

The weir is a commonly used device for measuring waste flows inasmuch as it is generally easy to install at low cost. Essentially, it is a dam, or other obstruction placed in a partly filled pipe, channel or stream. The water level at a given distance upstream from the weir is proportional to the flow. Commercially available weirs consist of a vertical plate with a sharp crest, the top of the plate being either straight or notched. Weirs can be installed at pipe outlets, in manholes or in open drains. Figure A shows five common types of sharp crested weirs with complete end contractions while Figure B shows a sharp crested weir profile. Proper form of the crest is important for accurate measurements, the water flowing over the crest being called the nappe. The main problem associated with rectangular weirs is that the flow will be contracted when it passes over the weir. Thus, the effective width of the weir is smaller than the width of the crest. The Cipolletti weir, which has sloping sides, was developed in order to compensate for this contraction and to be able to use the width of the crest for flow calculation. In order to design a weir that operates satisfactorily, the following general requirements should be considered:



L at least $3 H_{max}$
X at least $2 H_{max}$

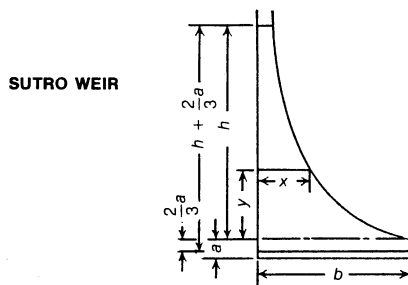
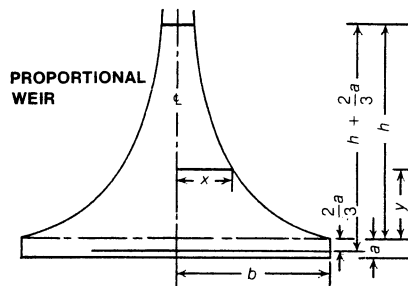


Figure A—Five Types of Weirs

1. The weir should consist of a thin plate about 1/4 inch thick with a straight edge or a thick plate with a knife edge, the sharp edge being important for preventing the nappe from adhering to the crest. The height of the weir from the bottom of the channel to the crest should be at least 2 times the expected head of water above the crest, this ratio being necessary to lower the velocity of approach. Also, the upstream velocity of flow should be greater than 0.3 ft/sec.
2. It is important to ventilate the weir to prevent a vacuum from forming on the underside of the falling water.

3. The connection of the weir to the channel should be waterproof. Therefore, the joint between the weir plate and channel should be packed with a chemically inert cement or asphalt type roofing compound. Grease compounds should not be used if oil concentrations are to be measured.
4. The weir must be exactly level to insure a uniform depth of flow.
5. The crest of the weir must be kept clean. Fibers, stringy materials and larger particles tend to cling to the crest and should be removed periodically. In water with high suspended solids concentrations, considerable sedimentation in the channel of approach will take place. Sediment influences the measurements and makes representative sampling more difficult.
6. The device for measuring the head should be placed upstream at a distance of at least 2.5 times the head on the weir and should be located in a quiet section of the sewer away from all disturbances.
7. The weir should be located at the end of a straight stretch of the sewer with little or no slope. The velocity of approach should be low and uniformly divided over the channel; however, the weir will usually lower the velocity sufficiently for measurement. For added accuracy, and when the sewer is flowing full, the weir should be placed at the end of the line in a weir stilling box as shown in Figure C. However, for fully flowing sew-

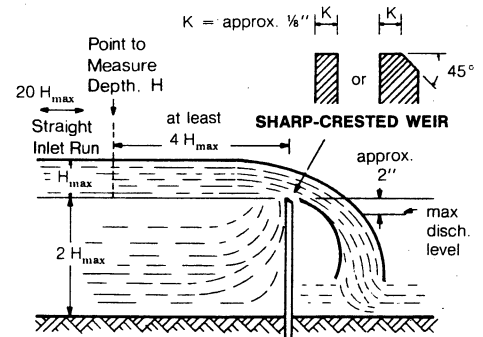
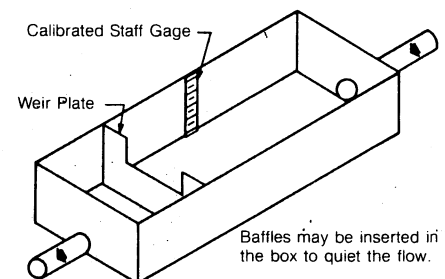


Figure B—Profile of Sharp-Crested Weir



Typical weir-stilling box. Dimensions can be varied to suit plant conditions so long as quiet flow can be effected.

Figure C—Weir Stilling box (1)

ers, other methods of flow measurement are recommended. It should be noted that the velocity distribution along a channel can be made more uniform by placing baffles in the sewer upstream in the channel of approach.

- The weir size should be selected after the preliminary surveys have determined the expected flow rates in the sewer.

The common formula for flow over a weir is:

$$q = 2/3 \sqrt{2g} H^{3/2}$$

where:

q = flow per unit of width, cfs

g = gravity (32 ft/sec²)

H = head above crest (upstream), feet

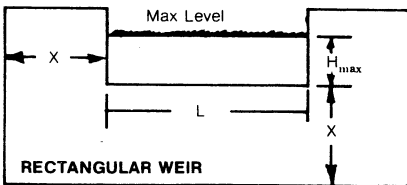
A coefficient C_w is usually included to compensate for the non-uniformity of flow. Thus, the equation for the flow per unit of width becomes:

$$q = C_w 2/3 \sqrt{2g} H^{3/2}$$

where:

C_w = non-uniformity coefficient (≤ 1)

Permanently installed weirs should be calibrated after installation inasmuch as coefficients in the weir formulas may vary due to many factors. However, reasonable flow estimates for the various types of weirs are available, and when used properly, produce little error.



L at least 3 H_{max}
X at least 2 H_{max}

Rectangular weirs may be straight or notched. A straight weir is called a suppressed weir without end contractions. A notched weir may have one or two end contractions. If the crest height is greater than 5 H, the approach velocity may be neglected. In a suppressed weir, the water flows over the full width of the weir and problems may develop when a vacuum forms under the nappe.

The most common type of rectangular weir is the notched weir with end contractions. If the end contractions are standard, that is, the width of each end contraction is at least 2.0 times the head above the crest, the Francis formula is applicable in computing the flow as follows:

$$Q = 3.33 L H^{3/2}$$

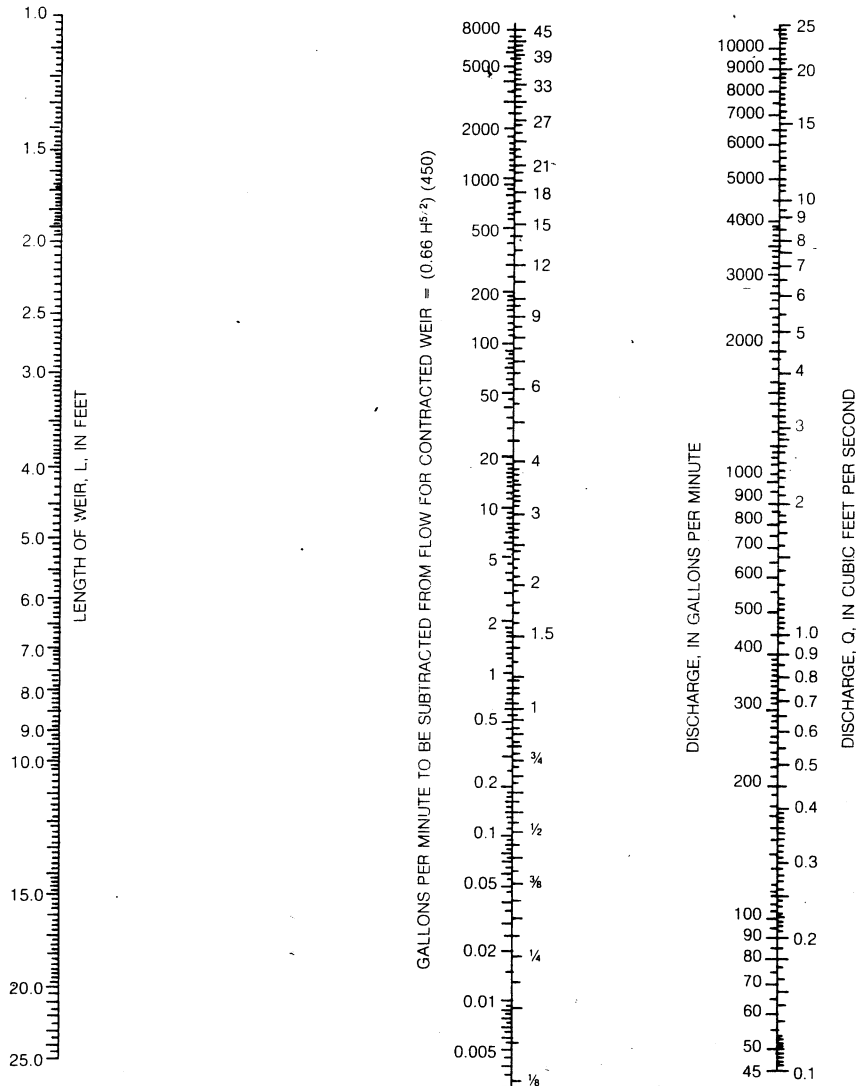
where:

Q = flow, cfs

L = effective width of the weir, ft

H = head, ft

Figure D presents a nomograph of the Francis Formula and can be used for a



Note: Based on Francis weir formula as follows:
or $Q = 3.33 L H^{3/2}$ (for suppressed weir)
 $Q = 3.33 (L - 0.2 H) H^{3/2}$
 $= 3.33 L H^{3/2} - 0.66 H^{5/2}$ (for contracted weir with two end contractions)

Where:

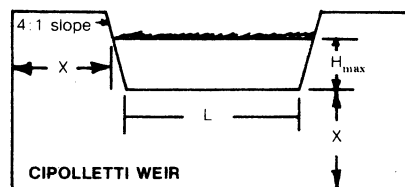
Q = discharge, in cubic feet per second.

L = length of weir, in feet.

H = head in feet.

Figure D—Nomograph for Capacity of Rectangular Weirs (2)

suppressed weir or a weir with standard end contractions. The conventional calculations are not applicable when estimating discharges with very low heads that cause the nappe to cling to the weir face.



L at least 3 H_{max}
X at least 2 H_{max}

The Cipolletti weir is of trapezoidal form with end slopes of one horizontal to four vertical, which corrects for the slide contraction of the nappe over the crest.

Thus, no correction is necessary for the crest width as in the rectangular contracted weir. The general equation for the Cipolletti type of weir is:

$$Q = 3.367 L H^{3/2}$$

where:

Q = discharge, cfs

L = length of the weir opening at the base, feet

H = measured head, feet

Velocity Head Correction

When the velocity of approach for a suppressed, contracted, or Cipolletti weir is too high to neglect, a correction factor can be introduced into the flow equation. The correction factor extends the use of the basic formula for weirs to include the velocity head as follows:

$$h = \frac{V^2}{2g}$$

where:

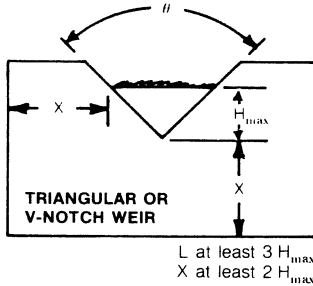
h = velocity head, ft.

V = approach velocity, ft/sec,

g = gravity (32 ft/sec²)

Then the term $H^{3/2}$ in the basic equations is converted to

$$H^{3/2} = (H + h)^{3/2} - h^{3/2}$$



The triangular weir of V-notch type is of value in measuring low flows. It should be used for flows less than 1 cfs (450 gpm) and is not recommended if the flow is greater than 2 cfs. The V-notch weir may be constructed of any angle, the most commonly used angle, 0, for V-notch weirs being 90°. The second most popular V-notch weir has an angle of 60°. The end contraction of the weir should be at least 3/4 L, where L is the width of the water surface at maximum elevation. (Figure E).

The formula for the 90° notch weir is:

$$Q = 2.49H^{2.5}$$

where flow, Q, is in cfs

The API manual (3) recommends against the use of V-notch weirs if $H < 0.3$ ft, since the possibility of forming a vacuum becomes too great. Table I gives the minimum discharge without forming a vacuum for heads lower than 0.3 ft.

TABLE I

Practical Minimum Discharge For 90-Degree V-Notch Weirs (3)

Weir Head (ft)	Discharge (gpm)
0.02	0.049
0.03	0.160
0.04	0.380
0.05	0.755
0.075	1.964
0.10	4.00
0.15	10.47
0.20	20.95
0.25	35.45
0.30	55.50

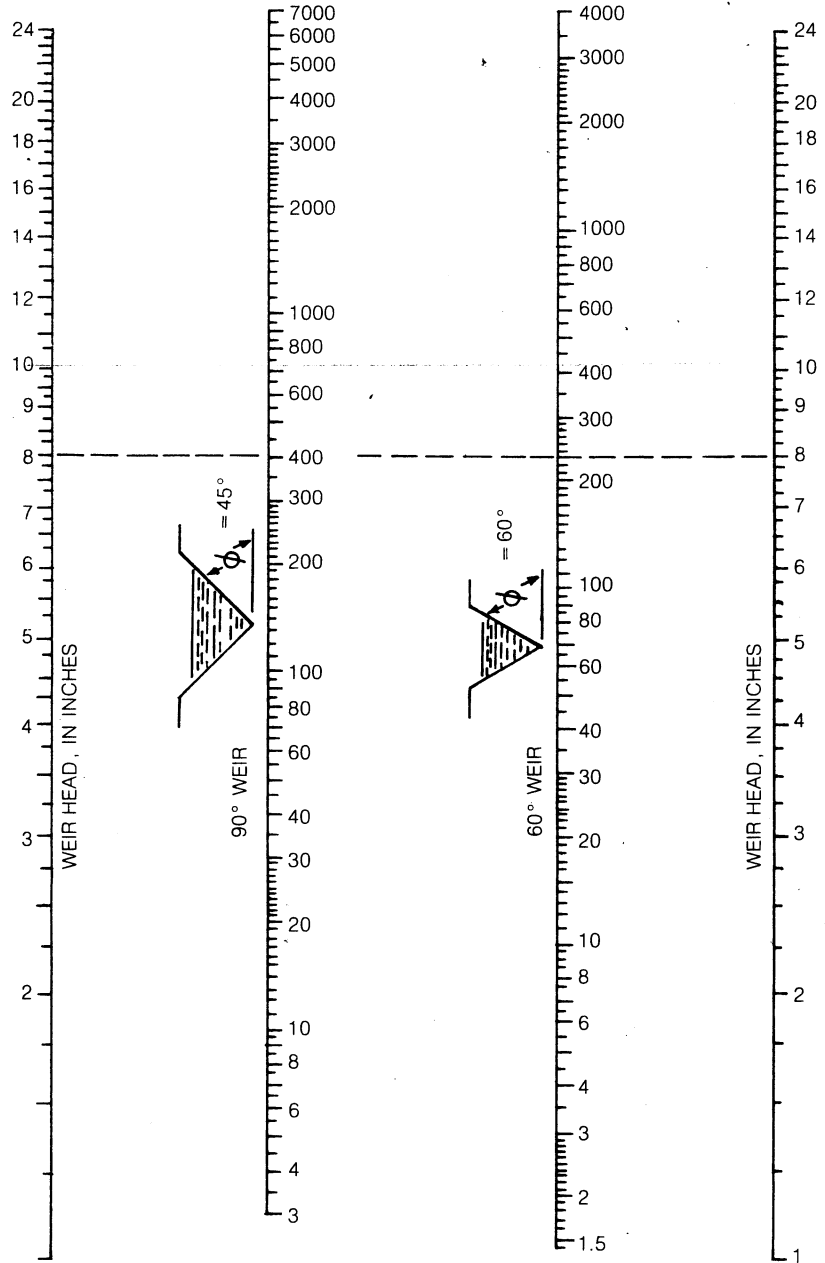


Figure E—Flow Rates for 60° and 90° V-Notch Weirs (2)

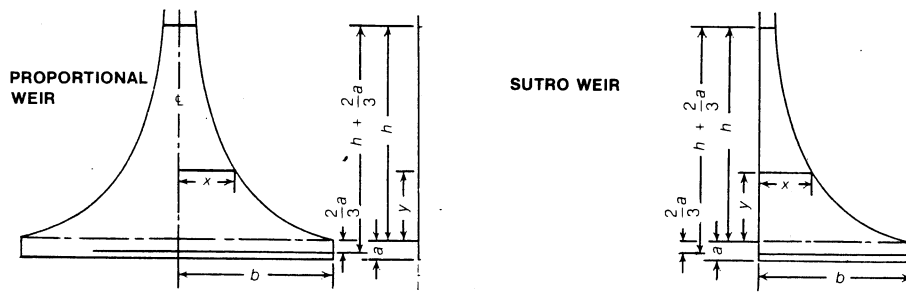


Figure F—Elements of Proportional and Sutro Weirs

Principles of Velocity Control.—Control of velocity within the effective length of a grit channel is provided through the use of a control section. To perform its function this control section must vary the cross-sectional area of flow in the channel in direct proportion to the flow. For instance, to maintain a constant velocity of 1 fps, the flow cross section (A) must equal 3 sq ft, when the volume of flow (Q) equals 3 cfs. When Q drops to 2.5 cfs, the flow cross section (A) must drop to 2.5 sq ft. In channels with straight side walls, this reduction in the flow cross section A must be accomplished by varying the depth of flow directly as Q . Control sections such as the Sutro weir and the proportional weir accomplish this purpose very satisfactorily.

Fig. F illustrates elements of both a proportional weir and a Sutro weir. The only difference between the two is that the proportional weir has both sides curved and the Sutro weir has only one side curved and the other straight. The following equations are used in connection with Fig. F:

$$x = b \left(1 - \frac{2}{\pi} \tan^{-1} \sqrt{\frac{y}{a}} \right) \dots \dots (3)$$

$$Q = b \sqrt{2 a g} (h + \frac{2}{3} a) \dots \dots (4)$$

and $Q_1 = \frac{2}{3} b \sqrt{2 g} [(h + a)^{3/2} - h^{3/2}] \dots \dots (5)$

in which Q is the total discharge past the weir, in cubic feet per second; and Q_1 is the discharge through the rectangular part of the weir, in cubic feet per second. Discharges Q and Q_1 are for only half of the proportional weir but for a full Sutro weir. These formulas are used to determine the shape of a weir of a specified capacity by selecting suitable dimensions for either a or b and h . The remaining variable a or b may then be determined by substitution in the appropriate equation. Upon determination of both a and b , x may be calculated for any value of y .

The design of each of the weirs is based on the relationship stated by Rettger (6) that a weir whose width is inversely proportional to the square root of the height of that point above the crest will have a theoretical discharge exactly proportional to the head. The simple form of this curve would result in the breadth of the

weir approaching infinity as the head approached zero. Since this is not practical, the base is limited to a convenient dimension and for a small height the cross section is rectangular. For water the minimum desirable height for this rectangle has been reported by Pratt (7) to be $\frac{1}{8}$ in. For sewage this dimension would be substantially greater to prevent fouling of the weir, and a minimum of 1 in. is suggested.

Although the maximum height of the rectangular section of the weir may be governed by the allowable width of the weir, it should be observed that in deriving the original formulas according to Pratt (7), it was assumed that the flow level constantly exceeded the top of the rectangular portion. In practice, when the surface of flow remains within the rectangular section of the weir, true velocity control is not being achieved.

Other limitations on the accuracy of the proportional or the Sutro weir involve the need for a grit-storage area. In most cases the crest of the weir will be set at least 4 in., and usually about 12 in., above the bottom of the chamber for such storage. In the case of mechanically cleaned chambers, some depth is needed for the operation of conveying equipment.

In each case, during the time that sewage is being displaced in the storage area, velocities will be somewhat lower than calculated. In practice it is common to adjust the crest of the weir in the field to obtain the best results under observed conditions. It is, therefore, highly desirable that provisions be made in the design for facilitating the adjustment of weir elevation. In designing the weir installation it is also essential that the discharge from the weir be unrestricted. Any variation from a "free-fall" condition will seriously affect the efficiency of control.

A rectangular control section may be used if the cross section of the grit chamber is shaped to maintain a constant velocity. With a rectangular weir-control section, the shape of the grit chamber must approach that of a parabola (3). This is conveniently accomplished by sloping the sides of the

chamber to a narrower width at the bottom, which has advantages in providing for easier grit removal. An adjustable weir is available, which permits selecting the optimum velocity for grit removal on the basis of actual operation.

Parshall flumes are frequently used as grit-chamber control sections. The advantages of the Parshall flume are that the head loss is kept at the absolute minimum and that the control section can be used conveniently for metering the flow. As the Parshall flume is a rectangular control section, the grit chamber above it must be designed to approach a parabolic cross section.

In large plants, where multiple units are used and where the ratio of maximum to minimum flows is not great, velocity control is often maintained by varying the number of grit chambers in service.

References

1. *Planning and Making Industrial Waste Surveys*, Ohio River Valley Water Sanitation Commission, April, 1952.
2. "Manual of Disposal of Refinery Wastes," *Volume of Liquid Wastes*, American Petroleum Institute, 1969.
3. Camp, T. R., "Grit Chamber Design," *Sewage Works Journal*, Vol. 14, No. 2, p. 368 (March, 1942).
4. Lee, M., and Babbitt, H. E., "Constant Velocity Grit Chamber with Parshall Flume Control," *ibid.*, Vol. 18, No. 4, p. 646 (July, 1946).
5. Skinner, J. F., discussion of "Grit Chamber Practice: A Symposium," *Transactions*, ASCE, Vol. 91, p. 524 (December, 1927).
6. Rettger, E. W., "A Proportional-Flow Weir," *Engineering News*, Vol. 71, No. 26, p. 1409 (June 25, 1914).
7. Pratt, E. A., "Another Proportional-Flow Weir; Sutro Weir" (letter to the editor), *ibid.*, Vol. 72, No. 9, p. 462 (August 27, 1914).

Note:

"*Sewage Treatment Plant Design—ASCE Manual No. 36*" has been reprinted under new titles as follow:

"*Wastewater Treatment Plant Design—ASCE Manual No. 36*", available from *American Society of Civil Engineers, 345 West 47th Street, New York, New York 10017*.

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