

QUICK REFERENCE

TYPE	MODEL	DETAIL	STANDARD SIZE RANGE (INCHES)	MAXIMUM NORMAL (FEET)		GENERAL USE					
				SEATING (FACE)	UNSEATING (BACK)	SEWAGE TREATMENT	WATER TREATMENT	FLOOD CONTROL	IRRIGATION	INDUSTRIAL	HYDRO POWER
HEAVY DUTY SLUICE GATES	Series 7000, 5000 and 4000	SQUARE	6 X 6 to 144 x 144 **	55 to 200 Varies with Size	10 to 75 Varies with Size	X	X	X	X	X	X
		RECTANGULAR	12 X 18 to 120 x 180 **			X	X	X	X	X	X
		ROUND	6 to 144 **			X	X	X	X	X	X
		SELF-CONTAINED	120 wide **			X	X	X	X	X	X
	Model P-32	ROUND SELF-CONTAINED	6 to 14	60	20	X	X	X	X	X	

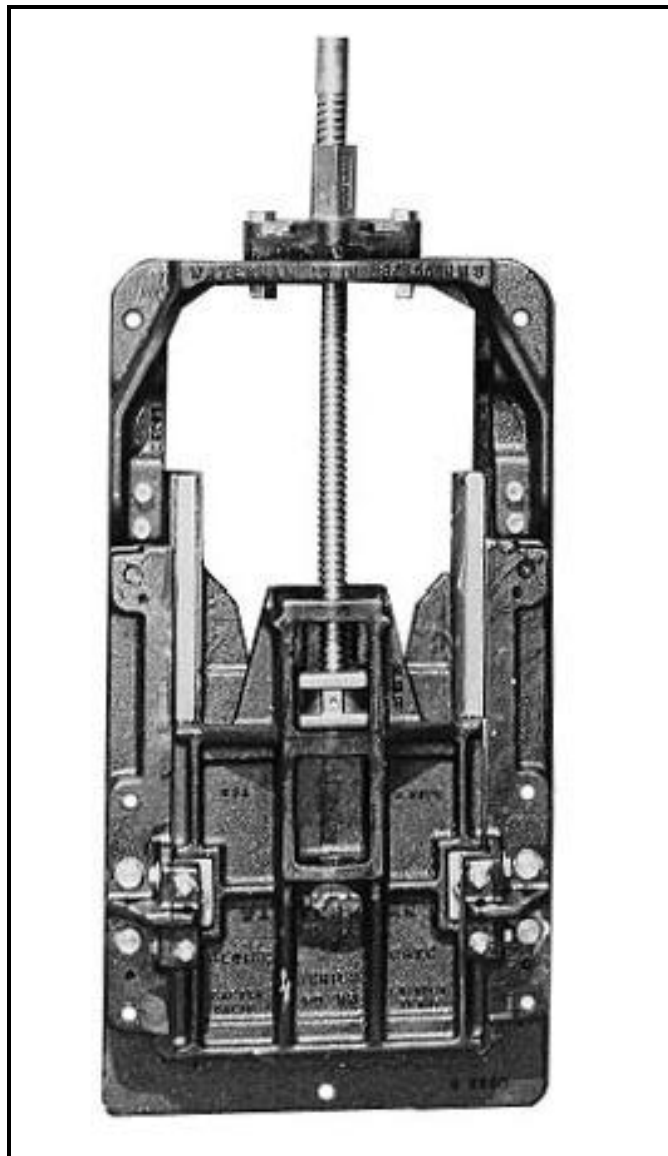
** INDICATES COMMON SIZES, OTHER LARGER SIZES ALSO AVAILBLE.

*** INDICATES STANDARD DESIGN, SPECIAL DESIGNS FOR HIGHER HEADS AVAILALBE.

Key to Waterman Sluice Gate Terminology

Prefix	Series	Suffix
Q = Flush Bottom Seal	7000	f = Standard Flangeback
S = Sluice Gate	5000	ff = Extended Flangeback
C = Circular Opening	4000	NRS = Non-Rising Stem
		Y = Self-Contained Frame (yoke)
		X = Special Modifications
		I = Inverted (downward opening)

Example: S-5000-f-NRS-Y
Sluice Gate with Standard Flange Back, Non-Rising Stem,
Self-Contained Gate



HEAVY DUTY, CAST IRON

SERIES 5000 AND 7000 SLUICE GATES

GENERAL DESCRIPTION

Waterman Series 7000, 5000, 4000 and P-32 Heavy Duty Sluice Gates are designed and manufactured to meet or exceed AWWA Specifications C-501 (latest revision).

USES

Waterman Heavy Duty Sluice Gates have been successfully used in a wide variety of applications, including municipal water works and treatment facilities, flood control projects, reservoirs and fish hatcheries.

FEATURES

Gate shapes include square or rectangular with square, rectangular or circular opening, and can be furnished with standard flangeback or extended flangeback frames. All units feature adjustable corrosion-resistant side wedges and corrosion-resistant malleable seat facings locked in dovetail grooves. All mating or sliding surfaces are fully machined including close tolerance tongue and groove guides. All assembly hardware is of corrosion-resistant material.

OPTIONAL FEATURES

Optional features available include Non-Rising Stem Adaptors, Flush Bottom Closures, Downward Opening Units, Top and Bottom Corrosion Resistant Adjustable Wedges, and fully Self-Contained Gates with extended guide rails, cast iron yoke, stem and lift.

SEATING AND UNSEATING HEADS

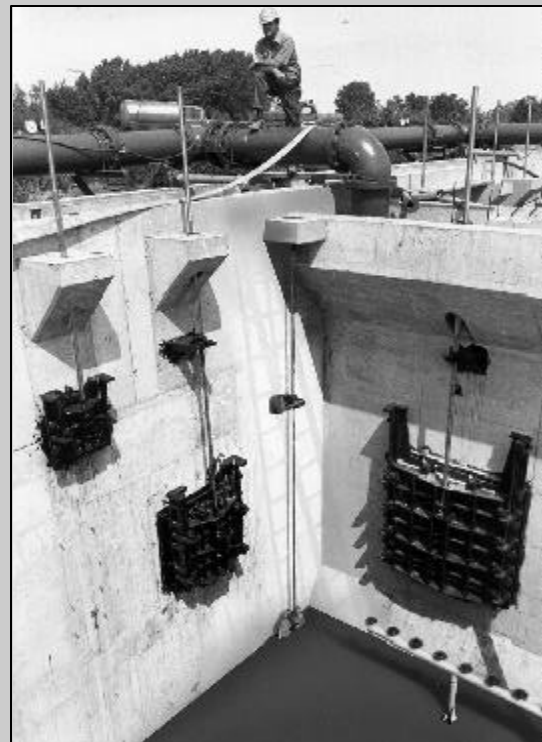
The basic design of these gates provides adequate safety with good sealing characteristics for seating and unseating heads as follows:

SERIES	Seating Heads, Feet (1)	Unseating Heads, Feet (2)
5000	55 to 200 (varies with size)	10 to 150 or higher (varies with size)
7000		

(1) Heads are measured from the horizontal center line of the gate opening to the surface of the water. With SEATING HEADS (or face pressure), the water is on the front of the gate and helps to press the seating surfaces together.

(2) With UNSEATING HEADS, the water is on the back of the gate and tends to push the slide away from the frame. Top and bottom wedges are usually necessary to overcome this back pressure. Structures for sluice gates should be designed so that the gate is subject to seating pressure whenever possible. For unseating heads top and bottom wedges are used on all gates having a width of 24" or more, except that gates with flush bottom seats have top wedges only.

Continued on next page.



HEAVY DUTY, CAST IRON

SERIES 5000 AND 7000 SLUICE GATES

GENERAL DESCRIPTION (continued)

FRAMES

The cast iron frames are square or rectangular in shape, of one piece construction and may have square, rectangular, or circular openings. Standard Flangeback, Rectangular Extended Flangeback and Circular Extended Flangeback types are available.

GUIDE RAILS AND WEDGES

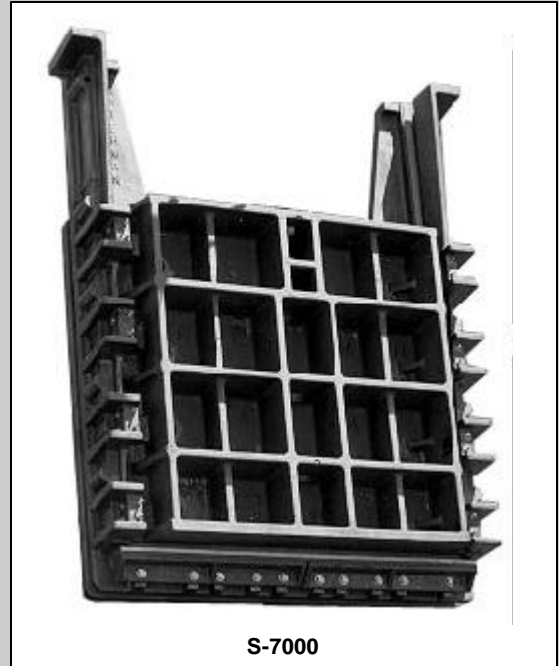
Cast iron guide rails of a length sufficient to support at least one-half of the slide when fully opened are cast integrally with the frame on small and medium size gates and are mounted on fully machined surfaces with dowels and corrosion resistant fasteners on the larger sizes. Wedge block pads are cast as a part of the guide rails and reinforced with heavy ribs. The wedge seal faces or adjustable wedge blocks are attached to these. A fully machined groove to receive the slide tongue extends the full length of each guide. Guides are extra heavy and reinforced for their full length to assure maximum rigidity against wedging pressure and unseating heads when the slide is partially open.

SLIDE

The cast iron Slide (Cover) has vertical and horizontal reinforcing ribs, a heavy square nut pocket cast integrally with the slide, and a machined guide tongue extending the full length of each side. Minimum tolerances are maintained between the slide tongue and guide grooves to provide maximum stability of the slide in partially open positions, thus minimizing chatter. Gates with Non-Rising Stems are furnished with a special slide having a heavy thrust nut pocket cast integrally with the slide. This pocket is located above the opening of the gate so that at no time will the stem protrude into the waterway. The thrust nut in the slide pocket is not secured to the stem and acts as a lift nut as the stem is rotated.

SEATS

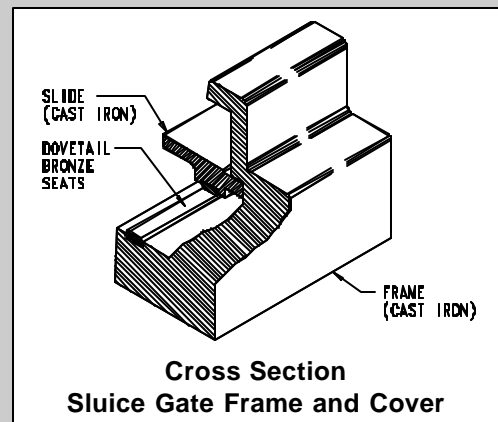
Seating faces are of a corrosion resistant material and are secured in full width dovetail grooves machined in the cast iron frame and slide (see material schedule for alloys available). Seat facings are of a work hardening malleable type and are deformed and locked into place in the grooves without the use of fasteners. An accurate and positive attachment is obtained with the grooves completely filled. The full width dovetail design eliminates the possibility of leakage between the corrosion resistant seat material and the castings. The full width dovetail design of the seating faces prevents damage to these faces which may occur in dovetail designs having overhangs which may work loose during normal operation of the gate. (See detail drawing)



JOBSITE HANDLING AND INSTALLATION

To assure proper operation of our gates, care must be taken in the receiving, handling, and storage of all gates and appurtenances. Installation must be accurately performed. See the Waterman Heavy Duty Sluice Gate Installation Manual for complete detailed instructions.

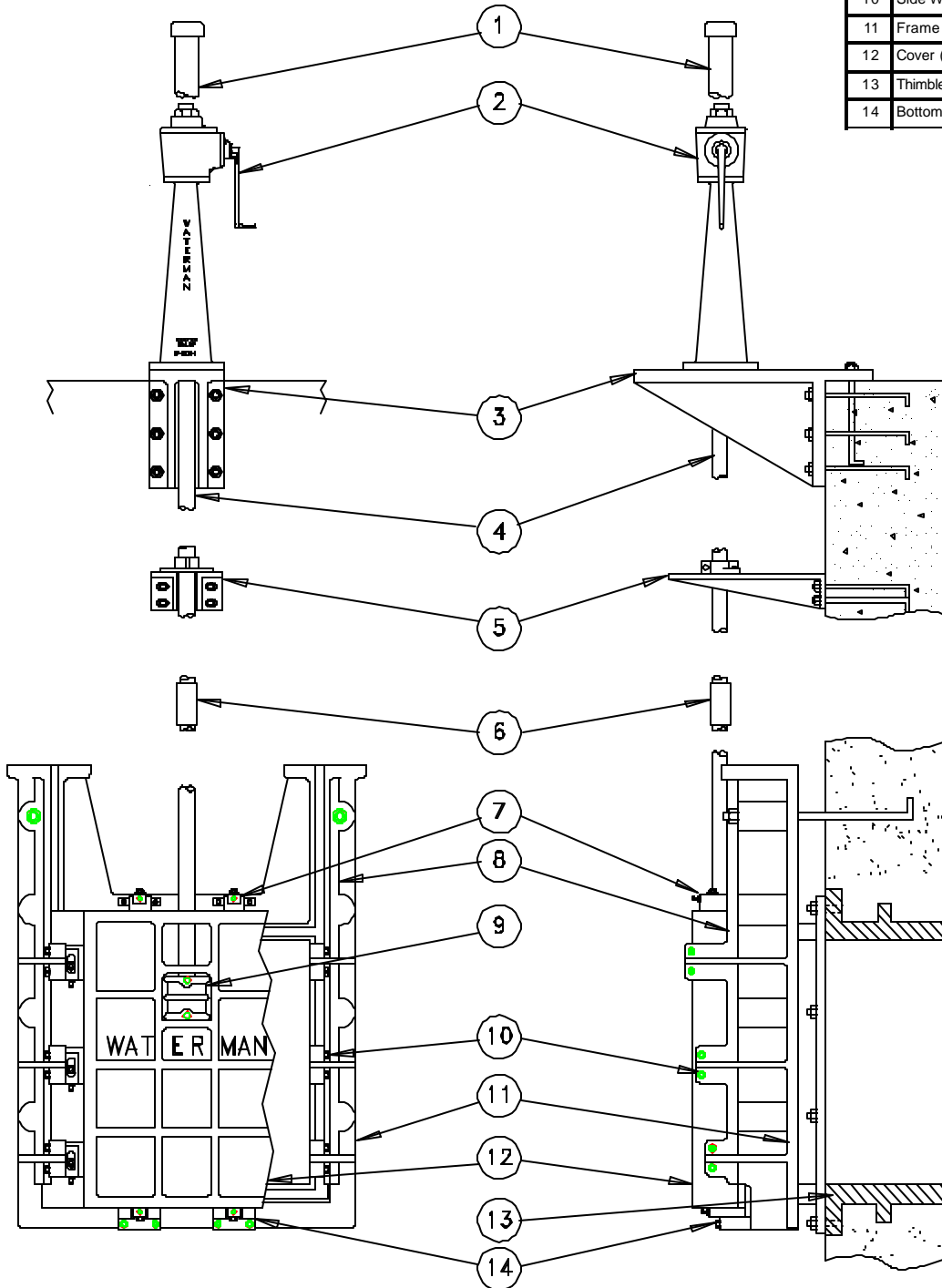
Waterman Heavy Duty Sluice Gates are completely assembled in the plant and are given an AWWA C-501 inspection by qualified inspectors before shipment. This includes operational, visual and feeler gauge tests. Seat clearance must not pass a .004 gauge. When required, a hydrostatic test can be performed before shipment at an extra charge. Waterman gates, properly handled, stored and installed should meet these same standards in operation.



HEAVY DUTY, CAST IRON

SERIES 5000 AND 7000 SLUICE GATES

PARTS IDENTIFICATION	
No.	Name
1	Stem Cover
2	Gate Operator (Lift)
3	Top Wall Mounting Bracket
4	Stem
5	Stem Guide
6	Stem Coupling
7	Top Wedge
8	Cover Guide Rail
9	Thrust Nut
10	Side Wedge
11	Frame
12	Cover (Slide)
13	Thimble
14	Bottom Wedge



SELF- CONTAINED SERIES 5000 AND 7000 SLUICE GATES

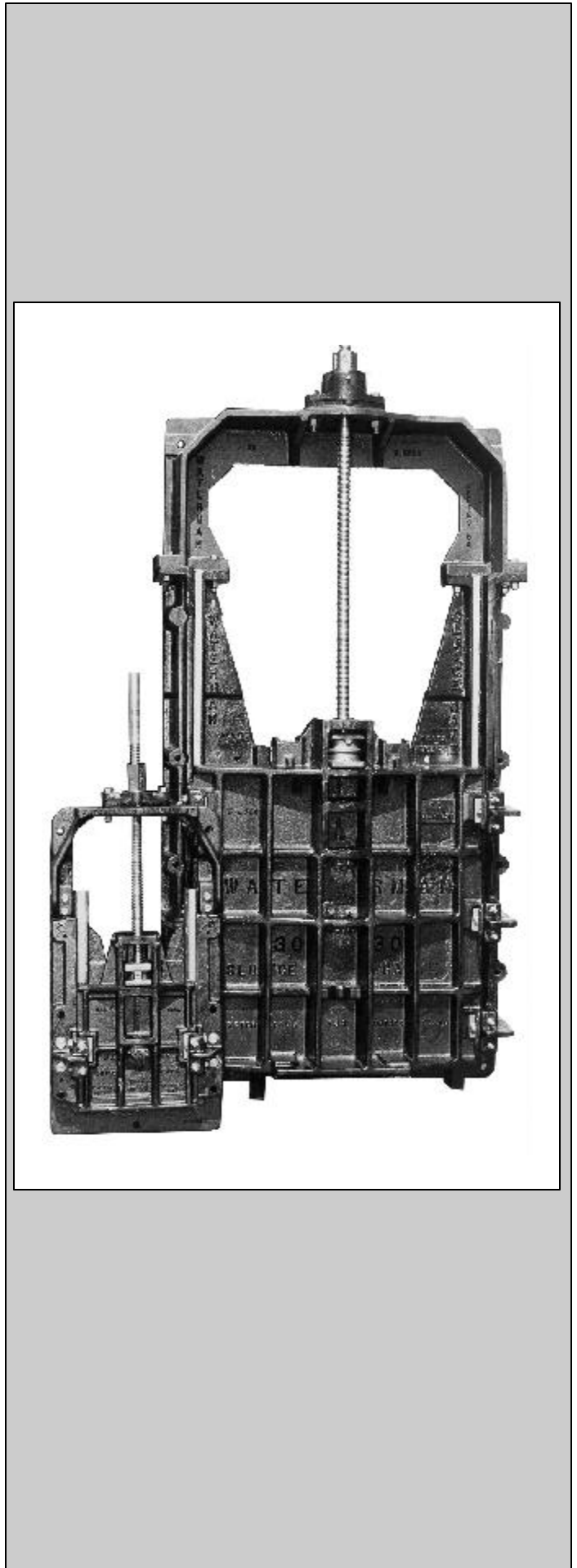
Self-contained gates are used when space above the gate installation, or the absence of structural supports, limits the installation of an independent operator.

Waterman self-contained gates are available in sizes up to 84" x 84" with standard cast yokes, and larger sizes with heavy duty fabricated yokes. Heavy duty cast iron yokes are attached to the machined pads on the gate guides. An extension of the guide provides clearance for the slide to move to the completely open position. A machined pad on the yoke provides a true surface for mounting the thrust collar or lift.

Self-contained gates may be furnished with rising stems, in which case the stem is secured to a standard slide thrust nut in the normal manner, and operated by a corrosion resistant stem and standard handwheel or crank type lift. The thrust of opening and closing is transmitted directly through the lift and yoke to the gate. Self-contained gates with non-rising stems utilize the non-rising stem (NRS) type cover arrangement and a stem having a thrust collar, contained in a housing on the yoke. Rotating the stem causes the stem block and slide to travel up and down. The operating thrust is transmitted directly to the yoke and gate frame.

Ball bearing lifts are not recommended for mounting on top of a self-contained yoke where the lift would be subject to submergence in the liquid being controlled. Special self-contained units with hydraulic cylinder operators or motorized lifts are available.

Non-Rising stems are not recommended for use in fluids with heavy slurry concentrations as threaded portions of stem may be submerged. Premature wear may result.



ADJUSTABLE

WEDGE SYSTEMS

There are two types of Waterman wedging systems, "B", and "B-1".

Type "B-1" wedges are always provided on Waterman computer-controlled machined sluice gates up to 48" in width. Type "B" wedges can be provided for all other Waterman heavy duty sluice gates.

TYPE "B" WEDGE SYSTEM

The "B" system has been designed to meet those specifications wherein the adjustable portion of the wedge must be on the slide. The wedge block facing surface is securely attached to the reinforced overhanging guide wedge block, double-bolted in shear and pinned to prevent movement. (This design allows for easy replacement of wedges in the field.)

The adjustable solid one-piece wedge operates on a machined tongue-and-groove surface, and is locked in place with a corrosion-resistant stud and adjusting bolt with lock nut.

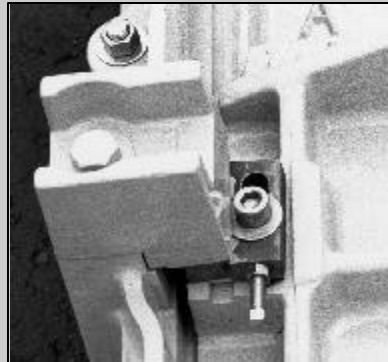
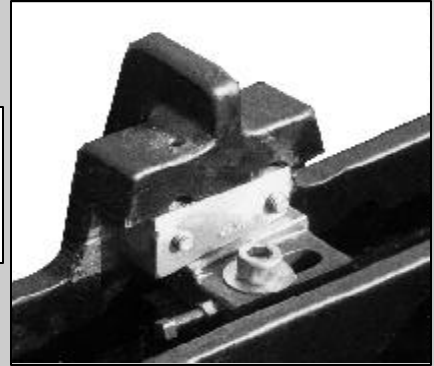
TYPE "B-1" WEDGE SYSTEM

The "B-1" wedging system is designed for unit compatibility with all of Waterman's computer-controlled machined sluice gate surfaces on gates up to 48" in width. The "B-1" wedge, also with computer-controlled machined surfaces, assures optimum mating of wedge and gate surfaces, and a positive, leak-inhibiting closure.

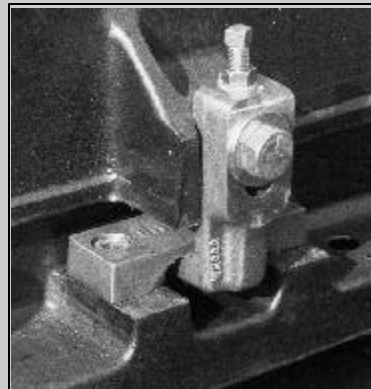
TOP AND BOTTOM WEDGES

When Top and Bottom Wedges are required for unseating heads, fully adjustable units, made of solid corrosion resistant castings, are provided. These wedges are easily adjustable and locked into position with corrosion resistant fasteners. All sliding, mating, and wedging surfaces are fully machined.

Waterman Standard Type "B" Wedge (Adjustable portion of wedge on slide)

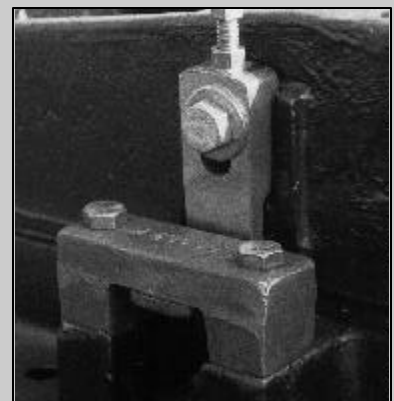


Waterman Standard Type "B-1" Wedge



Top Wedge

Bottom Wedge



CAST IRON SLUICE GATE WITH

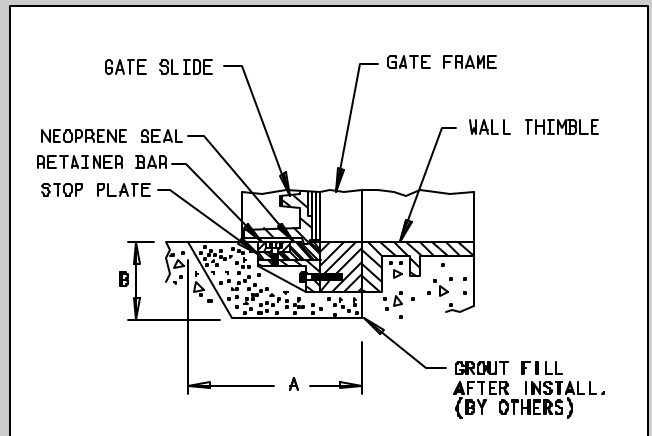
"Q-SEAL" FLUSHBOTTOM SEAL

A "Q-Seal" flushbottom seal gate is used wherever a continuous smooth opening (without obstructions to impede solids) is desirable. Typical installations include wastewater settling tanks, aeration tanks, and sedimentation and flocculation basins.

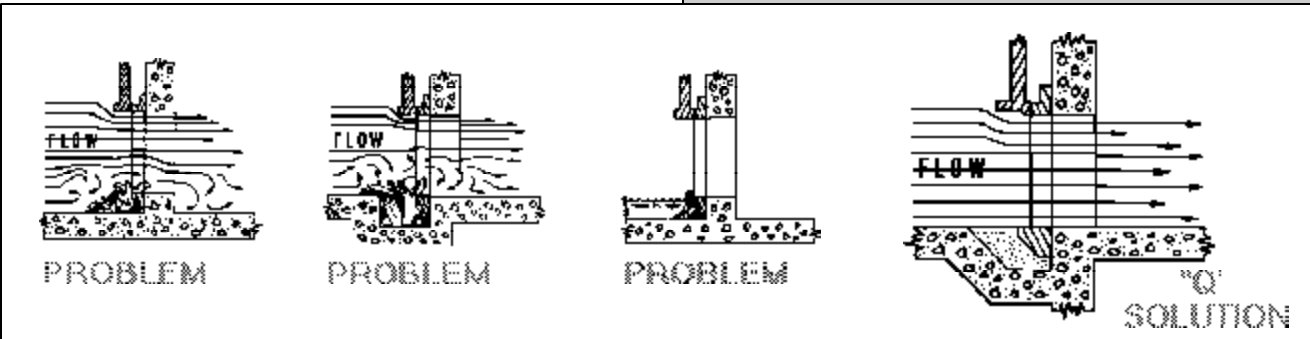
CONSTRUCTION FEATURES

Flushbottom closures feature a neoprene seal securely contained at the invert of the frame. The design of this seal provides a flat plane across the bottom of the gate without projections into the opening to obstruct flow. The seal is mounted on a cast iron bracket and held in place with a corrosion resistant retainer bar and fasteners. The seal is firmly supported on three sides, exposing only the flat top side, minimizing damage from floating objects, wet-dry conditions or sunlight. The seal is easily replaceable without disassembly of the gate.

When a flushbottom seal is used, a smooth rounded projection on the bottom of the slide replaces the normal metal seat and seat facing. The slide closes against the seal, compressing the neoprene between the slide and frame, making a watertight seal across the bottom of the opening. Bottom wedges are not used as they are not necessary for Waterman gates with a flushbottom closure.



RECOMMENDED INSTALLATION CLEARANCES FOR FLUSHBOTTOM GATES				
Gate Diameter or Opening Height	Standard Flangeback Gate		Extended Flangeback Gate	
	A	B	A	B
6" thru 24"	12	7	16	15
30" thru 42"	15	7	20	15
48" thru 72"	15	9	23	17
78" thru 120"	18	10	26	18



TYPICAL SPECIFICATIONS SERIES 7000, 5000, 4000 HEAVY DUTY SLUICE GATES

The following specifications for Waterman Heavy Duty Sluice Gates are presented as an aid to the engineer and can be augmented with additional information to meet specific needs.

Scope

This section covers all heavy duty sluice gates required on the project. Each gate shall be furnished and installed complete with wall thimble or anchor bolts, operating stem, gate lift operator and other appurtenances as specified or needed to make a complete and operable installation.

General

Gates, stems, lifts and other appurtenances shall be the size, type, material and construction as shown on the drawings and specified herein. Gates shall meet the requirements of AWWA Specifications C-501 (latest revision) or as modified per these specifications. (They shall be Waterman Heavy Duty Sluice Gates or approved equal.) All component parts shall be of the type of material shown, and interchangeable where size and material are the same without grinding, chipping or special fitting in the field. The gates shall be the product of one manufacturer having five or more years of experience in the manufacture of similar gates for similar use. All mating and sliding parts shall be fully machined. All sluice gate parts, including lift, shall be designed for the heads shown with a minimum safety factor of five.

All materials used in the construction of the gates and appurtenances shall be the best suited for the application and shall be as follows:

Frame and Guide Rails

The frame and guide rails shall be cast one-piece construction or may have guides dowelled and bolted to the frame. Frames shall be of the standard flangeback or extended flange type with round or rectangular opening as indicated on the plans and in the sluice gate schedule. A machined dovetail groove for the mounting of the bronze seat facings shall be provided on the front face of the frame around the full periphery of the opening. The frame shall be provided with cast-on pads which shall be machined, drilled, and tapped for the mounting of the wedge device. The back of the frame flange shall be machined to a plane and drilled to match the wall thimble, pipe flange, or anchor bolt pattern. Guide rails shall be of such length as to retain at least one-half of the vertical height of the slide when it is in the fully opened position. A groove running the full length of the guide rail shall be accurately machined to receive the slide tongue, with a nominal clearance of 1/16-inch.

Cover or Slide

The cover shall be of one piece cast construction with vertical and horizontal ribs, a reinforced pocket to receive the thrust nut, pads to receive the wedges, and a reinforced periphery around the back side of the cover for machining of the dovetail grooves in which the seating faces shall be mounted. All wedge pads shall be machined, drilled and tapped to receive the wedge devices. The cover shall have fully machined tongues running the full length of each side to properly engage the guide rail grooves. A thrust nut shall be provided to attach the slide to the stem. The nut shall be threaded and, in the case of rising stems, provided with keys on two set screws locked into indents in the stem to prevent rotation of the stem. For non-rising stems, the stem shall turn freely in the thrust nut, to open and close the slides as the stem is rotated.

Seating Faces

All seating faces for both covers and frames shall be malleable extruded corrosion resistant material (see materials section) of a shape that will fill and permanently lock in the full width dovetail grooves of the slide and the frame. No other means of attachment will be allowed. They shall be machined to a 63 micro-inch finish, or better.

Wedges

All wedges and wedge blocks shall be solid corrosion resistant material and shall be of sufficient number to provide a practical degree of watertightness. All wedge bearing surfaces and contact faces shall be machined to give maximum contact and wedging action. Wedges shall be fully adjustable, but once set shall not rotate or move from the desired position. All fasteners and adjustment screws shall be corrosion resistant.

Self-Contained Gates with Rising & Non-Rising Stems

When a self-contained gate is specified, a heavy yoke shall be mounted on the machined pads provided on the upper ends of the guide rails. The yoke shall have a machined bearing surface for the lift nut or pedestal mounting plate. On non-rising stems gates the nut pocket shall be cast on top of the slide so that the stem does not project into the waterway when the gate is fully opened. The thrust generated by gate operation shall be transferred to the yoke by the stem thrust collar or lift. When the operating floor is above the self-contained gate, a stem extension of cold-rolled or stainless steel shall be coupled to the operating stem with a bronze coupling or cast iron stem extension bracket. Operation shall be by a T-handle wrench or floor stand, shown on the plans and gate schedule. In a T-handle arrangement the stem extension shall be supported by at least one stem guide or a floor box with integral guide embedded in the operating floor.

Flushbottom Sluice Gates

When a flushbottom closure is specified, a resilient seal shall be attached to the frame so that it is flush with the invert. It shall be supported by a cast iron bracket which shall be bolted to machined pads provided on the frame. The seal shall be held in place by a bronze or stainless steel bar which shall be bolted through the seal to the bracket with stainless steel fasteners. The cover (slide) shall be shortened and provided with a smooth rounded surface along the bottom to depress

the seal. When unseating heads are to be acting on a flushbottom gate, top wedges shall be added, but bottom wedges will not be required. Sealing pressure shall be varied by adjusting side and top wedges.

Wall Thimbles and Anchor Bolts

Wall thimbles shall be provided with all gates except those to be mounted on pipe flanges or those gates to be attached to concrete headwalls with anchor bolts, as shown on the plans. Each thimble shall be of one-piece cast iron construction and of the section and depth as specified in the plans and gate schedule. There shall be integrally cast water stop around the periphery of the thimble. The front flange of the thimble shall be machined, drilled and tapped to receive the sluice gate attaching studs. Bolt pattern shall match gate bolt pattern. After machining, the front flange shall be marked with vertical centerline and the word "top" for correct alignment. Large square and rectangular opening thimbles shall be provided with grout holes in the invert to permit entrapped air to escape. The holes shall be 1 1/2" in diameter, no more than two feet apart and shall be upstream and downstream of the water stop.

A mastic type gasket shall be provided between the sluice gate and the wall thimble. Anchor bolts shall be corrosion resistant.

Gates mounted directly upon the headwall shall be sealed between the gate back and wall with a non-shrink grout. See manufacturers detailed installation instruction.

Stems and Stem Couplings

Operating stems shall be of a size to safely withstand, without buckling or permanent distortion, stresses induced by normal operating forces. Stems shall be fabricated from round bar stock of cold-finished steel, stainless steel or bronze, as shown on the plans or gate schedule and shall be provided with 290 modified or full acme threads. Stems composed of two or more sections shall be joined by bronze couplings threaded and keyed to stems, or couplings of the same material as the stems, pinned, bolted or welded and pinned to the stems. In section, couplings shall be stronger than the stems. Rising stems with manual lifts shall be provided with adjustable limit nuts or stop collars above and below the floor stand lift nut to prevent over travel of the gate in either direction.

Stem Guides

Stem guides shall be cast, with bronze bushings, and mounted on cast brackets. Guides shall be adjustable in two directions and shall be so constructed that when properly spaced they will hold the stem in alignment and still allow enough play to permit easy operation. Stem guide spacing shall be as recommended by the manufacturer, but in no case shall it exceed an l/r ratio of 200. Brackets shall be attached to the wall by anchor bolts and sufficient strength to prevent twisting or sagging under load.

Manually Operated Lifts

Sluice gates shall be operated manually by handwheel or crank operated pedestal floor stands or bench stands as required. Each lift shall be provided with a threaded cast bronze lift nut to engage the threaded portion of the stem. The lift nut shall have a machined flange, fitted above and below with thrust ball or roller bearings. Handwheel lifts shall be without gear reduction while crank operated lifts shall have either a single or double reduction. Lifts having a reduction greater than 4:1 shall be two-speed. A maximum effort of 40 lbs. pull (25 lb. pull) on handwheel or crank, shall operate the gates under the specified operating head. The gears, when required, shall be steel with machine-cut teeth. Pinion gears shall be supported by bronze bushings or roller bearings. The lift mechanism shall be totally enclosed within a cast iron housing adequately provided with lubrication fittings. The pedestal shall be structural steel or cast iron. The crank shall be of cast iron with a revolving brass handle and shall be removable. The crank shall be a maximum of 15" long. All lifts for rising stems shall be provided with a counter type position indicator and a galvanized steel stem cover or a transparent plastic stem cover with mylar strip position indicator. Non-rising stem gates shall be provided with a counter type position indicator unless extension stems, valve boxes, or T-handle wrenches make an indicator impractical. Handwheels and crank input shafts shall be approximately 36" from the operating floor unless otherwise shown. The word "open" shall be cast onto the housing or handwheel indicating direction of rotation to open the gate.

Painting

All cast iron parts of the sluice gate (not bearing or sliding contact) and stem guides shall be painted in accordance with the section on painting found elsewhere in these specifications. That portion of the wall thimbles which will be in contact with concrete shall not be painted.

Shop Testing

The completely assembled gate and hoist shall be separately shop-operated to insure proper assembly and operation. The gate shall be adjusted so that a .004" thick gauge will not be admitted at any point between frame and cover seating surfaces. All gates and equipment shall be inspected and approved by a qualified shop inspector prior to shipment.

Storage and Installation

Sluice gates and equipment shall be stored and installed in accordance with the installation manual furnished by the gate manufacturer. After installation the completely assembled gate, stem, guides and lift shall be operated through one full cycle to demonstrate satisfactory operation. Such adjustments as necessary will be made until operation is approved by the engineer. When required by the engineer, the gate shall be subjected to leakage tests and pass the standard requirements for maximum leakage as specified in AWWA standards AWWA-C-501.

MATERIAL SPECIFICATIONS FOR HEAVY DUTY SLUICE GATES

Materials used for construction of these gates may be varied to meet specific operating conditions. Suggested combinations are listed below. Many other combinations and materials are available when required.

GATE PART OR ITEM	#1 (STANDARD) BRONZE TRIM	#2 STAINLESS TRIM	#3 LOW-ZINC BRONZE TRIM	#4 NI-RESIST W/MONEL TRIM	#5 MONEL & 316 STAINLESS TRIM	#6 S-5900 RESILIENT SEATED
MOUNTING MATERIALS						
Wall Thimble	Cast Iron	Cast Iron	Cast Iron	Ni-Resist	Cast Iron	Cast Iron
Anchor Bolts & Nuts	18-8 Stainless (4)	18-8 Stainless (4)	18-8 Stainless (4)	Monel	316 Stainless (5)	18-8 Stainless
GATE ASSEMBLY						
Frame, Slide and Guide Rails	Cast Iron	Cast Iron	Cast Iron	Ni-Resist	Cast Iron	Cast Iron
Seating Faces	Naval Bronze	18-8 Stainless (2)	Low-Zinc Bronze	Monel	Monel	Rubber/PVC*
Wedges	Manganese Bronze	18-8 Stainless (3)	Low-Zinc Bronze	Monel	316 Stainless (6)	Manganese Bronze
Fasteners	18-8 Stainless (4)	18-8 Stainless (4)	18-8 Stainless (4)	Monel	316 Stainless (5)	18-8 Stainless
Stem Block	Manganese Bronze	Ni-Resist	Low-Zinc Bronze	Ni-Resist	Ni-Resist	Manganese Bronze
FLUSHBOTTOM SEAL						
Sill Plate	Cast Iron	Cast Iron	Cast Iron	Ni-Resist	Cast Iron	Cast Iron
Seal	Rubber	Rubber	Rubber	Rubber	Rubber	Rubber
Retainer	18-8 Stainless (1)	18-8 Stainless (1)	18-8 Stainless (1)	Monel	316 Stainless (5)	18-8 Stainless (1)
SELF-CONTAINED GATE						
Yoke	Cast Iron	Cast Iron	Cast Iron	Ni-Resist	Cast Iron	Cast Iron
Stem	18-8 Stainless (1)	18-8 Stainless (1)	18-8 Stainless (1)	Monel	316 Stainless	18-8 Stainless

* Poly Vinyl Chloride (PVC)

Note: For specifications on wall thimbles, lifts and stem guides, see other sections of this catalog.

MATERIAL APPLICATIONS & ASTM STANDARDS:		
MATERIAL	USE	ASTM STANDARD NUMBER
Cast Iron	Major Castings	A-126 Class B
Cast Austenetic Grey Iron (Ni-Resist)	Major Castings	A-436-Type 2 or 2B
Naval Bronze	Seat Faces & Stems	B-21 - Alloy 482
Low-Zinc Bronze (Silicon Bronze)	Seat Faces	ASTM B-98
Low-Zinc Bronze (Silicon Bronze)	Wedges & Stem Blocks	B-584 - Alloy 872
Manganese Bronze	Wedges & Stem Blocks	B-584 - Alloy 865
(1) 18-8 Stainless Steel	Stems, Retainers, Anchors & Studs	A-582 - Type 303 or 276 - Type 304
(2) 18-8 Stainless Steel	Seat Faces	A-276 - Type 304
(3) 18-8 Stainless Steel	Wedges	ASTM A-743
(4) 18-8 Stainless Steel	Fasteners	(Bolts) ASTM F-593 (Nuts) ASTM F-594
(5) 316 Stainless Steel	Fasteners, Retainers	A-276 - Type 316
(6) 316 Stainless Steel	Wedges	A-296-CF-8M
Monel	Seat Faces, Stems & Fasteners	B-164 Class A or B
Rubber	Flushbottom Seal, Seat Face	Neoprene 2000-Grade R-62
PVC*	Seat Face	N/A

TYPICAL SPECIFICATIONS

MODEL S-5900 HEAVY DUTY SLUICE GATE WITH RESILIENT SEATS

STORAGE AND INSTALLATION

The following specifications for Waterman Heavy Duty Sluice Gates are presented as an aid to the engineer and can be augmented with additional information to meet specific needs.

SCOPE

This section covers all heavy duty sluice gates required on the project. Each gate shall be furnished and installed complete with wall thimble or anchor bolts, operating stem, gate lift operator and other appurtenances as specified or needed to make a complete and operable installation.

PERFORMANCE

The resilient sluice gates must meet the performance requirements of **AWWA C-501** (latest revision) except that the resilient seated sluice gate must allow leakage of no more than .001 gallons per minute per perimeter foot. The resilient seated sluice gate must be able to withstand 25 feet seating, and 25 feet unseating head.

GENERAL

Gates, stems, lifts and other appurtenances shall be the size, type, material and construction as shown on the drawings and specified herein. Gates shall meet the requirements of **AWWA Specifications C-501** (latest revision), with the exception of the seats, as modified per these specifications. (They shall be Waterman Heavy Duty Sluice Gates or approved equal). All component parts shall be of the type of material shown, and interchangeable where size and material are the same without grinding, chipping or special fitting in the field. All mating and sliding metal parts shall be fully machined. All sluice gate parts, including lift, shall be designed for the heads shown with a minimum safety factor of five. All materials used in the construction of the gates and appurtenances shall be the best suited for the application.

FRAME AND GUIDE RAILS

The frame and guide rails shall be cast one-piece construction or may have guides dowelled and bolted to the frame. Frames shall be standard or extended flange type with round or rectangular opening as indicated on the plans and in the sluice gate schedule. Frames shall be of flushbottom design, with a resilient seal attached to the frame so that it is flush with the invert. The frame shall be provided with cast-on pads which shall be machined, drilled, and tapped for the mounting of the wedge devices. The back of the frame flange shall be machined to a plane and drilled to match the wall thimble, pipe flange, or anchor bolt pattern. Guide rails shall be of such length as to retain at least one-half of the vertical height of the slide when it is in the fully opened position. A groove running the full length of the guide rail shall be accurately machined to receive the slide tongue, with a nominal clearance of 1/16 inch.

COVER OR SLIDE

The cover shall be of one piece cast construction with vertical and horizontal ribs, a reinforced pocket to receive the thrust nut, and pads to receive the wedges. All wedge pads shall be machined, drilled and tapped to receive the wedge devices. The cover shall have fully machined tongues running the full length of each side to properly engage the guide rail grooves. A thrust nut shall be provided to attach the slide to the stem. The nut shall be threaded and, in the case of rising stems, provided with keys or two set screws locked into indents in the stem to prevent rotation of the stem. For non-rising stems, the stem shall turn freely in the thrust nut to open and close the slides as the stem is rotated.

SEATING FACES

Seats shall be of a resilient material, which is both abrasion and corrosion resistant. The seat material on both the frame and the cover (slide) shall be permanently attached.

WEDGES

All wedges and wedge blocks shall be solid corrosion resistant material and shall be of sufficient number to provide a practical degree of watertightness. All wedge bearing surfaces and contact faces shall be machined to maximize contact and wedging action. Wedges shall be fully adjustable, but once set shall not rotate or move from the desired position. All fasteners and adjustment screws shall be corrosion resistant.

TESTING, SHOP

The gate shall be adjusted so that the seats are slightly compressed and there is no clearance at any point between frame and cover seating surfaces.

TESTING, FIELD

Same as AWWA C-501-80, Sec. 6.3 except leakage requirements as specified above.

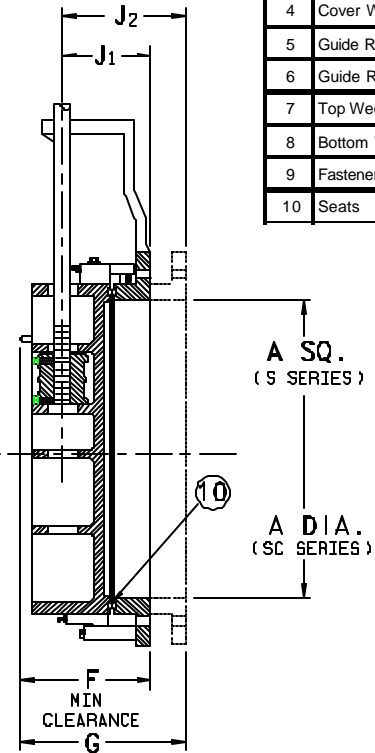
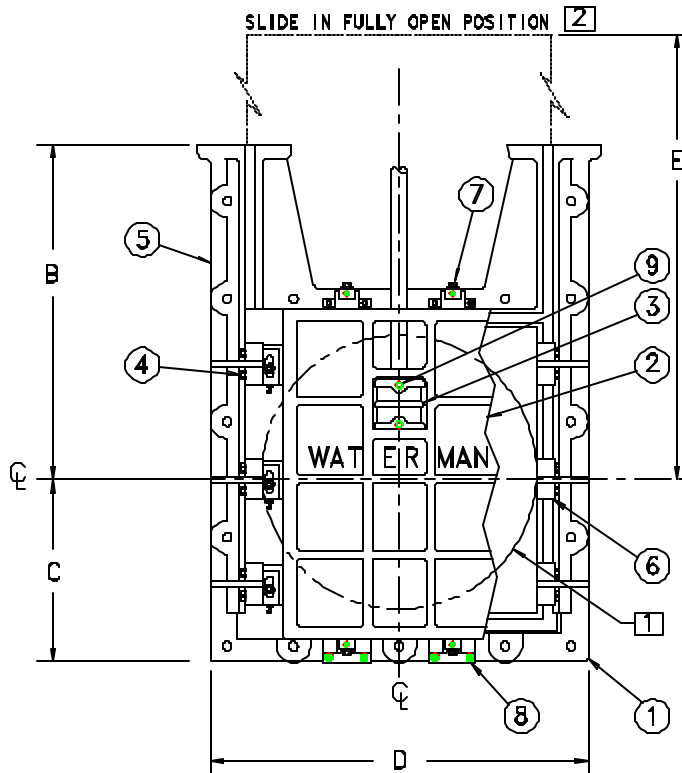
OTHER SPECIFICATIONS

See pages 10 and 11 of Heavy Duty Sluice Gate Specifications for such other items as:

Wall Thimbles and Anchor Bolts	Stem Guides
Stems and Stem Couplings	Painting
Manually Operated Lifts	Storage and Installation
Self-Contained Gates with Rising and Non-Rising Stems	

**S-5000 & SC-5000,
S-5900 & SC-5900 ***
SQUARE OR ROUND OPENING
SLUICE GATES**

PARTS	
No.	Name
1	Frame
2	Cover
3	Thrust Nut
4	Cover Wedge Assembly
5	Guide Rails
6	Guide Rail Wedge Assembly
7	Top Wedge Assembly
8	Bottom Wedge Assembly
9	Fasteners
10	Seats



NOTES:

- 1. SC Series shown. S Series gate has square opening.
- 2. Top of NRS cover or top of wedges.

GATE SIZE- ** A	B	C	D	E	F	J1*	G	J2*
6	9¾	6½	14½	15	9	4½	13	7½
8	10⅞	8	17	19	9	4½	13	7½
10	12	9½	19	22	9	5	13	8½
12	14¼	10⅝	20¾	25	9½	5	13½	8½
14	16	11½	23	28	9½	5	13½	8½
15	17	11½	23	29½	9½	5	13½	8½
16	18	12½	25	31	9½	5	13½	8½
18	20¾	13½	27	34	11½	6¼	15½	10⅝
20	23¾	15	30	37	11½	6⅝	15½	10½
21	24	15	30	37½	11½	6⅝	15½	9⅞
24	28½	16¾	33	43	11½	7½	15½	11½
30	37½	19¾	39	52	12½	7	17	11½
36	41½	22½	45	61	12½	7	17	11½
42	47½	26½	52½	70	12½	8	17	12
48	51¼	29	57	79	14	8	19	12

* Add for grout pad thickness if applicable.
** Square or Round

GATE SIZE** A	B	C	D	E	F	J1*	G	J2*
54	59¼	33	66	88	15½	8½	20	12½
60	64	36	72	97	15½	8¾	20	12½
66	68	39	78	107	15½	9	20	12½
72	74	42	84	116	15½	9	20	13¼
78	84	45	90	125	15½	10	20	13¾
84	87	47½	95¾	133	18½	9½	23	13¾
90	94	53	106	142	18½	11	23	15¼
96	100	56	112	151	18½	11	23	15¼
108	110	62	124	170	20	11	25	15½
120	124	68	136	188	20	11	25	15½
132	134	74	148	206	20	12½	25	16¾

* Add for grout pad thickness if applicable.
** Square or Round
*** Size limitations may apply to models S-5900 and SC-5900



NOTE: FOR PRELIMINARY DESIGN PURPOSES ONLY
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UNLESS PART OF CERTIFIED & APPROVED SUBMITTAL

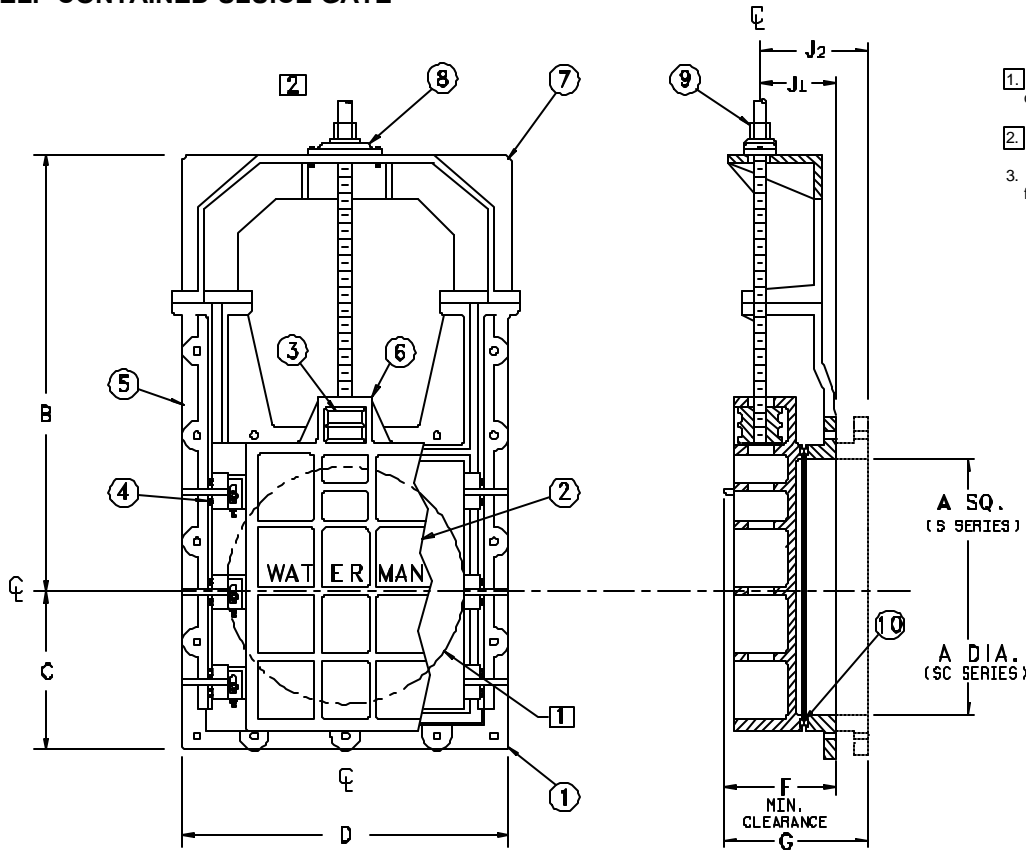
S-5000 & S-5900 RECTANGULAR OPENING (See drawing page 15)

GATE SIZE	B	C	D	E	F	J1	G	J2
12 X 18	20¾	13½	20¾	34	11½	5	15½	8¾
12 X 24	28½	17¼	21	43	11½	7	15½	11
12 X 36	38	22½	20¾	61	12½	7	17	11
15 X 18	20¾	13½	24	34	11½	6¼	15½	9⅞
18 X 6	9¾	7½	27	15	11½	6¼	15½	9
18 X 12	16¾	9¾	26	25	9¾	4¾	15½	8½
18 X 24	26½	16¾	27¼	43	11½	7	15½	11
18 X 30	37½	19¾	27	52	12½	7	17	11
18 X 36	38	22½	27	61	12½	7	17	11
18 X 48	51¼	29	27	79	14	7	19	11½
18 X 72	74⅞	41	27	116	14	7	19	11½
24 X 12	14¼	10¾	33	25	11½	6½	15½	9½
24 X 18	19	13½	33	34	11½	7	15½	10¾
24 X 30	37½	19¾	33	52	12½	7	17	11
24 X 36	38	22½	33	61	12½	7	17	11½
24 X 42	47¼	26½	33	70	12½	7	17	11½
24 X 48	50	29	33½	79	14	7	19	11
30 X 18	20¾	13½	39	34	12½	7	17	11½
30 X 24	28½	16½	39	43	12½	7	17	11½
30 X 36	41¼	22½	39	61	12½	7	17	11
30 X 42	47½	26½	40½	70	12½	8	17	12
30 X 48	51¼	29½	41	79	14	8	19	12
30 X 60	64	36	42	97	15½	8	20	12½
30 X 72	75	42	42	116	15½	8	20	12½
36 X 12	14¼	10¾	45½	25	12½	7	17	11
36 X 18	20¾	13¾	45½	34	12½	7	17	11
36 X 24	28½	16¾	45	43	12½	7	17	11
36 X 30	32	19¾	45	52	12½	7	17	11
36 X 42	47¼	26	46	70	12½	8	17	12
36 X 48	51¼	29½	47	79	14	8	19	12
36 X 60	64	36	48	97	15½	8	20	12½
36 X 72	74	42	48	116	15½	8	20	12½
36 X 84	87	48	48	139	18½	9½	23	13¾
39 X 84	87	48	51	139	18½	9½	23	13¾
42 X 30	37½	20¼	52½	52	12½	8	17	12
42 X 36	41½	23¼	52½	61	12½	8	17	12
42 X 48	51¼	29	52½	79	14	8	19	12
42 X 54	66¼	32¼	52½	91	12½	8	17	12
42 X 60	64	36	54	97	15½	8	20	12½
42 X 72	74¼	42	54¼	116	15	8	20	12½
48 X 24	28½	17	58	43	14	8	19	12
48 X 30	32	20½	59	52	14	8	19	12
48 X 36	38	23½	59	61	14	8	19	12
48 X 42	47½	26½	59	70	14	8	19	12
48 X 54	59¼	33	60	88	14	8	19	12½
48 X 60	62½	36	60	97	15½	8	20	12

GATE SIZE	B	C	D	E	F	J1	G	J2
48 X 72	74	42	60	116	15½	9	20	13¼
48 X 84	87	48	60	133	18½	9	23	13
48 X 96	100	56	64	155	18½	11	23	15¼
48 X 120	124	68	64	187	20	11	25	15½
54 X 24	28½	18	66	43	15½	8½	20	12½
54 X 36	41½	24	66	61	15½	8	20	12
54 X 48	51¼	30	66	79	15½	8½	20	12½
54 X 60	64	36	66	97	15½	8¾	20	12½
54 X 72	75	42	66	116	15½	9	20	13¼
54 X 84	87	48	66	133	14	8½	21¼	12
60 X 36	38	24	72	61	15½	8	20	12
60 X 48	52½	30	72	79	15½	8½	20	12½
60 X 72	74	42	72	116	15½	9	20	13¼
60 X 84	87	48	72	133	18½	8½	23	12
60 X 96	100	56	76	151	18½	11	23	15
60 X 120	124	68	76	191	20	13	25	15½
72 X 36	41½	24	84	61	15½	8	20	12
72 X 48	51½	30	84	79	15½	9	20	13
72 X 54	56	33	84	88	15½	9	20	12½
72 X 60	63¼	36	84	97	15½	9	20	13¼
72 X 84	87	47⅞	84	133	18½	9¾	23	13¾
72 X 96	100	56	88	151	18½	11	23	15¼
72 x 108	110	62	88	170	14	11	19	15½
84 x 48	52	30	96	79	18½	8	23	12½
84 x 60	64	36	96	97	18½	8½	23	12
84 x 66	68	39	96	107	18½	9½	23	13¾
84 x 72	74⅞	42	96	115	18½	9½	23	13¾
84 x 108	110	62	100	170	14	11	19	15½
96 x 24	28½	18	108	43	18½	10½	23	14½
96 x 36	41½	24	108	61	18½	10½	23	14½
96 x 42	47½	27	108	70	14	10½	19	14½
96 x 60	64	36	108	97	18½	11	23	15¼
96 x 72	74	44	112	116	18½	11	23	15¼
96 x 120	124	68	112	187	20	11	25	15¼
102 x 78	82	45	114	124	20	11	25	16
108 x 60	64	38	124	97	20	11	25	15
108 x 72	74	44	124	116	20	11	25	15
108 x 84	87	50	124	133	20	11	25	15½
108 x 120	124	68	124	187	20	12	25	16½
108 x 144	150	80	124	225	20¾	12½	27¼	17¾
120 x 60	64	36	136	97	18½	11	23	15¼
120 x 72	74	44	136	116	20	11	25	15½
120 x 84	87	50	136	133	20	11	25	15½
120 x 96	100	56	136	151	20	11	25	15½
120 x 108	110	62	136	175	20	11	25	15½
120 x 132	134	74	136	208	21¾	12½	27¼	18
144 x 84	87	50	160	133	22	11	27	15



**S-5000-Y, SC-5000-Y, S-5900-Y & SC-5900-Y **
SELF-CONTAINED SLUICE GATE**



- 1. SC Series shown. S Series gate has square opening.
- 2. Type 1 lift shown. Geared lifts also available.
- 3. All gates are available with special height fabricated steel or stainless steel yokes.

PARTS	
No.	Name
1	Frame
2	Cover
3	Thrust Nut
4	Side Wedge Assy.
5	Guide Rail
6	NRS Bracket
7	Yoke
8	Lift Collar
9	Lift Nut
10	Seats (non-corrosive)

GATE SIZE A	B	C	D	F	J1*	G	J2*
6	16	6½	14½	9½	4½	13½	7½
8	21½	8	17	9½	4½	13½	7½
10	24½	9½	19	9½	5	13½	8½
12	27¾	10¾	20¾	10	5	14	8½
14	30	11½	23	10	5	14	8½
15	31¾	11½	23	10	5	14	8½
16	33½	12½	25	10	5	14	8½
18	37	13½	27	12	6¼	16	10¾
20	41½	15	30	12	6¾	16	10½
21	41½	15	30	12	6¾	16	10
24	46	16¾	33	12	7½	16	11½
30	55	19¾	39	13	7	17½	11½
36	64	22½	45	13	7	17½	11½
42	73½	26½	52½	13	8	17½	12
48	82	29	57	14½	8	19½	12
54	111	33	66	15½	8½	20	12½
60	116	36	72	15½	8¾	20	12½
66	127	39	78	15½	9	20	12½
72	138	42	84	16¾	9¼	20¾	13¼
78	141	45	90	15½	10	20	13¾
84	150	47½	95¾	18½	9½	23	13¾

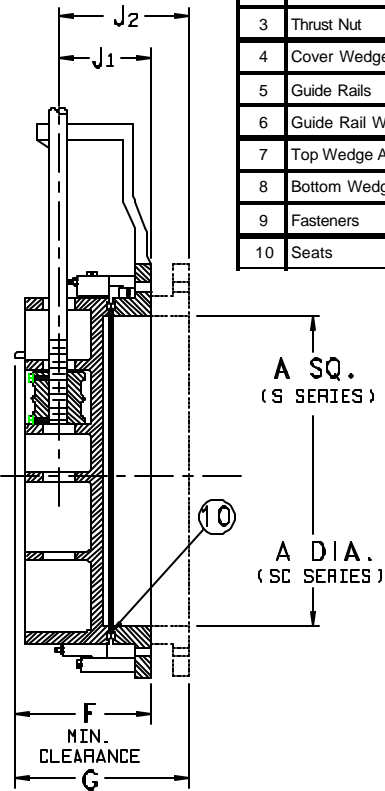
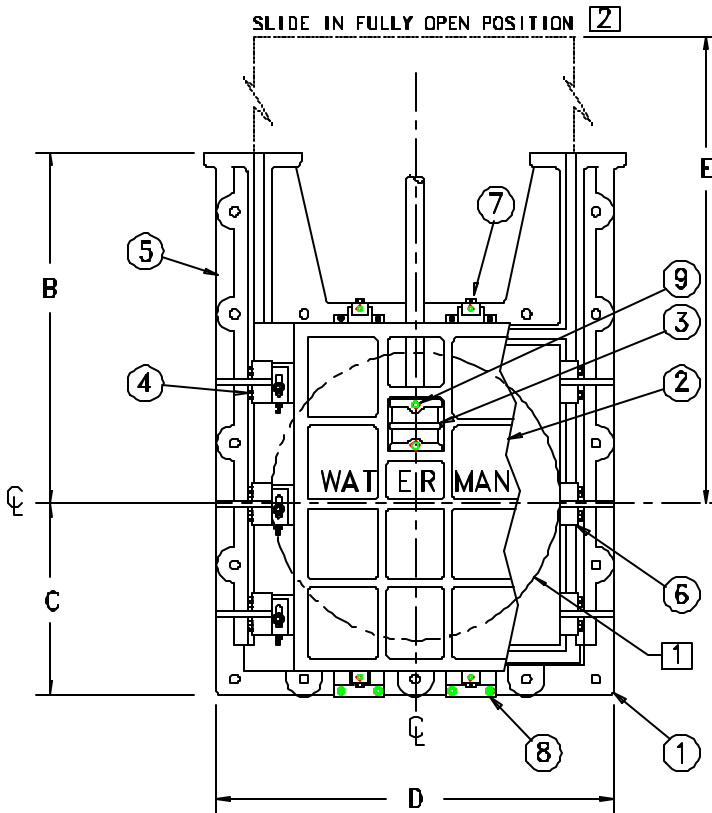
* Add for grout pad thickness if applicable.
** Size limitations may apply to models S-5900 and SC-5900.

GATE SIZE	B	C	D	F	J1	G	J2
12 x 24	44	17¼	21	11½	7	15½	11
12 x 36	62¾	22½	20¾	12½	7	17	11
15 x 18	36½	13½	24	11½	6¼	15½	9¾
18 x 6	26	7½	27	11½	6¼	15½	9
18 x 30	55	19¾	27	12½	7	17	11
18 x 36	63¾	22½	27	12½	7	17	11
24 x 18	37¼	13½	33	11½	7	15½	10¾
24 x 30	55	19¾	33	12½	7	17	11
24 x 36	63½	22½	33	12½	7	17	11½
24 x 48	81	29	33½	14	7	19	11
30 x 18	38¼	13½	39	12½	7	17	11½
30 x 24	46	16½	39	12½	7	17	11½
30 x 36	64¾	22½	39	12½	7	17	11
30 x 42	73½	26½	40½	12½	8	17	12
30 x 60	104	36	42	15½	8	20	12½
42 x 36	67½	23¼	52½	12½	8	17	12
42 x 54	95	32¼	52½	12½	8	17	12
48 x 24	59¼	17	58	14	8	19	12
48 x 30	62¾	20½	59	14	8	19	12
48 x 42	73½	26½	59	14	8	19	12
48 x 60	102¾	36	60	15½	8	20	12

NOTE: FOR PRELIMINARY DESIGN PURPOSES ONLY
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UNLESS PART OF CERTIFIED & APPROVED SUBMITTAL



S-7000 SQUARE, ROUND & RECTANGULAR SLUICE GATES



PARTS	
No.	Name
1	Frame
2	Cover
3	Thrust Nut
4	Cover Wedge Assembly
5	Guide Rails
6	Guide Rail Wedge Assembly
7	Top Wedge Assembly
8	Bottom Wedge Assembly
9	Fasteners
10	Seats

NOTES:

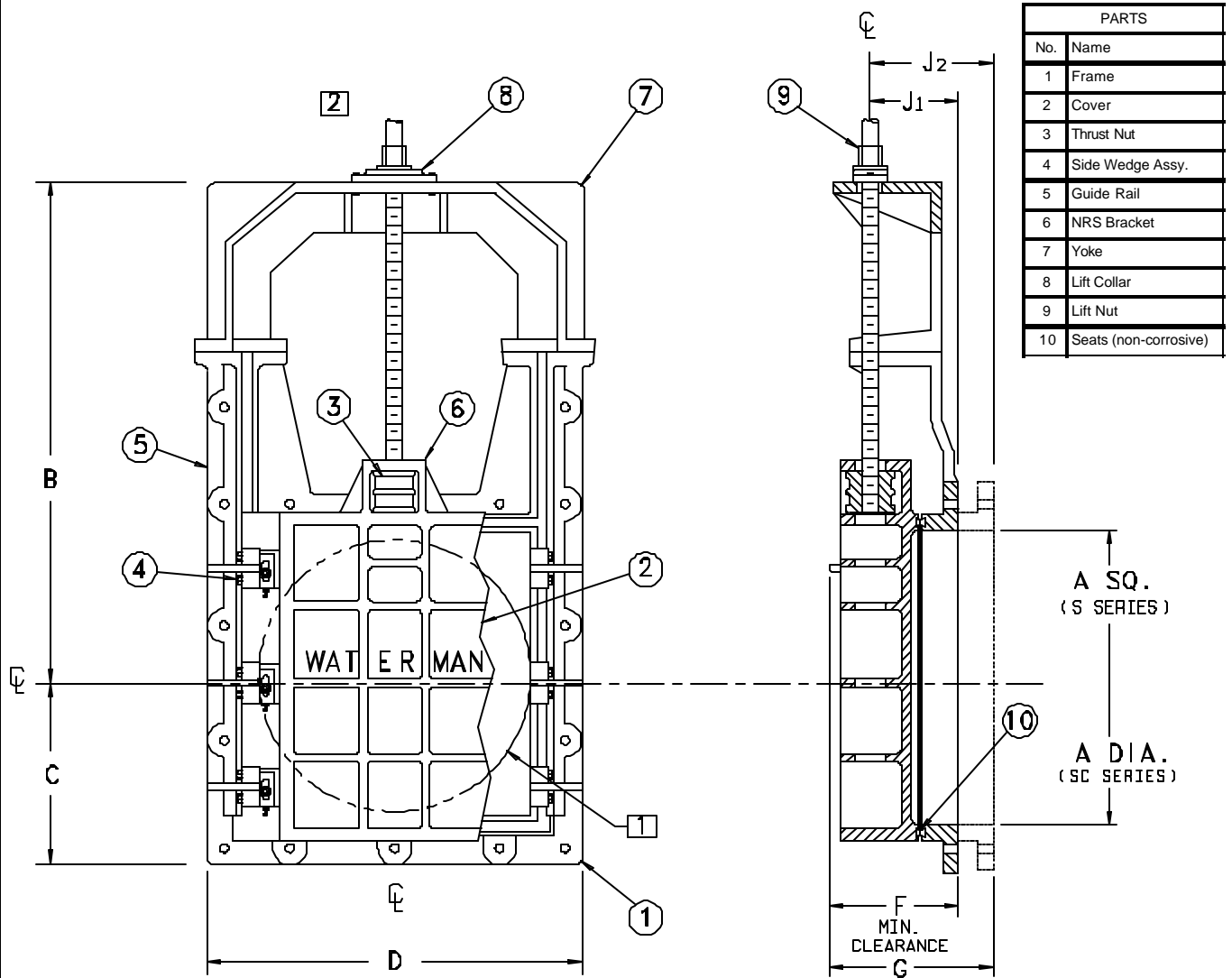
- [1] SC Series shown. S Series gate has square opening.
- [2] Top of NRS cover or top of wedges.

GATE SIZE A	B	C	D	E	F	J1	G	J2
12	14 1/4	10 3/8	20 3/4	21	9 1/2	5	13 1/2	8 1/2
16	18	12 1/2	25	27	9 1/2	5	13 1/2	8 1/2
18	20 3/4	13 1/2	27	31	11 1/2	6 1/2	15 7/8	10 3/4
24	28 1/2	16 3/4	33	39	10 1/2	8	14 1/2	12 1/2
30	37 1/2	20	40	48	13 3/4	8	17 3/4	12
36	41 1/2	22 1/2	49 1/4	57	12	8 1/2	17	12 1/2
39 3/8 1 METER	45	25	50	63 1/2	12	8	17	12
42	47 1/2	26 1/2	52	66	12	8	17	12
48	51 1/4	29	57 1/2	75	14 3/4	8 1/2	19	12 1/2
54	59 1/4	33	66	84	12	8 1/2	17	12 1/2
60	64	36	72	93	16	9	21	13 1/2
66	68	39	78	102	14	9	19	13 1/2
72	74	42	84	112	14	9	19	13 1/4
84	87	47 1/2	95 3/4	130	18 1/2	12 1/2	23	16 1/2
96	100	56	112	148	18 1/2	11	23	15 1/4

GATE SIZE	B	C	D	E	F	J1	G	J2
24 X 30	37 1/2	20	34	48	10 1/2	8	14 1/2	12
24 X 42	47 1/4	26 1/2	33	66	12 1/2	7	17	11 1/2
24 X 48	50	29	33 1/2	75	12	7	17	11
30 X 18	20 3/4	14	40	30	10 1/2	8	14 1/2	12
30 X 48	51 1/4	29	40	75	14	8	19	12
36 X 18	20 3/4	13 3/4	45 1/2	30	7	8 1/2	12	12 1/2
39 X 84	87	48	51	130	18 1/2	9 1/2	23	13 3/4
42 X 36	41 1/2	23 3/4	52 1/2	57	12	8	17	12
42 X 48	51 1/4	29	52 1/2	75	12	8	17	12
48 X 42	47 1/2	26 1/2	59	66	12	8	17	12
48 X 60	62 1/2	36	60	93	12	8	17	12
48 X 72	74	42	60	112	14	9	19	13 1/4
60 X 84	87	50	76	130	18 1/2	12	23	15 1/2
84 X 60	104	38 1/2	101	99	22	12 3/4	27	16 1/2
108 X 84	87	50	124	130	20	11	25	15 1/2

NOTE: FOR PRELIMINARY DESIGN PURPOSES ONLY
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S-7000-NRS-Y SQUARE & RECTANGULAR SLUICE GATES

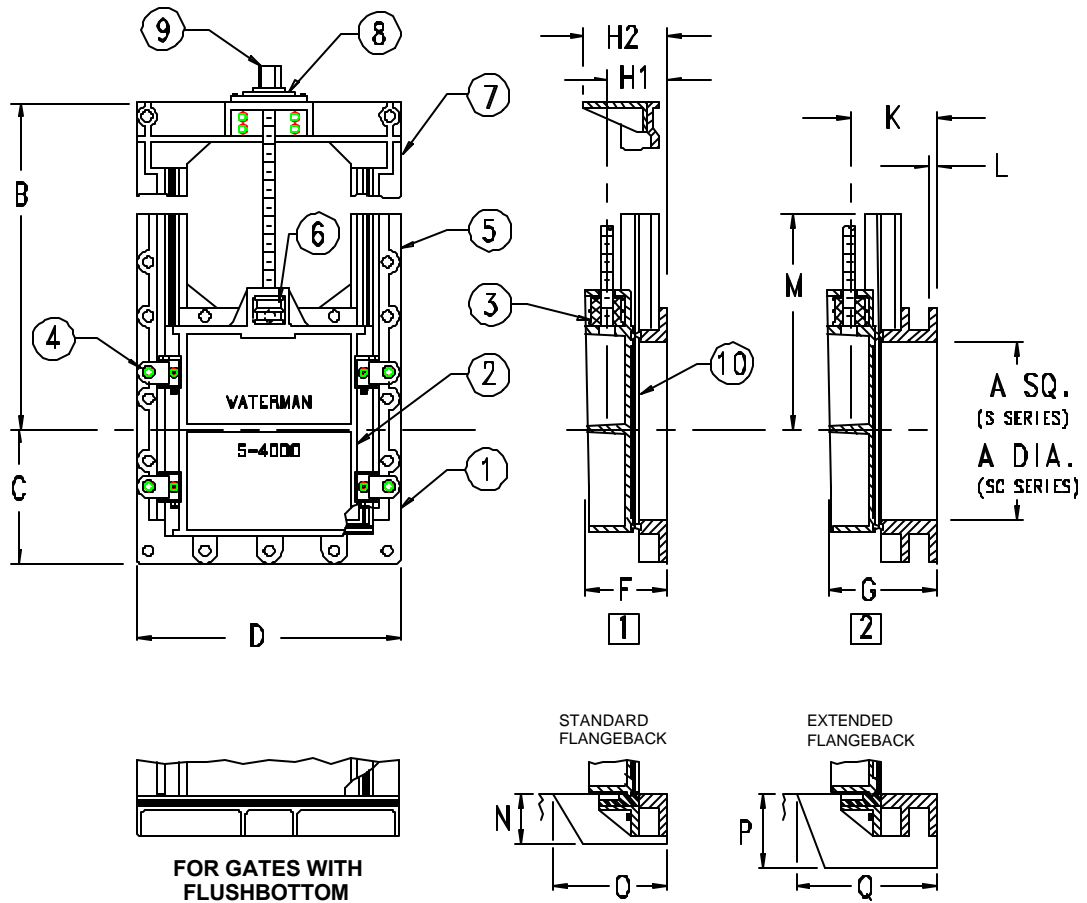


- 1 SC Series shown. S Series gate has square opening.
- 2 Type 1 lift shown. Geared lifts also available.
- 3. All gates are available with special height fabricated steel or stainless steel yokes.

GATE SIZE A	B	C	D	F	J1	G	J2
12	27 ³ / ₈	10 ³ / ₈	20 ³ / ₄	9 ¹ / ₂	5	13 ¹ / ₂	8 ¹ / ₂
16	33 ¹ / ₂	12 ¹ / ₂	25	9 ¹ / ₂	5	13 ¹ / ₂	8 ¹ / ₂
18	37	13 ¹ / ₂	27	11 ¹ / ₂	6 ¹ / ₂	15 ⁵ / ₈	10 ³ / ₄
24	49	16 ³ / ₄	33	10 ¹ / ₂	8	14 ¹ / ₂	12 ¹ / ₂
30	58 ³ / ₈	20	40	13 ³ / ₄	8	17 ³ / ₄	12
30 X 18	38 ³ / ₄	14	40	10 ¹ / ₂	8	14 ¹ / ₂	12
36	64	22 ¹ / ₂	49 ¹ / ₄	12	8 ¹ / ₂	17	12 ¹ / ₂
39 ³ / ₈ 1 METER	71	25	50	12	8	17	12
42	77 ¹ / ₂	26 ¹ / ₂	52	12	8	17	12
48	82	29	57 ¹ / ₂	14 ³ / ₄	8 ¹ / ₂	19	12 ¹ / ₂
48 X 42	73 ¹ / ₂	26 ¹ / ₂	59	12	8	17	12
48 X 60	102 ³ / ₄	36	60	12	8	17	12

NOTE: FOR PRELIMINARY DESIGN PURPOSES ONLY
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S-4000 METRIC



PARTS	
No.	Name
1	Frame (shown as self-contained)
2	Cover
3	Thrust Nut
4	Side Wedge Ass'y.
5	Guide Rail, Cast on (integral with frame) 14" and larger
6	Thrust Nut Pocket
7	Yoke, Cast on (integral with frame)
8	Lift Collar
9	Lift Nut
10	Seats (non-corrosive)

GATE SIZE	S-4000 GATE DIMENSIONS IN MILLIMETERS															
	A [2]	B	C	D	F [1]	G [1]	H1*	H2*	K*	L	M	N	O	P	Q	
150	152	346	152	282	121	191	64	102	127	24	190	102	254	254	356	
200	203	422	178	333	121	191	64	102	127	24	241	102	254	254	356	
250	254	498	203	384	121	191	64	102	127	24	292	102	254	254	356	
300	305	583	235	445	149	216	89	133	155	24	343	102	279	254	381	
350	356	767	305	610	210	295	127	197	213	27	432	127	356	305	457	
380	381	767	305	610	210	295	127	197	213	27	432	127	356	305	457	
400	406	805	318	635	210	295	127	197	213	27	462	127	356	305	457	
450	457	884	343	686	210	305	127	197	222	27	508	127	356	305	457	
500	508	967	369	738	210	295	127	197	213	27	558	127	356	305	457	
600	610	1224	419	838	210	298	127	197	224	27	660	127	356	305	457	
700	700	1360	465	930	226	311	127	197	213	27	750	127	356	305	457	
750	762	1452	495	991	226	324	133	197	229	30	838	127	356	305	457	
800	800	1530	515	1030	226	324	133	197	229	30	860	127	356	305	457	
900	914	1681	571	1143	226	324	133	197	229	30	991	127	356	305	457	
1000	1000	1810	615	1230	222	324	133	197	229	30	1050	127	356	305	457	
1050	1066	1975	648	1295	248	362	165	241	279	38	1118	127	381	356	508	
1200	1219	2199	724	1448	273	381	165	241	279	38	1273	127	381	356	508	

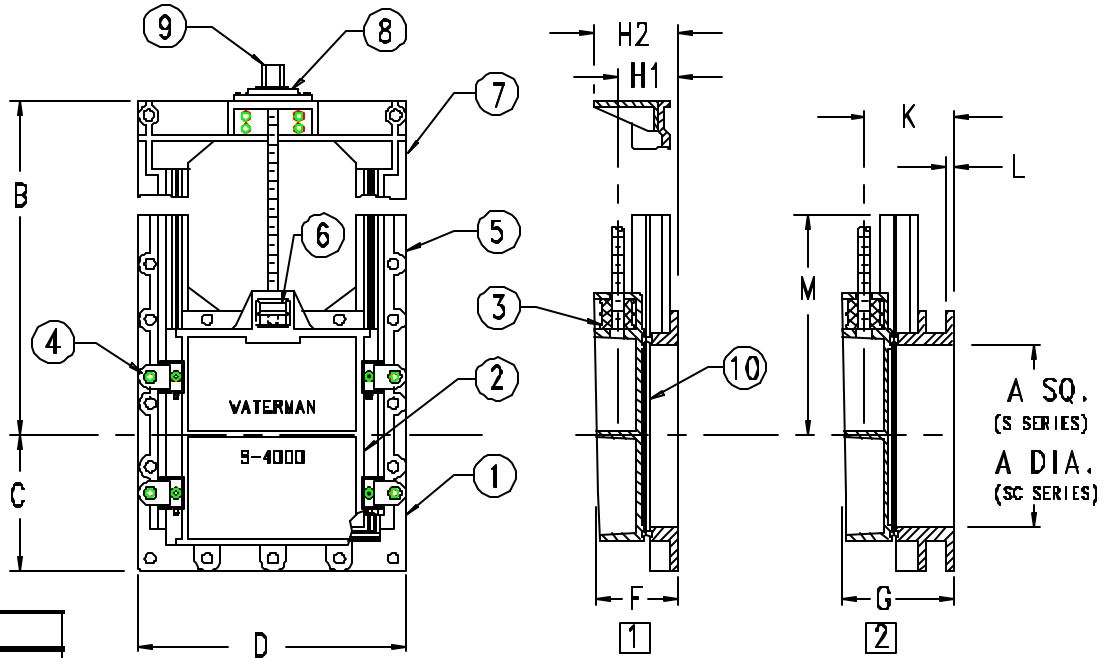
[1]. Minimum required clearance dimensions.

[2]. Actual.

* Add for grout pad if applicable

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S-4000 INCHES

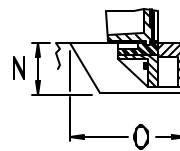


PARTS	
No.	Name
1	Frame (shown as self-contained)
2	Cover
3	Thrust Nut
4	Side Wedge Assy.
5	Guide Rail, Cast on (integral with frame) 14" and larger
6	Thrust Nut Pocket
7	Yoke, Cast on (integral with frame)
8	Lift Collar
9	Lift Nut
10	Seats (non-corrosive)

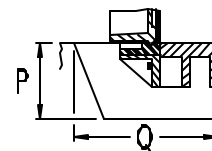


FOR GATES WITH FLUSHBOTTOM

STANDARD FLANGEBACK



EXTENDED FLANGEBACK



1. S Series shown. SC Series has circular opening.

2. Minimum required clearance dimensions.

GATE SIZE	S-4000 GATE DIMENSIONS IN INCHES													
	A	B	C	D	F 2	G 2	H1*	H2*	K*	L	M	N	O	P
6	13 ⁵ / ₈	6	11 ¹ / ₈	4 ³ / ₄	7 1/2	2 1/2	4	5	1 ⁵ / ₁₆	7 1/2	4	10	10	14
8	18 ⁵ / ₈	7	13 ³ / ₈	4 ³ / ₄	7 1/2	2 1/2	4	5	1 ⁵ / ₁₆	9 1/2	4	10	10	14
10	19 ⁵ / ₈	8	15 ¹ / ₈	4 ³ / ₄	7 1/2	2 1/2	4	5	1 ⁵ / ₁₆	11 1/2	4	10	10	14
12	22 ¹⁵ / ₁₆	9 ¹ / ₄	17 1/2	5 ⁷ / ₈	8 1/2	3 1/2	5 1/4	6 1/8	1 ⁵ / ₁₆	13 1/2	4	14	10	15
14	30 ³ / ₁₆	12	24	8 1/4	11 ⁵ / ₈	5	7 ³ / ₄	8 ³ / ₈	1 ¹ / ₁₆	17	5	14	12	18
15	30 ³ / ₁₆	12	24	8 1/4	11 ⁵ / ₈	5	7 ³ / ₄	8 ³ / ₈	1 ¹ / ₁₆	17	5	14	12	18
16	31 ¹¹ / ₁₆	12 1/2	25	8 1/4	11 ⁵ / ₈	5	7 ³ / ₄	8 ³ / ₈	1 ¹ / ₁₆	18 ³ / ₁₆	5	14	12	18
18	34 ¹¹ / ₁₆	13 1/2	27	8 1/4	12	5	7 ³ / ₄	8 ³ / ₄	1 ¹ / ₁₆	20	5	14	12	18
20	38 ¹ / ₁₆	14 1/2	29	8 1/4	11 ⁵ / ₈	5	7 ³ / ₄	8 ³ / ₈	1 ¹ / ₁₆	22	5	14	12	18
24	48 ³ / ₁₆	16 1/2	33	8 1/4	11 ³ / ₄	5	7 ³ / ₄	8 ¹¹ / ₁₆	1 ¹ / ₁₆	26	5	14	12	18
27 1/2	53 ³ / ₁₆	18 ¹⁵ / ₁₆	36 ⁵ / ₈	8 ⁷ / ₈	12 1/4	5	7 ³ / ₄	8 ³ / ₈	1 ¹ / ₁₆	29 1/2	5	14	12	18
30	57 ³ / ₁₆	19 1/2	39	8 ⁷ / ₈	12 ³ / ₄	5 1/4	7 ³ / ₄	9	1 ³ / ₁₆	33	5	14	12	18
31 1/2	60 ¹ / ₄	20 1/4	40 ⁹ / ₁₆	8 ⁷ / ₈	12 ³ / ₄	5 1/4	7 ³ / ₄	9	1 ³ / ₁₆	33 ³ / ₈	5	14	12	18
36	66 ³ / ₁₆	22 1/2	45	8 ⁷ / ₈	12 ³ / ₄	5 1/4	7 ³ / ₄	9	1 1/4	39	5	14	12	18
39 ³ / ₈	71 1/4	24 1/4	48 ⁷ / ₁₆	8 ³ / ₄	12 ³ / ₄	5 1/4	7 ³ / ₄	9	1 1/4	41 ¹ / ₁₆	5	14	12	18
42	77 ³ / ₄	25 1/2	51	9 ³ / ₄	14 1/4	6 1/2	9 1/2	11	1 1/2	44	5	15	14	20
48	86 ⁹ / ₁₆	28 1/2	57	10 ³ / ₄	15	6 1/2	9 1/2	11	1 1/2	50 ⁵ / ₈	5	15	14	20

*Add for grout pad if applicable

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