# AUTOMATIC
# LEVEL CONTROL GATES

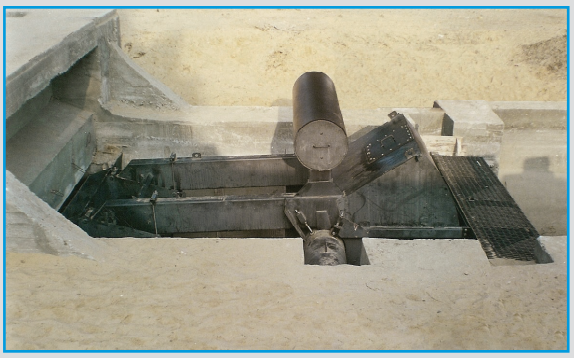
## WATERMAN DOWNSTREAM LEVEL CONTROL

Waterman Types "A" and "B" Automatic gates provide constant downstream water level control regardless of upstream level conditions or downstream demands.

This remarkably constant control is achieved without any operators, without motors or power supply, and irrespective of upstream level conditions.

Waterman downstream level control gates are designed to respond automatically and instantly to downstream level changes to maintain a constant downstream water level. They are ideally suited for:

- "Demand control" on open canals
- Canal and network automation
- Control of detention basins and reservoirs
- Flood Control
- Channel water level maintenance
- "Constant source" flow for cooling and recirculation systems and water and wastewater treatment facilities.
- Constant downstream discharge when used with a Waterman baffle distributor
- Control of head (head breaking)




WATERMAN

**TYPE "A"**

AND

**TYPE "B"**

CONSTANT DOWNSTREAM LEVEL CONTROL GATES

## TYPE "A"

Maximum upstream head of 2 meters for largest gates.

No breastwall.

Designed for continuous canal lengths with upstream level variations relatively small.

## TYPE "B"

Maximum upstream head of 11 meters for largest gates.

Breastwall or other orifice needed.

Designed for higher heads and greater upstream level requirements working against breastwall or other opening.

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# DOWNSTREAM LEVEL CONTROL

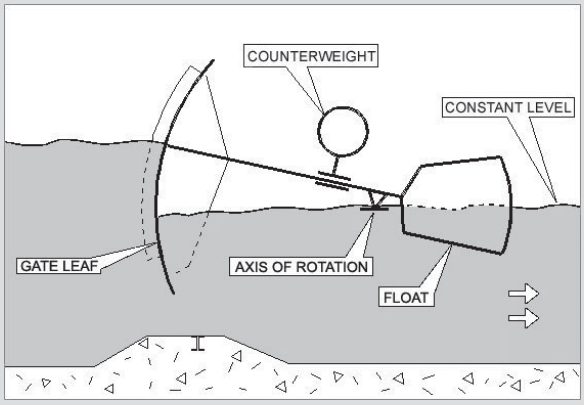
## GATE CONSTRUCTION

The Waterman Type "A" and Type "B" constant downstream level gates basically consist of a radial leaf of trapezoidal shape, a float that is rigidly fixed to the moving frame downstream of the pivot axis, a float shield tank in which the inlet butterfly valve is fixed, a counterweight tank and a frame structure which consists of the main shaft with bearings and beams connecting the float to the gate leaf.

The walkway is a standard feature for all sizes of Waterman Type "A" and Type "B" gates. Waterman Type "A" gate has a damper on the upstream surface of the leaf and bottom/sides metal seats. Waterman Type "B" gate has an embedded metal intake structure.

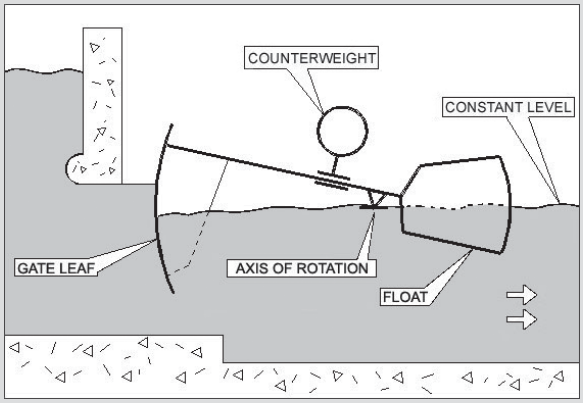
## TYPE "A"

CONSTANT DOWNSTREAM
LEVEL CONTROL GATES




## TYPE "B"

CONSTANT DOWNSTREAM
LEVEL CONTROL GATES




## PRINCIPLE OF OPERATION

With the downstream water level at the pivot axis, the gate is balanced so that the moment caused by the center of gravity about the hinge is equal to the moment caused by the upthrust of the float. Any change in the water level alters this stability, causing the gate to rotate, thereby increasing or decreasing the discharge to restore the water level to the pivot centerline. If the water level falls, the reduced flotation couple allows the gate to open increasing the discharge into the downstream channel. Conversely, if the water level rises, the increased flotation couple shuts the gate, decreasing the discharge and maintaining the water level at the pivot centerline.

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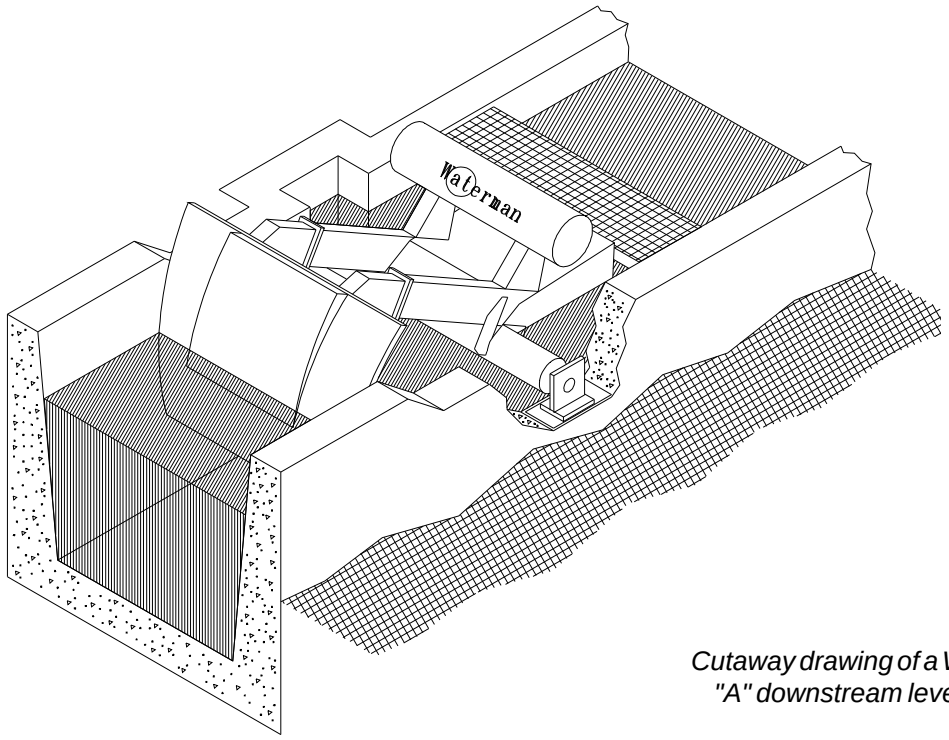
WATERMAN
# TYPE "A"

## TYPE "A"

Waterman Type "A" gates are designed to maintain a constant downstream water level irrespective of the upstream variations, provided that the upstream level variations are small enough to be satisfied by a surface gate.

Two Type "A" configurations are available. The low head has a wider gate leaf of lesser height, while the high head gate leaf is not as wide, but has greater height. At equal loss of head, a Waterman Type "A" low head gate allows a bigger flow, but the maximum permissible head is less.




*Cutaway drawing of a Waterman Type "A" downstream level control gate*

## SELECTING A SUITABLE WATERMAN DOWNSTREAM LEVEL CONTROL GATE

Selection is based on the required hydraulic performance of the installation. The following data must be known when choosing a suitable gate for a given supply system:

a- Maximum discharge
b- Minimum head differential under which the maximum discharge must still be delivered
c- Maximum head differential
d- Largest discharge to be delivered under the maximum head differential

The gate to be selected is the smallest one (smallest index number) whose head-discharge curve, represented on the selection charts, encompasses all possible head/discharge operating points which may be encountered for the installation.

# DOWNSTREAM LEVEL CONTROL

*CONSULT THE FACTORY FOR THE GATE SELECTION CHART (HEAD DIFFERENTIAL VS. FLOW)*

**TYPE "A"**
**LOW HEAD**
**GATE SELECTION CHART**

**TYPE "A"**
**HIGH HEAD**
**GATE SELECTION CHART**

*CONSULT THE FACTORY FOR THE GATE SELECTION CHART (HEAD DIFFERENTIAL VS. FLOW)*

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# DOWNSTREAM LEVEL CONTROL

## EXAMPLES

For example, the minimum head differential **1** under which the maximum discharge **2** must still be delivered. **1** and **2** define point **A.**
Maximum head differential **3** and the largest discharge **4** to be delivered under this maximum head differential. **3** and **4** define point **B.**

**EXAMPLE 1:**
Water flows from a reservoir to a canal, Which gate shall be used to control the flow from the reservoir in order to maintain a constant water level in the canal irrespective of the level in the reservoir and irrespective of the water demand?

- withdrawal rate varies from 400 to 7000 L/s
- level in the reservoir can fluctuate between 3082 cm and 3260 cm.
- desired Constant Level in canal: 3050 cm.

Point $A^1$ is defined by:
**1** 3082 - 3050 = 32 cm.
**2** 7000 L/s

Point $B^1$ is defined by:
**3** 3260 -3050 = 210 cm.
**4** 7000 L/s

Note that no Type "A" will answer the problem. However, Type B-16 is the smallest gate whose characteristics encompass $A^1$ and $B^1$ and is therefore the gate to be selected. Gates up to B-21 can work but the gate chosen shouldn't be too generously dimensioned since its leakage rate would then be disproportionate compared to the normal gate flow.

**EXAMPLE 2:**
A control structure is to be installed in a canal to maintain a constant downstream water level irrespective of the discharge in the canal.

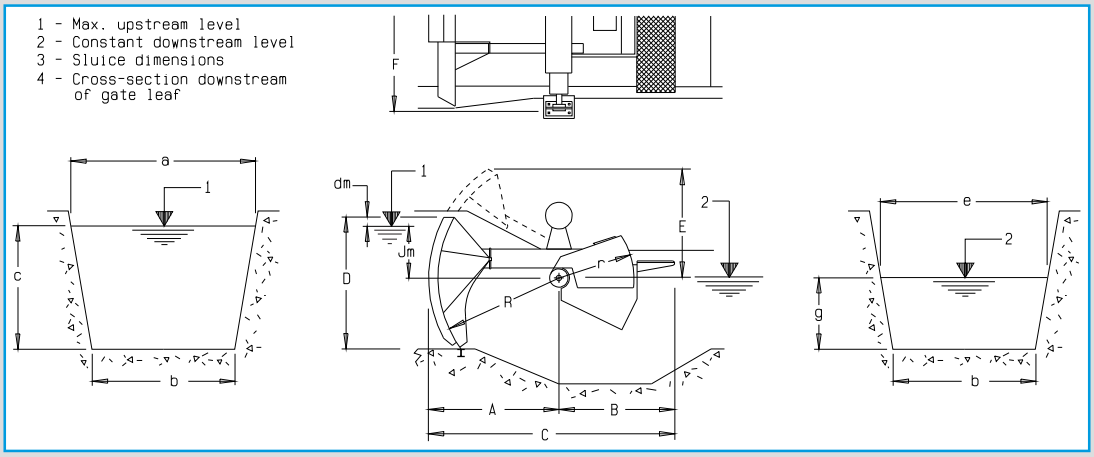
- desired constant downstream level: 5500 cm
- at maximum flow of 3000 Lit/s the water level in the canal upstream of the structure is 5503cm
- at minimum flow of 850 Lit/s the water level in the canal upstream of the structure is 5590 cm

Point $A^2$ is defined by:
**1** 5503 - 5500 = 3 cm
**2** 3000 L/s

Point $B^2$ is defined by:
**3** 5590 - 5500 = 90 cm
**4** 850 Lit/s

Automatic gates A-7, A-18, B-18 and B-23 all have characteristics which encompass $A^2$ and $B^2$. However, since the A-7 & B-18 are the smaller, these gates are to be selected according to the type of installation.

1 - Max. upstream level
2 - Constant downstream level
3 - Sluice dimensions
4 - Cross-section downstream of gate leaf




| TYPE A | | Overall Dimensions | | | | | | | | dimensions in mm | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| High Head | Low Head | A | B* | C* | D | E | F | R | r | Jm | dm | b | e | g | a | b | c |
| A-1 | | 1020 | 620 | 1640 | 980 | 900 | 1400 | 900 | 560 | 400 | 20 | 1060 | 1250 | 560 | 1385 | 1060 | 960 |
| A-2 | | 1270 | 780 | 2050 | 1235 | 1100 | 1810 | 1120 | 710 | 500 | 25 | 1320 | 1600 | 710 | 1800 | 1320 | 1210 |
| A-3 | | 1580 | 1000 | 2580 | 1560 | 1350 | 2220 | 1400 | 900 | 630 | 30 | 1700 | 2000 | 900 | 2210 | 1700 | 1530 |
| | A-4 | 1800 | 1000 | 2800 | 1385 | 1300 | 2370 | 1600 | 900 | 355 | 30 | 1900 | 2240 | 1000 | 2360 | 1900 | 1355 |
| A-5 | | 2020 | 1900 | 3920 | 1960 | 1750 | 2860 | 1800 | 1100 | 800 | 40 | 2120 | 2500 | 1120 | 2775 | 2120 | 1920 |
| | A-6 | 2250 | 1900 | 4150 | 1740 | 1650 | 3160 | 2000 | 1100 | 450 | 40 | 2360 | 2800 | 1250 | 2960 | 2360 | 1700 |
| A-7 | | 2520 | 2100 | 4620 | 2450 | 2150 | 3600 | 2240 | 1400 | 1000 | 50 | 2650 | 3150 | 1400 | 3505 | 2650 | 2400 |
| | A-8 | 2820 | 2100 | 4920 | 2210 | 2050 | 4000 | 2500 | 1400 | 560 | 50 | 3000 | 3550 | 1600 | 3745 | 3000 | 2160 |
| A-9 | | 2820 | 2330 | 5150 | 2755 | 2400 | 4020 | 2500 | 1600 | 1100 | 55 | 3000 | 3550 | 1600 | 3930 | 3000 | 2700 |
| | A-10 | 3150 | 2330 | 5480 | 2485 | 2300 | 4470 | 2800 | 1600 | 630 | 55 | 3350 | 4000 | 1800 | 4225 | 3350 | 2430 |
| A-11 | | 3150 | 2540 | 5690 | 3110 | 2700 | 4550 | 2800 | 1800 | 1250 | 60 | 3350 | 4000 | 1800 | 4450 | 3350 | 3050 |
| | A-12 | 3550 | 2540 | 6090 | 2760 | 2600 | 5050 | 3150 | 1800 | 700 | 60 | 3750 | 4500 | 2000 | 4765 | 3750 | 2700 |
| A-13 | | 3550 | 2740 | 6290 | 3470 | 3000 | 5070 | 3150 | 2000 | 1400 | 70 | 3750 | 4500 | 2000 | 5025 | 3750 | 3400 |
| | A-14 | 4000 | 2740 | 6740 | 3110 | 2900 | 5570 | 3550 | 2000 | 800 | 70 | 4250 | 5000 | 2240 | 5270 | 4250 | 3040 |
| A-15 | | 4000 | 3020 | 7020 | 3920 | 3400 | 5710 | 3550 | 2200 | 1600 | 80 | 4250 | 5000 | 2240 | 5535 | 4250 | 3840 |
| | A-16 | 4500 | 3020 | 7520 | 3480 | 3250 | 6310 | 4000 | 2200 | 900 | 80 | 4750 | 5600 | 2500 | 5905 | 4750 | 3400 |
| A-17 | | 4500 | 3310 | 7810 | 4390 | 3800 | 6340 | 4000 | 2500 | 1800 | 90 | 4750 | 5600 | 2500 | 6215 | 4750 | 4300 |
| | A-18 | 5000 | 3310 | 8310 | 3890 | 3650 | 7040 | 4500 | 2500 | 1000 | 90 | 5300 | 6300 | 2800 | 6660 | 5300 | 3800 |
| A-19 | | 5000 | 3600 | 8600 | 4900 | 4300 | 7130 | 4500 | 2800 | 2000 | 100 | 5300 | 6300 | 2800 | 7015 | 5300 | 4800 |
| | A-20 | 5650 | 3600 | 9250 | 4350 | 4050 | 7930 | 5000 | 2800 | 1100 | 100 | 6000 | 7100 | 3150 | 7485 | 6000 | 4250 |

** Dimensions are approximate and subject to change*

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## TYPICAL SPECIFICATIONS FOR TYPE "A"

**MANUFACTURER QUALIFICATION.** Gates shall be Waterman or approved equal in quality, characteristics and performance, of a manufacturer regularly engaged with a previous experience in manufacturing similar automatic level control gates of ten years prior to bid opening.

**GATE CONSTRUCTION.** The gate shall be designed to withstand the pressure forces produced by the upstream water level at its maximum elevation, with no tailwater (and, as the case may be, by the exceptional maximum tailwater level). The gate shall mainly consist of a radially shaped faceplate, suitably reinforced and matching trapezoidal-shaped sluice way, a framework including the float and ballasting compartments, and two roller bearings enclosed in sealed housings to be anchored in the concrete structure. The float ballast compartment shall be protected by a shield specially designed to prevent any silt deposit likely to impair the traveling of the moving assembly. The gates shall include a counterweight tank that is suitable for accurate, sensitive and stable gate operation. The gate shall be carefully checked and adjusted to tolerances required in the factory for straight forward field assembly, erection and proper operation.

**SUBMITTALS.**

**Submittal Drawings.** Submittal drawings shall include a complete list of equipment and materials, including manufacturer's descriptive and technical literature, performance charts, catalog cuts, and installation instructions. Drawings shall show proposed layout and anchorage of the system and appurtenances, design of structure to receive gates and equipment relationship to other parts of the work including clearances for maintenance and operation. Submittal data shall include weights of the ballast which shall be supplied by the customer.

**Certificate of Compliance.** A certificate of compliance that the gates furnished are in conformance with the drawings and specifications shall be submitted to the project engineer.

**Operating Instructions.** Operating characteristics and instructions outlining procedure required for system start-up and system operation shall be furnished.

**Maintenance Instructions.** O&M manuals detailing the maintenance instructions and listing routine maintenance procedures, possible breakdown and repairs shall be submitted.

**SHIPMENT AND DELIVERY.** Gates shall be shipped from factory in components or sub-assemblies to be bolted together in the field to the exclusion of any field welding. The dimensions of individual components shall be compatible with rail or road transportations clearances. Match marks shall be provided on the heaviest components to facilitate field erection. When shipping and delivering gate components, the gate shall be handled carefully to ensure a sound, undamaged condition. Particular care shall be taken not to damage any coating.

**MATERIALS.** All materials used in construction of the gate shall be new and selected according to the best engineering practice for this type of equipment. The steel used in construction shall be DIN 17100 ST 37-2.

## TYPICAL SPECIFICATIONS FOR TYPE "A"

**OPERATION REQUIREMENTS.** The gate shall operate automatically, regulating the downstream water level with no external power, motor or level sensors and hoists, and no manual intervention, under the desired head differential and flows.

**SURFACE PREPARATION AND PAINTING.** Surface preparation shall consist of blast cleaning of all surfaces. Mechanical surfaces shall be protected by appropriate masking. Protective coating shall consist of:

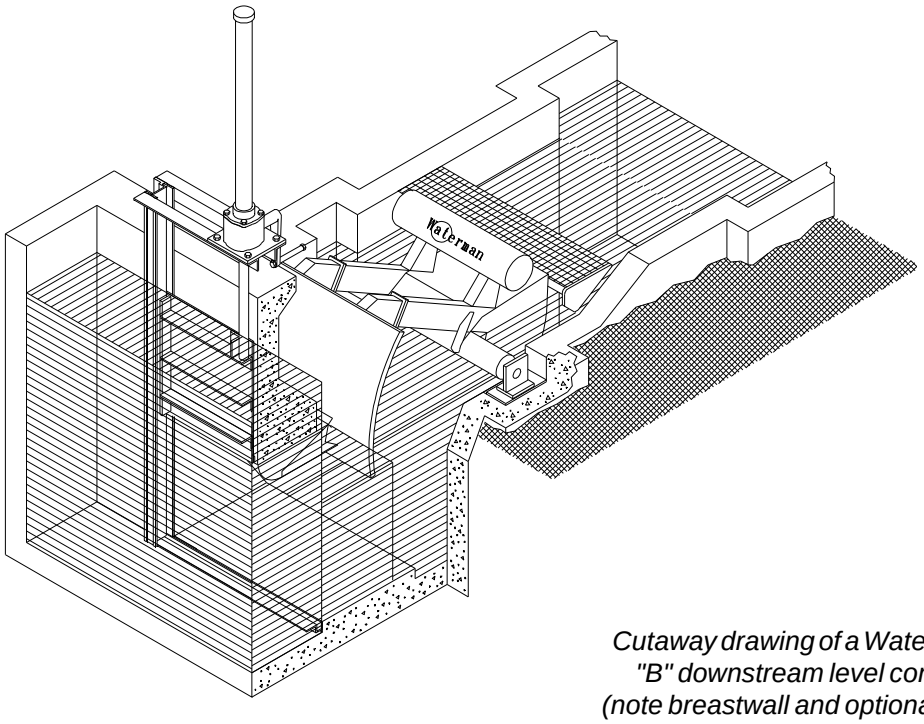
a. On machined surfaces, one coat of gasoline-soluble, rust-preventing compound.
b. On all other surfaces, including surfaces to be grouted in, two coats of factory applied epoxy paint.

WATERMAN
# TYPE "B"

## TYPE "B"

Waterman Type "B" gates are designed for sluice installations, usually controlling an orifice set in a breastwall, and permitting a higher upstream head.

Low head Waterman Type "B" gates differ from the high head type by their gate leaf, which is twice as wide. For equal head losses, they have twice the flow capacity as the high head, but the maximum permissible head is reduced by half.




*Cutaway drawing of a Waterman Type "B" downstream level control gate (note breastwall and optional stop gate)*

## SELECTING A SUITABLE WATERMAN DOWNSTREAM LEVEL CONTROL GATE

Selection is based on the required hydraulic performance of the installation. The following data must be known when choosing a suitable gate for a given supply system:

a- Maximum discharge
b- Minimum head differential under which the maximum discharge must still be delivered
c- Maximum head differential
d- Largest discharge to be delivered under the maximum head differential

The gate to be selected is the smallest one (smallest index number) whose head-discharge curve, represented on the selection charts, encompasses all possible head/discharge operating points which may be encountered for the installation.

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# DOWNSTREAM LEVEL CONTROL

*CONSULT THE FACTORY FOR THE GATE SELECTION CHART (HEAD DIFFERENTIAL VS. FLOW)*

**TYPE "B" LOW HEAD GATE SELECTION CHART**

**TYPE "B" HIGH HEAD GATE SELECTION CHART**

*CONSULT THE FACTORY FOR THE GATE SELECTION CHART (HEAD DIFFERENTIAL VS. FLOW)*

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# DOWNSTREAM LEVEL CONTROL

## EXAMPLES

For example, the minimum head differential **1** under which the maximum discharge **2** must still be delivered. **1** and **2** define point **A.**
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**EXAMPLE 1:**
Water flows from a reservoir to a canal, Which gate shall be used to control the flow from the reservoir in order to maintain a constant water level in the canal irrespective of the level in the reservoir and irrespective of the water demand?

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Point $A^1$ is defined by:
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**2** 7000 L/s

Point $B^1$ is defined by:
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**4** 7000 L/s

Note that no Type "A" will answer the problem. However, Type B-16 is the smallest gate whose characteristics encompass $A^1$ and $B^1$ and is therefore the gate to be selected. Gates up to B-21 can work but the gate chosen shouldn't be too generously dimensioned since its leakage rate would then be disproportionate compared to the normal gate flow.

**EXAMPLE 2:**
A control structure is to be installed in a canal to maintain a constant downstream water level irrespective of the discharge in the canal.

- desired constant downstream level: 5500 cm
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Point $A^2$ is defined by:
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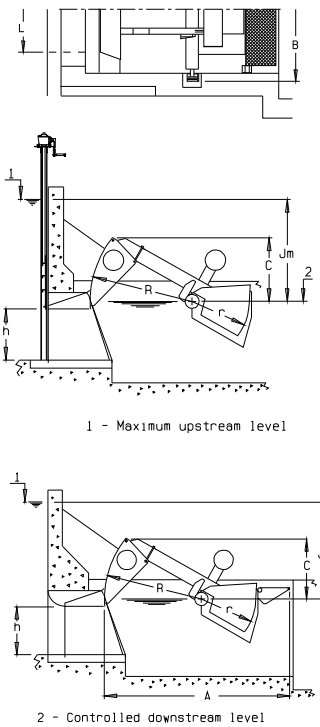
Automatic gates A-7, A-18, B-18 and B-23 all have characteristics which encompass $A^2$ and $B^2$. However, since the A-7 & B-18 are the smaller, these gates are to be selected according to the type of installation.

**High-head and Low-head Waterman Type B Gates from B-1 to B-26**




| TYPE "B" | | Overall Dimensions | | | | | Max. Head | Opening | |
|---|---|---|---|---|---|---|---|---|---|
| High Head | Low Head | A* | B | C | R | r | Jm | h | L |
| B-1 | | 900 | 700 | 350 | 500 | 280 | 1120 | 250 | 250 |
| B-2 | | 1100 | 850 | 450 | 630 | 360 | 1400 | 320 | 320 |
| B-3 | | 1400 | 1030 | 550 | 800 | 450 | 1800 | 400 | 400 |
| | B-4 | 1400 | 1030 | 550 | 800 | 450 | 900 | 400 | 800 |
| B-5 | | 1700 | 1200 | 700 | 1000 | 560 | 2240 | 500 | 500 |
| | B-6 | 1700 | 1200 | 700 | 1000 | 560 | 1120 | 500 | 1000 |
| B-7 | | 2100 | 1600 | 900 | 1250 | 710 | 2800 | 630 | 630 |
| | B-8 | 2100 | 1600 | 900 | 1250 | 710 | 1400 | 630 | 1250 |
| B-9 | | 2650 | 2000 | 1100 | 1600 | 900 | 3550 | 800 | 800 |
| | B-10 | 2650 | 2000 | 1100 | 1600 | 900 | 1800 | 800 | 1600 |
| B-11 | | 3900 | 3200 | 1400 | 2000 | 1100 | 4500 | 1000 | 1000 |
| | B-12 | 3900 | 3200 | 1400 | 2000 | 1100 | 2240 | 1000 | 2000 |
| B-13 | | 4700 | 4100 | 1800 | 2500 | 1400 | 5600 | 1250 | 1250 |
| | B-14 | 4700 | 4100 | 1800 | 2500 | 1400 | 2800 | 1250 | 2500 |
| B-15 | | 5200 | 4500 | 2000 | 2800 | 1600 | 6300 | 1400 | 1400 |
| | B-16 | 5200 | 4500 | 2000 | 2800 | 1600 | 3150 | 1400 | 2800 |
| B-17 | | 5800 | 5100 | 2200 | 3150 | 1800 | 7100 | 1600 | 1600 |
| | B-18 | 5800 | 5100 | 2200 | 3150 | 1800 | 3550 | 1600 | 3150 |
| B-19 | | 6400 | 5600 | 2500 | 3550 | 2000 | 8000 | 1800 | 1800 |
| | B-20 | 6400 | 5600 | 2500 | 3550 | 2000 | 4000 | 1800 | 3550 |
| B-21 | | 7100 | 6350 | 2800 | 4000 | 2200 | 9000 | 2000 | 2000 |
| | B-22 | 7100 | 6350 | 2800 | 4000 | 2200 | 4500 | 2000 | 4000 |
| B-23 | | 7900 | 7100 | 3200 | 4500 | 2500 | 10000 | 2200 | 2200 |
| | B-24 | 7900 | 7100 | 3200 | 4500 | 2500 | 5000 | 2200 | 4500 |
| B-25 | | 8700 | 8000 | 3500 | 5000 | 2800 | 11000 | 2500 | 2500 |
| | B-26 | 8700 | 8000 | 3500 | 5000 | 2800 | 5600 | 2500 | 5000 |

** Dimensions are approximate and subject to change*

*Dimensions in mm*

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## TYPICAL SPECIFICATIONS FOR TYPE "B"

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**GATE CONSTRUCTION.** The gates shall be designed to withstand the pressure forces produced by the upstream water level at its maximum elevation, with no tailwater (and, as the case may be, by the exceptional maximum tailwater level). The gate shall mainly consist of a radially shaped faceplate, suitably reinforced and matching trapezoidal-shaped sluice way, a framework including the float and ballasting compartments, and two roller bearings enclosed in sealed housings to be anchored in the concrete structure. The float ballast compartment shall be protected by a shield specially designed to prevent any silt deposit likely to impair the traveling of the moving assembly. The gates shall include a counterweight tank that is suitable for accurate, sensitive and stable gate operation. The gate shall be carefully checked and adjusted to tolerances required in the factory for straight forward field assembly, erection and proper operation. The gate shall have an embedded metal intake structure.

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**MATERIALS.** All materials used in construction of the gate shall be new and selected according to the best engineering practice for this type of equipment. The steel used in construction shall be DIN 17100 ST 37-2.

## TYPICAL SPECIFICATIONS FOR TYPE "B"

**OPERATION REQUIREMENTS.** The gate shall operate automatically, regulating the downstream water level with no external power, motor or level sensors and hoists, and no manual intervention, under the desired head differential and flows.

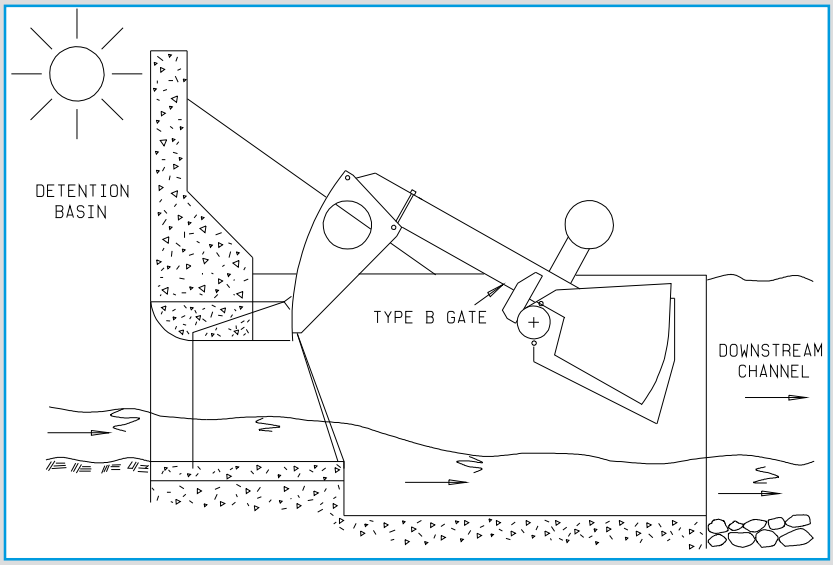
**SURFACE PREPARATION AND PAINTING.** Surface preparation shall consist of blast cleaning of all surfaces. Mechanical surfaces shall be protected by appropriate masking. Protective coating shall consist of:

a. On machined surfaces, one coat of gasoline-soluble, rust-preventing compound.
b. On all other surfaces, including surfaces to be grouted in, two coats of factory applied epoxy paint.

# DOWNSTREAM LEVEL CONTROL

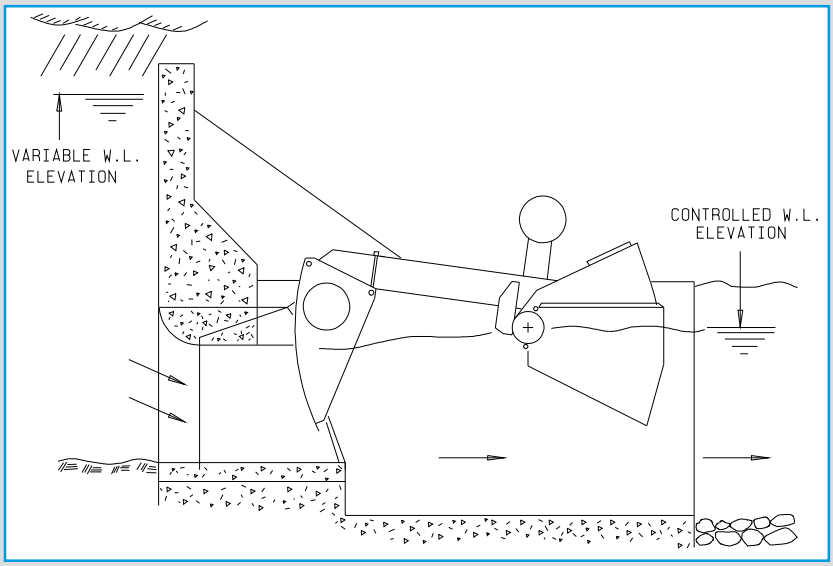
**Control of Detention Basin Outlets: A Typical Application of the Waterman TYPE "B" Constant Downstream Level Control Gate.**

*Computer? Electronics? Motors? No! Not even a single switch.. and yet the sturdy Waterman Type "B" gate does precisely what is required from a detention basin outlet. With the Waterman Type "B" gates, costly detention basins and draining canals become 100% efficient.*




## NORMAL FLOW CONDITION

The Type "B" Gate is fully open and remains conveniently out of the flow. Large cross section area of the sluice minimizes chances of clogging. As long as the runoff does not exceed the downstream canal full capability, the detention basin is kept empty, its storage capacity available to its maximum value.




## FLOOD CONDITION

When, and only when, the incoming runoff exceeds the canal capacity does the Type "B" Gate back up the excess flow in the detention basin. Maintaining a constant water line at the head of the canal the Type "B" Gate releases only the discharge that can be handled.

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## TYPE "A" / TYPE "B" TYPICAL GATE APPLICATIONS

| | |
|---|---|
| **Demand Control** | - The headworks to an open canal can be automated with the use of Waterman Type "A"/Type "B" downstream level control gates providing required flows "on demand." |
| **Irrigation Canals** | - Automatic canal check gates for reliable turnout control at "demand" flows. |
| **Flood Control** | - Control of detention basin outlets. Basins are kept empty until the runoff exceeds the downstream canal full capability at which time the Waterman Type "A"/Type "B" gates will back up the flow in the detention basin. The gates release only the discharge that can be handled. |
| **Constant Source Flow** | - Provides needed supply to cooling water recirculation systems or wet-wells for pump stations. |
| **Wastewater Treatment** | - Flow through the headworks can be equalized during peak and off-peak hours by using a Waterman Type "A"/Type "B" downstream control gate as the main influent gate. During peak flows the excess will be retained upstream of the gate and during off-peak flows the gate would remain open.<br>- By using the Waterman Type "A"/Type "B" gate as a "demand control" device, sedimentation basin levels can be automatically regulated during fluctuating flow rates. |