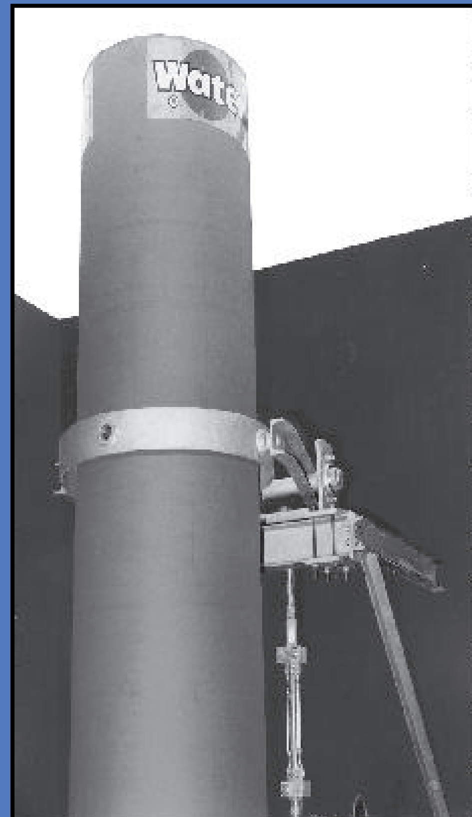
# CYLINDRICAL VALVES

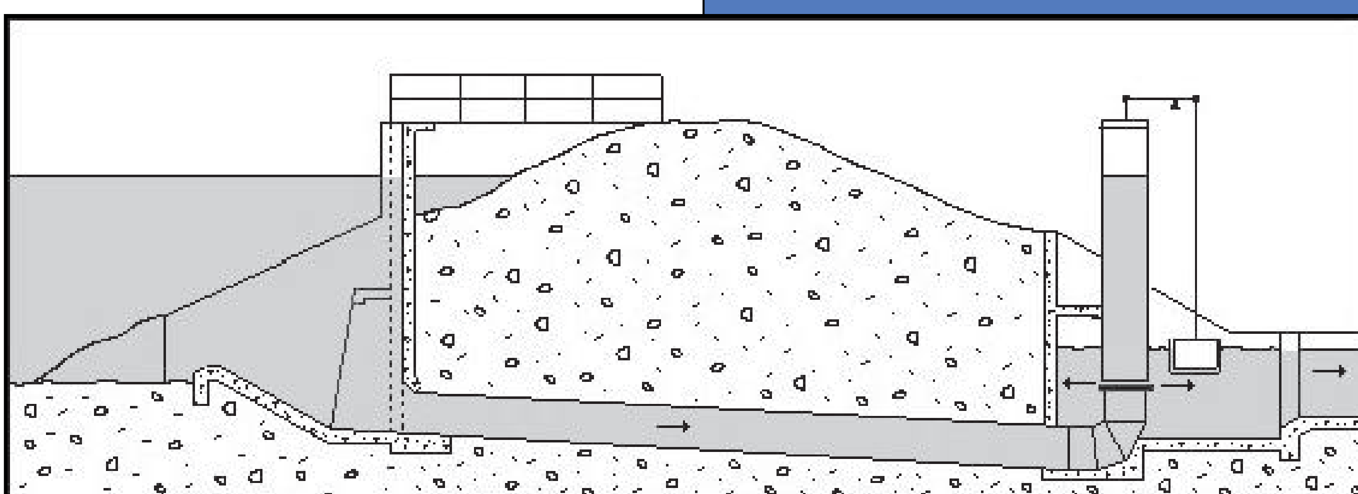
Cylindrical valves provide a nearly constant downstream level and are used in connection with an outlet pipe from a reservoir, basin, or chamber-like enclosure. Also, they are ideally suited to maintain chamber minimum levels in return or recirculated flows from downstream filters or other applications.

Cylindrical valves are often selected when an additional structure is not feasible, and also when the advantage of closing off the flow may be required.

Cylindrical valves operate in the manner of balanced float valves in which a vertical cylindrical sleeve modulates or closes off the flow from a pipe outlet.

Since the upstream water level is reproduced in the cylindrical sleeve, the valve is insensitive to pressure and variations in the head, resulting in extremely accurate downstream level control with no surging.





**Connected to the outlet pipe of a reservoir, the cylindrical valve controls the discharge, resulting in exceptional downstream water level contol.**

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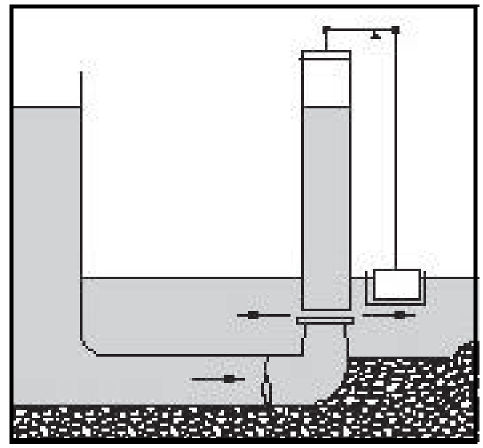
## SELF-CENTERING CYLINDRICAL GATE
## BASIC FEATURES



**PURPOSE AND OPERATION:**
The Self-Centering Cylindrical Valve is an automatic, discharge-regulated valve whose basic components are: (a) A proper hydraulically shaped elbow with a machined seat at the upper end; (b) a vertical cylinder, which is axially aligned with the circular seat and capable of moving up and down. The lower edge of this cylinder is machined for a tight closure of the gate when resting on the seat. Upon raising the cylinder, there is a circular opening of variable cross section above the valve seat; (c) an "actuating system."

Connected to the outlet pipe of a reservoir or basin, the cylindrical valve controls the discharge of this outlet through the "actuating system" in accordance with the requirements of the project.

The Self-Centering Cylindrical valve is an ideal piece of automatic water control equipment, because operation of the cylinder is:
- Free of unwanted vertical forces due to variable water level;
- Free of friction in the cylinder linkage as no lateral forces prevail.

For downstream water level control this results in exceptional accuracy even though very simple "actuating systems" are used.

**INSTALLATION:**
Installation is very simple and easy. Complete installation and calibration instruction and drawings are provided.

CYLINDRICAL VALVES

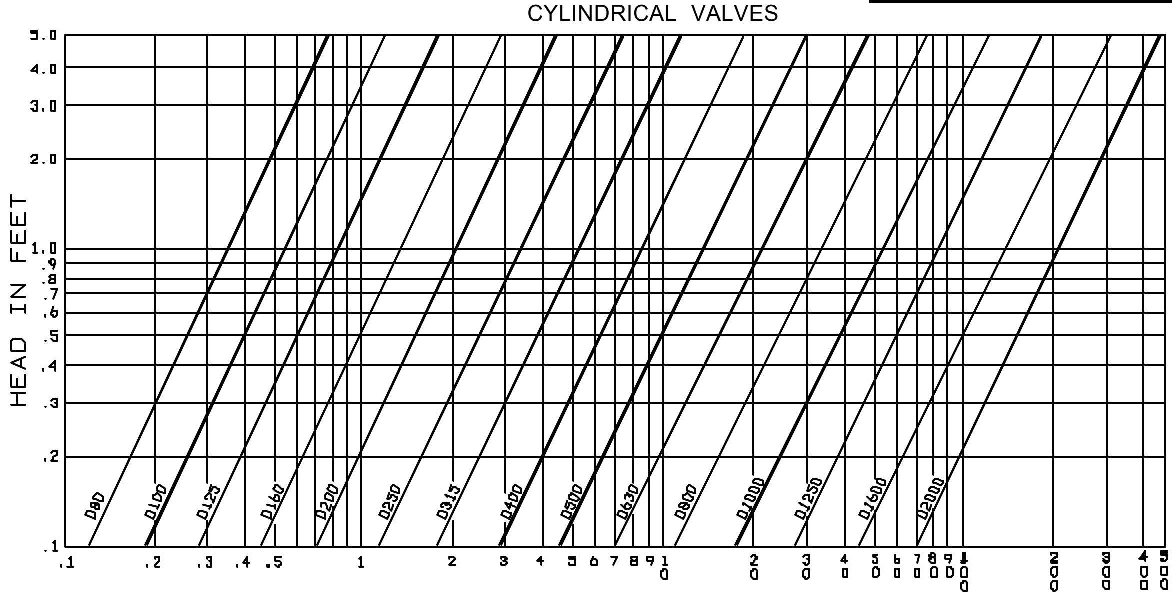



Chart of minimum head loss against discharge, with valve fully open.

## CYLINDRICAL VALVE APPLICATIONS

- Irrigation - Cylindrical valves can be used as an automatic turnout for lateral ditches or canals, supplying water "on demand."
- Industrial - Automatic control of cooling water recirculation ponds or basins.
  - Automatic control of pump station wet-well levels.
- Wastewater Treatment - Wet-well supply for trickling filter recirculation pumps to automatically regulate the flow, or the media wetting rate.

## TYPICAL SPECIFICATION
## WATERMAN CYLINDRICAL DOWNSTREAM LEVEL CONTROL VALVE

Downstream level control valves shall be Waterman Cylindrical Valves as herein specified. The valves shall consist of a vertical cylinder, an elbow, a suspension unit, and a float mechanism with rod and float chamber. The cylinder shall be of the specified material and shall rest on a hydraulically shaped elbow with a machined seat at the upper end. The cylinder shall be capable of raising and lowering sufficiently to allow level to be maintained within the specified range of flow. The seat shall be machined in such a way as to cause the cylinder to "self-center" and allow for complete closure of the unit and shall not require guides to maintain its alignment. The float shall ride within the furnished float chamber, isolating the float from the turbulence of the flow. The suspension system shall consist of rocker arms with adjustable stop and shall provide the cylinder with "friction-free" movement throughout its length of travel.

**Typical Materials of Construction:**

**Cylinder**
Mild Steel - ASTM A-36 (galvanized per ASTM A-123) or Stainless Steel ASTM A-276 type 304 or 316

**Elbow**
Mild Steel - ASTM A-36 (galvanized per ASTM A-123) or Stainless Steel ASTM A-276 type 304 or 316

**Suspension Unit**
Mild Steel - ASTM A-36 (galvanized per ASTM A-123) or Stainless Steel ASTM A-276 type 304 or 316

**Float and Float Chamber**
Mild Steel - ASTM A-36 (galvanized per ASTM A-123) or Stainless Steel ASTM A-276 type 304 or 316

# DOWNSTREAM LEVEL CONTROL CYLINDRICAL VALVE

**OPERATION**

Operation of the valve is easily understood. A call for discharge downstream tends to lower the level in the basin, and the float is drawn downwards. The rocker arm follows and raises the sleeve so as to admit the flow required. Conversely, if the downstream demand falls off or ceases altogether, the float tends to rise causing the sleeve to lower until it eventually seats down on the sill to close off the valve completely.

**CONTROL FEATURES**

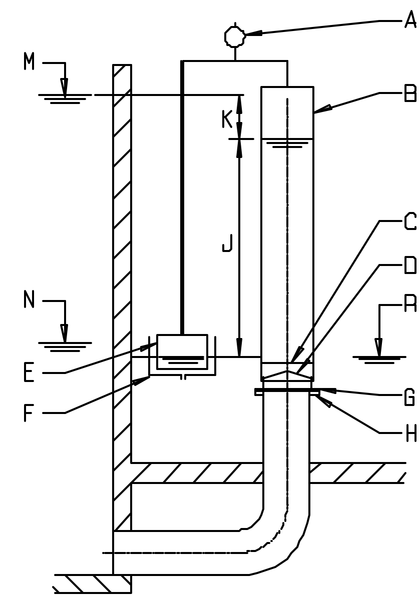
**Accuracy and Compensating Weight**

The Cylindrical valve as described above would have a "decrement", i.e. would cause a variation of the downstream level as the valve moved from the closed to the fully open position, equal to the float travel. The apparent weight of the float and its degree of immersion are constant.

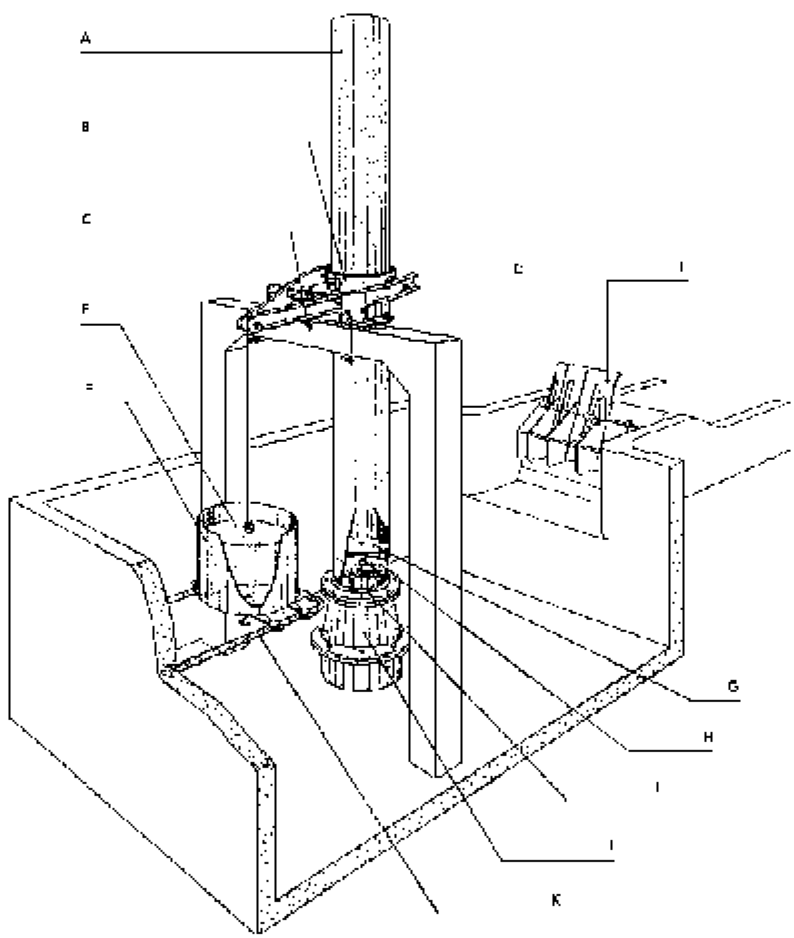
On standard production valves of this type (orifice dia. up to 0.5m) the lever arms are of equal length, and the vertical travel of the sleeve, and therefore of the float, is equal to 0.2 Ø, where Ø = the sill orifice diameter. For larger valves, float travel and "decrement" are reduced to 0.1 Ø. The vertical displacement of the rocker arm is equally divided to either side of the horizontal position.

If required the natural "decrement" of the valve may be reduced by the addition of a compensating weight to the rocker arm, the effect of which is to unbalance the valve by raising its center of gravity. Under these circumstances, the immersion depth of the float is no longer fixed since the torque due to the weight of the rocker arm alters with the angle through which it is displaced.

**A** Compensating weight
**B** Sleeve
**C** Restrictor plate
**D** Deflector
**E** Float
**F** Float chamber
**G** Sill
**H** Built-in flange
**J** Head loss in valve
**K** Head loss in duct
**M** Max. upstream level
**N** Min. upstream level
**R** Controlled downstream level




**Diagrammatic layout of a Cylindrical Valve**



**A** Cylindrical sleeve
**B** Universal suspension
**C** Adjustable screw stop
**D** Rocker arm
**E** Float
**F** Float chamber
**G** Valve sleeve restrictor plate
**H** Fixed deflector
**I** Shaped sill
**J** Converging section
**K** Float chamber bracket
**L** Distributor

**Cylindrical Valve, with universal-joint sleeve suspension (type C), which acts as a constant discharge if used with a distributor as shown.**

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## CONTROL FEATURES

### Accuracy and Compensating Weight (continued)

The theoretical value for the level variation thus obtained remains sufficiently small for it to be neglected being actually about $\frac{b}{500}$ for standard valves.

b = lever arm length on float side

To ensure valve stability at all points in its travel a rise of the sleeve must correspond to a fall in the downstream level, no matter how small this fall may be.

## SENSITIVITY

As has already been mentioned, the cylindrical valve sleeve centers itself hydraulically on the water jet, so that no guides are required. The number of pivots is reduced to a minimum and these are all mounted on knife edges or in ball bearings, so that mechanical friction is practically eliminated together with any chance of jamming. The valve therefore has a high inherent sensitivity, which is imperative for good level control accuracy.

## SIZES AND CHARACTERISTICS

Cylindrical valves are characterized by the sleeve diameter (1.25 Ø), followed by the sill orifice diameter Ø, expressed in millimeters. The table shows the dimensions for standard valves of this type.

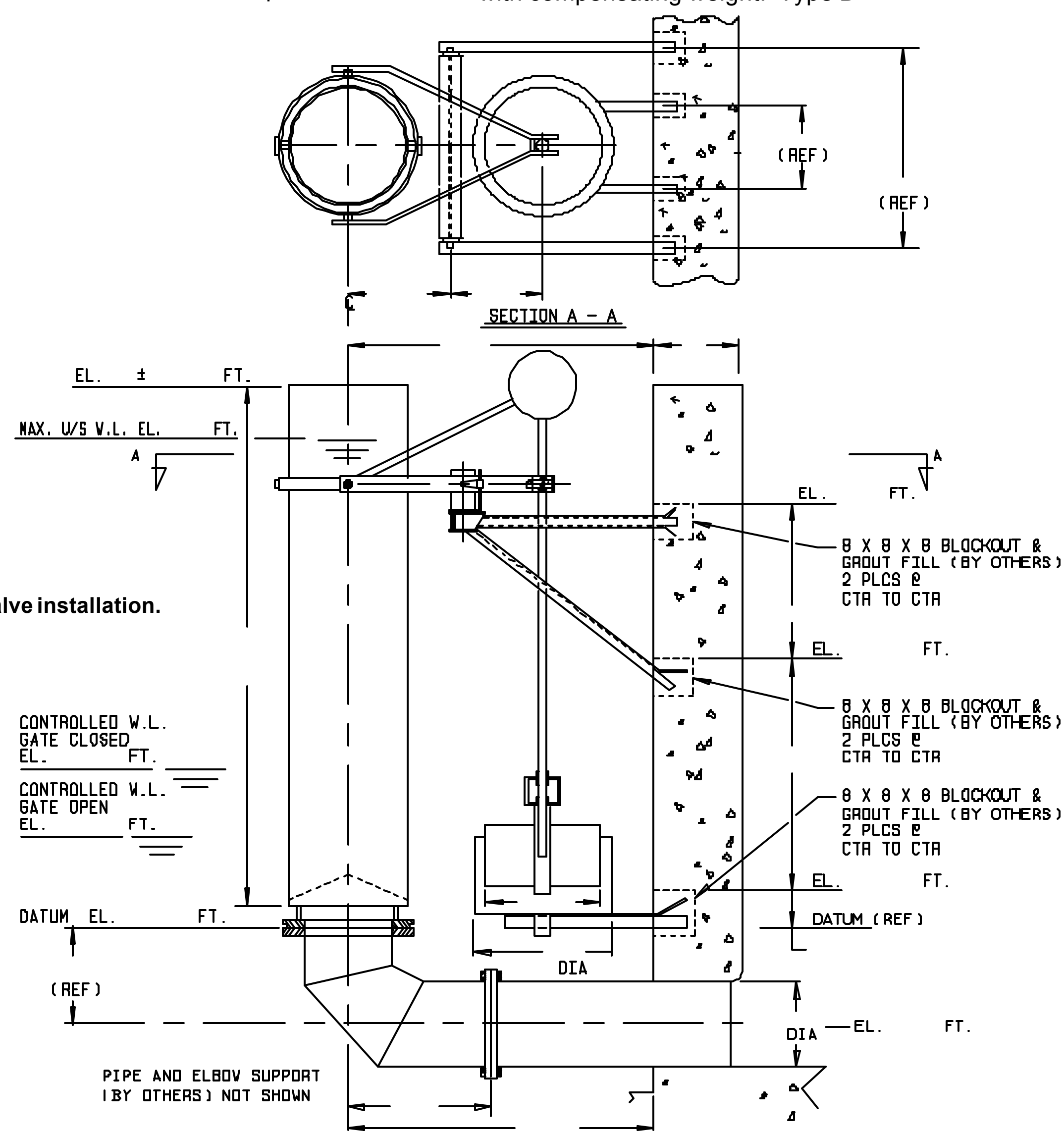
Larger cylindrical valves can be supplied on request, to meet particular operating conditions or discharge requirements.

Depending on the relative length L of the sleeve and what layouts are possible for the pivot beam support bracket bedding, the sleeve may either be suspended from the top (short sleeve) or supported in the middle by a universal joint arrangement (long sleeve), as required by the customer.

The above choice, coupled with whether a compensation weight is required or not, results in the standard valves being classified into four types, A, B, C and D, as follows.

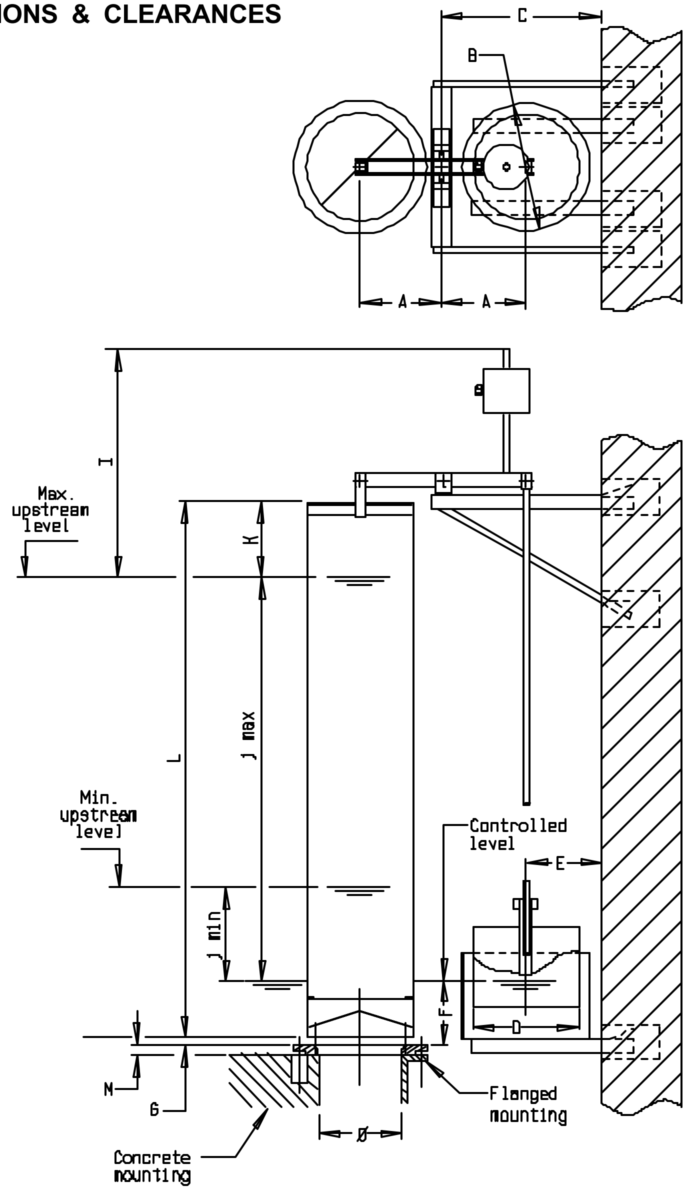
Valve fitted with a top suspended sleeve:
- without compensating weight: Type A
- with compensating weight: Type B

Valve fitted with universal joint suspended sleeve:
- without compensating weight: Type C
- with compensating weight: Type D




**Example of cylindrical valve installation.**

**CYLINDRICAL VALVE DIMENSIONS & CLEARANCES**

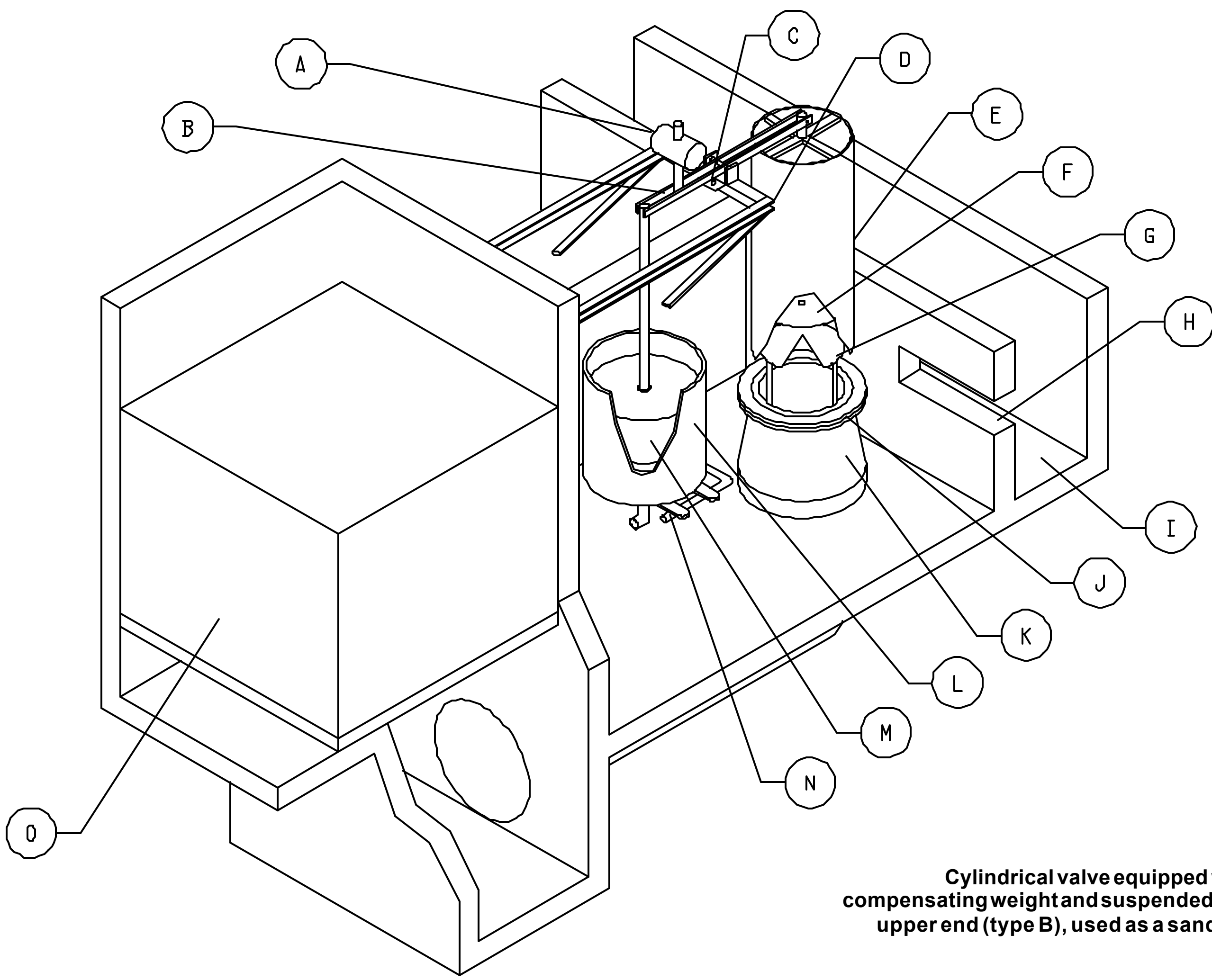



| STANDARD DIMENSIONS | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Designation** | **Ø** | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **I** | **K** | **L** | **M** | **J min.** | **J max.** |
| Ø 100/80 | 80 | 200 | 120 | 350 | 100 | 150 | 80 | 8 | 360 | 108 | L = J max. + F + K - G | 18 | See graph on Page **44** | This governs length of sleeve. |
| Ø 125/100 | 100 | 200 | 150 | 350 | 125 | 150 | 100 | 10 | 380 | 110 | | 20 | | |
| Ø 160/125 | 125 | 200 | 200 | 350 | 160 | 150 | 125 | 13 | 430 | 113 | | 23 | | |
| Ø 200/160 | 160 | 200 | 240 | 400 | 200 | 200 | 160 | 16 | 480 | 116 | | 25 | | |
| Ø 250/200 | 200 | 200 | 300 | 400 | 250 | 200 | 200 | 20 | 530 | 120 | | 28 | | |
| Ø 315/250 | 250 | 250 | 380 | 490 | 315 | 240 | 250 | 25 | 640 | 125 | | 30 | | |
| Ø 400/315 | 315 | 315 | 480 | 605 | 400 | 290 | 315 | 32 | 850 | 132 | | 35 | | |
| Ø 500/400 | 400 | 400 | 600 | 750 | 500 | 350 | 400 | 40 | 1000 | 140 | | 40 | | |
| Ø 630/500 | 500 | 500 | 750 | 930 | 630 | 430 | 500 | 50 | 1120 | 150 | | 45 | | |

Above dimensions are expressed in millimeters.
The arrangement shown is for a top suspended sleeve. If a universal joint arrangement is used (suspension half-way up the sleeve) dimension "I" does not apply.

The top suspended type usually gives the least expensive installation, and is thus always preferred where the existing structure design permits, as for example, cylindrical valves fitted near filter beds or dams.

Depending on the basin layout, the shaped sill may either be bolted to a preset built-in flange or screwed on to grouted plugs.




**Cylindrical valve equipped with a compensating weight and suspended by its upper end (type B), used as a sand filter valve.**

| | | | |
|---|---|---|---|
| **A** | **Compensating weight** | **I** | **Filtered water channel** |
| **B** | **Rocker arm** | **J** | **Shaped sill** |
| **C** | **Adjustable screw stop** | **K** | **Converging section** |
| **D** | **Supporting beam bracket** | **L** | **Float chamber** |
| **E** | **Cylindrical sleeve** | **M** | **Float** |
| **F** | **Valve sleeve restrictor plate** | **N** | **Float chamber bracket** |
| **G** | **Fixed Deflector** | **O** | **Sand filter** |
| **H** | **Equal flow division orifice** | | |

## CHOICE OF SIZE

The sill diameter Ø is simply a matter of the maximum flow, $Q_{max.}$, that must be passed through the valve under the minimum upstream head, $J_{min.}$. This flow is given by the following equation:

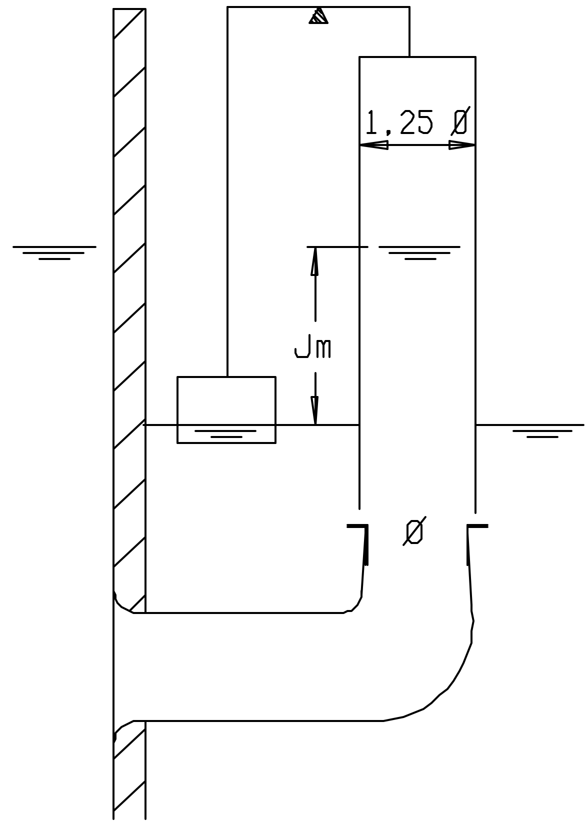
$$Q_{max.} = 0.8 \frac{\pi \, Ø^2}{4} \sqrt{2 \, g \, J_{min.}}$$

The required diameter can, however, be determined by reading off the chart on page 37 or 44. In order to pass the "$Q_{max.}$" flow, it is only necessary to choose the smallest valve for which the head loss is not greater than the minimum "$J_{min.}$" head available.

Example: $J_{min.}$ = 15 cm
$Q_{max.}$ = 150 liters/sec

The Ø 500/400 valve passes 150 liters/sec for a head loss of 11 cm.

The maximum upstream head, "$J_{max.}$", determines the length of sleeve, see "Standard Dimensions" table on page 41, though this length is limited to a few meters, practically speaking, for reasons of economy or aesthetics, which become more important when the valve is sited in open country at the end of a duct.




## STANDARD VALVE SPECIFICATION

Having determined the sill diameter Ø and the sleeve length L, all that is left is to give the letter A, B, C or D of the type chosen, see page 40, and the method of fitting the sill, in order to fully define the standard valve required when ordering.

Generally speaking, a preliminary discussion is necessary to finalize the required operating conditions for all gates upwards of the type Ø 800/630 and for any special application or non-standard supply.

The supply for a standard cylindrical valve includes:

- The shaped sill and its deflector, complete with sealing joint and mounting bolts.
- The cylindrical sleeve with restrictor plate.
- The rocker arm, supplied with or without a compensating weight according to the type, complete with bearings for mounting to the support bracket.
- The float, complete with rod.
- The float chamber and its mounting, ready for installation.
- The bearing support beam, with bracket.

The whole assembly is manufactured in steel or stainless. The use of paints having metallic pigments, other then zinc salts, is to be avoided, particularly those with red lead.

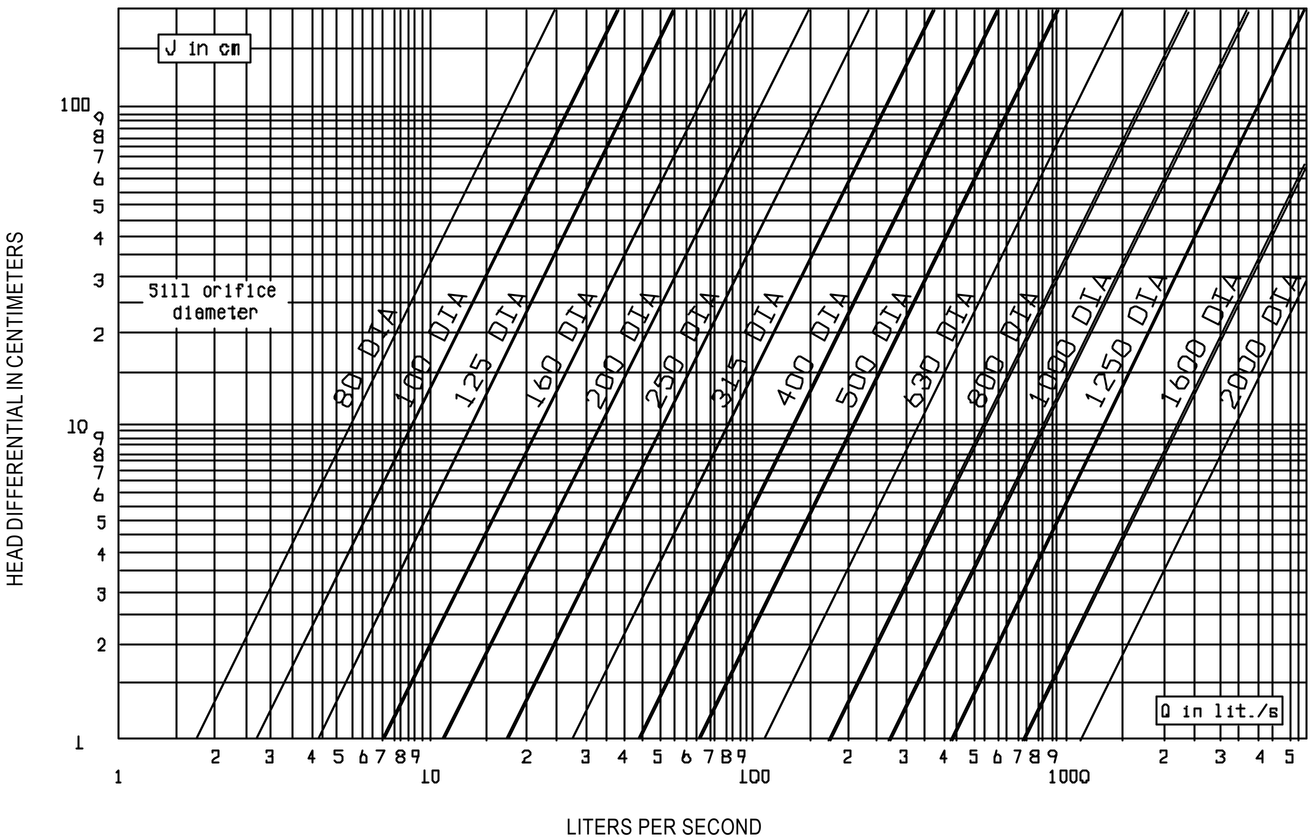



**Chart of minimum head loss against discharge, with valve fully open.**

## INSTALLATION

The table on page 45 shows the structural details to be considered.

The dimensions and shape of the basin in which the valve is to be installed needs design consideration in order to:

- Ensure good energy dissipation and avoid excessive flow turbulence with the formation of marked intumescences at the edges of the basin, as these are prejudicial to correct downstream supply i.e. canal, sill, distributors, etc.
- Avoid interfering with the valve discharge coefficient. A too narrow basin may result in part of the jet being returned on the sleeve, thus disturbing the flow and reducing the discharge from the water off-take in a like manner. In most cases, the effective volume of the basin should be at least equal to:

$$V = 7.\ Q_{max.}\ J_{max.}$$

where V is expressed in $dm^3$ and $Q_{max.}$ is liters/sec., or V in $m^3$ and Q in $m^3$/sec., and $J_{min.}$ in meters. This corresponds to an energy of approx. 2HP dissipated per $m^3$. The water depth below the controlled level must not be less than 2 Ø (with a minimum of 50 cm, in the case of valves smaller than the type Ø 315/250). The vertical center line of the valve should be at a distance of at least C + A from the walls of the basin, see "Standard Dimension" table on page 41.

## FITTING AND ADJUSTMENT

Fitting the valve presents no particular difficulty. All that is required is to keep closely to the geometrical data prescribed, especially concerning concentricity of the sleeve with the sill in the closed position and leveling of the rocker arm in the valve half open position. An adjustable screw stop, fitted on the support bracket or the float, limits movement of the rocker arm in order to restrict the maximum valve sleeve rise to its normal value of 0.2 Ø.

Adjusting the valve involves:

- **Actual balancing of the valve.** For most of the small and medium diameter valves, this is usually carried out by ballasting at the factory before delivery. Otherwise balancing is carried out on site, according to manufacturer's instructions.

- **Setting the float at the required height.** This adjustment sets the desired datum for the downstream water level, and is carried out by raising or lowering the float on its rod.

Finally, the restrictor orifice diameter may be increased if valve operation is considered to be too slow.

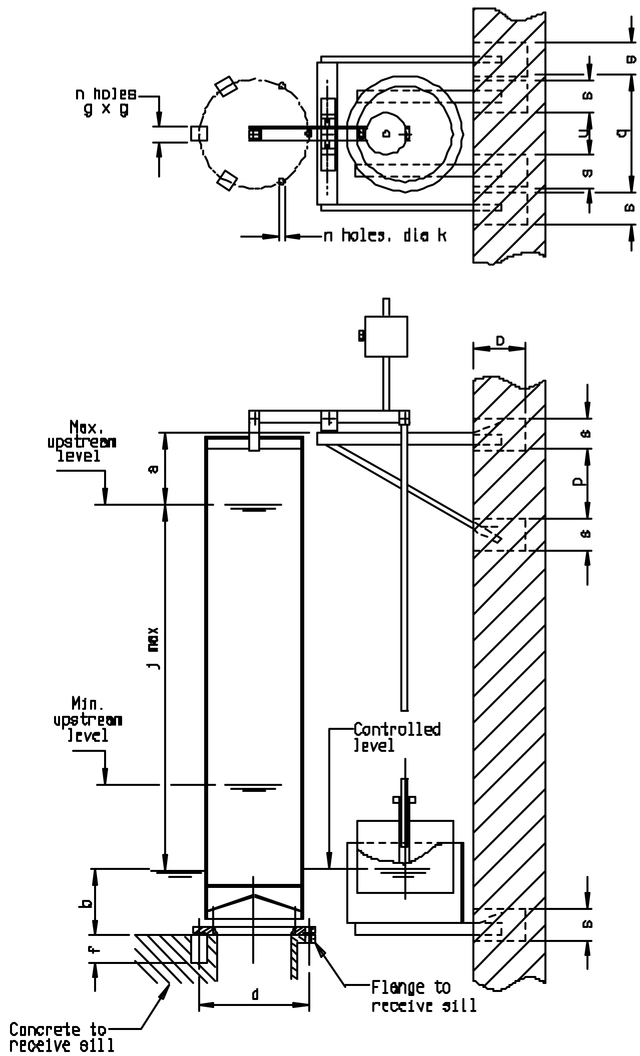



**Figure 8**

| STRUCTURAL DETAILS | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Designation** | **a** | **b** | **c** | **d** | **f** | **g** | **k** | **n** | **o** | **p** | **q** | **s** | **u** | **T** | **C** |
| Ø 100/80 | 109 | 98 | 170 | 160 | 100 | 50 | 12 | 4 | 100 | 130 | 160 | 120 | 0 | 100 | 100 |
| Ø 125/100 | 115 | 120 | 180 | 180 | 100 | 50 | 12 | 4 | 100 | 130 | 160 | 120 | 0 | 100 | 100 |
| Ø 160/125 | 121 | 148 | 190 | 210 | 120 | 50 | 12 | 8 | 100 | 130 | 160 | 120 | 0 | 100 | 100 |
| Ø 200/160 | 128 | 185 | 200 | 270 | 120 | 75 | 14 | 8 | 120 | 170 | 330 | 120 | 70 | 100 | 150 |
| Ø 250/200 | 136 | 228 | 212 | 295 | 130 | 75 | 14 | 8 | 120 | 170 | 330 | 120 | 110 | 150 | 200 |
| Ø 315/250 | 145 | 280 | 224 | 350 | 130 | 80 | 16 | 6 | 120 | 220 | 480 | 120 | 130 | 200 | 300 |
| Ø 400/315 | 155 | 350 | 236 | 460 | 140 | 80 | 16 | 8 | 120 | 270 | 480 | 150 | 160 | 300 | 400 |
| Ø 500/400 | 165 | 440 | 250 | 515 | 140 | 80 | 16 | 8 | 200 | 600 | 580 | 200 | 180 | 400 | 600 |
| Ø 630/500 | 175 | 545 | 265 | 620 | 150 | 80 | 18 | 10 | 200 | 710 | 690 | 200 | 300 | 700 | 800 |

Above dimensions are expressed in millimeters, and forces in kilograms.
Forces T and C are calculated for a 2 meter long sleeve.
The figure shows a top suspended sleeve. If a universal joint arrangement is used (suspension half-way up the sleeve), calculate $\frac{\text{Jmax.}}{2}$ - a. Measure the resulting dimension below the max. upstream level and disregard the dimension "a" given on the figure.

## APPLICATION

With its special features, the cylindrical valve is ideally suited for short pipelines operating under a head of only a few meters or so.

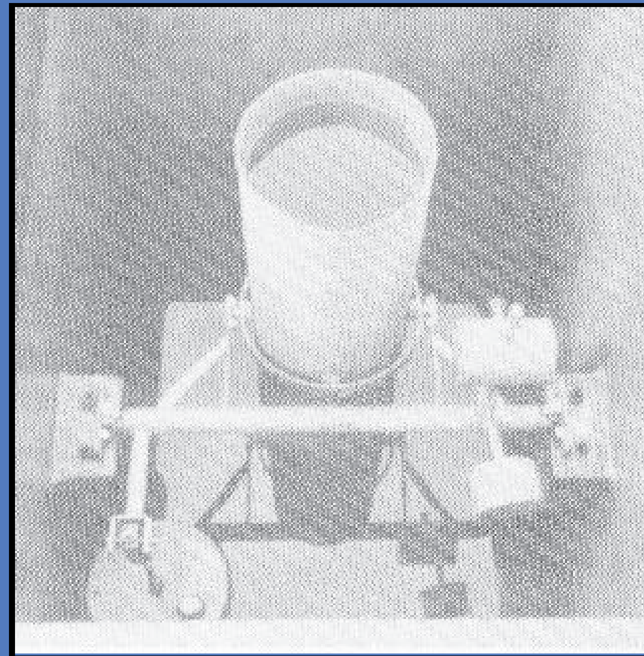
A typical application of the cylindrical valve is on the turnout of a downstream-controlled canal from a dam, when its sole purpose is to maintain the head water level in the canal irrespective of the flow demand. Installed at the foot of a dam, in a basin or diversion on a canal and followed by a weir or distributor, the cylindrical valve forms an accurately adjustable constant flow turnout.

Finally, applied to sand filters, cylindrical valves enable automatic downstream controlled operation, together with the possibility of equal flow division between the various parallel operating filters, and automatic limitation of the maximum admissible unit discharge, by a technique evolved in collaboration with water treatment specialists.

Some thousands of cylindrical valves are at present in service under the widest range of operating conditions, and to the complete satisfaction of operators. The range of discharges supplied varies from a few liters per second up to several cubic meters per second.

The result of intensive technical development combined with meticulous manufacture, these valves all embody the same qualities culminating in the two most important, and those most favorably commented on by hydraulic engineers connected with schemes for which cylindrical valves have been chosen, which are:

- Their high accuracy of control.
- Their complete operating reliability.



**Cylindrical Valve with compensating weight and universal joint suspension (Type D), used as a filter valve.**

**Ø 1000/800 cylindrical valve used with 2700 liters/sec. distributors for an offtake on a canal.**