

## 1. GENERAL DESCRIPTION

Valve normally used for closing and regulating bottom and intermediate water outlets of dams and reservoirs as well as a turbine bypass valve in hydroelectric power stations. The fixed cone valve (fig. 1) discharges directly into the atmosphere.

This valve releases a hollow cone shaped jet (fan or spray type jet). Upon contact with the air, the energy is dissipated by pulverisation and mixing with the air. The water is normally collected downstream in a stilling pool.

Cone valves are excellent regulation devices, since they can operate at any partially open position and they have practically no design load limitations.

The most common use for these valves is free discharge into the atmosphere, but they can also be adapted for submerged discharges through the downstream wall of the dam.

The advantages of the hollow jet valves compared with other types of valves which have the same functions are notable: they are light, simple, they have no cavitation or vibration problems, and are very easy to operate and maintain.



Fig. 1 Fixed cone valve.

## 2. DESIGN CHARACTERISTICS

All ORBINOX fixed cone are designed for the specific service conditions of each particular case.

The structural evaluation is performed using the finite elements method and CAD modelling systems.

The standards used in the evaluations are:

- DIN 19704: "Hydraulic Steel Structures. Criteria for Design and Calculation".

- DIN 19705: "Hydraulic Steel Structures. Recommendation for Design, Construction and Erection".

The valve has a high rate of discharge making it ideal for managing large water flows (fig.2).

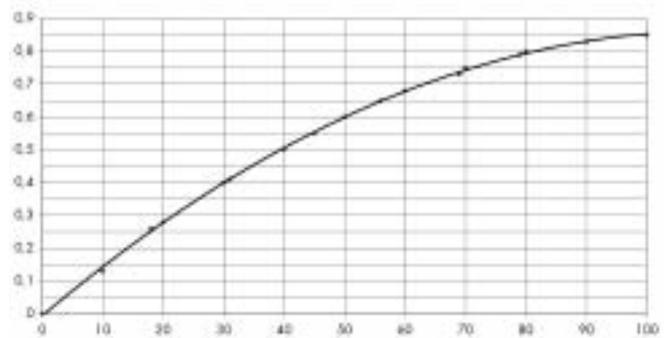


Fig. 2 Rate of discharge Cd.

The amplitude of the jet constitutes a certain disadvantage, in special cases, above all in channel discharges, or discharges in regions with cold winter temperatures where the areas surrounding the valve are exposed to frost and the fine dew sprayed out by the valve turns to ice. For this type of case the extension of the jet is limited using a tube with a larger diameter (concentrator shield fig.3), or by installing the valve inside a load rupture chamber which flows into a drainage channel. The use of shields decreases the discharge rate by approximately 10%.

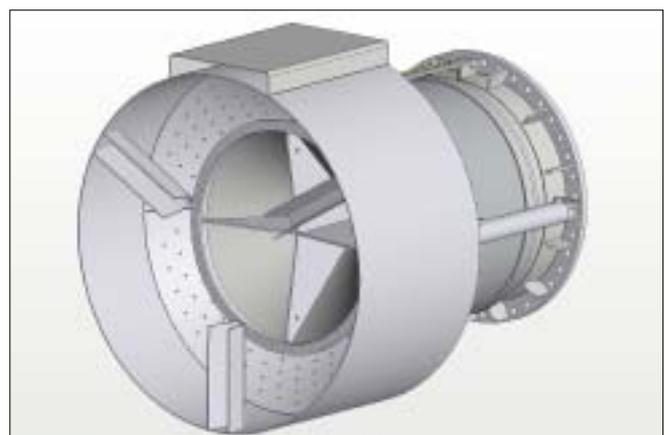


Fig. 3 Fixed cone valve with concentrator.

The water jet from the valve, due to its intense mix with the air, drags large volumes of air along with it. This must be closely considered when placing a hood as the jet must be sufficiently aerated through different openings on the hood.

### 3. MANUFACTURING CHARACTERISTICS

This type of valve is formed by a fixed cylindrical body upon which a cylindrical sleeve will slide concentrically to the body and lengthways.

It has the following elements:

- Body
- Sleeve or shutter
- Drive cylinders

#### Body:

The body of the valve is formed by a stainless steel collar which is machined on the outer side. Internally has radial ribs which extend downstream where it is welded with the dispersion cone. The visible parts of the radial ribs are covered in bronze applied by welding and subsequent machining, and are flush with the external diameter of the tube which forms the body.

The valve has a drilled flange in accordance with standards DIN (PN 10, PN16) and AWWA C207 Class "D" at the upstream end.

Around the base of the dispersion cone is the housing for the EPDM seat which is fixed to the body by a fabricated ring and stainless steel screws. The outer edges of the sleeve will sit on this joint in the fully closed position.

#### Sleeve:

The sleeve consists of a steel cylinder which has internal stainless steel rings that act as rollers and slide over the uncovered part of the ribs on the main body, in such a way that the sliding action is always between stainless steel and bronze. On the upstream part of the sleeve there is a watertight compression gland which slides on the machined stainless steel body of the valve. The contact surface with the watertight joint is made from stainless steel. The ends of the cylinder shafts are joined to the sleeve.

If the valve has a fixed hood (for submerged discharge), the sleeve is manufactured in stainless steel and is machined on the outside. The fixed hood, normally positioned in concrete, has a system of watertight joints against which the machined outer part of the sleeve will slide.

#### Drive Cylinders:

The standard valve actuation is obtained from two parallel hydraulic cylinders, mounted horizontally. They are double acting cylinders, with stainless steel shafts, treated with hard chrome. The normal operation pressure is between 60 and 120 Bar.

The body incorporates a position indicator which is comprised of a frame with a graded aluminium strip. The indicator needle moves with the sleeve. There are two indication positions on the indicator (open and closed).

There is an option for installing a position transducer (4-20mA) for remote valve regulation.

### 4. ACTUATORS

This gate can be actuated manually, electrically and hydraulically (fig.4), although the application usually recommended is the hydraulic actuator due to simplicity and high stresses required.

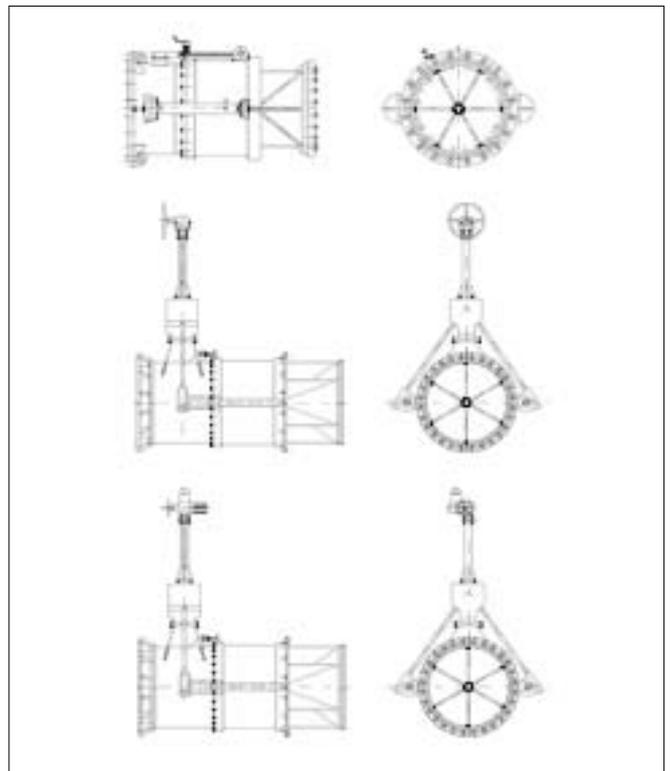


Fig. 4 Actuators.

The hydraulic unit will normally be equipped with a double motor pump and an emergency manual pump. Nitrogen accumulators can be used for emergency purposes.

The electrical cabinet has a PLC for programming the opening and closing manoeuvres along with further manoeuvres specific to each case.

In the case of motor and manual actuation, a double spindle and gear is used to transmit sleeve movement.

## 5. SERVICE AND LOAD CONDITIONS

The fixed cone valves are designed to support water loads of up to 160 mwc. For loads in excess of this, please consult our technicians.

The nominal forces for opening and closing the valve at the specified speed will be determined as the algebraic sum of the components of the forces applied, corrected by the applicable rates in each case.

## 6. ANTI-CORROSION PROTECTION SYSTEM

Steel structures permanently immersed in water:

- Shot blasting SA 2 1/2
- 50 microns polyamide cured epoxy primer
- 300 microns glassflake reinforced polyamine adduct tar free epoxy coating

Structures in open air:

- Shot blasting SA 2 1/2
- 50 microns polyamide cured epoxy primer
- 100 microns aliphatic acrylic polyurethane finish blue RAL 5015

## 7. MATERIALS AND STANDARDS

Structural Parts: Carbon steel:

EN 10025	DIN	ASTM
S275JR	1.0044	A570 Gr40

Moving Parts: Stainless Steels

EN 10088	DIN	AISI
X2CrNi18-9	1.4307	304L
X2CrNiMo17	1.4404	316L
DUPLEX 2205	1.4462	A240

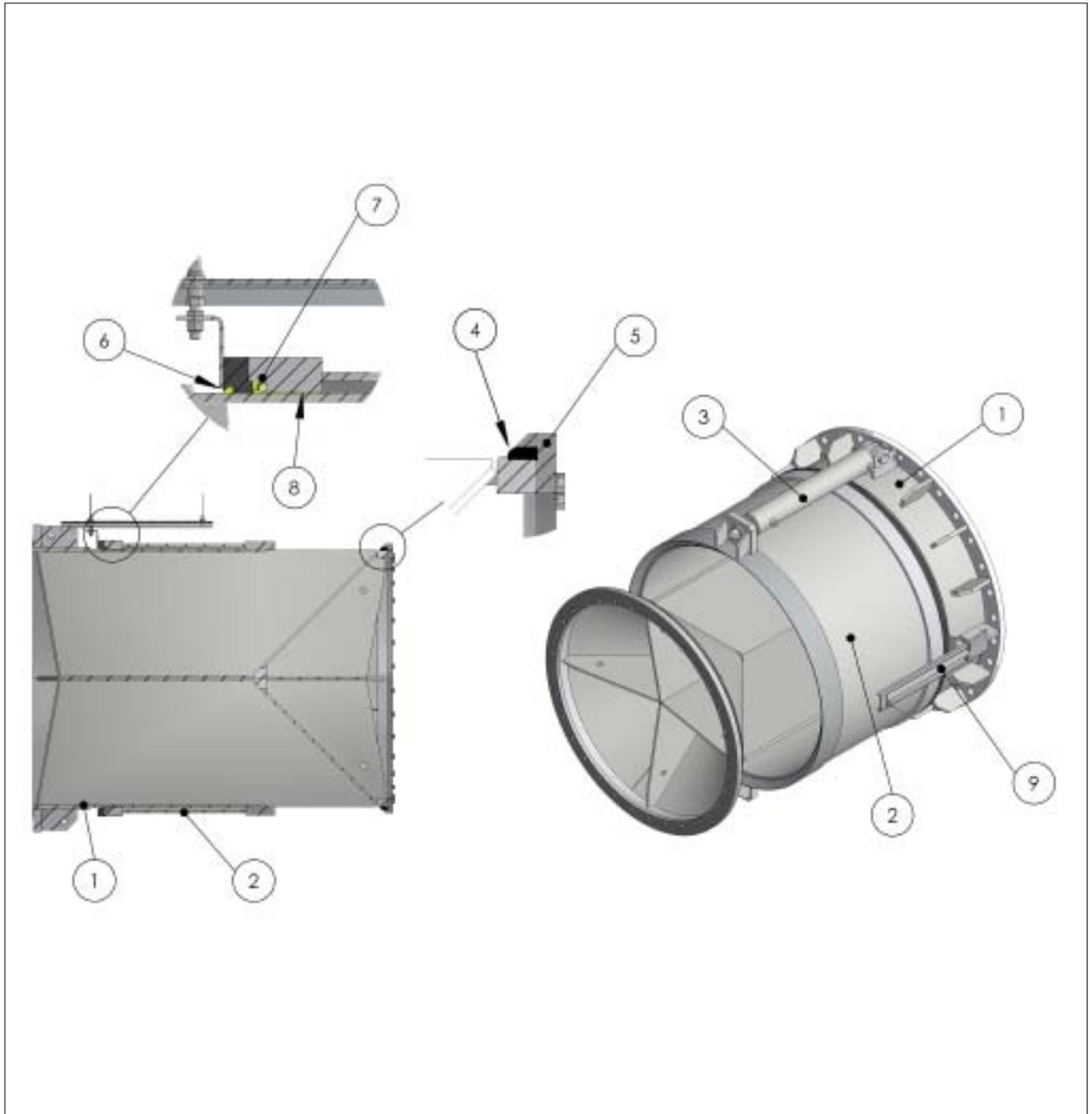
Rib coverings: Bronze:

CDA	ASTM
C86500	B584-96

## 8. TESTS

Hydraulic Tests:

- Body at 1.5 x Design Pressure
- Valve closing at 1.1 x Design Pressure.



**POSSIBLE MATERIAL COMBINATIONS**

1. Body:	S-275-JR + (AISI 304 / AISI 316)	6. Wiper:	NBR
2. Sleeve:	S-275-JR + (AISI 304 / AISI 316)	7. Lip seal + O ring:	NBR
3. Hydraulic Cylinder:	Steel with shaft in ASI 420	8. Slides:	Turcite
4. Joint:	EPDM	9. Graduated strip:	AISI 304 / AISI 316
5. Joint fixture ring:	AISI 304 / AISI 316		

