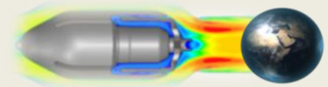
HYREVAL® VALVE SYSTEM

AXIAL CHECK VALVE



HYDROMAT® WORLD PATENTED
MULTI-FUNCTIONAL VALVE SYSTEM

MAIN OPERATING MODE AND TYPES OF THE AXIAL CHECK VALVE TYPE HYREVAL®:

➢ FM – FLOW MEDIUM SOLUTIONS

Operating of the check valve based only with flow medium (water, oil, gas, compressed air, low and high temperature mediums)

Closing direction caused by the action of back flow medium by using of spring or accumulator at larger check valves. Design and operating possibility:

- **FM** - simplest solution without adjusting of the closing and/or opening speed and damping of the end position
- **FMW** - with using additional flow control valve to adjusting of closing and/or opening speed and damping of the end position (apply by cleaner flow medium)

➢ HS – HYDRAULIC SOLUTIONS

Combined operating of the check valve based with flow medium and hydraulics.

Closing direction caused by the action of back flow medium and spring or accumulator at different hydraulic solutions.

Design and operating possibility regardless of the purity of flow medium.

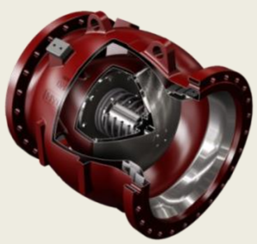
- **HS** – by using of additional oil tank and hydraulic throttle check valve provides adjusting of the opening and/or closing speed and preventing strikes of the disc in the end positions.
- **HED** – hydraulics external drive, allows:
  - ✓ total elimination of flow losses caused by the action of spring force or external accumulator. Better back flow protection and the better check valve function means introduction of a stronger spring or a stronger accumulator forces. This on the other hand means greater flow losses which implies financial losses, especially at lower flow rates.
  - ✓ provides adjusting the speed of opening and/or closing and preventing strikes in the end positions.
  - ✓ most reliable function of the check valve especially at larger nominal diameter and heavy duty applications.

FEEDBACK SYSTEM FOR THE CHECK VALVE OPENNESS

Internal and External feedback system to control of check valve open/close position, options:

1. **VC** device to local visual control of check valve openness
2. **VC & LS** device to local visual control & limit switches mechanical or inductive types
3. **VC & LS & RT** device to local visual control & limit switches & rotary or linear transmitter (most often 4-20 mA)

Axial check valve **DN 800_PN 16**
Valve body from carbon steel cast, all internal parts from stainless steel.



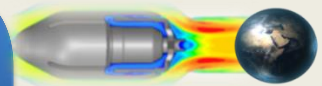
Axial check valve **DN 150_PN 160**
Operating with compressed air, valve body from carbon steel cast,
Internal feedback system with linear transmitter 4-20 mA

Axial check valve **DN 250_PN 40**
Operating with hydraulic pressure oil. External VS feedback system, valve body from stainless steel.

DYNAMIC PERFORMANCE OF THE CHECK VALVES

AND INFLUENCE ON THE SIZE OF THE WATER HAMMER

Intensity of the water hammer depends on the method of check valve closing → DYNAMIC PERFORMANCE



SOLUTIONS FOR SYSTEM PROTECTION

Generally, the water hammer in the plants, leads to highly dangerous situations with enormous damages

Example of water hammer typical consequences
There are completely destroyed:

- Discharge pipe DN600 (wall thickness 12 mm)
- Rotor of circulation pump (rotor diam. 1600 mm)

The *Zhukovsky* equation is of fundamental importance in the water hammer theory

The equation defines a pressure rise ΔH when the check valve changes velocity by Δv

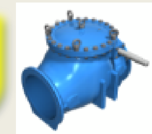
$$\Delta H = c \cdot \Delta v / g$$

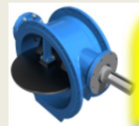
ΔH (mWs)	Transient pressure rise (transient head rise)
c (m/s)	Speed of pressure disturbance = wave speed pressure, e.g. water and steel pipeline, transmits at the speed of sound v > 1000 (m/s)
Δv (m/s)	Velocity flow change (reflux velocity) → The water back-flow will be damped to v=0 (m/s) within the reflux time
g (m/s²)	Gravity constant (9,81 m/s²)

Example for the plant with 8 (m/s²) flow deceleration dv/dt (m/s²), according upper Zhukovsky equation, theoretical max. water hammer effect is (see diagram No.2):

- Classical weight loaded check valve v=0,85 (m/s) → **ΔH=85 mWs**
- HYREVAL check valve v=0,1 (m/s) → **ΔH=10 mWs**

1. Swing check valve

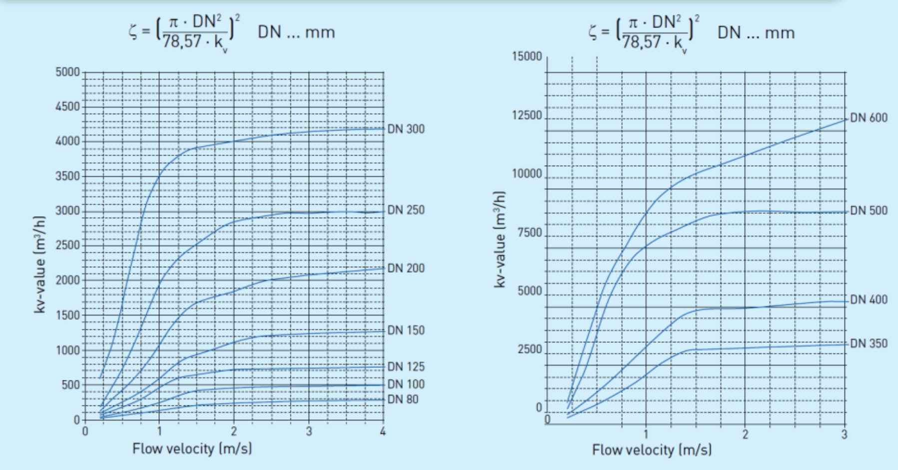


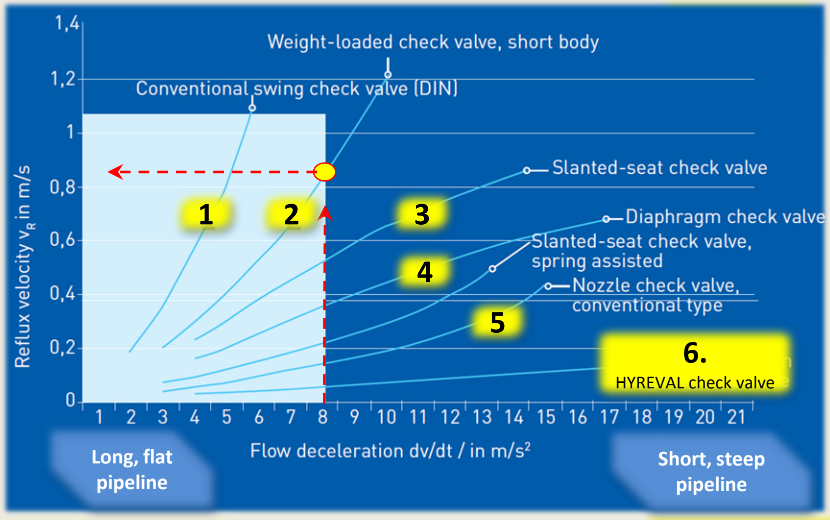


2. Butterfly check valve

Diagram No. 2 - Hydraulic characteristic for the Nozzle check valve with SPRING
NOTE: The HYREVAL check valve with hydraulic control has even better performance and because it is free of flow losses due to spring force.

Data source: ERHARD Armaturen GmbH by TALIS Group





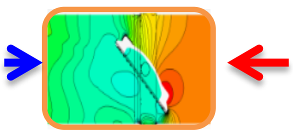
3. Slanted seat check valve

4. Diaphragm check valve

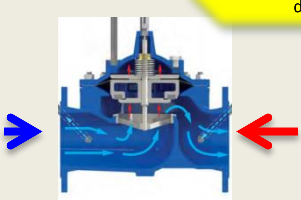
5. Nozzle check valve

6. HYREVAL check valve

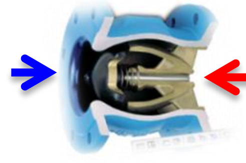
Type of check valve with flaps (swing and butterfly tilting)



Type of the check valve with diaphragm



Conventional type of the nozzle check valve



WHY IS THE HYREVAL CHECK VALVE THE BEST TECHNICAL AND VERY ECONOMICAL SOLUTION?

The equation for energy cost saving:

$\Delta C_s = ((\pi \cdot DN^2 \cdot v^3 \cdot (\xi_2 - \xi_1) \cdot \rho) / 8000 \cdot \eta_g) \cdot R_t \cdot E_c$

ΔC_s (EUR/a)	Cost saving per time unit
DN (m)	Check valve or pipe nominal diameter
v (m/s)	Flow velocity
ξ_1 (-)	Head-loss coefficient of valve 1 (Diaphragm CV)
ξ_2 (-)	Head-loss coefficient of valve 2 (HYREVAL CV)
η_g (-)	Overall efficiency of pumping plant
Rt (Hours/a)	Operating time of pumping plant
Ec (EUR/kWh)	Energy costs
P (kg/m³)	Density of the flow medium

ENERGY SAVING POTENTIAL

The HYREVAL check valve provides enormous energy saving – thanks to its low head-loss coefficients. The diagram shows that for large sizes and high flow velocities, the annual saving might even exceed the purchase price of the valve.
The diagram shows sizes DN 80 - DN 300, for sizes DN > 350 similar saving can be expected.

With DN 300 and an assumed flow velocity of 3,0 m/s, the possible annual saving when using HYREVAL check valve (ξ-value=0,7) instead of a diaphragm check valve will be about 7.500,- EUR / year.
In any case, it pays comparation costs.

WHY IS THE HYREVAL VALVE THE BEST CHECK VALVE CONCEPT:

- Perfectly hydrodynamic shape result with very low pressure losses in case of uni or bi-directional streaming
- Perfectly closing performance provides the best water hammer protection in comparison of all the know check valves
- A much higher service life
- Great selection of:
  - Nominal dimensions, operating pressures and medium temperatures
  - Flow mediums
  - Control possibilities

Data source: ERHARD Armaturen GmbH by TALIS Group

Annual energy saving potential of the **HYREVAL check valve** compared to a **Diaphragm check valve**

Diagram No. 4

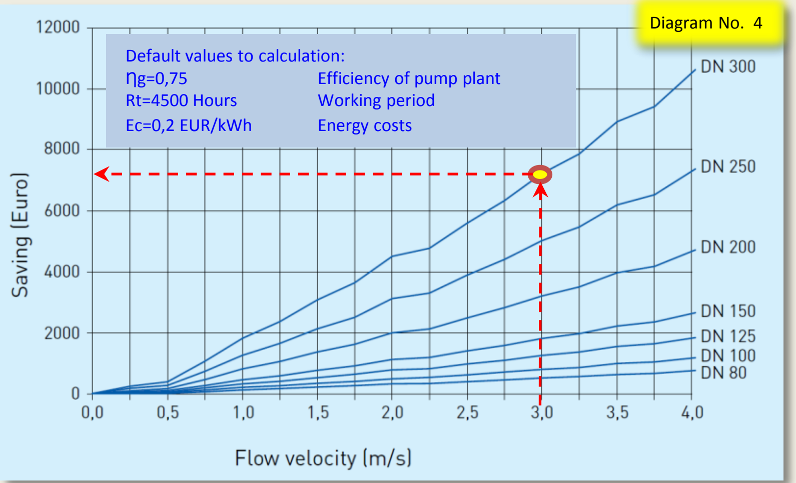
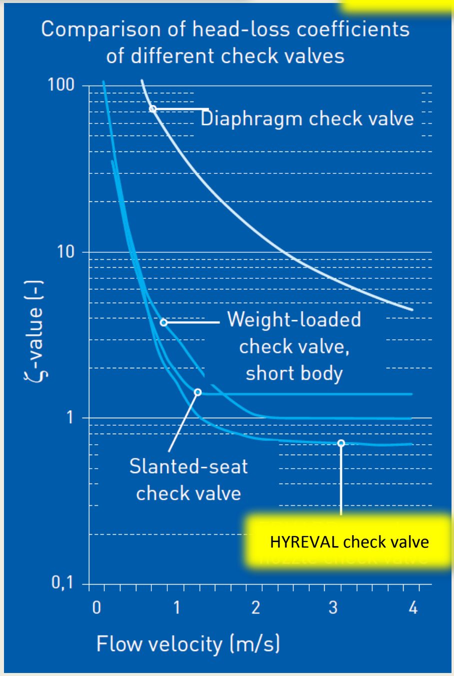
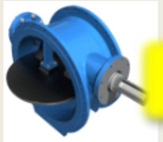


Diagram No. 5



Diaphragm check valve

Slanted seat check valve



Butterfly tilting check valve

HYREVAL check valve

HYDRAULIC BEHAVIOR IN THE COMPARISON

The optimized curve of cross sections and the well designed streamlined contour of the HYREVAL check valve result in minimum head-loss coefficient during operation. Compared to other check valves the Zeta-value of HYREVAL check valve is record-suspiciously well.
For example there will be an Zeta-value of 0,5 for nominal size DN 150 in fully open position (at a flow velocity of approximately 2 m/s).