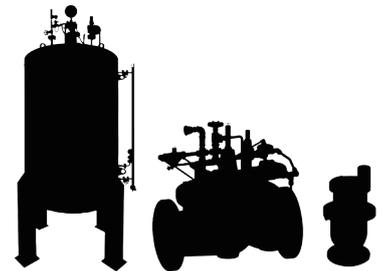




# Water Hammer

**Surge** Protection  
System



## Company Profile &amp; History

Company Name: FLOWTECH CO., LTD.  
CEO: Jae-gu Yang

## History

- 2005** Established FLOWTECH CO., LTD. - Water hammer prevention equipment, integrated pump system and automatic fluid filtering system  
Developed water hammer prevention controller (HAMMERtrol) and testing analysis equipment.
- 2006** Supplied integrated pump system (I&I WMS) to Hyundai Seongwoo Resort for the first time in Korea  
Obtained ISO 9001 & ISO 14001 (CRK-Q0-420, CRK-E0-066)
- 2007** Registered a patent(1) - CES & local cooling and heating N2 pressure expansion water controlling system (No.10-0702469)  
Obtained a Venture certificate (No.20070200808)  
Registered a patent(2) - Expansion water and feed water control system for parallel circulation system (No.10-0760985)  
Registered a patent(3) - Water hammer prevention system for cooling & heating circulation piping system (No.10-0760984)
- 2008** Registered a patent(4) - I&I WMS integrated pump system(No.10-0795592)  
Registered six trademarks including Eco-trol, HAMMER-trol  
Registered a patent(5) - Pressure Maintaining system auto control(No.10-0842818)  
Registered a patent(6) - Combined heat & power Plant N2 gas filling expansion pressure equipment (No.10-0845472)  
Gained an INNO-BIZ certificate (No.8071-2171)  
Registered a patent(7) - Water hammer prevention system (No.10-0868908)
- 2009** Registered a patent(8) - Cold Accumulator (No.10-0879629)  
Gained a venture ethical management certificate (No.08-05), Registered the company R&D center (No.2009110132)  
Selected as Promising SME by Incheon City (No. 250)
- 2010** Registered a utility model(1) - Energy saving water supply line pressure pump system (No.20-0446721)  
Registered a patent(9) - Energy saving and highly reliable water hammer prevention system and operating method (No.10-0933656)  
Registered a patent(10) - Water level control method for pressure tank with multiple sensors (No.10-0982683)
- 2011** Registered a patent(11) - Water level control method for pressure tank using level transmitter and level switch (No.10-1069126)  
Registered a utility model(2) - Energy saving water hammer prevention system (No.20-0456211)  
Registered a patent(12) - Damage sensor of bladder-type expansion tank(No.10-1077059)  
Selected as a Quality Product Maker by Incheon City (Water Hammer Prevention System, Pressure Maintaining System (Nov. 2011- Jan. 2014)  
Selected a VISION 2011 Company by Incheon City  
Registered a patent(13) - Controlling method of cooling/heating system pressure maintaining facilities with multiple sensors(No. 10-109882)
- 2012** Registered a patent(14) - Partial pressuring device for community energy supply systems(No. 10-1142098)  
Performance certified by Small Business Administration(No. 21-233)  
Green Technology certified by the Ministry of Land and Maritime Affairs(No. GT-12-00090)  
Registered a patent(15)(patent in China) - Nitrogen gas filling expansion & pressurization device(ZL 2009 8 0104325.1)  
Designated as a supplier of excellent water hammer prevention controllers(No. 2012097)
- 2013** Designated as a Promising Exprot Firm by the Small & Medium Administration  
Reported as "Engineering Industry Promotion Act"  
Reported as "Constructino Industry"  
Installed a Thermal Storage Tank at Combined Heat & Power Plant(Jinju)
- 2014** Certified as a clean business; Completed Risk assessment & field test  
Submitted to the Korean Intellectual Property Office (KIPO) three patent applications for valve control technologies related to water hammer reduction  
Established a branch in Dubai  
CE Certification (Pressure Vessel, Air Chamber)  
Moved to a new building in Incheon Nam-dong Industrial Park
- 2015** KC-Certificate(KCW-2015-0027)  
Acquire confirmation order of the surge vessel (100m<sup>3</sup>x 18units, 60m<sup>3</sup>x1unit) from Eagle Electromechanical(Contractor)for DEWA project & Award Al Riyadh Authority Project, Execute Surge
- 2016** ASME U Certificate of Authorization  
ASME S Certificate of Authorization



## Definition of Water Hammer

Water hammer (or, more generally, fluid hammer) is a pressure surge or wave caused when a fluid (usually a liquid but sometimes also a gas) in motion is forced to stop or change direction suddenly (momentum change). A water hammer commonly occurs when a valve closes suddenly at an end of a pipeline system, and a pressure wave propagates in the pipe. It is also called hydraulic shock.

This pressure wave can cause major problems, from noise and vibration to pipe collapse. It is possible to reduce the effects of the water hammer pulses with accumulators, expansion tanks and other features.

## Damage of Water Hammer

- Raised pressure in the pipeline causes break of facilities such as pumps, valves, pipes, and supporting structures.
- Vapor cavities causes collapse and heavy shock wave generated in the course of column separation and subsequent causes break of the pipeline.
- Low pressure in water supply pipeline causes health risk by letting in pollutants from outside.
- Water hammer may cause vibration and noise or make automatic control hard due to abnormal pressure wave.

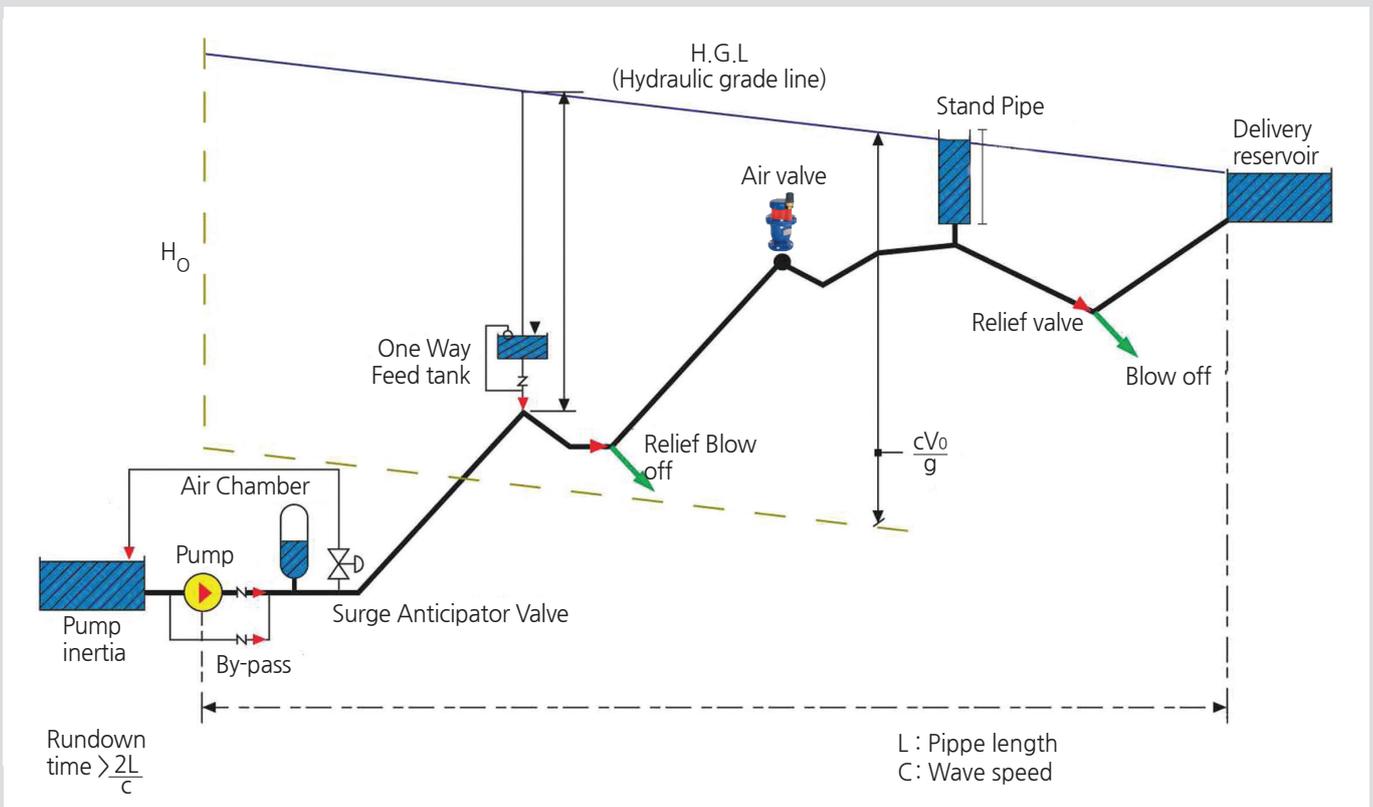


## Why hydraulic transient analysis is necessary?

- Pressure extremes usually occur during a period of transient flow
- Pressures may exceed design limits
- Undesirable conditions occur (low pressures, cavitation, large pressure spikes, etc.)
- High pressure transients break pipes
- Low pressure transients destroy seals
- Low pressure transients may cause health risk
- Evaluate surge protection schemes



# Surge Protection System



## Features of water hammer protection system types

ITEM TYPE	Control properties				Component	Feature
	EXTERNAL POLLUTANT	UP SURGE	DOWN SURGE	SURGE CONTROL		
Stand Pipe	Flowed in	Controllable	Controllable	Passive	Pipe	Simple design, needed to install higher than H.G.L, Fluid is exposed to air, which may result in smell leakage in case of sewage water and cause health risk for water supply.
Feed Tank (one way)	Flowed in	Uncontrollable	Controllable	Passive	Open tank	Prevents column separation due to inflow under negative pressure. Installation place is limited as it is fixed on the top of the pipeline.
Air Valve (Vacuum Breaker)	Flowed in	Uncontrollable	Controllable	Passive	Air Valve (Vacuum Breaker)	Handles negative pressure by letting in air, when negative pressure works in the pipeline. Often installed on the pipeline, making maintenance hard. Pollutants may flow in with air.
Surge Valve	Blocked	Controllable	Uncontrollable	Passive	Control Valve	Control only follows water hammer, and surge control at the time of system failure may be useless.
Air Chamber	Blocked	Controllable	Controllable	Active	Pressure Vessel Compressor, auto control panel	Expensive, positive measure against up/down surge, possible to install in/outdoors, and clean by using a closed tank.

## Types of Water Hammer Protective Device



### MIN-trol® Separate Water Hammer cushion

MIN-trol is a separate small-sized water hammer cushion, which can be easily mounted on water tap and valve front where water hammer occurs.

- MODEL : MIN150
- Max working pressure : 10kg/cm<sup>2</sup>·G
- Max velocity : 3m/sec
- Outside dimension : Φ88mm×113mm
- Volume : 160cc(ml)
- Max shock pressure : 14kg/cm<sup>2</sup>·G
- Max working temp : 90°C
- Pre-charged Air : Set to 1.5kg/cm<sup>2</sup>·G which can be adjusted if necessary.

#### [Structure and Mechanism]

Once the valve is closed, shock(water hammer) occurs.

In this case, resulting extremely high pressure is separated by the diaphragm, compressing sealed air, which absorbs shock energy and prevents shock

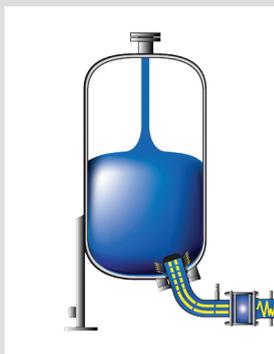


### DIA-trol® Small-sized Water Hammer cushion

DIA-trol is designed with a sufficient capacity to install at places such as water pipe of a building. Installation capacity and quantity are calculated by FU values as in the table below. Air seal pressure must be set to the pipeline pressure at the place of installation.

- Max working pressure : 7.0kg/cm<sup>2</sup>·G
- Max shock pressure : 15kg/cm<sup>2</sup>·G
- Max working temp : 60°C
- Pre-charged Air : 3.5kg/cm<sup>2</sup>·G

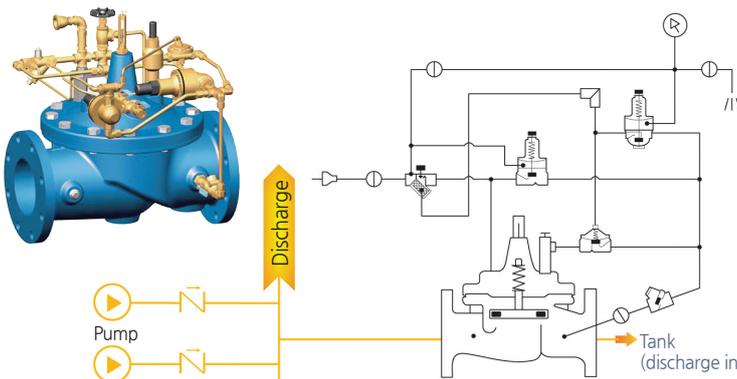
Model	Capacity	Outside dimension (mm)			Unit grade(FU)
		Diameter	Height	Joint	
DUF-010	2.6	155	21B	20A	1-1
030	2.9	155	232	20A	12-332
060	3.2	155	24B	20A	33-66
150	3.8	155	286	32A	114-154
330	4.1	155	302	32A	155-330



### BAL-trol® BAL-trol Bladder-embedded Water Hammer Protective Device

The embedded bladder in the compression tank helps storing compressed air semi-permanently, which removes the need for a separate compressor. Besides, it controls rise/falling surge as well as various surges effectively in combination with UD-con (Patent technology) that provides interactive friction co-efficient.

- Model : 200~5000lit, 10kg/cm·G, 16kg/cm<sup>2</sup>·G
- Option : 10~60lit, 200kg/cm<sup>2</sup>·G, 300kg/cm<sup>2</sup>·G



### Pressure Relief & Surge Anticipator Valves

It senses when the pressure of Down Surge is low upon the pump stopping and opens the main valve to effectively control the Up Surge pressure.

- Size : 65A 65A (2½")~ 600A (24")
- Material(Body) : ASTM·A536 (250Psi/#150, ASTM A216-WCB, 720Psi/#300)
- Flow(gpm) : 670/65A, 1800/100A, 1000/200A, 1600/300A, 25000/400A

Petrochemical Plant Bladder-type Water Hammer Protective Device

# Qchem II , BAL-trol<sup>®</sup> with UD-con

### Pressure Vessel

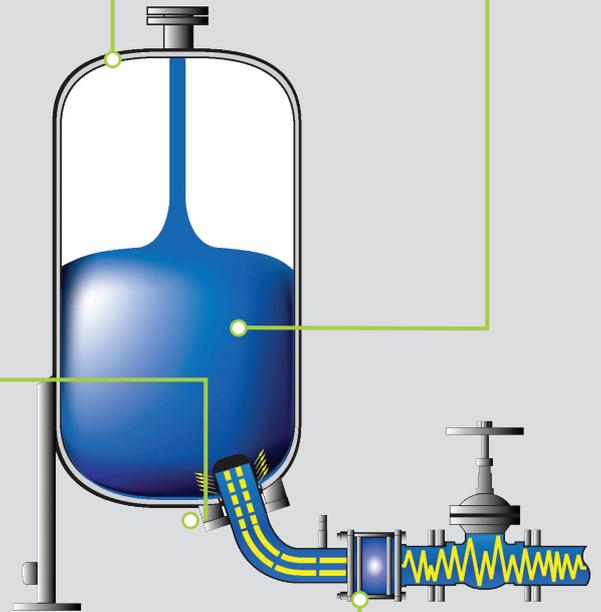
Examined by the Korea Occupational Safety and Health Agency (KOSHA)  
 Bladder Type-Closed it should be approved by KOSHA Korea Occupational Safety and Health Agency according to the industrial safety and health law section 34 and its enforcement regulations section 58-9(ASME possible)  
 -Pressure vessel : Examined by the Korea Occupational Safety and Health Agency (KOSHA)-ASME Stamp(Optional)  
 -Size : 0.2~5.0 cm<sup>3</sup>  
 -Pressure : 10k, 16k

### Butyl/NBR/Viton/EPDM Bladder

High quality butyl rubber that the air transmissivity is very low, the thermal resistance is excellent, and the durability is proved.  
 -Bladder : low in air permeability and possible to provide various types of bladders

### Silent Distribution Chamber

Anti-noise & vibration distribution chamber: Bladders can be easily damaged by shock wave; thus, input and output resistance factor is optimized while absorbing shock wave (if necessary)



### Up & Down Surge Control alve (UD-con)

As a two-way control check valve for differential friction factor, the bypass pipes with built-in Orifice are installed in parallel to the connecting pipes to effectively control surge. These are an all-in-one control valve that effectively control the Water Hammer phenomenon. (Patent No. 10-0868908)

## Reference



- Middle-east Qatar achem II , Olefins (C4~30) production line 16 units in 2008, first domestic supply to Petrochemical Plants
- SHOAIBA II Combined Cycle Power Plant Saudi Arabia, 7 units

Model	Volume	Dimension		Connection	Weight	Remarks
	Liter	A, mm	B, mm	C, mm	Kg	
BAL 200K	200	1280	610	65A	150	150
BAL 300K	300	1610	610	65A	200	200
BAL 400K	400	1960	610	65A	220	220
BAL 500K	500	2310	610	65A	270	270
BAL 600K	600	1920	753	100A	340	340
BAL 800K	800	2380	753	100A	420	420
BAL 1000K	1000	2120	915	100A	550	550
BAL 1500K	1500	2800	915	100A	680	680
BAL 2000K	2000	2410	1233	150A	1020	1020
BAL 2500K	2500	2850	1233	150A	1080	1080
BAL 3000K	3000	2510	1570	200A	2050	2050
BAL 4000K	4000	3060	1570	200A	2200	2200
BAL 5000K	5000	3600	1570	200A	2450	2450

## BAL-trol<sup>®</sup> "K" Series (KS B 6750-3, Butyl Standard)

## Air-Chamber Type

In the piping of pump discharge, installed is the compressed container with water and compressed air in the ratio of 50 to 50 to control Up and Down Surge in the Water Hammer protection system. If an Orifice is installed in a side pipe of the connecting piping, the Up and Down Surge is more effectively controlled.

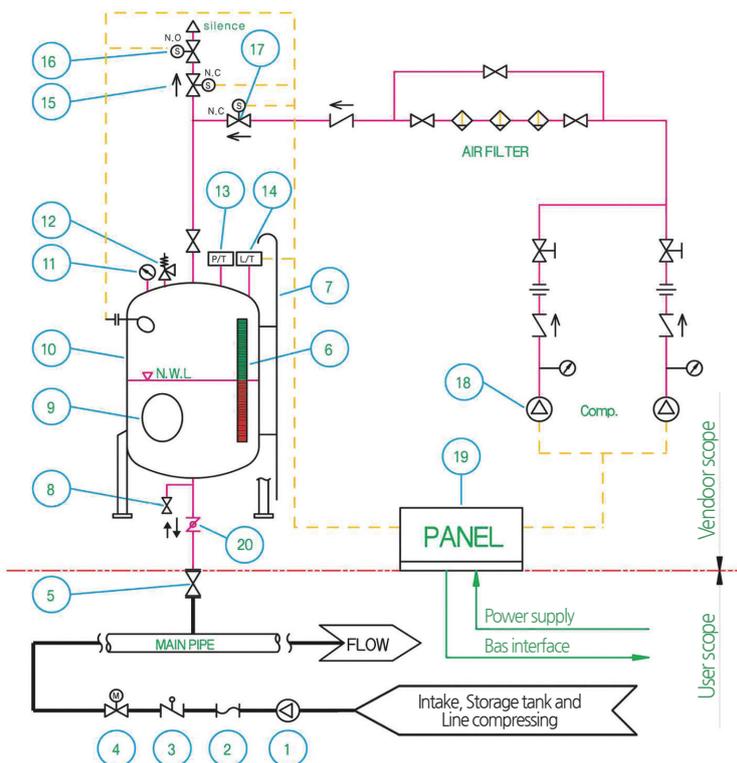
Model V: vertical H: horizontal	Capacity (m <sup>3</sup> )	Air - Chamber Dimension (Φ X H)mm	Tank weight per at 10 kg/cm <sup>2</sup> . design			Remarks
			Product	Operation	Hydraulic pressure	
HWT-500V	0.5	Φ700 X 2,350H	400	650	900	Customized production is available, depending on on-site
800V	0.8	Φ930 X 2,500H	600	1,000	1,400	
1,000V	1.0	Φ930 X 2,700H	700	1,200	1,700	
1,500V	1.5	Φ1,208 X 2,800H	900	1,700	2,500	
2,000V	2.0	Φ1,208 X 3,500H	1,020	2,010	3,020	
5,000V	5.0	Φ1,540 X 4,700H	2,000	4,600	7,100	
10,000V	10.0	Φ2,000 X 5,200H	5,200	11,200	17,200	
10,000H	10.0	Φ2,000 X 4,100H	5,200	11,200	17,200	
20,000V	20.0	Φ2,720 X 5,900H	6,560	16,560	26,560	
20,000H	20.0	Φ2,720 X 4,700H	6,560	16,560	26,560	
30,000V	30.0	Φ2,980 X 4,700H	8,750	23,750	38,750	
50,000V	50.0	Φ3,240 X 4,900H	13,670	38,670	63,670	
90,000H	90.0	Φ4,000 X 8,700L	32,000	77,000	122,000	
100,000H	100.0	Φ4,000 X 9,700L	38,000	88,000	138,000	

Either the vertical or horizontal type is available according to the onsite condition, and the pipe diameter may be changed according to the distance.

1. Designed Compression: 10, 15, 20, 25, 30, 40K  
(every product shall meet the qualifications of KOSHA for compression containers)
2. Vertical or horizontal types
3. Compressor: Selected according to the chamber capacity and operation pressure
4. Chamber materials or coating specifications selected according to the type of the fluid(water system)



## Components of Air Chamber Type System



No	DESCRIPTION
1	Pump
2	Flexible Joint
3	Check Valve
4	Motor Operated Valve
5	Connection Valve
6	Level Gauge
7	Plat Form/Ladder
8	Drain Valve
9	Manhole
10	Air Chamber
11	Pressure Gauge
12	Safety Valve
13	Pressure Sensor
14	Level Transmitter
15	Vent Sol. Valve
16	Gas Maintaining S.Valve
17	Charge Sol. Valve
18	Compressor
19	Control Panel
20	Up Down Sureg Control Valve (Option)

## Key Features of Controller

### Digital PID Controlling Method

The adoption of Digital PID Controlling Method realizes high-accuracy controlling by drastically reducing the deflection of controlling the water level of the Air Chamber according to the operation, stop, and flow of the pump.

### Korean LCD/ Touch Screen/ Graph

Data displayed on LCD is intended for a user to easily understand for maintenance and operation. Besides, the operation records of water impact facilities can optionally be displayed on touch screen graphically.

### Remote Control System(OPTION)

A user can monitor remotely on a smart phone and receive the services necessary for maintenance such as remote adjustment of direct operation state monitoring and settings.

### Skip & Rotary Control

Malfunctioning of the duty compressor automatically initiates the operation of the next compressor except when it is operating. A compressor stopped due to malfunctioning returns to the working mode upon reset, and the number of compressors is adjusted according to the water level. To evenly control the operation hours and times of the compressors in parallel, the priority of the compressors being operated is to be periodically changed, which prevents wear and breakdown of a compressor.

### Powerful Self-diagnosis

Water levels can be monitored by comparing level transmitter, level gauge and level switch(4 ea) and the levels can be controlled by level switch as any abnormal level transmitter is detected by itself(patented). In addition, if a controller is in trouble, malfunction is prevented by electric sequence, enabling dual or triple highly reliable operation.

### Reliable Level Sensing & High Efficiency Control

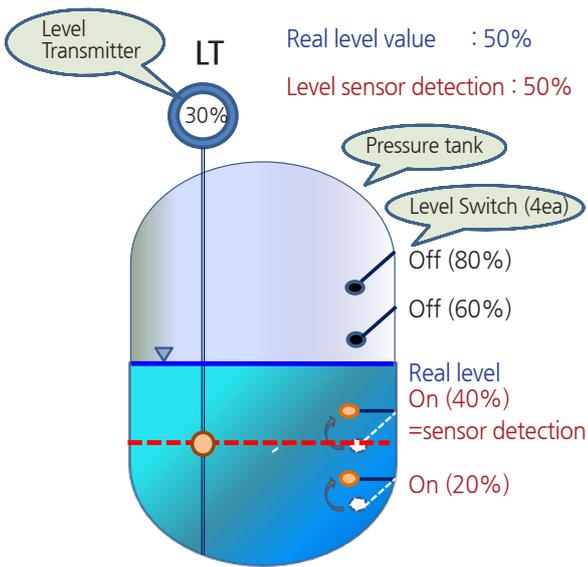
Upon excessive errors or malfunctions of the level transmitter, the technology to sense and compare the level properly helps operating the unit in a reliable manner(patent). In connection with the operating pumps, it recognizes the proper range of the water level according to the pump operation, which saves the compressor power as much as 50% of the existing way(patent).

### Operation and Failure Data Management

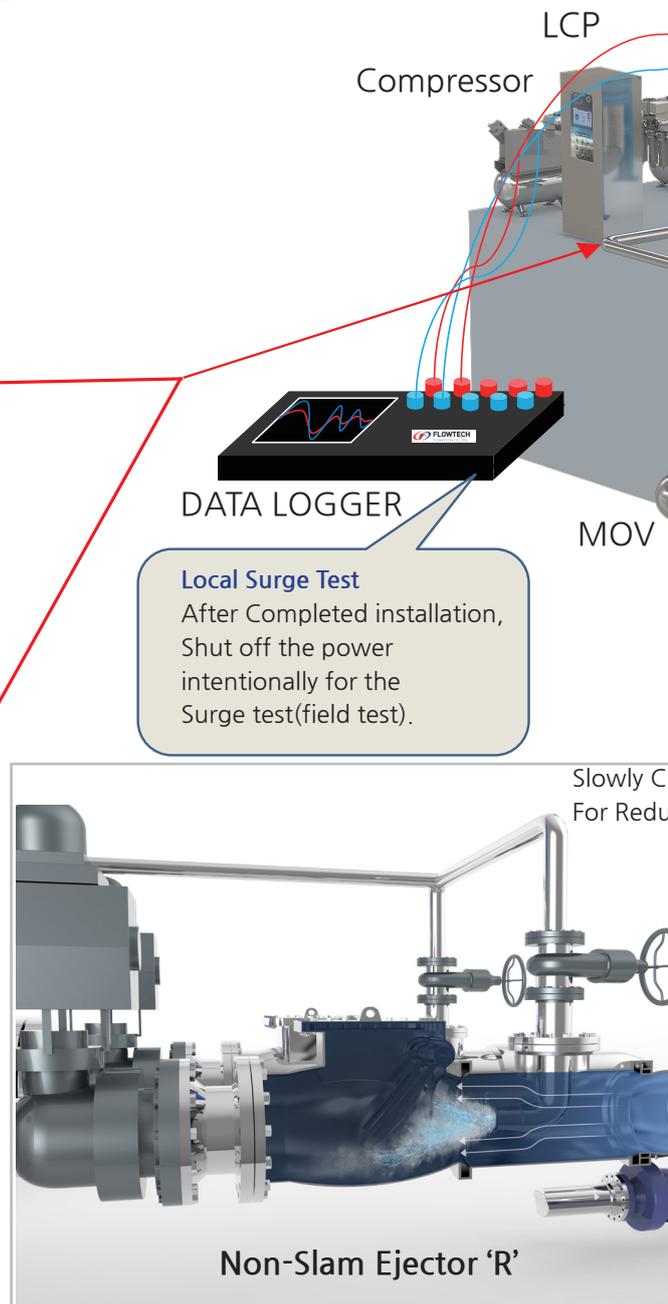
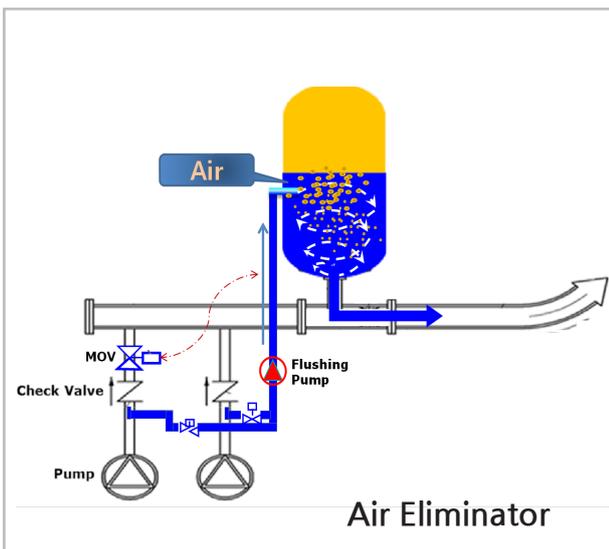
Upon Water Hammer, the specific information including the highest pressure, level(the upper and lower limits), operation data of each compressor, causes and time of malfunctions, etc is recorded in the Non-Volatile Memory in order to continue to monitor the operating condition and provide accurate service information upon problems. The records of accumulated hours of use and operating times of each compressor are kept as a part of the various maintenance predictive functions for the maintenance of major parts.

## The Surge/Expansion Controlling Technology of Piping System ; **The World Greatest Number of Patents**

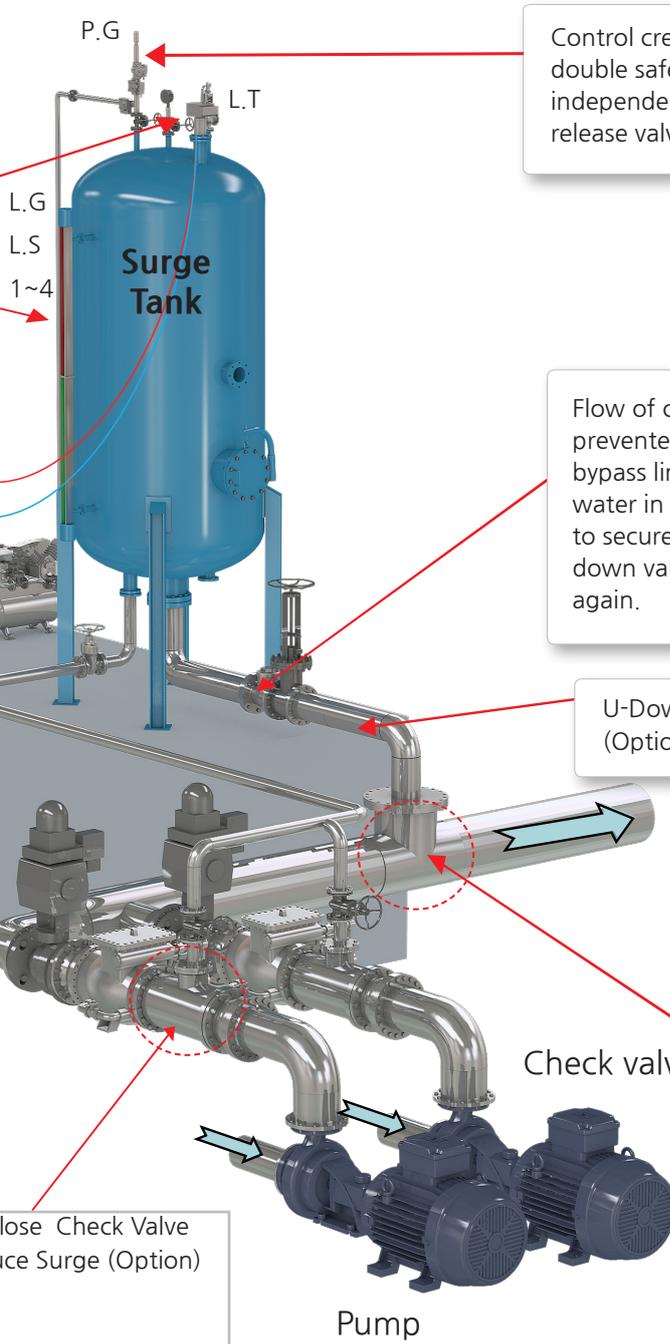
- Up & Down Water Hammer Protection System (No. 10-0868908)
- The Water Hammer Protection System of the Cooling/heating purifying pipe system (No. 10-0760984)
- The surge/expansion controlling system of a parallel circulation system (No. 10-0760985)
- Decompression/nitrogen pressurization expansion controller (No. 10-0702469)
- Emergency Operation Method of the Pressure Tank System (Eco-trol) (No. 10-0842818)
- The heat-damage preventive expansion controller of the diaphragm expansion tank (No. 10-0879629)
- Nitrogen-gas refilling expansion controller (No. 10-0845472)
- Power-saving & High reliability Water Hammer-protection device (No. 10-0933656)
- High reliability of air chamber level sense and recognition technologies etc (No. 10-0982683)
- Energy saving water hammer protection system (No.20-0456211)
- Damage sensor of bladder-type expansion tank (No.10-1077059)
- Partial pressuring device for community energy supply systems (No. 10-1142098)



The credibility is improved with comparative logic control by the level switch in spite of a trouble with level sensor.



# Best Technology and Patents



Control credibility is improved through the double safety shutdown function linked with independent level switch if a compressed air release valve is installed.

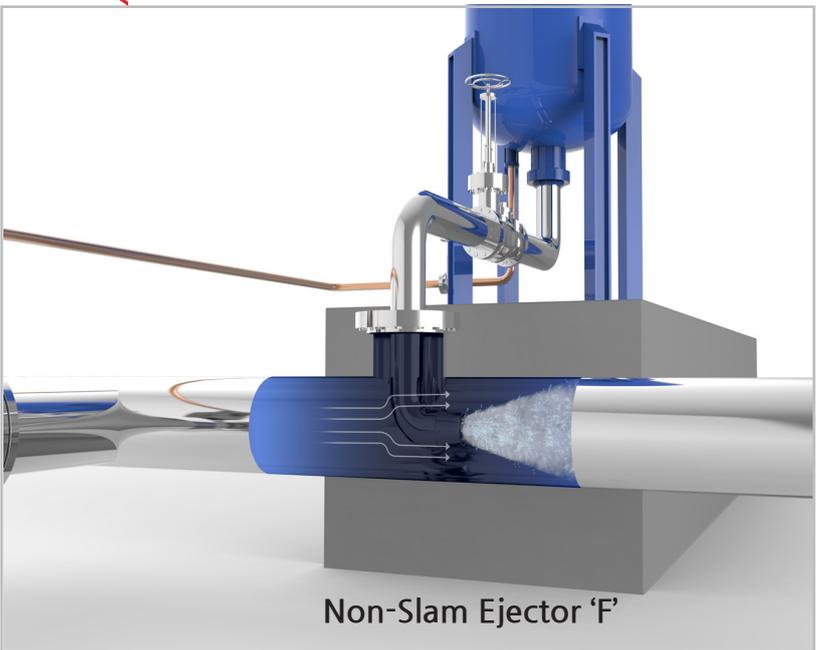
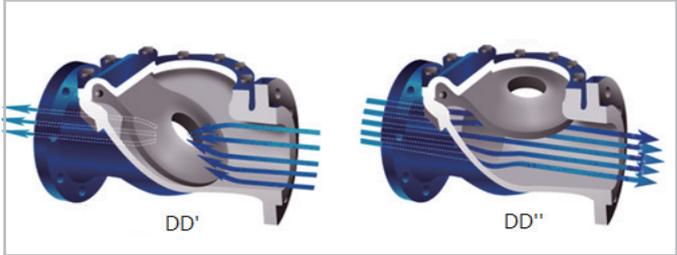
Flow of compressed air into the pipes is prevented. A check valve is installed in the bypass line and, in case of elevated surge, the water in the pipes flows to the air chamber to secure adequate level; the emergency shut down valve is then automatically opened again.

U-Down Con. Orifice (Option)

Check valve

Pump

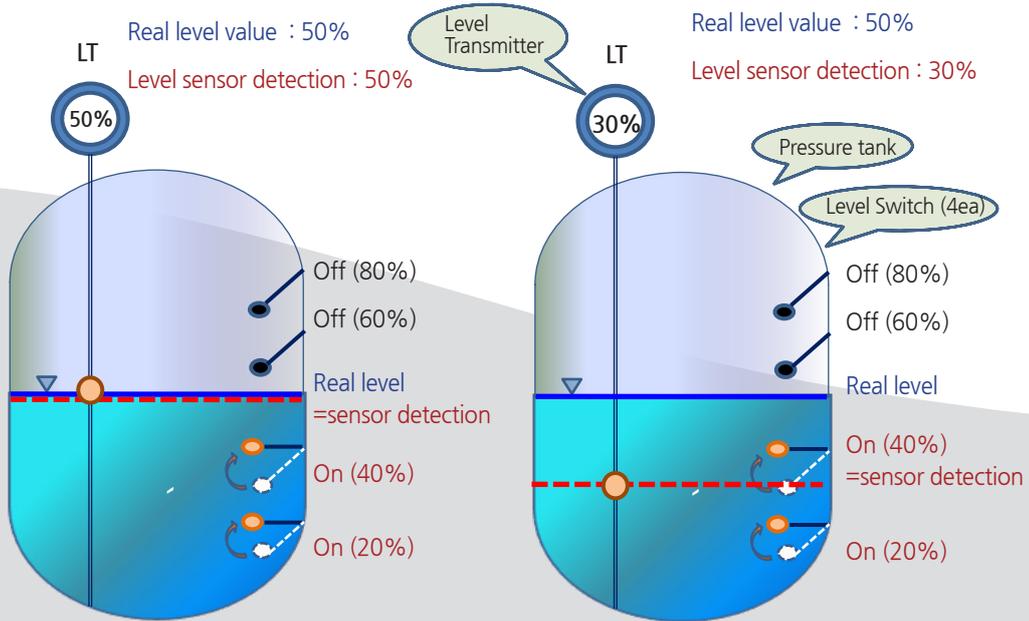
Close Check Valve  
Prevent Surge (Option)



Non-Slam Ejector 'F'

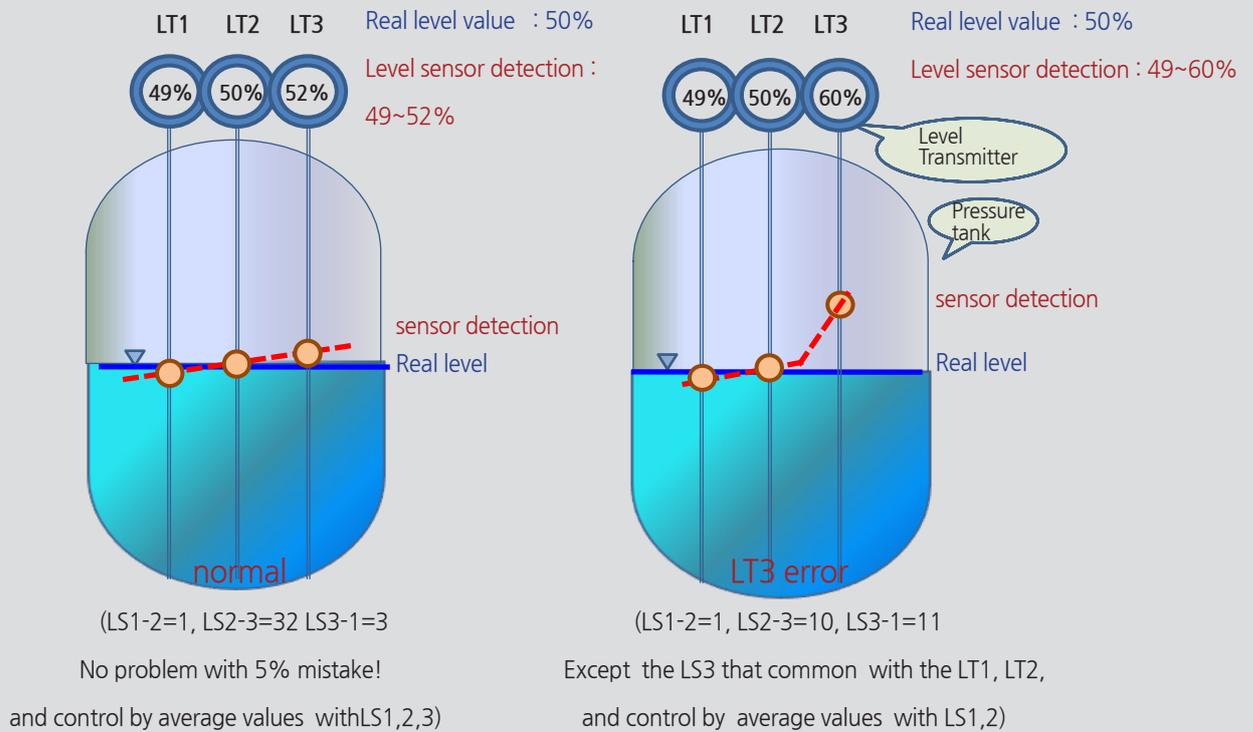
## Key Technology # 1

- Technology of water level control by using the level switch & level transmitter.



## Key Technology # 2

- Technology of water level control by using Multiple level transmitter.



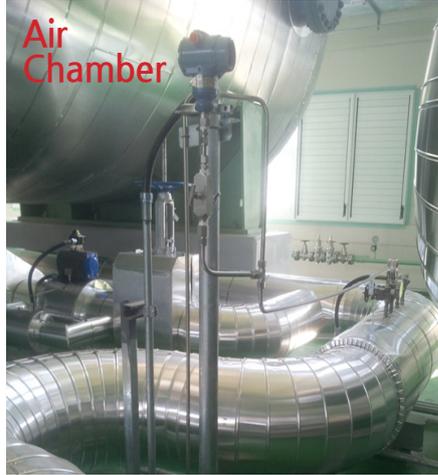
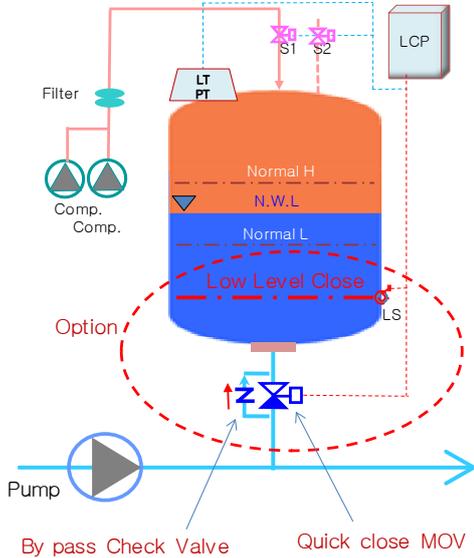
Detect a failure before problem occurrence

Emergency operate after find problem by self

Protect the problem with property damage and damage of humans by water logging

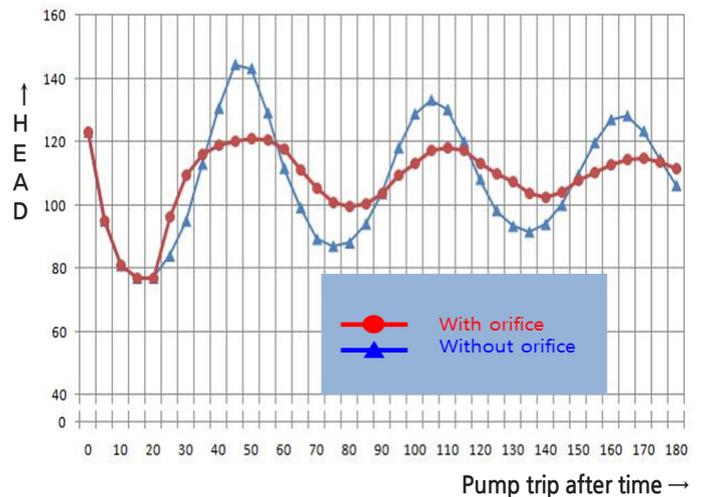
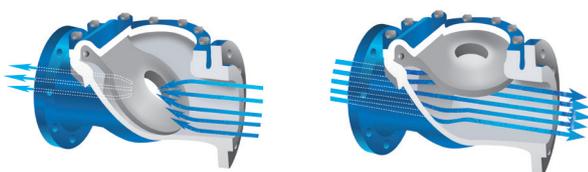
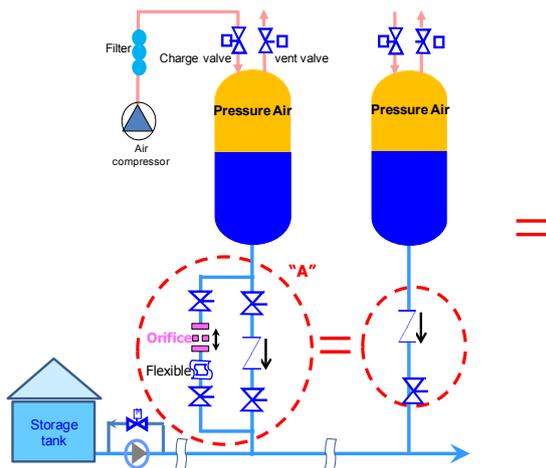
## Quick close, but acceptable up surge

Flow of compressed air into the pipes is prevented. A check valve is installed in the bypass line and, in case of elevated surge, the water in the pipes flows to the air chamber to secure adequate level; the emergency shutdown valve is then automatically opened again.



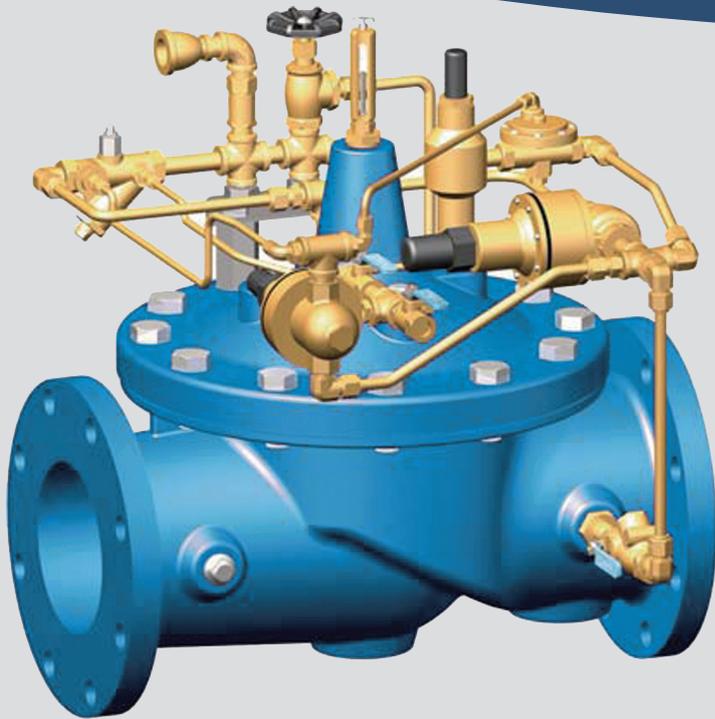
## UD-con

UP-DOWN Surge Control Valve



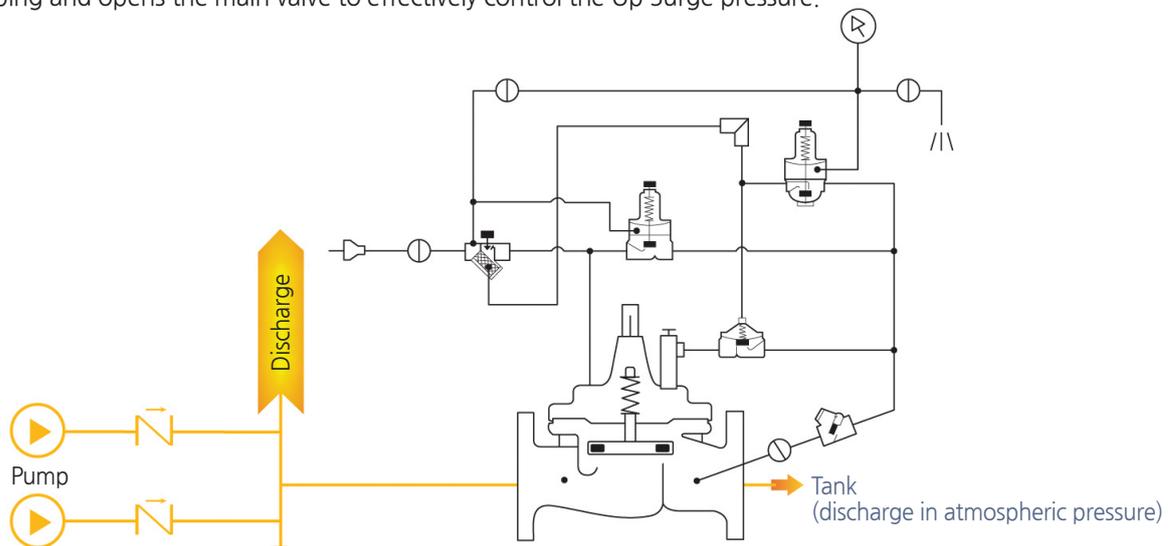
If an orifice is installed in the air-chamber connection pipe, up-surge may be more reduced in some cases.

Pressure Relief & Surge Anticipator Valves



CLA-VAL 100-01 Hytrol

It senses when the pressure of Down Surge is low upon the pump stopping and opens the main valve to effectively control the Up Surge pressure.



Size

Pattern	Threaded	Flanged	Grooved End
Globe	3/8"-3"	1 1/2"-36"	1 1/2"-2"-2 1/2"-3"-4-6-8"
Angle	1 1/4"-3"	2"-16"	2"-3"-4"

Operating Temperature

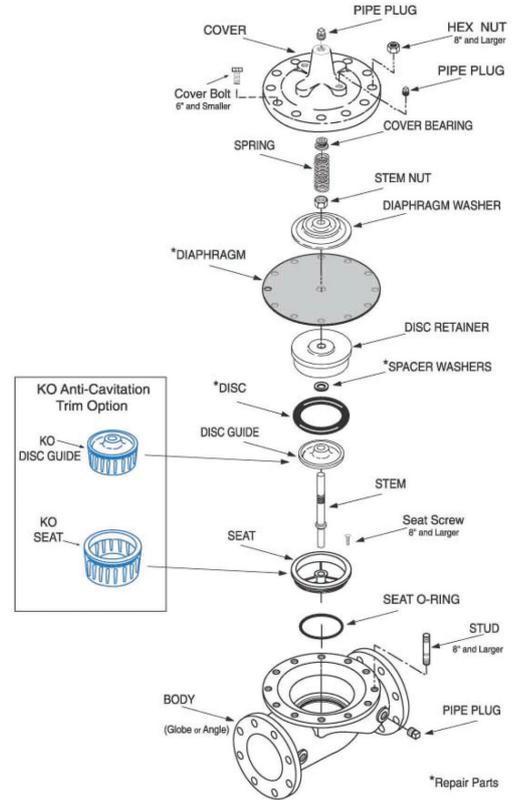
Fluids
-40°C to 82°C

Pressure Range(High Pressure, barg)

Valve Body & Cover		Pressure Class			
		Flanged		Threaded	
Grade	Material	ANSI Standards*	150 lb	300 lb	End* Details
ASTM A536	Ductile Iron	B16.42	17.2	27.6	27.6
ASTM A216-WCB	Cast Steel	B16.5	19.7	27.6	27.6
ASTM B62	Bronze	B16.24	15.5	27.6	27.6

Materials

Component	Standard Material Combinations		
Body & Cover	Ductile Iron	Cast Steel	Bronze
Available Sizes	1 1/4"-36"	1 1/4"-16"	1 1/4"-16"
Disc Retainer & Seat & Cover Bearing	Cast Iron	Cast Steel	Bronze
Trim:Disc Guide, Seat & Cover Bearing	Bronze is Standard Stainless Steel is optional		
Disc	Buna-N Rubber		
Diaphragm	Nylon Reinforced Buna-N Rubber		
Stem, Nut & Spring	Stainless Steel		



Functional Data

Valve Size		Inches	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	14	16	20	24	30	36
		m.m	10	15	20	25	32	40	50	65	80	100	150	200	250	300	350	400	500	600	800	900
Cv Factor	Globe Pattern	Gal./Min.(qpm)	1.8	6	8.5	13.3	30	32	54	85	115	200	440	770	1245	1725	2300	2940	5345	7655	10150	13320*
	Angle Pattern	Litres/Sec.(Vs)	.43	1.44	2.04	3.2	7.2	7.7	13	20	28	48	106	185	299	414	552	706	1286	1837	2436	3200
Equivalent Length of Pipe	Globe Pattern	Feet(ft)	25	7	6	23	19	37	51	53	85	116	211	291	347	467	422	503	595	628	1181	2285
	Angle Pattern	Meters(m)	7.6	2.2	4.8	7.1	5.7	12	15.5	16	26	35	64	89	106	142	129	154	181	192	552	569
K Factor	Globe Pattern	Feet(ft)	-	-	-	-	28	46	40	37	58	80	139	176	217	222*	238*	247*	-	-	-	-
	Angle Pattern	Meters(m)	-	-	-	-	8.7	14	12	11	18	25	43	54	66	68	73	75	-	-	-	-
Liquid Displaced from Cover Chamber When Valve Opens	Globe Pattern	Fl. Oz	.12	.34	.34	.70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Angle Pattern	U.S Gal	-	-	-	-	.02	.02	.03	.04	.08	.17	.53	1.26	2.51	4.0	6.5	9.6	12	29	48	90
	Globe Pattern	ml	3.5	10.1	10.1	20.7	75.7	75.7	121	163	303	643	-	-	-	-	-	-	-	-	-	-
	Angle Pattern	Litres	-	-	-	-	-	-	-	-	-	-	2.0	4.8	9.5	15.1	24.6	36.2	45.4	109.8	197	340

Cv Factor

$$C_v = \frac{Q}{\sqrt{\Delta P}} \quad Q = C_v \sqrt{\Delta P} \quad \Delta P = \left( \frac{Q}{C_v} \right)^2$$

K Factor (Resistance Coefficient)

The Value of K is calculated from the formula  $K = \frac{894d^4}{C_v^2}$

Equivalent Length of Pipe

Equivalent Length of Pipe(L) are determined from the formula :

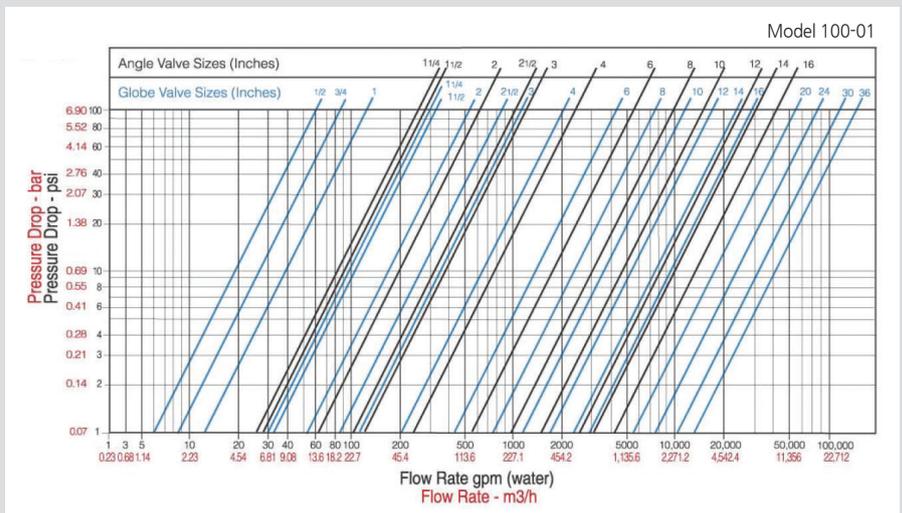
$$L = \frac{K d}{12 f}$$

Fluid Velocity

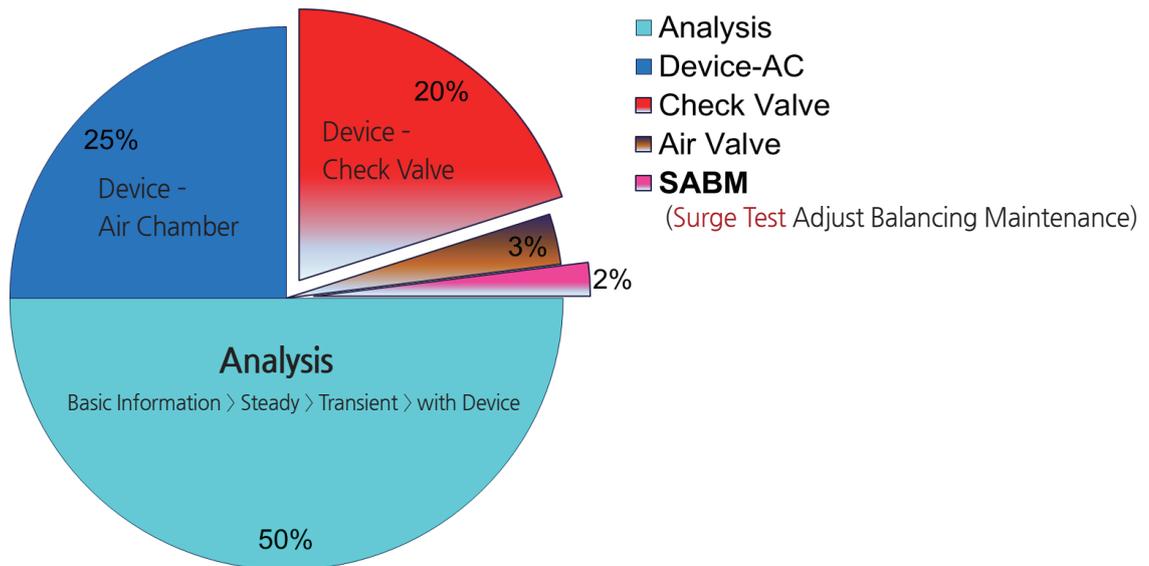
Fluid Velocity can be calculated from the following formula :

$$V = \frac{.4085 Q}{d^2}$$

- Cv = U.S. (gpm) @ 1 psi differential at 60°F water
- d = Inside pipe diameter of Schedule 40 Steel Pipe (inches)
- f = Friction factor for clean, new Schedule 40 pipe
- K = Resistance Coefficient (calculated)
- L = Equivalent Length of Pipe (feet)
- Q = Flow Rate in U.S. (gpm) or (l/s)
- V = Fluid Velocity (feet per second) or (meters per second)
- ΔP = Pressure Drop in (psi) or (bar)



## Problems of Surge (Water hammer)



## Current status of the surge (water hammer) protection system market

Each Stake-Holder ;

1. Review on the flow in the pipeline and Hydraulic transient Analyst  
In most cases, safety devices such as Capacity of air chamber, valve size, etc. are recommended as a countermeasure.
2. Contractor(EPC) : Construct based on the design. EPC is avoiding any problems or accident of water hammer after construction because EPC claimed, construct based on the design
3. Supplier of surge vessel has no knowledge of water hammer
4. Consultant (Engineering), Construction Inspection Company & Construction Developer :  
Manages and supervise a constructor(EPC) to build the system as designed.  
The Worst Scenario is Supervisor(Consultant) do not understand cause of Water Hammer(Surge) so they are not able to diagnose a Surge problem.
5. Operator : In general, Operator has difficulty in finding problems of Water Hammer(Surge) and not able to manage water Hammer(Surge)

## Proposal of FLOWTECH

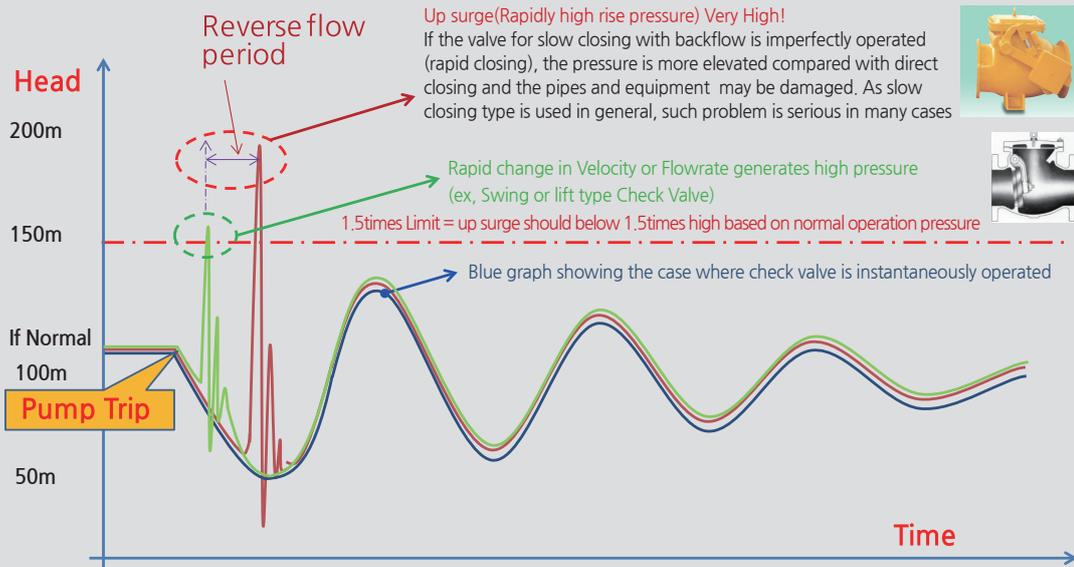
FLOWTECH as following technology :

- ☞ Through Hydraulic Transient Analysis, provide exact size of (specification) surge vessel, air valve, check valve and its location in your pipeline.
- ☞ Manufacture Surge Vessel and supervise installation
- ☞ Execute field surge test (FST) in front of clients. So that clients feel comfortable about our cutting-edge solution.
- ☞ Execute maintenance of surge (water hammer)

**FLOWTECH** has world-class cutting edge new technology, holds 20 patents on surge(water hammer) protection system which is the largest number in the world. For this reason we are the total world-class package solution provider in terms of surge(water hammer) protection system market, and its high-tech technology.

Conclusion FLOWTECH shall be responsible for surge(water hammer).

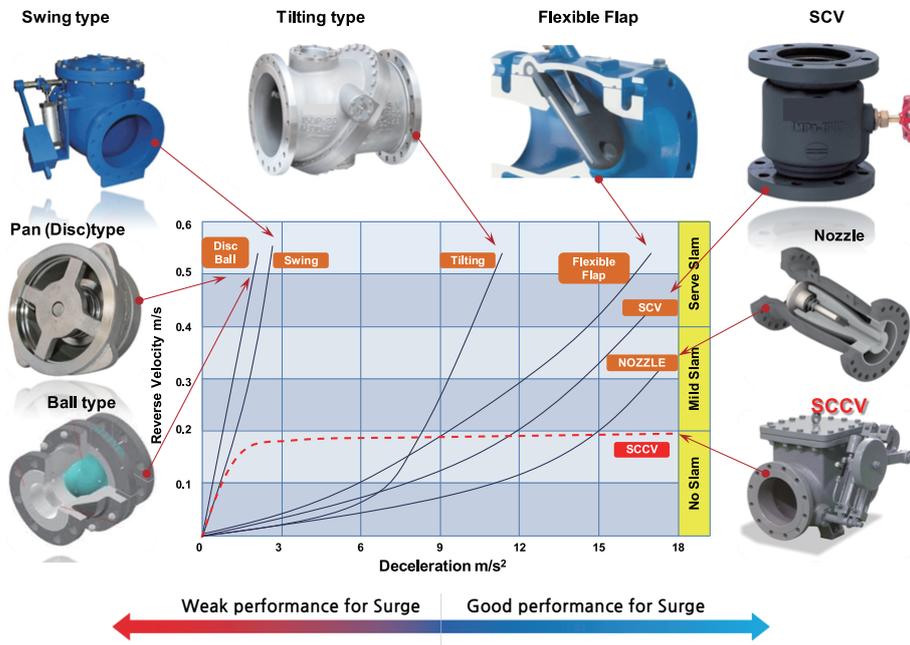
## How many increase by Disc Closure



## Ideal Check Valve

1. Disc close instantaneously on flow reverse
2. The next best way?
  - Minimize reverse flow just before complete closure
3. How to minimize reverse flow?
  - Reduce disc travel (but, friction loss increase=BFI)
  - Spring assisted closure(BFI)
  - Low inertia & friction of moving parts(BFI)

## Feature of Closure of Check Valve



# Reference

## 1. Waterworks/Sewerage

- Project : Daejeon city (waterworks)  
Developer : Daejeon Metropolitan City Waterworks Authority  
Date : 2010. 7  
Capacity : 40m<sup>3</sup> x 2 set
- Project : Yeongjeong water quality restoration center(sewage)  
Developer : Incheon Development & Tourism Corporation  
Constructor : HYUNDAI E&C  
Date : 2011. 1  
Capacity : 9m<sup>3</sup> x 1 set
- Project : Gumi purification facility(waterworks)  
Developer : K-water  
Constructor : SANMSUNG C&T  
Date : 2011. 12  
Capacity : 20m<sup>3</sup> x 1 set
- Project : Suncheon complex construction enterprise(sewage)  
Developer : Suncheon City  
Constructor : JS Construction  
Date : 2012. 3  
Capacity : 6m<sup>3</sup> x 1 set
- Project : Deajuk sewage treatment plant(sewage)  
Developer : Seosan City  
Date : 2012. 5  
Capacity : 5m<sup>3</sup> x 2 set
- Project : Ochang industrial complex 2 (waterworks)  
Developer : Cheongwon-Gun  
Constructor :  
Date : 2012. 9  
Capacity : 4m<sup>3</sup> x 1 set, 6m<sup>3</sup> x 1 set
- Project : Water supply facility construction(sewage)  
Developer : Korea Land & Housing Corporation  
Constructor : KYERYONG  
Date : 2012. 9  
Capacity : 20m<sup>3</sup> x 1 set
- Project : Hoeya water purification plant 1 (waterworks)  
Developer : Ulsan City  
Date : 2012. 9  
Capacity : 30m<sup>3</sup> x 9 set
- Project : NHN industrial complex water supply facility (waterworks)  
Developer : Water Service Management Agency of Chuncheon  
Date : 2012. 12  
Capacity : 5m<sup>3</sup> x 1 set
- Project : Busan-Jinhae Free Economic Zone (sewage)  
Developer : Goobo  
Date : 2013. 2  
Capacity : 15m<sup>3</sup> x 1 set
- Project : Jigok water reservoir(waterworks)  
Developer : Clean water Agency of Jeonju  
Date : 2013. 4  
Capacity : 5m<sup>3</sup> x 1 set
- Project : Pungnap water intake facility(waterworks)  
Developer : Water Service Management Agency of Incheon  
Date : 2013. 6  
Capacity : 20m<sup>3</sup> x 3 set
- Project : Seawater desalination R&D foundation facility(waterworks)  
Developer : Water Service Management Agency of Busan  
Date : 2013. 7  
Capacity : 10m<sup>3</sup> x 1 set
- Project : Sabeolmaeho lake water intake installation (waterworks)  
Developer : Sangju City  
Date : 2013. 11  
Capacity : 10m<sup>3</sup> x 1 set

## 2. Industrial/Agricultural water

- Project : Yeongsangang river (agricultural water)  
Developer : Korea Rural community Corp.  
Date : 2012. 8  
Capacity : 40m<sup>3</sup> x 2 set
- Project : Dangjin (industrial water)  
Developer : K-water  
Date : 2012. 12  
Capacity : 40m<sup>3</sup> x 2 set

### 3. Combined Heat & Power Plant

- Project : Paju Combined Heat & Power Plant  
Developer : Korea District Heating Corp.  
Constructor : DAEWOO E&C  
Date : 2009. 1  
Capacity : 90m<sup>3</sup> x 2 set



- Project : Osan Combined Heat & Power Plant  
Developer : DAESUNG  
Constructor : Shinhan Engineering Co., Ltd.  
Date : 2009. 4  
Capacity : 65m<sup>3</sup> x 1 set



- Project : Goyangsamsung Combined Heat & Power Plant  
Developer : Korea District Heating Corp.  
Constructor : HYUNDAI  
Date : 2009. 12  
Capacity : 90m<sup>3</sup> x 2 set



- Project : Incheon district heating  
Developer : Korea midland Power Co., Ltd.  
Constructor : Kumho  
Date : 2012. 9  
Capacity : 100m<sup>3</sup> x 3 set



### 4. Petrochemical Plant

- Project : Q-Chem II Ethylene Derivatives Project  
Developer : QATAR, Q-Chem  
Constructor : Q-Chem Co., Ltd  
Date : 2008. 11  
Capacity : 1m<sup>3</sup> x 16 set



- Project : SHO AIBA II CCPP PROJECT  
Constructor : DAELIM  
Date : 2012. 11  
Capacity : 0.6m<sup>3</sup> x 4 set, 0.3m<sup>3</sup> x 3 set



### 5. Safety Diagnosis

- Project : Hydraulic Transient Analysis and Safty Diagnosis of Goheung-Gangyang industrial water  
Customer : K-water/Korea Construction Quality Research  
Use : Surge test & Hydraulic Transient Analysis  
Report Date : 2010. 4
- Project : Bukcheon integrated water intake pumping facility safety diagnosis  
Customer : Water Service Management Agency of Goseong  
Use : Hydraulic Transient Analysis  
Report Date : 2013. 5

### 6. Combined Heat & Power Plant - Thermal Storage Tank

- Project : Innovation City(Jinju)  
Developer : MOORIM  
Use : Combined Heat & Power Plant for District Heating  
Date : 2013.12





Water Hammer  
Surge Protection  
System

Services Provided\_

1. Piping flow interpretation
2. Chlorine content simulation of a water system piping(minimization of the chlorine content. Design of the project method for optimization)
3. Thermal flow interpretation of the circulation piping(local heating:zone cooling/heating), pressure storage facility and evaporation preventive measures
4. Design/production/installation Surge test/follow-up maintenance of a Water Hammer preventive device

Note\_

The information provided on these pages in for guidance only. FLOWTECH accept no responsibility for the misuse or misapplication of this information. All specification are subject to change without notice.



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