

FLOWERVE

Flow Control Division
Anchor/Darling Valves
Valtek Valves
BWIP Valves
Durco Valves

701 First
Street
P.O. Box
3428

Williamsport
Pennsylvania
17701-0428

JOHN ZELENAK
Control Products Manager

Telephone
670 327 4943
Fax
670 327 4806
E-Mail
jzelenak@flowserve.com

FAX MESSAGE

PAGE 1 OF 17

DATE: 8/25/99

TO: Wisconsin Electric Power Company/Point Beach NPS
Attn.: John Schroeder

FAX #: 920 7556930

SUBJECT: Quotation No. C9643A
Feedpump Recirculation Minimum Flow Element

John,
Per our telecom of this afternoon, here is a copy of the quote originally sent to Alex
Foltynowicz. Please call me with any questions.

Regards,



A/85

Page Two
July 15, 1999
Quote C9643A

Commercial and Technical Notes:

1. A purchase order issued against this quotation should, at a minimum, reference quotation number C9596A to ensure fast and accurate order entry. This order should reflect the valve description and accept the comments and terms of this offer.
2. Terms of shipment are FOB Williamsport, PA, prepaid and add
3. This quotation is valid for acceptance until October 15, 1999.
4. Terms and conditions enclosed form a part of this offer.
6. The proposed control element consists of a set of ChannelStream severe service trim installed in a globe -style body, capped with a blind bonnet flange. The element is subject to cavitation damage when operating under service conditions 1 and 2. The use of ChannelStream severe service trim will eliminate cavitation damage. Full technical details on ChannelStream Trim are included in the following paragraph and the attached product bulletin.

ChannelStream SEVERE SERVICE TRIM

Flowserve proposes the use of ChannelStream multiple stage trim for energy dissipation. This trim is designed to effectively eliminate cavitation by using a variety of mechanisms to reduce high-pressure drop. Flow is directed through a series of close-fitting cylindrical stages, each constructed with expansion holes and intersecting circumferential channels that restrict the flow. Flow travels first through the expansion holes in the outer cylinder and then enters the specially-engineered channels machined into the outer surface of the second cylinder. The liquid is confined to the channel until it reaches the intersecting expansion hole in the second cylinder and passes through it to the next restrictive channel, and so forth. This flow path of multiple restrictions and enlargements reduces the pressure gradually across each trim cylinder, avoiding the sharp pressure drop typical of conventional, single throttling point trims.

7. The attached assembly drawing is provided for reference only.
8. The six stage ChannelStream trim design offered as part of this quotation is guaranteed to absolutely prevent cavitation when operated at the service conditions as specified on the valve data sheet. Also, as a result of this design, noise levels will be less than 70 dBA during operation and vibration will be eliminated.

Page Three
July 15, 1999
Quote C9643A

9. The minimum flow area dimensions of the quoted trm are .090" x .015".
10. A ChannelStream experience list is enclosed.

Should you require further additional information to support our proposal, please contact the undersigned.

Sincerely,

Flowserve Corporation - Flow Control Division



Edna Ulsamer
Contract Administrator

cc: J. Schlereth - Regional Manager
J. Zelenak - Control Products Manager

Encl. Vaitek Bulletin: ChannelStream
Valve Data Sheet
Reference Assembly Drwg.
Terms and Conditions

FLOWSERVE

Flow Control Division
Anchor/Darting Valves
Valtek Valves
BW/HP Valves
Durco Valves

701 First
Street
P.O. Box
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Williamsport
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17701-0428

JOHN ZELENAK
Control Products Manager

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670 327 4943
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jzelenak@flowsERVE.com

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PAGE 1 OF 17

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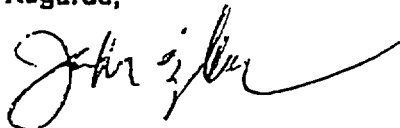
FAX #: 920 7556830

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Regards,



Aug-25-99 03:38pm

From-FLOWERVE WILLIAMSPORT

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T-852 P.02/02 F-501

Sheet 1 of 1

Control Valve Specification

Prepared By:

Flowserve Corporation
Springville Utah

Customer: Wiscan Elec/Point Beach

PO #:

Quote # : C9643

Rev/By : 0 0/JOHNZELENAK

Application: Boiler Feedpump Recirculation

Project: Feedwater Min Flow

Proj Num:

Contract #:

Alternate:

Valve Tag #: Feedwater Min Flow

Page #: 1

P&ID

Line

Date / Ver: 1999-02-17 / 99 B234

Process Data For Control Valve Selection						Actuator					
1	Pipe Size, Up/Down	2.000 / 2.000				151	Actuator Type	None, Body S/A only			
2	Pipe Sch, Up/Down	160 / 160				152	Actuator Size				
3	Allow Noise/Add Attn/Type	80 / 0 /				153	Stroke	1.50			
4	Process Fluid	Water				154	Spring				
5	Critical Pressure	3207.40 ps(a)				155	Air To				
6		Cond 1	Cond 2	Cond 3	Cond 4	156	Volume Tank				
7	Temperature (°F)	90.000	90.000	90.000		157	Tubing & Fz	N/A			
8	Inlet Press (psa (g))	1200.000	1200.000	1350.000		158	Handwheel				
9	Outlet Press (psa (g))	0.000	0.000	0.000		159					
10	Liq. Flow Rate (gpm US/min)	70.000	100.000	89.000	← CHANGE	160	Act./Pos. O-Rings				
11	Gas Flow Rate (1000 SCFH)	0	0	0		161					
12	Viscosity (cP)	0.000	0.000	0.000		162	Model/Material	/			
13	Vapor Press (psa (g))	-13.897	-13.897	-13.897		163	Signal/Options	/			
14	SG-MW	0.987	0.987	0.987		164	Transducer				
15	Max Shutoff / Shutoff Class	• 1214.700 ps / None				165	Mounting				
16	Available Air Supply	60.000 psi (g)				166	Tag #/Cert	/			
17	Fail Position / Valve Function	• Close / Throttling				167	Model				
18		Cond 1	Cond 2	Cond 3	Cond 4	168	Indicate				
19	Flow Coeff (Cv)	2.008	2.868	2.407		169					
20	Est Stroke (Percent)	80.000	88.000	72.000		170					
21	Pressure Drop (psa)	1200.000	1200.000	1350.000		171	Tag #				
22	Choke Drop (psa)	1214.028	1214.028	1364.028		172	Model				
23	Noise (Fmax) (dBA)	<70	<70	<70		173	Position On De-en				
24	Valve Vel (ft/s)	7.152	10.218	8.094		174	Electrical				
25	Pipe Vel (ft/s)	14.361				175	Mounting				
26	Valve Model	ChannelStream				176	Haz. Loc				
27	Size/Pressure Rating/Body Type	2.00 / CL 800 / Globe				177					
28	Trim # - Cv / Characteristic	0.75 Cv 3 300 / Linear				178	Tag #				
29	Number of Stages	6 Stage				179	Air Filter	/			
30	Flow Direction	Flow Over				180	Filter-Reg	/			
31	Body Matl / Bonnet Matl	316 SS / N/A				181	Flow Booster	/			
32	End Conn/Sch/Face to Face	Socket Weld / / ISA S75.03				182	Booster Config				
33	Flange Finish					183	Quick Exhaust				
34	Bonnet Type	N/A				184					
35	Trim Type	Unbalanced				185	Lockup				
36	Plug Matl / Facing	N/A /				186	Plate ID				
37	Plug Stem Facing					187	Plate Type				
38	Seat Ring Matl / Facing	N/A /				188	Controller Model	None			
39	Soft Seat Material					189	Pwr Sup				
40	Retainer Matl/Sleeve Matl	316 SS /				190	Wiring Conn. Type				
41	Guides Upper/Lower	N/A / N/A				191	Haz. Loc				
42	Packing Matl / Style / Vac / Fire	N/A / Single / /				192	Drawings				
43	Body Drain					193	Assem Hydro				
44	Bonnet Port Type					194	Seat Leak Test				
45	Belows Type					195	Documentation				
46	Belows Material					196	Cert of Conf				
47	Body Bolting/Bonnet Flange Matl	B7-2H / Carbon Steel				197	Cleaning				
48	Gaskets	Spiral Graphite				198	CMTR				
49	Gland Flange Material	N/A				199	Special Paint				
50	Gland Flange Bolting	N/A				200	ValStar Test				

Loc # Remarks

Body with Channelstream retainer only No bonnet, plug, actuator or any other associated parts Blind bonnet flange to cap body.

Quantity 1

FLOWERVE

ADDENDUM FOR NUCLEAR LIABILITY PROTECTION

If Seller furnishes Equipment or Services or the Product thereof for a nuclear power plant the following provisions for Nuclear Liability Protection are hereby incorporated in the contract or purchase

Definitions

The terms as used herein shall have the following meanings

"Equipment" means all equipment (including materials and labor, incorporated therein) or operational spare parts or renewal parts or any other material (including tooling) or parts or any combination thereof furnished by Seller to Purchaser under the contract or purchase

"Owner" means any person or entity with a legal or equitable interest in the Plant.

"Plant" means a nuclear power plant or other nuclear facility for handling, storing or processing nuclear fuel at which the Product will be located

"Plant Site" means the location of the Plant

"Product" means any process, equipment, information, service, output or other thing of value which incorporates or results directly or indirectly from the Equipment or Services

"Services" means work, direction of work, technical information or technical consulting and advice or other services furnished by Seller to Purchaser under the contract or purchase and include such activities as the installation, testing, alignment, startup, operation, repair and maintenance of the Equipment

"Suppliers" means any of Seller's suppliers of material or services for the Equipment or Services, regardless of tier, including any engineering, design review or services contracted for and performed by other companies

Government Indemnity and Insurance

If the Plant is located in the United States, Purchaser shall obtain and maintain, or shall require Owner to obtain and maintain, without cost to Seller, the following for the Plant in which the Product or Equipment are to be used or the Services are to be performed:

1. An agreement of indemnification as contemplated by Section 170 of the Atomic Energy Act of 1954, as amended (herein called the "Act") and
2. Nuclear liability insurance from ANI or MAELU or both in such form and in such amount as will meet the financial protection requirements of the United States Nuclear Regulatory Commission pursuant to Section 170 of the Act

If the Plant is located outside the United States, Purchaser shall obtain and maintain, or shall require Owner to obtain and maintain, without cost to Seller, for the Plant in which the Product or Equipment are to be used or the Services are to be performed, an agreement of indemnification and nuclear liability insurance for equivalent protection satisfactory to Seller.

The agreement of indemnification and nuclear liability insurance shall be in effect during the entire period that the Equipment, Services or Product are utilized in the Plant and shall remain in the effect until decommissioning of the Plant.

In the event that the nuclear liability protection system provided by Section 170 of the Act is repealed, modified, expires or is otherwise not available, Purchaser shall, without cost to Seller, maintain or require Owner to maintain, in effect during the period the Equipment, Services or Product are utilized in the Plant and until decommissioning of the Plant, to the extent available on reasonable terms and consistent with industry practice, liability protection through government or private contractual indemnity, limitation of liability and/or liability insurance in order to avoid a material impairment of the protection afforded Seller and its Suppliers by the nuclear liability protection system of the Price-Anderson Act and the provisions of this Addendum.

Property Damage Waiver

Neither Seller nor its Suppliers shall have any liability to Purchaser or its insurers for nuclear damage to any property located at the Plant Site, and Purchaser shall indemnify Seller and its Suppliers against such liability.

If Purchaser sells or otherwise transfers the Equipment or Services, Purchaser shall secure from Owner an agreement that neither Seller nor its Suppliers shall have any liability for nuclear damage to any property at the Plant Site and that Owner shall indemnify Seller and its Suppliers against any such liability.

Removal, Sale, Transfer or Lease

Purchaser agrees or Purchaser shall secure from Owner an agreement not to remove the Equipment or any items of equipment upon which Services have been performed or to which Services directly relate from the Plant Site (except temporarily for repair work or permanently to a nuclear repository) or sell or otherwise transfer any interest therein or in the Services (including but not limited to the bulk sale or transfer of electrical output from the Plant) or lease from others equipment or nuclear fuel for use in the Plant or at the Plant Site, without first providing Seller with written assurances of limitation of and protection against liability (nuclear and non-nuclear) following the proposed removal, sale, transfer or lease at least equivalent to that afforded Seller and its Suppliers in this Addendum for "Nuclear Liability Protection" and in Section 7 of Seller's Domestic Terms and Conditions (P-736) or Section 8 of Seller's Export Terms and Conditions (P-730) for "General Limitations of Liability." In the event of a sale, transfer or lease, such assurances shall be obtained by Purchaser or Owner from the buyer, transferee or lessor as applicable. Removal, sale, transfer or lease contrary to the provisions of this Addendum shall, in addition to any other legal or equitable rights of Seller, make Purchaser or Owner the indemnitor of Seller and its Suppliers to the same extent that Seller and its Suppliers would have been protected had such removal, sale, transfer or lease not taken place.

10 CFR Part 21

Seller and Purchaser shall comply with the provisions of 10 CFR Part 21 "Reporting of Defects and Noncompliance."

Applicability of This Addendum

The provisions of this Addendum shall apply to the full extent permitted by law to any claims against Seller or its Suppliers, whether based upon contract, tort (including negligence), strict liability or otherwise, and survive termination, cancellation or completion of the work hereunder.

FLOWSERVE

DOMESTIC TERMS AND CONDITIONS

1. Definitions.

"Equipment" means all equipment (including materials and labor incorporated therein) or operational spare parts or renewal parts or any other material (including tooling) or parts or any combination thereof furnished by Seller to Purchaser under the contract of purchase.

"Product" means any process equipment information service, output or other thing of value which incorporates or results directly or indirectly from the Equipment or Services.

"Services" means work, direction of work, technical information or technical consulting and advice or other services furnished by Seller to Purchaser under the contract of purchase and include such activities as the installation, testing, alignment, startup, operation, repair and maintenance of the Equipment.

"Suppliers" means any of Seller's suppliers of material or services for the Equipment or Services regardless of tier, including any engineering design review or services contracted for and performed by other companies.

2. Acceptance.

This quotation supersedes all previous quotations and agreements and is void unless accepted within fifteen days from date hereof unless otherwise stated and is subject to change upon notice.

Recommendations and quotations are made upon the basis of operating conditions specified by Purchaser. Should actual conditions be different than those specified and performance of the Equipment be adversely affected thereby or not adequate, Purchaser shall be responsible for the cost of all changes in the Equipment required to accommodate such conditions and Seller reserves the right to cancel Purchaser's order and Seller shall be reimbursed for all costs and expenses incurred and reasonable profit for performance executed prior to the date of such termination.

All orders are subject to written acceptance by Seller's supplying plant.

When this quotation is accepted by Purchaser, all the terms and conditions contained herein become a part of the contract of purchase unless otherwise stated in this quotation. Any conflicting or additional terms and conditions contained in any order submitted by Purchaser shall be of no effect unless assented to in writing by Seller.

3. Delivery:

Delivery of the Equipment hereunder shall be made F.O.B. Seller's plant. Shipping dates are approximate and are based on prompt receipt of all necessary information at Seller's plant. In case of delay in furnishing complete information, dates of shipment may be extended for a reasonable time based on conditions at Seller's plant. Receipt of the Equipment by Purchaser shall constitute a waiver of all claims for delay.

Seller shall not be liable for delay in delivery due to causes beyond its reasonable control or due to acts of God, acts of Purchaser, fires, labor disputes, boycotts, floods, epidemics, quarantine restrictions, war, insurrection, riot, civil or military authority, freight embargoes, transportation shortages or delays, unusually severe weather or inability to obtain necessary labor, materials or manufacturing facilities due to such causes, and in the event of any such delay, the date of delivery shall be extended for a length of time equal to the period of the delay.

4. Warranties:

A. Equipment

Seller warrants that the Equipment shall be free from defects in material, workmanship and true.

Accessories supplied by Seller but manufactured by others carry whatever warranty the manufacturers of such accessories conveyed to Seller and which can be passed on to Purchaser.

Seller's obligations under this warranty shall expire one (1) year after shipment by Seller.

B. Services

Seller warrants that the Services shall be performed in accordance with industry practices.

Seller's obligations under this warranty shall expire one (1) year after the Services are performed except that Seller's warranty obligations for repair work shall expire ninety (90) days from date of initial start-up or one (1) year after completion of repair work, whichever occurs first.

C. Conditions Applying to Warranties

1. This warranty for Equipment is conditioned upon the Equipment's being received, unloaded, stored, handled, installed, tested, maintained and operated in a proper manner.

2. Neither the warranty for Equipment nor the warranty for Services shall be applicable in the event that failure to meet such warranty is the result of acts or omissions of persons (other than Seller or Seller's Suppliers in connection with the work performed by them hereunder), accidents or alteration, abuse or misuse of the Equipment or alteration or misuse of the Services.

3. Unless otherwise specifically agreed in writing, Seller's warranty of performance is based on shop tests at the specified rating, when handling clear, fresh, nonaerated water at a temperature not exceeding 85°F.

4. The conditions of any tests and the basis of any calculations in connection with the warranties for Equipment or Services shall be acceptable to Seller and Purchaser, and the tests may be witnessed by representatives of either. Measurement readings shall be based on plant instrumentation, if applicable, and actual readings shall be utilized. In lieu thereof, Purchaser or Seller may, at its expense, provide temporary special test instruments. Purchaser and Seller reserve the right to inspect and calibrate any instruments to ensure accuracy of measurements, and such expenses shall be borne by the party exercising such right.

D. Remedy

1. Seller agrees to repair or replace F.O.B. Seller's plant any Equipment manufactured by the Seller which does not conform to the warranty for Equipment and to reperform Services which do not conform to the warranty for Services, provided that notice of claim of defect is received by Seller within one year from date of shipment of Equipment from Seller's plant or performance of Services. Equipment claimed to be defective must be returned, freight prepaid and in accordance with Seller's instructions to the point of manufacture, unless Seller directs otherwise.

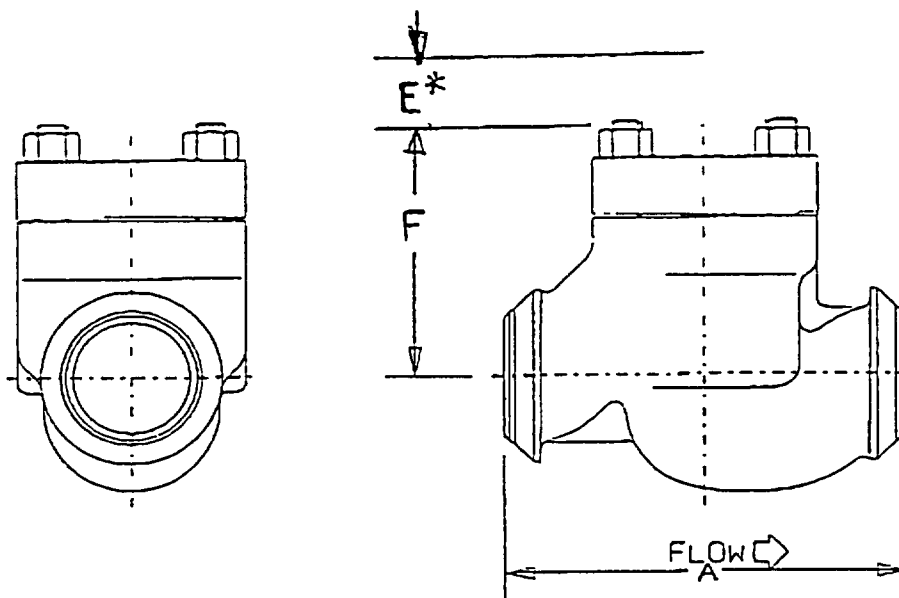
2. Purchaser shall give Seller written notice of any defect, damage or nonconformity as soon as possible in order to permit Seller to make a timely investigation of the facts.

3. In connection with the performance of any corrective work, all removal and reinstallation of the Equipment shall be performed by Purchaser. Purchaser shall, at its expense, be responsible for removing, reinstalling, replacing or supplying any equipment, materials or structures which are necessary to provide reasonable access to the Equipment to be repaired or replaced. Any decontamination or radiation protection necessary in connection with the removal or on-site repair of the Equipment shall be performed by Purchaser without cost to Seller.

4. Title to and risk of loss of any Equipment being repaired shall remain with Purchaser at all times during the correction period wherever the repair takes place, provided, however, that Seller shall bear the risk of loss of any Equipment being repaired while such Equipment is away from Purchaser's facility and under Seller's care, custody and control. Transportation costs with respect to any replacement Equipment shall be paid by Purchaser.

E. Repaired or Replacement Equipment, Reperformed Services

When any Equipment is repaired or replaced or a Service is reperformed, the Equipment repaired or its replacement or the reperformed Service shall be subject to the same warranties, the same conditions and the same remedies provided for the original Equipment or Service, provided that the warranty period for the repaired or replacement Equipment or reperformed Service shall be for the balance remaining of the warranty period for the original Equipment or Service extending from the date of repair or replacement of the repaired or replacement Equipment or reperformance of the Service, provided, however, that the warranty period shall expire in no event later than twenty-four (24) months after the delivery of the original Equipment or performance of the original Service.



* - DISASSEMBLY / MAINTENANCE CLEARANCE

	A	E	F	B	WT
INCH	11.5	4.8	5.3	2.3	45.00 lbs
mm	292.1	121.9	134.6	58.4	20.5 kg

Note: Dimensions are certified correct per associated specification sheet. End connections and scaling may not be actual. For accessory information, see associated specification sheet.

MODEL ChannelStream		FLOWERVE	CERTIFIED DIMENSIONAL DRAWING	
SIZE 2 INCH		BY JOHNZELENAC	CUSTOMER Wiscon Elec/Point Beach	ITEM
RATING / FIF STD 600 / ISA		DATE 1999-02-12	VALVE TAG Mark One	SHEET 1 OF 1
END CONNECTION SOCKET WELD	SPRING STANDARD	THIRD ANGLE PROJECTION	P.O. NUMBER	REVISION 0.0
TRIM TYPE C/S	TRIM / CV Cv 3.3		PROJECT Feedwater Min Flow	SERIAL NUMBER 000000 001



Flow Control Division
Valtek Control Valves

ChannelStream

Flow Characteristics

ChannelStream valves can be designed with a linear flow characteristic, producing essentially equal changes of flow with equal changes in valve stroke. The linear characteristic cartridge design consists of an axially uniform hole and channel pattern. The linear characteristic is most commonly used for high-drop liquid applications.

Equal percentage is available by designing an appropriate non-uniform hole pattern, along with a corresponding axial change in the area of the restrictive channels to produce the desired characteristic.

Maintenance

Like the Mark One globe valve, ChannelStream is built for easy, simple, inexpensive maintenance. Heavy-duty, double top-stem guiding is standard. The clamped-in seat and top-entry trim design permits quick disassembly, eliminating problems associated with corroded, screwed-in seat rings. The spring cylinder actuator is smaller, lighter and easier to disassemble than comparable diaphragm actuators.

While the stacked discs of comparable anti-cavitation valves can experience problems with clearance flow between the plug head and the discs, ChannelStream avoids such problems. The cartridge's smooth, continuous inner-stage surface allows close-clearance plug motion.

Dirt and Debris

Anti-cavitation valves are typically constructed with small flow passages that can become plugged by dirt or other debris in the fluid stream. Such devices usually direct the flow initially to the throttling plug before passing it through the restrictive device. This results in sticking and galling as dirt and other material become trapped between the sliding plug and the inside surface of the anti-cavitation device.

On the other hand, ChannelStream is designed with two important protective features to minimize such plugging problems:

1. Flow is first brought through the cartridge. Dirt too large to pass through the small outer channels is trapped at the outer-most stage of the cartridge preventing debris from traveling through the device to the throttling plug.
2. Because the inner channels progressively become larger, small particles which pass through the first set of channels are easily passed through the rest of the cartridge.

In extremely dirty services, the cartridge can be periodically disassembled and cleaned.

Table I:
Standard Materials of Construction

Body Assembly

Body & Bonnet	Steel, stainless steel, alloys as required
Plug	316 stainless steel with Stellite, alloys as required
Cartridge	316 stainless steel, Ni-Al-Bronze, Inconel, Monel
Seat Ring	316 stainless steel with Stellite, alloys as required
Separable End & Bonnet Flanges	Steel, 316 stainless steel (Integral flanges optional)
Guides	Bronze, glass-loaded Teflon, Grafoil, Stellite
Packing	Teflon V-ring, asbestos-free packing, graphite, Grafoil
Packing Spacer	316 stainless steel
Gaskets	Stainless steel and graphite spiral wound, Teflon
Bonnet Flange Bolting	Zinc-plated steel
Gland Flange	Stainless steel
Gland Flange Bolting	Zinc-plated steel
Yoke Clamp	Stainless steel

Actuator Assembly

Cylinder & Piston	Anodized aluminum
Yoke	Ductile iron
O-rings	Buna-N, Viton
Stem Bushings	Oilite bronze
Stem Nut	Zinc-plated steel
Cylinder Retaining Ring	Zinc-plated steel
Stem Clamp	Stainless steel
Actuator Stem	316 stainless steel
Spring	Steel
Spring Button	Zinc-plated steel

Other materials available - contact factory for further information

ChannelStream

Pressure Reduction Mechanisms

Although it uses many pressure reduction mechanisms, the gradual reduction in pressure through ChannelStream trim occurs principally as a result of four physical mechanisms

1. Sudden expansion of the flow areas as the liquid exits the restrictive channels and enters the intersecting expansion holes
2. Frictional losses due to multiple, small passageways.
- 3 Turbulent mixing in the expansion holes
- 4 Mutual impingement of opposing streams in the expansion holes.

In addition, the small channel size generates only small, rapidly dissipated vortex turbulence, minimizing vortex cavitation associated with larger flow geometrics.

The above mechanisms and others occurring in multiple stages minimize pressure recovery.

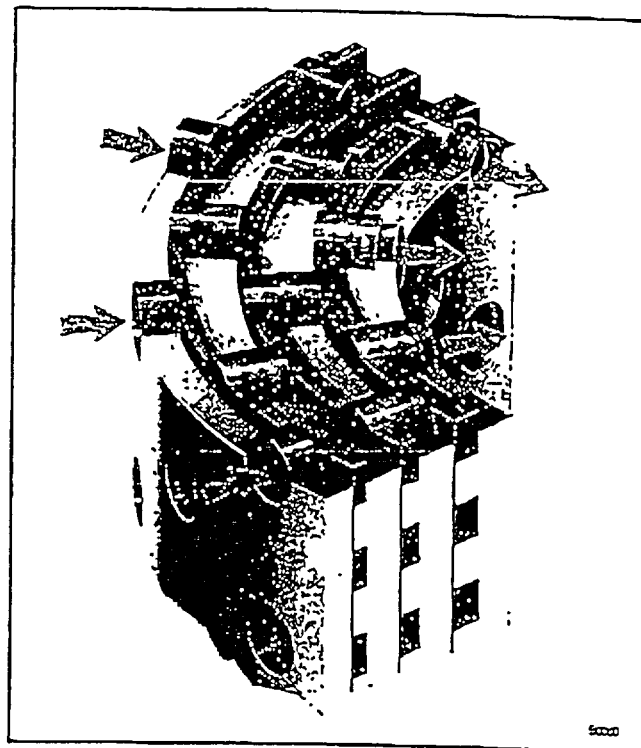


Figure 6: ChannelStream's Unique Flow Path

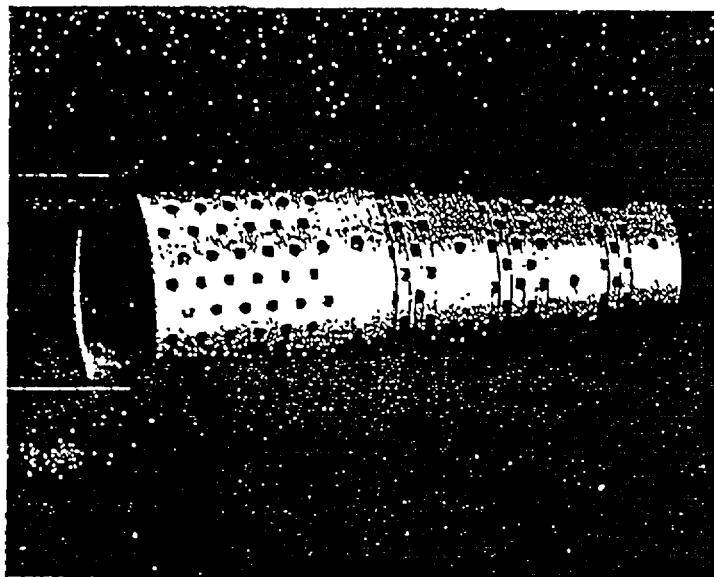


Figure 7: ChannelStream Cartridge

Stage Design

The number of stages and the flow area of the channels in each stage of the ChannelStream cartridge are designed to produce the desired overall pressure drop while avoiding cavitation at any point. The flow area of the channel is usually greater in each successive stage in order to minimize the number of stages. This results in higher pressure drops being taken in the outer (or initial) stages as compared with the inner (or final) stages.

Velocity and Pressure

The velocities at the inlet and outlet of a ChannelStream valve are generally designed for a maximum of 30 feet per second. In addition, ChannelStream valves are designed to ensure that the pressure of the fluid in the valve body (including the ChannelStream cartridge) is always greater than the liquid vapor pressure.



Flow Control Division
Valtek Control Valves

ChannelStream

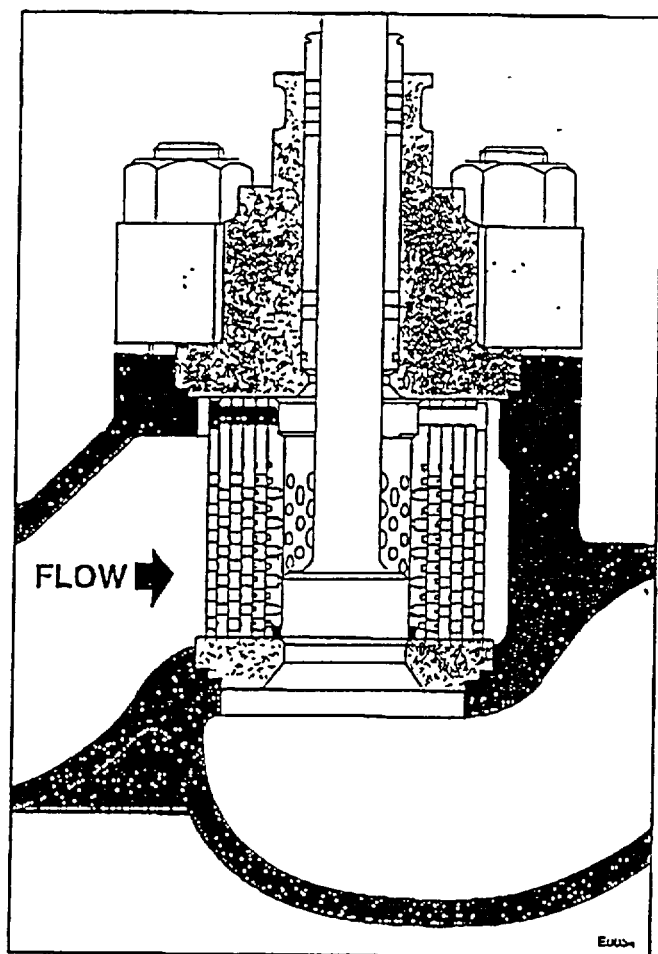


Figure 4: Unbalanced ChannelStream with Soft Seat Design

The Valtek Solution

Valtek's ChannelStream trim is designed to effectively eliminate cavitation by using a variety of mechanisms to reduce high pressure drops. Flow is directed over the plug through a series of close-fitting cylindrical stages, each constructed with expansion holes and intersecting circumferential channels that restrict the flow. Flow travels first through the expansion holes in the outer cylinder and then enters the specially-engineered channels machined into the outer surface of the second cylinder. The liquid is confined to the channel until it reaches the intersecting expansion hole in the second cylinder and passes through to the next restrictive channel, and so forth. This flow path of multiple restrictions and enlargements reduces the pressure gradually across each trim cylinder, avoiding the sharp pressure drop typical of conventional, single-throttling-point trims.

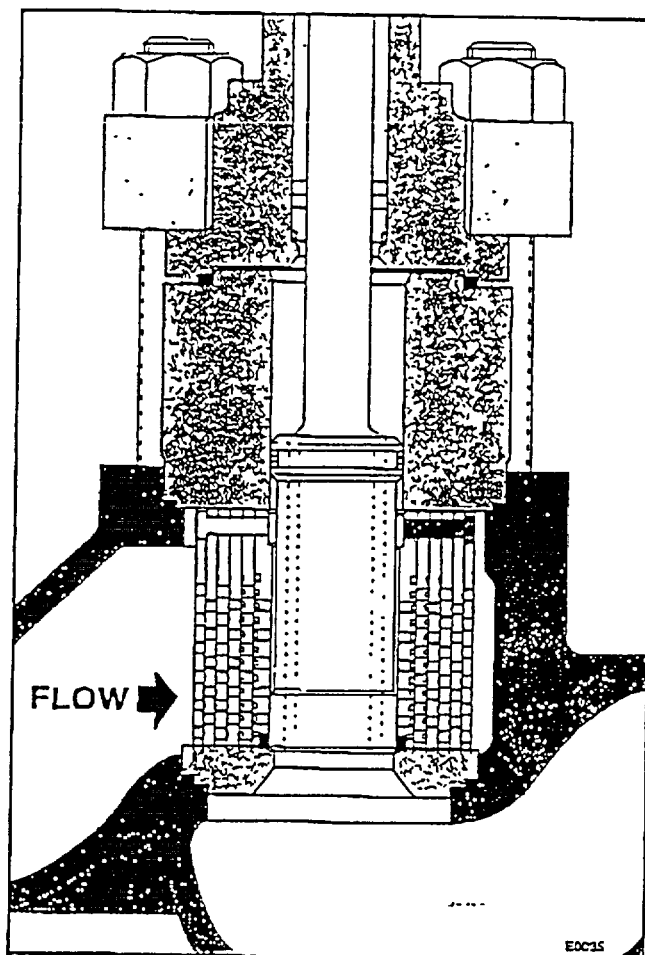


Figure 5: Pressure-balanced ChannelStream

A number of holes are machined near the top of the ChannelStream cartridge. Several of these holes allow fluid to vent upstream from the volume above the plug during normal operation. Other holes are for pinning the stages of trim together in the correct rotational alignment. The pins and alignment holes have shoulders to index the proper position within the cartridge. A small bead weld prevents the pin from loosening. The bead weld can be easily ground or machined out for disassembly.

The plug fits closely inside the cartridge bore and is designed to uncover or cover the inner expansion holes, controlling the flow. Both the plug and ChannelStream cartridge can be used with either metal or resilient insert seat rings.

Both unbalanced and pressure-balanced designs are available.

ChannelStream Basic Principles

In conventional, single-throttling-point globe valves, a vena contracta (point of narrowest flow constriction) occurs immediately downstream of the throttling point. A simplified pressure profile of the fluid, as it passes through the valve, shows slight pressure losses in the inlet and outlet passages, and a substantial excursion of pressure at the vena contracta. But the overall pressure drop across the valve – or the difference in pressure between the inlet and outlet – does not reveal how far the pressure may have dropped within the valve itself.

The Problem with Liquids: Cavitation

When control valves fail in liquid service, cavitation is often the cause. Cavitation is a two-stage process. First, as fluid velocity increases through the restriction at the vena contracta, the pressure of the flowing liquid drops below the vapor pressure of the liquid, causing vapor bubbles to form. Second, as the flow enters the enlarging flowstream downstream of the vena contracta, the velocity decreases. The resultant pressure recovery raises the fluid pressure back above the vapor pressure, causing the vapor bubbles to collapse – or implode.

The energy released by the collapsing vapor bubbles can result in extensive noise and vibration, often causing severe damage to metal surfaces. The inception (or beginning) of cavitation is heard in a piping system as intermittent popping or cracking, but as the pressure drop increases the noise becomes a steady hiss or rattle. Fully developed cavitation results in choking of the liquid flow such that further increases in pressure drop cause no corresponding increase in the flow.

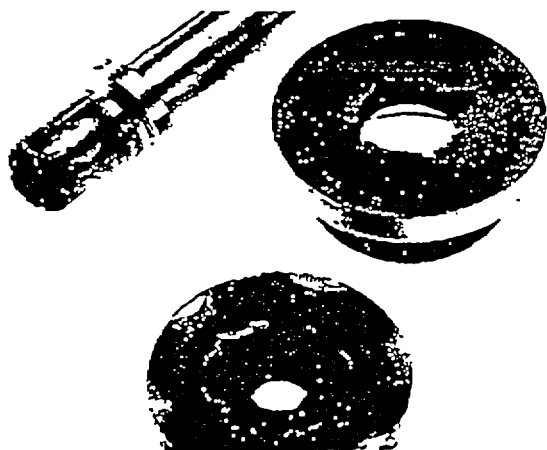


Figure 2: Cavitation Damaged Trim Parts

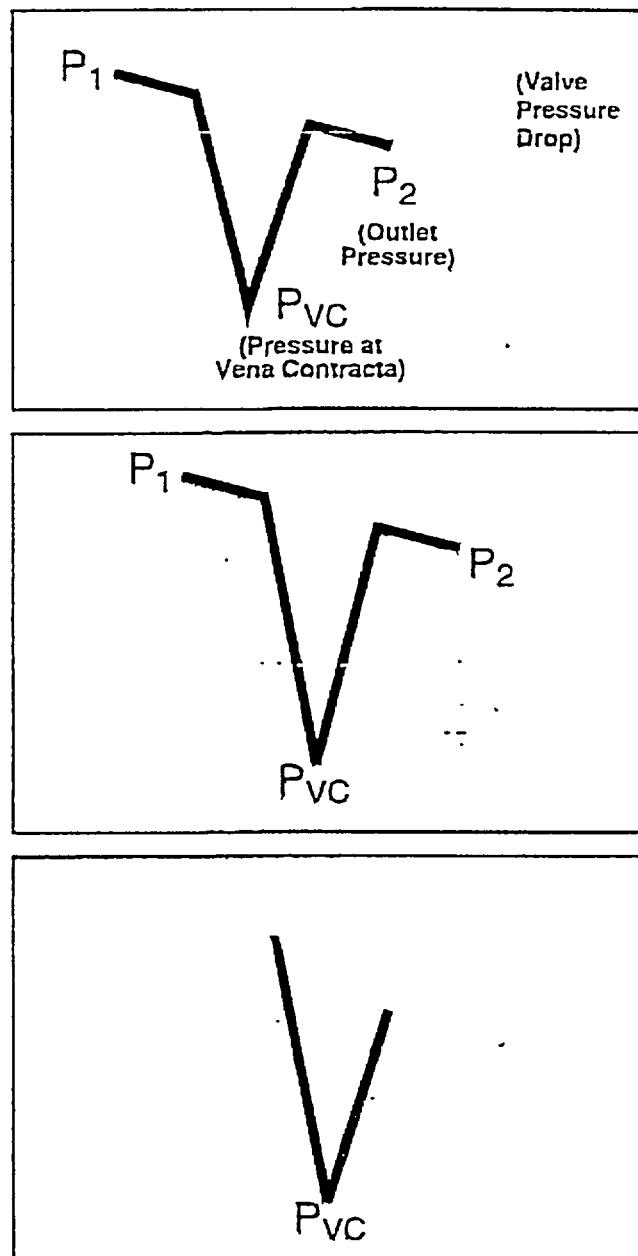


Figure 3: Pressure / Velocity Graphs

The Solution

The solution to cavitation is to reduce the pressure from the inlet to the outlet gradually – without allowing the liquid pressure to drop below its vapor pressure. By always keeping the pressure through the valve above the vapor pressure, cavitation can be successfully avoided.



Flow Control Division
Valtek Control Valves

ChannelStream

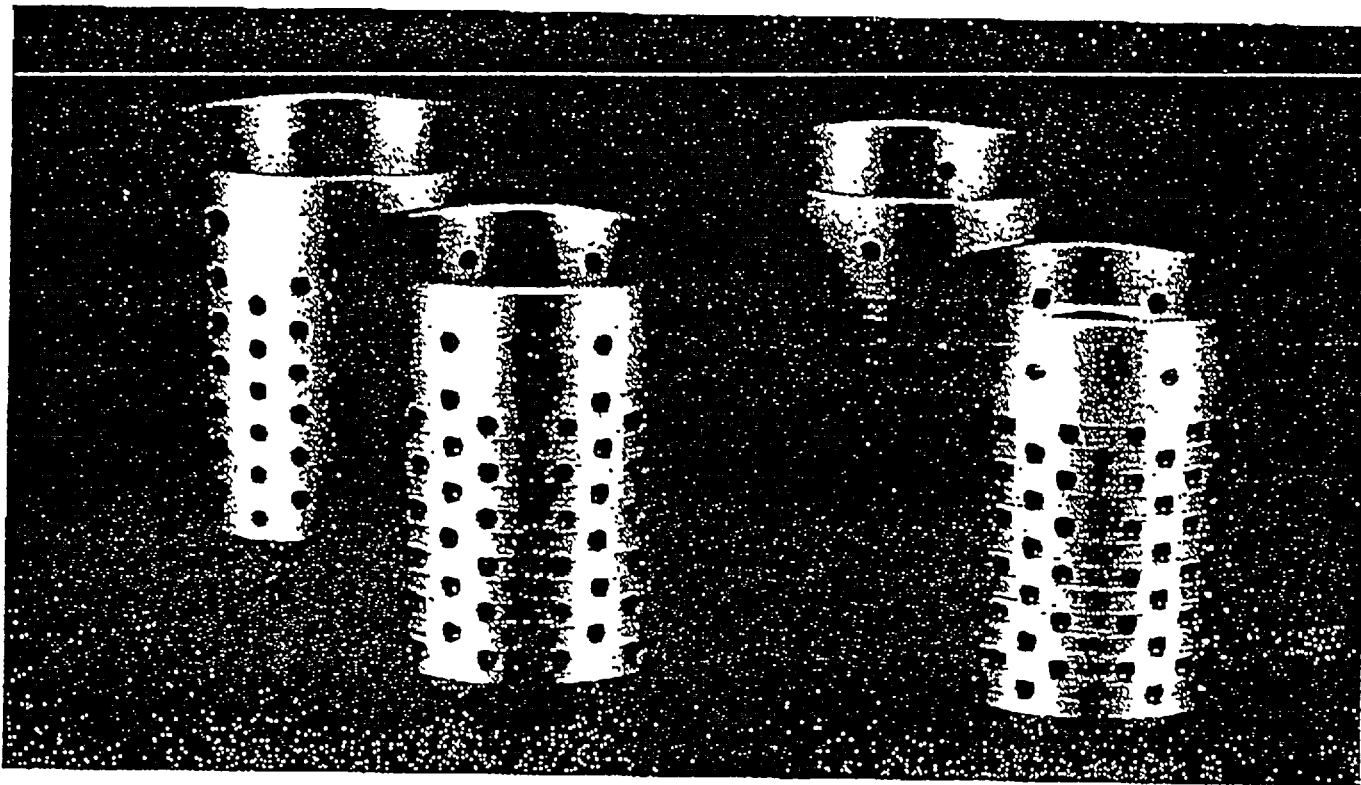


Figure 1: Disassembled ChannelStream Cartridge

ChannelStream™ control valves prevent cavitation damage and minimize hydrodynamic noise even under the most severe liquid applications. This unique, patented design not only eliminates cavitation damage, but also provides easy maintenance and long life even with difficult applications.

What makes ChannelStream trim unique? At first appearance, the ChannelStream cartridge may seem familiar because of its drilled holes and close-fitting cylinders. Here the similarity ends. Rather than restricting flow, the drilled holes in the ChannelStream cartridge are used as expansion areas for the fluid as it enters from restrictive channels machined in the outside of all interior cylinders.

The successive intersections of the restrictive channels and expansion holes create a series of expansions and contractions that result in a series of pressure drops. This staged pressure drop ensures that damaging cavitation will not occur.

The ChannelStream concept, explained in detail on the following pages, is the result of careful research and engineering. Extensive laboratory testing and field expe-

rience have proven ChannelStream valves to be outstanding anti-cavitation devices. This research, along with Valtek's extensive expertise in severe service applications, has been incorporated into advanced computer programs for sizing and selecting ChannelStream control valves. We invite you to work closely with a Valtek® field representative to evaluate your severe service control valve requirements and to explore the advantages of ChannelStream.

WARNING: High acoustic noise levels are accompanied by high mechanical vibration levels. These vibration levels can cause failure of the valve, piping or associated equipment resulting in property damage and/or personal injury. Acoustic noise and mechanical vibration levels are greatly compounded (up to 50 times) when the frequency of the excitation matches acoustic and/or mechanical natural frequencies of the system. Noise control trim (source treatment) should always be considered in any high energy (high pressure and high flow) and/or resonant noise/vibration applications.

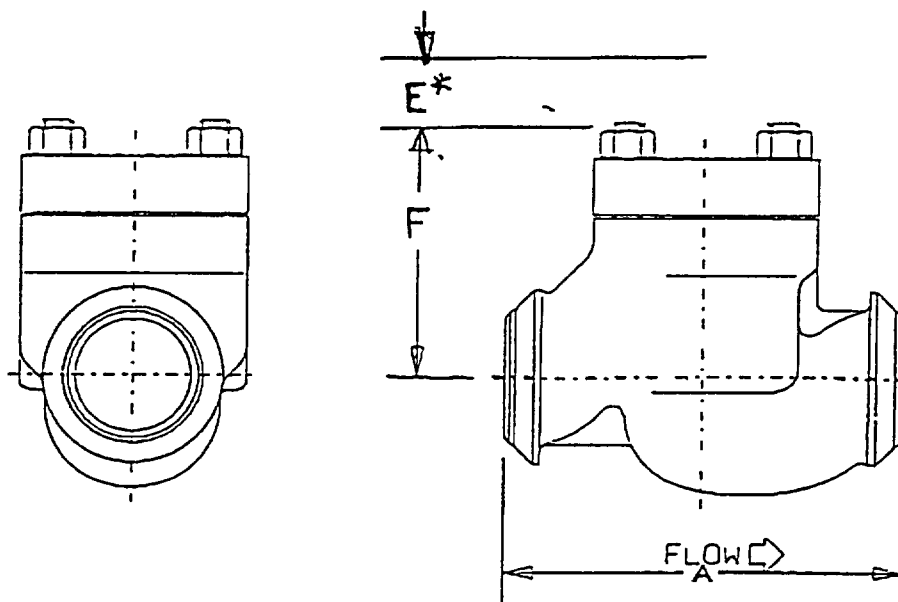
1989 - 1994

85484 001	FLORIDA POWER CORP		ChannelStream	4	900	WATER	120 F
83223 001	HAWKER SIDDELEY POWER ENG INC	RICHMOND VA	ChannelStream	1 5	1500	WATER	250 F
83223 002	HAWKER SIDDELEY POWER ENG INC	RICHMOND VA	ChannelStream	6	1500	WATER	250 F
78379 001	HAWKER SIDDELEY POWER ENGR	RICHMOND VA	ChannelStream	2	300	WATER	240
81818 003	JORDAN CONTROLS INC	MILWAUKEE WI	ChannelStream	4	2500	WATER	382
86134 002	KANSAS CITY PWR & LT CO	CLINTON MO	ChannelStream	2	2500	WATER	350 F
80514 002	KANSAS CITY PWR & LT CO	CLINTON MO	ChannelStream	2	2500	WATER	350 F
80514 002	KANSAS CITY PWR & LT CO	CLINTON MO	ChannelStream	2	2500	WATER	350 F
80511 004	METRIC CONSTRUCTORS INC	RICHMOND VA	ChannelStream	4	300	WATER	109 F
80511 008	METRIC CONSTRUCTORS INC	RICHMOND VA	ChannelStream	3	300	WATER	70 F
85046 001	PUBLIC SER CO OF NEW MEXICO	WATERFLOW NM	ChannelStream	3	150	WATER	70 F
71414 030	TYGER CONSTRUCTION CO INC	BATTLEBORO NC	ChannelStream	4	300	WATER	
71414 018	TYGER CONSTRUCTION CO INC	BATTLEBORO NC	ChannelStream	3	300	WATER	
76383 005	WALSH CONSTRUCTION CO	MECCA CA	ChannelStream	3	1500	WATER	340 F
82277 001	WISCONSIN ELECTRIC POWER CO	OAK CREEK WI	ChannelStream	3	1500	WATER	246 F
76295 001	WISCONSIN ELECTRIC POWER CO	OAK CREEK WI	ChannelStream	3	1500	WATER	246 F
76295 001	WISCONSIN ELECTRIC POWER CO	OAK CREEK WI	ChannelStream	3	1500	WATER	246 F
76295 001	WISCONSIN ELECTRIC POWER CO	OAK CREEK WI	ChannelStream	3	1500	WATER	246 F
76295 001	WISCONSIN ELECTRIC POWER CO	OAK CREEK WI	ChannelStream	3	1500	WATER	246 F
76295 001	WISCONSIN ELECTRIC POWER CO	OAK CREEK WI	ChannelStream	3	1500	WATER	246 F

1989 - 1994

Vatvak Power Users List
US Manufacture - 1989-1994

S/N.	CUSTOMER	LOCATION	VALVE	SIZE	CLASS	FLUID	TEMP
97681 001	ARTHUR KILL	STATEN ISLAND NY	ChannelStream	8	2500	WATER	367 F
97681 001	ARTHUR KILL	STATEN ISLAND NY	ChannelStream	6	2500	WATER	367 F
95055 001	BALTIMORE GAS & ELECTRIC CO	LUSBY MD	ChannelStream	8	150	WATER	150 F
95055 002	BALTIMORE GAS & ELECTRIC CO	LUSBY MD	ChannelStream	8	150	WATER	150 F
95055 001	BALTIMORE GAS & ELECTRIC CO	LUSBY MD	ChannelStream	8	150	WATER	150 F
95055 002	BALTIMORE GAS & ELECTRIC CO	LUSBY MD	ChannelStream	8	150	WATER	150 F
95055 001	BALTIMORE GAS & ELECTRIC CO	LUSBY MD	ChannelStream	8	150	WATER	150 F
95055 002	BALTIMORE GAS & ELECTRIC CO	LUSBY MD	ChannelStream	8	150	WATER	150 F
91856 002	BECHTEL POWER CORPORATION	SWEDESBO RO NJ	ChannelStream	8	300	WATER	111.5 F
91856 001	BECHTEL POWER CORPORATION	SWEDESBO RO NJ	ChannelStream	4	2500	WATER	354 DEG F
91855 002	BECHTEL POWER CORPORATION	BOOTHWYN PA	ChannelStream	6	300	WATER	111.5 F
91854 001	BECHTEL POWER CORPORATION	BOOTHWYN PA	ChannelStream	4	2500	WATER	354 DEG F
81755 023	BLACK & VEATCH POWER DEV CORP	FORT GREEN SPRINGS FL	ChannelStream	4	1500	WATER	571 F
81755 019	BLACK & VEATCH POWER DEV CORP	FORT GREEN SPRINGS FL	ChannelStream	3	1500	WATER	230 F
83555 018	BLACK & VEATCH POWER DEV CORP		ChannelStream	6	300	WATER	115 F
83555 015	BLACK & VEATCH POWER DEV CORP	JACKSONVILLE FL	ChannelStream	1.5	800	WATER	170 F
83555 016	BLACK & VEATCH POWER DEV CORP	JACKSONVILLE FL	ChannelStream	6	300	WATER	115 F
83555 005	BLACK & VEATCH POWER DEV CORP	JACKSONVILLE FL	ChannelStream	3	1500	WATER	335 F
89267 001	CAROLINA POWER & LIGHT CO	SOUTHPORT NC	ChannelStream	16	300	WATER	105 F
89267 001	CAROLINA POWER & LIGHT CO	SOUTHPORT NC	ChannelStream	16	300	WATER	105 F
89267 002	CAROLINA POWER & LIGHT CO	SOUTHPORT NC	ChannelStream	16	300	WATER	105 F
89267 003	CAROLINA POWER & LIGHT CO	SOUTHPORT NC	ChannelStream	16	300	WATER	105 F
89267 004	CAROLINA POWER & LIGHT CO	SOUTHPORT NC	ChannelStream	16	300	WATER	105 F
89267 001	CAROLINA POWER & LIGHT CO	SOUTHPORT NC	ChannelStream	16	300	WATER	105 F
89267 002	CAROLINA POWER & LIGHT CO	SOUTHPORT NC	ChannelStream	16	300	WATER	105 F
89267 003	CAROLINA POWER & LIGHT CO	SOUTHPORT NC	ChannelStream	16	300	WATER	105 F
89267 004	CAROLINA POWER & LIGHT CO	SOUTHPORT NC	ChannelStream	16	300	WATER	105 F
89266 001	CAROLINA POWER & LIGHT CO	SOUTHPORT NC	ChannelStream	16	300	WATER	318 F
89266 001	CAROLINA POWER & LIGHT CO	SOUTHPORT NC	ChannelStream	16	300	WATER	316 F
89266 002	CAROLINA POWER & LIGHT CO	SOUTHPORT NC	ChannelStream	16	300	WATER	318 F
89266 003	CAROLINA POWER & LIGHT CO	SOUTHPORT NC	ChannelStream	16	300	WATER	316 F
89266 004	CAROLINA POWER & LIGHT CO	SOUTHPORT NC	ChannelStream	16	300	WATER	316 F
89266 001	CAROLINA POWER & LIGHT CO	SOUTHPORT NC	ChannelStream	16	300	WATER	316 F
89266 002	CAROLINA POWER & LIGHT CO	SOUTHPORT NC	ChannelStream	16	300	WATER	316 F
89266 003	CAROLINA POWER & LIGHT CO	SOUTHPORT NC	ChannelStream	16	300	WATER	316 F
89266 004	CAROLINA POWER & LIGHT CO	SOUTHPORT NC	ChannelStream	16	300	WATER	316 F
89266 001	CAROLINA POWER & LIGHT CO	SOUTHPORT NC	ChannelStream	16	300	WATER	316 F
89266 002	CAROLINA POWER & LIGHT CO	SOUTHPORT NC	ChannelStream	16	300	WATER	316 F
89266 003	CAROLINA POWER & LIGHT CO	SOUTHPORT NC	ChannelStream	16	300	WATER	316 F
89266 004	CAROLINA POWER & LIGHT CO	SOUTHPORT NC	ChannelStream	16	300	WATER	316 F
74109 003	CAROLINA POWER & LIGHT CO	SOUTHPORT NC	ChannelStream	4	800	WATER	100
100538 003	CONSOLIDATED EDISON	QUEENS NY	ChannelStream	3	2500	WATER	500 DEG F
100538 003	CONSOLIDATED EDISON	QUEENS NY	ChannelStream	3	2500	WATER	500 DEG F
100538 001	CONSOLIDATED EDISON	QUEENS NY	ChannelStream	3	2500	WATER	500 DEG F
100538 001	CONSOLIDATED EDISON	QUEENS NY	ChannelStream	3	2500	WATER	500 DEG F
100538 002	CONSOLIDATED EDISON	QUEENS NY	ChannelStream	2	2500	WATER	500 DEG F
100538 002	CONSOLIDATED EDISON	QUEENS NY	ChannelStream	2	2500	WATER	500 DEG F
93414 001	CONSOLIDATED EDISON	NEW YORK NY	ChannelStream	4	1500	WATER	228 F
92982 001	CONSOLIDATED EDISON	BROOKLYN NY	ChannelStream	8	800	WATER	230 F
90429 001	CONSOLIDATED EDISON	NEW YORK NY	ChannelStream	4	1500	WATER	228 F
89816 001	CONSOLIDATED EDISON	QUEENS NY	ChannelStream	6	300	WATER	92 F
80847 012	CONSOLIDATED EDISON	ASTORIA NY	ChannelStream	12	1500	WATER	348 F
80847 012	CONSOLIDATED EDISON		ChannelStream	12	1500	WATER	348 F
80847 001	CONSOLIDATED EDISON	NEW YORK NY	ChannelStream	4	1500	WATER	220 F
85101 001	CONSOLIDATED EDISON	NEW YORK NY	ChannelStream	4	1500	WATER	381 F
89782 001	CONSOLIDATED EDISON	ASTORIA NY	ChannelStream	4	1500	WATER	320 F



* - DISASSEMBLY / MAINTENANCE CLEARANCE

	A	E	F	B	WT
INCH	11.5	4.8	5.3	2.3	45.00 lbs
mm	292.1	121.9	134.6	58.4	20.5 kg

Note: Dimensions are certified correct per associated specification sheet. End connections and scaling may not be actual. For accessory information, see associated specification sheet.

MODEL	ChannelStream	FLOWSERVE	CERTIFIED DIMENSIONAL DRAWING	
SIZE	2 INCH	BY	JOHNZELENAK	CUSTOMER
RATING / F/F STD	600 / ISA	DATE	1999-02-12	Wiscon Elec/Point Beach
END CONNECTION	SOCKET WELD	THIRD ANGLE PROJECTION	Mark One	VALVE TAG
TRIM TYPE	C/S			P.O. NUMBER
	SPRING			PROJECT
	STANDARD			Feedwater Min Flow
	TRIM / CV			SHEET
	Cv:3.3			1 OF 1
				REVISION
				0.0
				SERIAL NUMBER
				000000 001



Valve Flow Curve

Tag Number : Feedwater Min Flow

Valve Model : ChannelStream
Trim 0.75 Cv:3.300
Customer : Wiscon Elec/Point Beach
Project : Feedwater Min Flow
Page Number : 1

