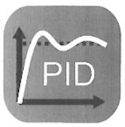
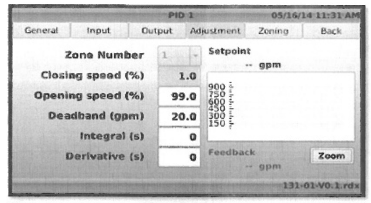
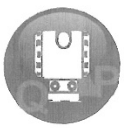
VALVE FUNCTIONS



PID Control

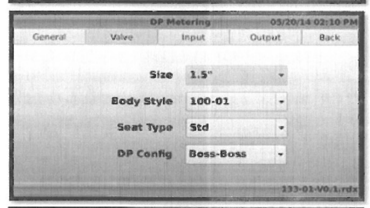
Used in maintaining a control valve at setpoint.





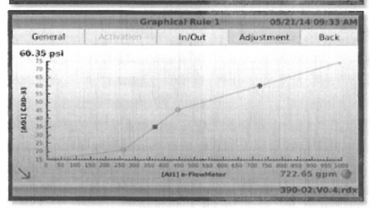
DP Metering

Used to return an accurate flow rate without having a flow meter installed. Using a valve position transmitter & DP transmitter, this function will calculate flow.



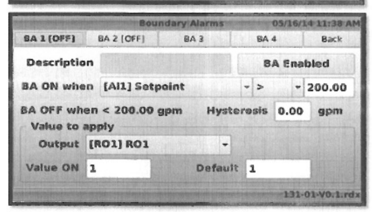
Control Curves

Uses a graphical function, allowing the user to make different signal types (for example: flow and pressure). The user also has the ability to make relationships as a function of time. This is the primary function employed in pressure management/water savings applications.



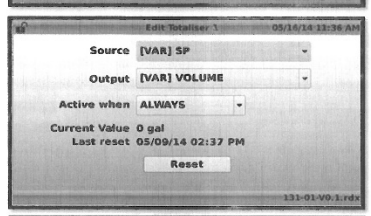
Actions

Used to take "action" (or alarms) on an input, output, or variable when a programmable condition is met.



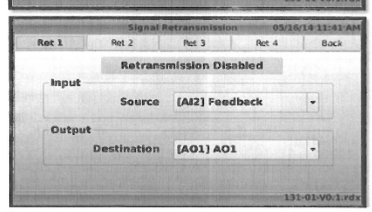
Totalizer

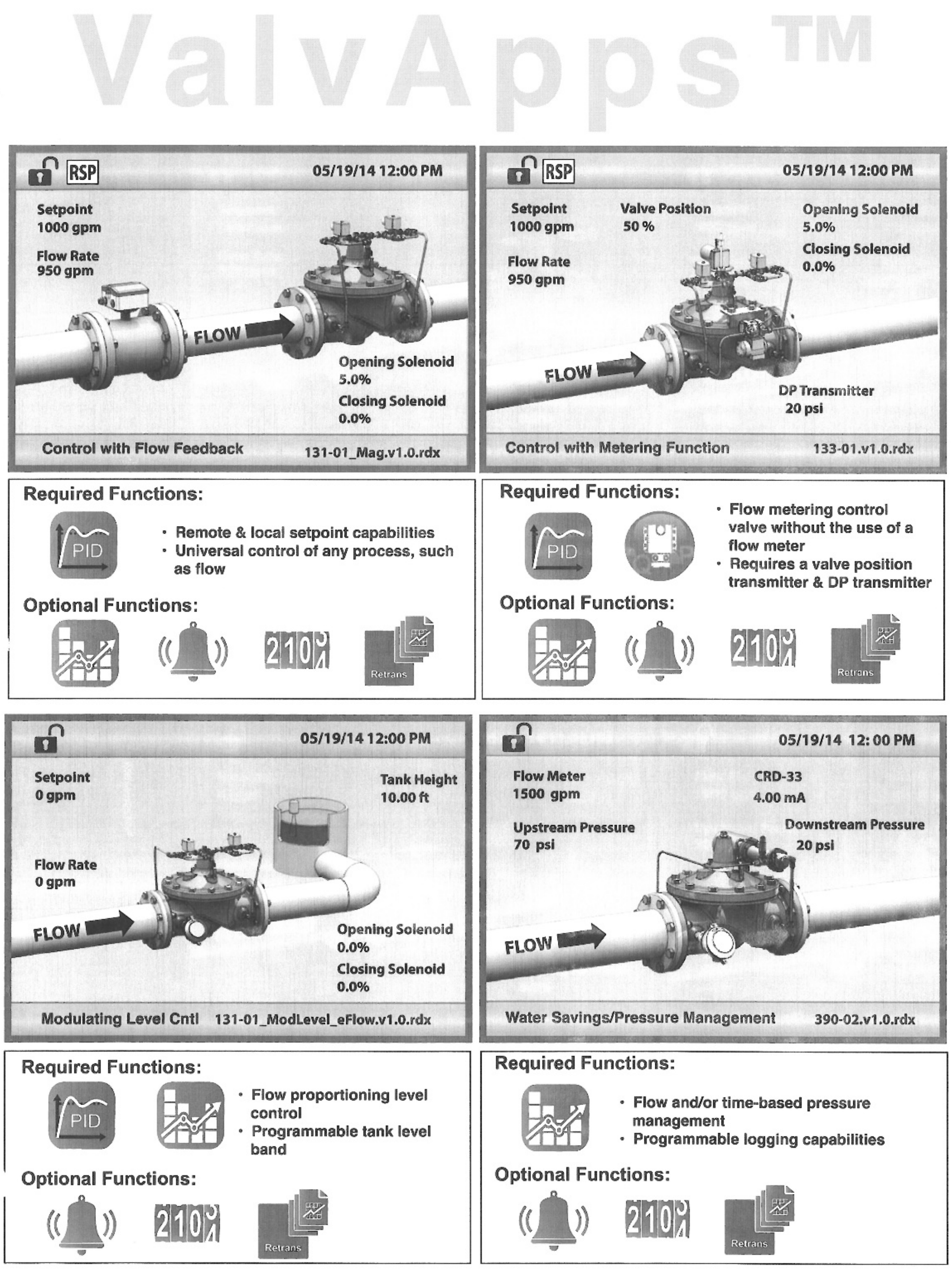
Keeps track of total volume as a function of time. Customizable units & reset functionality allow for simplified set-up and configuration.



Retransmission

Used to retransmit any input signal, variable, or calculation to a SCADA system. Retransmission outputs include analog 4-20mA or digital (contact closure).




ValvApps™
RSP
05/19/14 12:00 PM
Setpoint
1000 gpm
Flow Rate
950 gpm
FLOW
Opening Solenoid
5.0%
Closing Solenoid
0.0%
Control with Flow Feedback
131-01_Mag.v1.0.rdx
Required Functions:
PID
• Remote & local setpoint capabilities
• Universal control of any process, such as flow
Optional Functions:
210
Retrans
RSP
05/19/14 12:00 PM
Setpoint
1000 gpm
Valve Position
50 %
Opening Solenoid
5.0%
Closing Solenoid
0.0%
Flow Rate
950 gpm
FLOW
DP Transmitter
20 psi
Control with Metering Function
133-01.v1.0.rdx
Required Functions:
PID
• Flow metering control valve without the use of a flow meter
• Requires a valve position transmitter & DP transmitter
Optional Functions:
210
Retrans
05/19/14 12:00 PM
Setpoint
0 gpm
Tank Height
10.00 ft
Flow Rate
0 gpm
FLOW
Opening Solenoid
0.0%
Closing Solenoid
0.0%
Modulating Level Cntl
131-01_ModLevel_eFlow.v1.0.rdx
Required Functions:
PID
• Flow proportioning level control
• Programmable tank level band
Optional Functions:
210
Retrans
05/19/14 12: 00 PM
Flow Meter
1500 gpm
CRD-33
4.00 mA
Upstream Pressure
70 psi
Downstream Pressure
20 psi
FLOW
Water Savings/Pressure Management
390-02.v1.0.rdx
Required Functions:
• Flow and/or time-based pressure management
• Programmable logging capabilities
Optional Functions:
210
Retrans

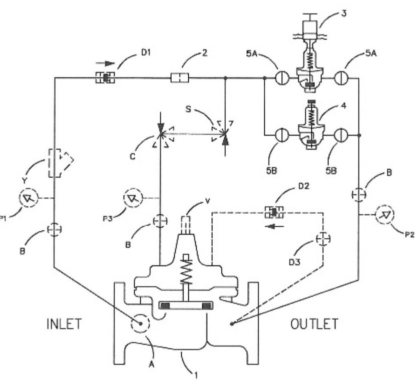
SPECIFICATIONS

Component	Specification Details
Enclosure	
Enclosure Material	Flame retardant UL rated PC/ABS plastic
Enclosure Connections	M16/M20 Cable ; IP-68 Cable Glands IP-68 USB Type A & Type B Connection, IP-68 Ethernet Port
Environmental	IP-68, 2 meters for 48 hours
Enclosure Dimensions	8.75" (223 mm) H x 6" (153 mm) W x 3.5" (89 mm) D
Enclosure Weight	3 lbs. (1.37 kg)
Mounting Bracket	Anodized Aluminum - Standard
Power Requirement	
Power	300 mA @ 24VDC (Steady State)
Fuse Type	3A Fuse recommended
Display	
Display Type	4.3" Color TFT-LCD, 480 x 272 pixels
Display Update Rate	100ms
Programming Method	Mechanical Push Button; VNC
Password	5 digit
Mass Data Storage	
Type	2GB SD Card
Language	English
Temperature	40° F to 130° F (5° C to 55° C)
Humidity	90% RH, non-condensing
Power Input	12-24VDC – Full Function (standard) or optional power supply
Memory Protection	10-year lithium battery
Input Logging	
Configurable	Yes
Logging Speed	1 minute
Output	CSV format suitable for exporting to MS Excel
Inputs	
Analog	(6) Inputs (4-20mA / 0-5 V / 0-10 V)
Resolution	10 bit
Digital	(6) digital inputs (Dry contact)
Units	Configurable
Decimal Point	0 / 0.0 / 0.00 / 0.000
Signal Filter	Configurable 1 to 60 seconds
Totalizer	Configurable input and units
Totalizer Reset	Yes
I/O Connection	Screw Terminals
Outputs	
Analog	(4) Outputs (4-20mA)
Resolution	10 bit
Solenoid	(2) Solid State Relay (DC), Zero Switching Voltage • For AC Solenoids, use PC-22D Power Converter
Relay	(2) Mechanical Relay, Rated Voltage 250VAC, Rated Current 6A
Control Parameters	
Control Input	4-20mA full scale / 0-5 V / 0-10V / digital (dry contact
Proportional Band	0-100% (50% default) adjustable in 1% increments • Independently for opening and closing
Dead Band	Adjustable 0 to full scale of set-point signal
Cycle Time	0 to 60 seconds in 1 sec. increments
Integral Band	Adjustable 0 to 60 seconds
Derivative Band	Adjustable 0 to 60 seconds
Loop Zoning	Adjustable up to (4) zones
PID Loops	4 Configurable

CLA-VAL®

MODEL **390-07** (Full Internal Port) **3690-07** (Reduced Internal Port)

Electronic Actuated Pressure Reducing Valve with Manual Hydraulic Bypass



- **Simplified Remote Valve Set-Point Control**
- **Isolated Input**
- **Ideal for Pressure Management**
- **12-24VDC Input Power**
- **Reverse Polarity Protection**
- **Submersible (IP-68)**

The Cla-Val Model 390-07/3690-07 Electronic Actuated Pressure Reducing Control Valve with Manual Hydraulic Bypass combines precise control of field proven Cla-Val hydraulic pilots and simple, remote valve control. The Cla-Val Model 390-07/3690-07 Pressure Reducing Valve automatically reduces a higher inlet pressure to a steady lower downstream pressure regardless of changing flow rate and/or varying inlet pressure. This valve is an accurate, pilot-operated regulator capable of holding downstream pressure to a pre-determined limit. The valve uses a CRD-33 pilot control, consisting of a hydraulic pilot and integral controller, that accepts a remote set-point command input and makes set-point adjustments to the pilot.

The recommended control method is simple remote set-point change from an RTU (Remote Telemetry Unit) to the CRD-33 where the 4-20 mA command signal is ranged to specific pressure range. Very accurate control can be achieved when span does not exceed 100 psi. Since the CRD-33 is pre-ranged to the full spring range, some on-site calibration may be necessary when this control method is used. Free downloadable software is available from Cla-Val website for this purpose. The CRD-33 can also accommodate control systems where the RTU compares pressure transmitter signal to the remote set point command signal. The RTU adjusts the CRD-33 with 4-20 mA command signal containing an adequate deadband to prevent actuator dithering after the two signals agree.

Internal continuous electronic monitoring of actuator position results in virtually instantaneous position change with no backlash or dithering when control signal is changed. In the event of a power or control input failure, the CRD-33 pilot remains in hydraulic control virtually assuring system stability under changing conditions. If check feature ("D") is added, and pressure reversal occurs, the valve closes to prevent return flow. During SCADA startup and maintenance the manually-adjusted CRD pilot control allows automatic hydraulic valve operation when no electric power is available for CRD-33.

Schematic Diagram

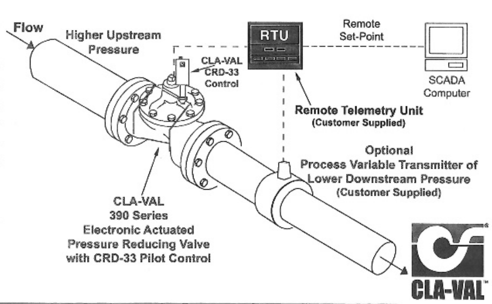
Item	Description
1	Hytrol (Main Valve)
2	X58C Restriction Fitting
3	CRD-33 Electronic Pressure Reducing Control
4	CRD Pressure Reducing Control
5	CK2 (Isolation Valve)

Optional Features

Item	Description
A	X46A Flow Clean Strainer
B	CK2 (Isolation Valve)
C	CV Flow Control (Closing)
D	Check Valves with Isolation Valve
P	X141 Pressure Gauge
S	CV Flow Control (Opening)
V	X101 Valve Position Indicator
Y	X43 "Y" Strainer

Typical Applications

The CRD-33 is installed on Cla-Val 390 Series valves that maintain downstream pressure and require this pressure to be changed from a remote location. It can be an effective solution for lowering costs associated with "confined space" requirements by eliminating the need for entry in valve structure for set-point adjustment. It is also ideal for pressure management, and can be programmed to minimum night time and optimum daytime pressures. Optional profiler can be used to create custom correlation between pressure and flow information.
Flow information can also be provided from the main valve, see E-X133VF.
Additional pilot controls, hydraulic and/or electronic, are also available to perform multiple functions to fit exact system requirements.



Model 390-07 (Uses Basic Valve Model 100-01)

Pressure Ratings (Recommended Maximum Pressure - psi)

Valve Body & Cover		Pressure Class				
		Flanged			Grooved	Threaded
Grade	Material	ANSI Standards*	150 Class	300 Class	300 Class	End‡ Details
ASTM A536	Ductile Iron	B16.42	250	400	400	400
ASTM A216-WCB	Cast Steel	B16.5	285	400	400	400
ASTM B62	Bronze	B16.24	225	400	400	400

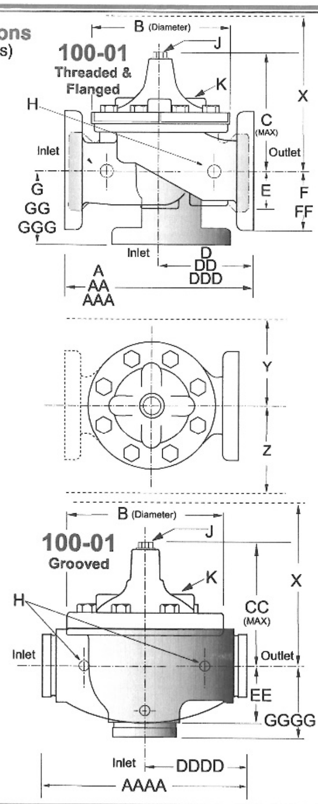
Note: * ANSI standards are for flange dimensions only.
Flanged valves are available faced but not drilled.
‡ End Details machined to ANSI B2.1 specifications.
Valves for higher pressure are available; consult factory for details

Materials

Component	Standard Material Combinations		
Body & Cover	Ductile Iron	Cast Steel	Bronze
Available Sizes	1" - 36"	1" - 16"	1" - 16"
Disc Retainer & Diaphragm Washer	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		

For material options not listed, consult factory.
Cla-Val manufactures valves in more than 50 different alloys.

Dimensions
(In inches)



Model 390-07 Dimensions (In Inches)

Valve Size (Inches)	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	14	16	18	20	24	30	36
A Threaded	7.25	7.25	7.25	9.38	11.00	12.50	—	—	—	—	—	—	—	—	—	—	—	—
AA 150 ANSI	—	—	8.50	9.38	11.00	12.00	15.00	20.00	25.38	29.75	34.00	39.00	41.38	46.00	52.00	61.50	63.00	76.00
AAA 300 ANSI	—	—	9.00	10.00	11.62	13.25	15.62	21.00	26.38	31.12	35.50	40.50	43.50	47.64	53.62	63.24	64.50	76.00
AAAA Grooved End	—	—	8.50	9.00	11.00	12.50	15.00	20.00	25.38	—	—	—	—	—	—	—	—	—
B Dia.	5.62	5.62	5.62	6.62	8.00	9.12	11.50	15.75	20.00	23.62	28.00	32.75	35.50	41.50	45.00	53.16	56.00	66.00
C Max.	5.50	5.50	5.50	6.50	7.56	8.19	10.62	13.38	16.00	17.12	20.88	24.19	25.00	39.06	41.90	43.93	54.60	61.50
CC Max. Grooved End	—	—	4.75	5.75	6.88	7.25	9.31	12.12	14.62	—	—	—	—	—	—	—	—	—
D Threaded	3.25	3.25	3.25	4.75	5.50	6.25	—	—	—	—	—	—	—	—	—	—	—	—
DD 150 ANSI	—	—	4.00	4.75	5.50	6.00	7.50	10.00	12.69	14.88	17.00	19.50	20.81	—	—	30.75	—	—
DDD 300 ANSI	—	—	4.25	5.00	5.88	6.38	7.88	10.50	13.25	15.56	17.75	20.25	21.62	—	—	31.62	—	—
DDDD Grooved End	—	—	—	4.75	—	6.00	7.50	—	—	—	—	—	—	—	—	—	—	—
E	1.12	1.12	1.12	1.50	1.69	2.06	3.19	4.31	5.31	9.25	10.75	12.62	15.50	12.95	15.00	17.75	21.31	24.56
EE Grooved End	—	—	2.00	2.50	2.88	3.12	4.25	6.00	7.56	—	—	—	—	—	—	—	—	—
F 150 ANSI	—	—	2.50	3.00	3.50	3.75	4.50	5.50	6.75	8.00	9.50	10.50	11.75	15.00	16.50	19.25	22.50	25.60
FF 300 ANSI	—	—	3.06	3.25	3.75	4.13	5.00	6.25	7.50	8.75	10.25	11.50	12.75	15.00	16.50	19.25	24.00	25.60
G Threaded	1.88	1.88	1.88	3.25	4.00	4.50	—	—	—	—	—	—	—	—	—	—	—	—
GG 150 ANSI	—	—	4.00	3.25	4.00	4.00	5.00	6.00	8.00	8.62	13.75	14.88	15.69	—	—	22.06	—	—
GGG 300 ANSI	—	—	4.25	3.50	4.31	4.38	5.31	6.50	8.50	9.31	14.50	15.62	16.50	—	—	22.90	—	—
GGGG Grooved End	—	—	—	3.25	—	4.25	5.00	—	—	—	—	—	—	—	—	—	—	—
H NPT Body Tapping	.375	.375	.375	.375	.50	.50	.75	.75	1	1	1	1	1	1	1	1	2	2
J NPT Cover Center Plug	.25	.25	.25	.50	.50	.50	.75	.75	1	1	1.25	1.5	2	1.5	1.5	1.5	2	2
K NPT Cover Tapping	.375	.375	.375	.375	.50	.50	.75	.75	1	1	1	1	1	1	1	1	2	2
Stem Travel	0.4	0.4	0.4	0.6	0.7	0.8	1.1	1.7	2.3	2.8	3.4	4.0	4.5	5.1	5.63	6.75	7.5	8.5
Approx. Ship Wt. Lbs.	15	15	15	35	50	70	140	285	500	780	1165	1600	2265	2982	3900	6200	7703	11720
X Pilot System	11	11	11	13	14	15	17	29	31	33	36	40	40	43	47	68	79	85
Y Pilot System	9	9	9	9	10	11	12	20	22	24	26	29	30	32	34	39	40	45
Z Pilot System	9	9	9	9	10	11	12	20	22	24	26	29	30	32	34	39	42	47

Note: The top two flange holes on valve size 36 are threaded to 1 1/2"-6 UNC.

Pressure Ratings (Recommended Maximum Pressure - psi)

Valve Body & Cover		Pressure Class Flanged		
Grade	Material	ANSI Standards*	150 Class	300 Class
ASTM A536	Ductile Iron	B16.42	250	400
ASTM A216-WCB	Cast Steel	B16.5	285	400
ASTM B62	Bronze	B16.24	225	400

Note: * ANSI standards are for flange dimensions only.
Flanged valves are available faced but not drilled.
Valves for higher pressure are available; consult factory for details

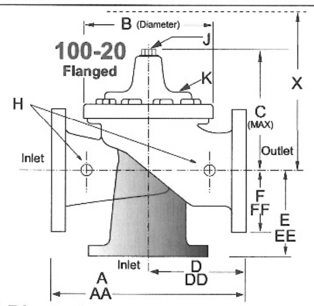
Materials

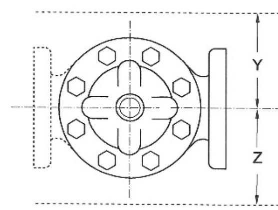
Component	Standard Material Combinations		
Body & Cover	Ductile Iron	Cast Steel	Bronze
Available Sizes	3" - 48"	3" - 16"	3" - 16"
Disc Retainer & Diaphragm Washer	Cast Iron	Cast Steel	Bronze
Trim: Disc Guide, Seat & Cover Bearing	Bronze is Standard Stainless Steel is Optional		
Disc	Buna-N® Rubber		
Diaphragm	Nylon Reinforced Buna-N® Rubber		
Stem, Nut & Spring	Stainless Steel		

For material options not listed, consult factory.
Cla-Val manufactures valves in more than 50 different alloys.

Dimensions
(In inches)

100-20
Flanged





Model 3690-07 Dimensions (In Inches)

Valve Size (Inches)	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48
A 150 ANSI	10.25	13.88	17.75	21.38	26.00	30.00	34.25	35.00	42.12	48.00	48.00	63.25	65.00	76.00	94.50
AA 300 ANSI	11.00	14.50	18.62	22.38	27.38	31.50	35.75	36.62	43.63	49.62	49.75	63.75	67.00	76.00	94.50
B Dia.	6.62	9.12	11.50	15.75	20.00	23.62	27.47	28.00	35.44	35.44	35.44	53.19	56.00	66.00	66.00
C Max.	7.00	8.62	11.62	15.00	17.88	21.00	20.88	25.75	25.00	31.00	31.00	43.94	54.60	61.50	61.50
D 150 ANSI	—	6.94	8.88	10.69	CF*	CF*	CF*	CF*	CF*	CF*	CF*	—	—	—	—
DD 300 ANSI	—	7.25	9.38	11.19	CF*	CF*	CF*	CF*	CF*	CF*	CF*	—	—	—	—
E 150 ANSI	—	5.50	6.75	7.25	CF*	CF*	CF*	CF*	CF*	CF*	CF*	—	—	—	—
EE 300 ANSI	—	5.81	7.25	7.75	CF*	CF*	CF*	CF*	CF*	CF*	CF*	—	—	—	—
F 150 ANSI	3.75	4.50	5.50	6.75	8.00	9.50	11.00	11.75	15.88	14.56	17.00	19.88	25.50	28.00	31.50
FF 300 ANSI	4.12	5.00	6.25	7.50	8.75	10.25	11.50	12.75	15.88	16.06	19.00	22.00	27.50	28.00	31.50
H NPT Body Tapping	.375	.50	.75	.75	1	1	1	1	1	1	1	1	2	2	2
J NPT Cover Center Plug	.50	.50	.75	.75	1	1	1.25	1.25	2	2	2	2	2	2	2
K NPT Cover Tapping	.375	.50	.75	.75	1	1	1	1	1	1	1	1	2	2	2
Stem Travel	0.6	0.8	1.1	1.7	2.3	2.8	3.4	3.4	3.4	4.5	4.5	6.5	7.5	8.5	8.5
Approx. Ship Wt. Lbs.	45	85	195	330	625	900	1250	1380	1500	2551	2733	6500	8545	12450	13100
X Pilot System	13	15	27	30	33	36	36	41	40	46	55	68	79	85	86
Y Pilot System	10	11	18	20	22	24	26	26	30	30	30	39	40	45	47
Z Pilot System	10	11	18	20	22	24	26	26	30	30	30	39	42	47	49

*Consult Factory

Note: The top two flange holes on valve sizes 36 thru 48 are threaded to 1 1/2"-6 UNC.

390-07/3690-07 Purchase Specifications (CRD-33 supplement)

The Electronic Actuated Pressure Reducing Pilot Control shall have an integral hydraulic pilot and electronic controller contained in a IP-68 rated submersible enclosure to provide interface between remote telemetry and valve set-point control. It will compare a remote analog command signal with an internal position sensor signal and adjust the hydraulic pilot control spring mechanism to a new set-point position. Remote analog signal input shall be isolated and reverse polarity protected and resettable. 4-20 mA actuator position feed-back output shall be supplied standard. A second command control input shall be from dry-contact switch closure for clockwise or counter clockwise actuator rotation.

If power fails, the control pilot valve shall continue main valve to control to last set-point command. If the Remote Set-Point signal is lost the actuator is programmable to go to either the 4mA, Last, or 20mA command set-point. No mechanical adjustments shall be necessary to the actuator. The low and high position range adjustment shall be accomplished only with valve manufacturer's components and instructions to be supplied in a separate kit.

The Electronic Actuated Pressure Reducing Pilot Control shall be Cla-Val Model CRD-33 or CRA-33 as manufactured by Cla-Val, Newport Beach, CA.

390-07 Valve Selection	100-01 Pattern: Globe (G), Angle (A), End Connections: Threaded (T), Grooved (GR), Flanged (F) Indicate Available Sizes																		
	Inches	1	1¼	1½	2	2½	3	4	6	8	10	12	14	16	18	20	24	30	36
	mm	25	32	40	50	65	80	100	150	200	250	300	350	400	450	500	600	750	900
Basic Valve 100-01	Pattern	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G	G	G, A	G	G
	End Detail	T	T	T, F, Gr*	T, F, Gr	T, F, Gr*	T, F, Gr	F, Gr	F, Gr*	F, Gr*	F	F	F	F	F	F	F	F	F
Suggested Flow (gpm)	Maximum	55	93	125	210	300	460	800	1800	3100	4900	7000	8400	11000	14000	17000	25000	42000	50000
	Maximum Intermittent	68	120	160	260	370	580	990	2250	3900	6150	8720	10540	13700	17500	21700	31300	48000	62500
	Minimum	1	1	1	1	2	2	4	10	15	35	50	70	95	120	150	275	450	650
Suggested Flow (Liters/Sec)	Maximum	3.5	6	8	13	19	29	50	113	195	309	442	530	694	883	1073	1577	2650	3150
	Maximum Intermittent	4.3	7.6	10	16	23	37	62	142	246	387	549	664	863	1104	1369	1972	3028	3940
	Minimum	.03	.03	.03	.06	.09	0.13	0.25	0.63	0.95	2.2	3.2	4.4	6.0	7.6	9.5	17.4	28.4	41.0

100-01 Series is the full internal port Hytrol. **For Lower Flows Consult Factory** *Globe Grooved Only

3690-07 Valve Selection	100-20 Pattern: Globe (G), Angle (A), End Connections: Flanged (F) Indicate Available Sizes														
	Inches	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48
	mm	80	100	150	200	250	300	350	400	450	500	600	750	900	1000	1200
Basic Valve 100-20	Pattern	G	G, A	G, A	G, A	G	G	G	G	G	G	G	G	G	G	G
	End Detail	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Suggested Flow (gpm)	Maximum	260	580	1025	2300	4100	6400	9230	9230	16500	16500	16500	28000	33500	33500	33500
	Minimum	1	2	4	10	15	35	50	50	95	95	95	275	450	450	450
Suggested Flow (Liters/Sec)	Maximum	16	37	65	145	258	403	581	581	1040	1040	1040	1764	2115	2115	2115
	Minimum	.06	.13	.25	.63	.95	2.2	3.2	3.2	6.0	6.0	6.0	17.4	28.4	41.0	41.0

100-20 Series is the reduced internal port size version of the 100-01 Series. **For Lower Flows Consult Factory**

We recommend providing adequate space around valve for maintenance work

CRD-33 and CRD Subassembly Specifications

Adjustment Ranges

2 to 30 psi
15 to 75 psi
20 to 105 psi
30 to 300 psi (factory ranged 40 to 140 psi)

End Connections

3/8" NPT

Temperature Range

Water: to 180°F

Materials

Pilot Control: Bronze ASTM B62
Trim: Stainless Steel Type 303
Rubber:Buna-N® Synthetic Rubber

Available with optional Stainless Steel or Monel materials. Consult factory for details.

Note: Available with remote sensing control (specify CRA-33)

When Ordering, Please Specify

1. Catalog No. 390-07 or 3690-07
2. Valve Size
3. Pattern - Globe or Angle
4. Pressure Class
5. Threaded or Flanged
6. Trim Material
7. Adjustment Range
8. Desired Options
9. When Vertically Installed

130VC-3 (CRD-33) Actuator Specifications

Supply Power Input: 12V to 24V DC
No Load draw: 50 mA
Max. Load draw: 250 mA

Remote Command Inputs:
- 4-20mA, analog signal (isolated and reverse-polarity protected)
- Dry contact closure (CW/CCW)

Position Feedback Signal: 4-20 mA

Alarm Output: Dry-contact closure (High/Low)

Speed of Rotation: Adjustable On/Off time, max 6 rpm

Diagnostic: LED Indicator

Loss of Power: Actuator will remain in last commanded position.

Loss of Signal Position: Programmable - 4 mA, Last, or 20 mA

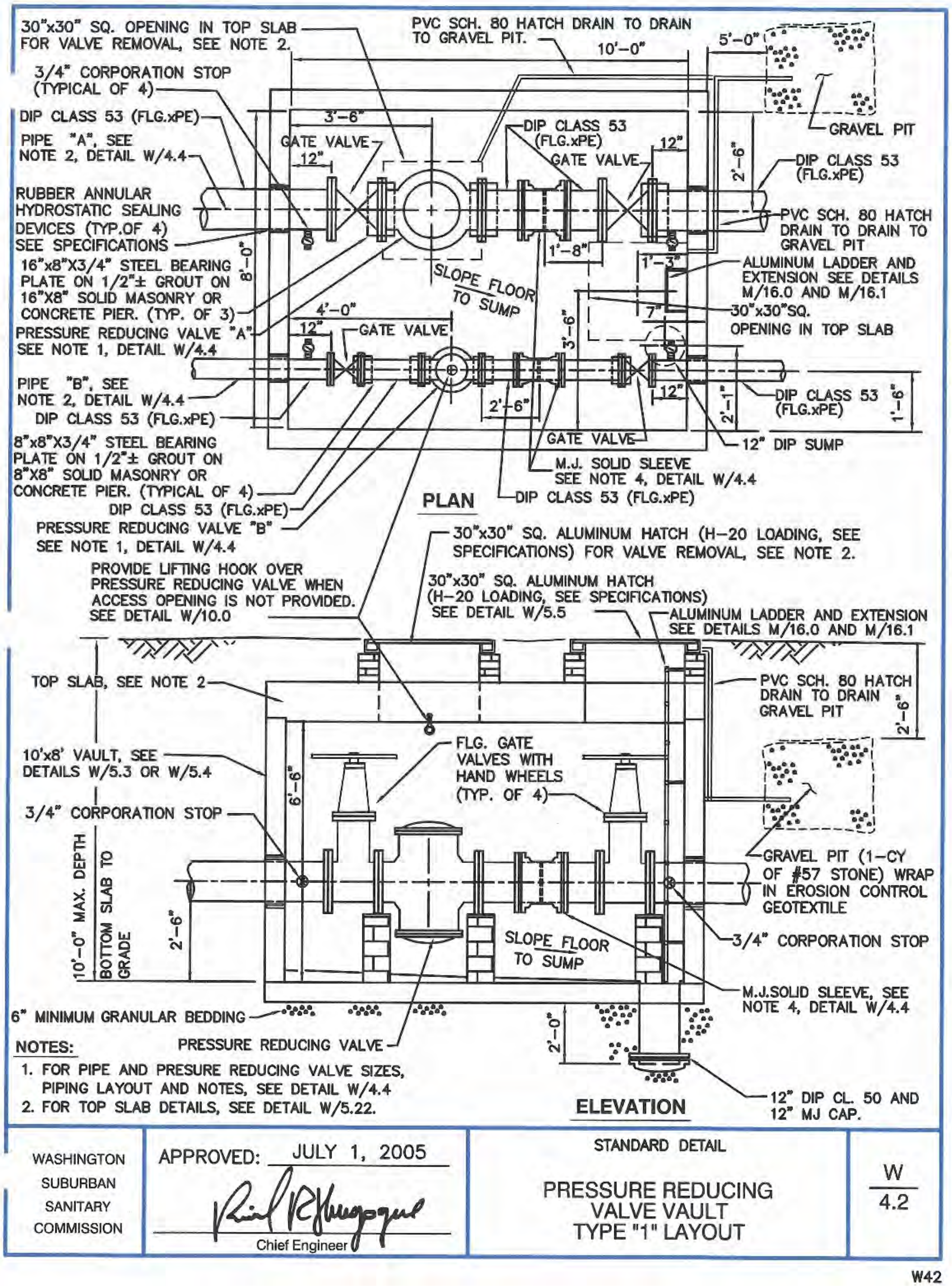
Electrical Connections: Single, 30 feet of permanently attached cable with color-coded power supply and signal wires

Mechanical Specifications:
Environmental
Protection Class: IP-68 (Temporary submersible)
Ambient Temperature: 15° to 150° F (-10° to 65° C)

Materials
Electronics Enclosure: Anodized Aluminum
Mechanical Housing: Bronze
Coupling Assembly: Stainless Steel
Gear Train: Stainless Steel, permanently lubricated

CLA-VAL P.O. Box 1325 • Newport Beach, CA 92659-0325 • Phone: 949-722-4800 • Fax: 949-548-5441 • E-mail: claval@cla-val.com • Website cla-val.com

E-390-07/3690-07 (R-2/2012)


30"x30" SQ. OPENING IN TOP SLAB FOR VALVE REMOVAL, SEE NOTE 2.
PVC SCH. 80 HATCH DRAIN TO DRAIN TO GRAVEL PIT.
10'-0"
5'-0"
3/4" CORPORATION STOP (TYPICAL OF 4)
DIP CLASS 53 (FLG.xPE)
3'-6"
GRAVEL PIT
PIPE "A", SEE NOTE 2, DETAIL W/4.4
GATE VALVE
12"
DIP CLASS 53 (FLG.xPE)
GATE VALVE
12"
2'-6"
DIP CLASS 53 (FLG.xPE)
RUBBER ANNULAR HYDROSTATIC SEALING DEVICES (TYP.OF 4) SEE SPECIFICATIONS
PVC SCH. 80 HATCH DRAIN TO DRAIN TO GRAVEL PIT
1'-8"
1'-3"
ALUMINUM LADDER AND EXTENSION SEE DETAILS M/16.0 AND M/16.1
16"x8"X3/4" STEEL BEARING PLATE ON 1/2"± GROUT ON 16"X8" SOLID MASONRY OR CONCRETE PIER. (TYP. OF 3)
8'-0"
SLOPE FLOOR TO SUMP
7"
30"x30"SQ. OPENING IN TOP SLAB
4'-0"
PRESSURE REDUCING VALVE "A" SEE NOTE 1, DETAIL W/4.4
12"
GATE VALVE
3'-6"
PIPE "B", SEE NOTE 2, DETAIL W/4.4
12"
DIP CLASS 53 (FLG.xPE)
DIP CLASS 53 (FLG.xPE)
2'-6"
2'-1"
1'-6"
8"x8"X3/4" STEEL BEARING PLATE ON 1/2"± GROUT ON 8"X8" SOLID MASONRY OR CONCRETE PIER. (TYPICAL OF 4)
GATE VALVE
12" DIP SUMP
M.J. SOLID SLEEVE SEE NOTE 4, DETAIL W/4.4
DIP CLASS 53 (FLG.xPE)
PLAN
DIP CLASS 53 (FLG.xPE)
PRESSURE REDUCING VALVE "B" SEE NOTE 1, DETAIL W/4.4
30"x30" SQ. ALUMINUM HATCH (H-20 LOADING, SEE SPECIFICATIONS) FOR VALVE REMOVAL, SEE NOTE 2.
PROVIDE LIFTING HOOK OVER PRESSURE REDUCING VALVE WHEN ACCESS OPENING IS NOT PROVIDED. SEE DETAIL W/10.0
30"x30" SQ. ALUMINUM HATCH (H-20 LOADING, SEE SPECIFICATIONS) SEE DETAIL W/5.5
ALUMINUM LADDER AND EXTENSION SEE DETAILS M/16.0 AND M/16.1
TOP SLAB, SEE NOTE 2
PVC SCH. 80 HATCH DRAIN TO DRAIN GRAVEL PIT
2'-6"
10'x8' VAULT, SEE DETAILS W/5.3 OR W/5.4
FLG. GATE VALVES WITH HAND WHEELS (TYP. OF 4)
6'-6"
3/4" CORPORATION STOP
10'-0" MAX. DEPTH BOTTOM SLAB TO GRADE
GRAVEL PIT (1-CY OF #57 STONE) WRAP IN EROSION CONTROL GEOTEXTILE
2'-6"
SLOPE FLOOR TO SUMP
3/4" CORPORATION STOP
M.J.SOLID SLEEVE, SEE NOTE 4, DETAIL W/4.4
6" MINIMUM GRANULAR BEDDING
2'-0"
PRESSURE REDUCING VALVE
NOTES:
1. FOR PIPE AND PRESURE REDUCING VALVE SIZES, PIPING LAYOUT AND NOTES, SEE DETAIL W/4.4
2. FOR TOP SLAB DETAILS, SEE DETAIL W/5.22.
ELEVATION
12" DIP CL. 50 AND 12" MJ CAP.
WASHINGTON SUBURBAN SANITARY COMMISSION
APPROVED: JULY 1, 2005
Chief Engineer
STANDARD DETAIL
PRESSURE REDUCING VALVE VAULT TYPE "1" LAYOUT
W
4.2
W42

22. Specialty Valves.

a. Types of Specialty Valves.

1) Use of the following specialty valves is covered in this section: Altitude Valve, Pressure Reducing Valve, Pressure Relief Valve, Swing Check Valve, Backflow Preventer, Butterfly Valve, Eccentric Plug Valve and Line Stops.

b. General Requirements for Valve and Piping Arrangement in Vaults.

1) Vault Location and Layout.

a) Location of vaults:

(1) Locate vaults out of the roadway right of way or easement. Provide rights of way and construction strips for vault and piping, see Part Three, Section 2 (Rights of Way and Construction Strips).

(2) Vaults shall be out of paved roadways.

(3) Vaults shall be located away from drainage paths to prevent storm water from flowing into the vault.

2) Design of Vault Structures.

a) Allow a minimum of six and one half (6-1/2) feet of headroom inside the vault structure. The depth of the pipeline should be based on this dimension. For other requirements, see Part Three, Section 16 (Design of Pipeline Structures).

b) Provide no less than the minimum clearance above and below the specialty valve, per the manufacturer's requirements for maintaining the valve. For minimum inside height dimensions of the vault and additional design requirements, see Part One, Section 17 (Design of Structures).

c) The top elevation the access hatches or frames and covers shall be set at an elevation equal to or higher than the roadway centerline elevation. If the location selected for the vault will not allow the access opening elevation to be equal to or higher than the roadway centerline elevation, re-select the location for the vault.

d) All pipe connections into vaults shall have a watertight seal. Provide rubber annular hydrostatic sealing device in accordance with the Specifications and Standard Details.

e) Provide a sump in the vault.

f) If equipment access is not provided directly over the specialty valve in the vault, provide lifting hooks in the under side of top slab directly over the specialty valve, see Standard Detail W/10.0. The lifting hook and top slab must be designed to handle the additional loads that will be transmitted to the lifting hook and to the top slab.

g) Access to the vault location. When the vault location requires WSSC to detour traffic or close the roadway to traffic for maintenance of the vault, provide vehicle access to the vault. (Driveway, curb cutouts, etc.)

h) For additional structural design requirements for vaults, see Part One, Section 15, Design of Structures and Part Three, Section 16, Design of Pipeline Structures.

i) See requirements under WSSC Design Guideline 28-ME-DG-03, "Mechanical and Electrical Design Guidelines for Control Valve Vaults in the Water Distribution System that are to be Electrically Operated and Remotely Controlled".

j) Standard Details.

(1) When using the Standard Details for Pressure Reducing Valves and Pressure Relief Valves, verify that the depth of the proposed pipeline is adequate for the use of the Standard Details.

(2) The maximum vertical depth from the finished grade to the top of the bottom slab of Pressure Reducing Valve Vaults and Pressure Relief Valve Vaults shall be ten (10) feet.

[a] If the mainline water pipeline requires the bottom of the vault to be greater than the ten (10) feet vertical depth, design the piping from the mainline water pipeline to the vault to meet the requirements of the ten (10) feet vertical depth. Provide this design on the drawing, showing all necessary plan and section views, and label all materials, dimensions, etc.

[b] Soil investigation requirements for the use of Standard Details for Pressure Reducing Valve and Pressure Relief Valve Vaults.

[1] Provide a soil boring at the proposed location of the Pressure Reducing Valve Vault or Pressure Relief Valve Vault, see Part Three, Section 19, Geotechnical and Corrosion Submittals, for soil boring location requirements. Use the information on the boring logs to confirm the elevation of the groundwater table, prior to using the Standard Details for Pressure Reducing Valve Vaults and Pressure Relief Valve Vaults.

[2] Elevation of groundwater table must be at least two (2) feet below the bottom slab elevation of the Pressure Reducing Valve Vaults or Pressure Relief Valve Vaults. If the actual groundwater table is higher than the above, the Standard Details must be modified or provide a specially designed structure, see requirements for Special Design Structures.

k) Special Design Structures.

(1) Special designed structures are required if the Standard Details are not adequate for the particular design. Provide details on the drawings, showing all necessary plan and section views, and label all materials, dimensions, etc.

(2) When the soil investigation indicates that the elevation of the groundwater table is higher than two (2) feet below the bottom slab elevation of the Pressure Reducing Valve Vaults or Pressure Relief Valve Vaults, including special designs for waterproofing and dampproofing. See requirements under WSSC Design Guideline 28-ME-DG-03, "Mechanical and Electrical Design Guidelines for Control Valves Vaults in the Water Distribution System that are to be Electrically Operated and Remotely Controlled".

(3) For other design requirements, see information listed under each type of specialty valve.

3) Vault Access.

a) For additional requirements for vault access, see requirements listed under each type of specialty valve.

b) When hatches are provided, design the hatch drain as follows:

(1) When the top slab is set above grade, design the hatch drain to discharge outside the vault.

(2) When the hatch is set to grade, design the hatch drain to discharge into the vault, see Standard Details W/4.2, W/4.3 and W/4.4 for additional requirements.

4) Vault Piping.

a) Provide adequate space between the bolted flanges and the wall where pipes enter and exit the vault, see Part Three, Section 14 (Pipe Joint Clearances within Structures).

b) Provide adequate support for all valves and piping within the vault, see Standard Detail W/2.4 for typical design requirements.

c) Provide a mechanical coupling, see Standard Detail B/3.0, or a mechanical joint solid sleeve with wedge action retainer gland, see Standard Detail B/2.7.

d) Provide flanged ends with pressure ratings similar to gate valves (Class 125 or 250 valves), see Part One, Section 19 (Pipeline Valves) for requirements.

e) Verify the pressure rating of the specialty valve. Provide the setting information on the Drawings in accordance with Standard Detail W/4.4.

f) For additional requirements for vault piping, see requirement listed under each type of specialty valve.

c. Altitude Valves.

1) In most cases, altitude valves are designed for installation at water storage facilities (elevated tanks, standpipes or reservoirs). The altitude valve controls the water level in the facility at a specified level and prevents overflow. Altitude valves can be designed to operate in two ways.

a) The first way is to only control the filling or refilling of the facility when the water level is low. A check valve or other means to control the withdrawal of water from the facility is required. This type of altitude valve is called a single acting altitude valve.

b) The second way is to control both the filling/refilling and the withdrawal of water from the facility. This valve will control both the water level of the facility and the operating pressure of the piping system. When the water level in the facility is low, the valve will open and allow the facility to refill and when the piping system is below the system operating pressure, the valve will open and allow the facility to maintain a level of pressure in the piping to operate the piping system. The valve will close when both the facility and the piping system are at the designed operating level. This type of altitude valve is called a double acting altitude valve.

c) WSSC normally designs systems using the single acting altitude valve. WSSC will provide guidance on the type of altitude valve to be used.

2) Altitude valve and piping arrangements.

a) Design a vault to house the altitude valve and appurtenances. For additional requirements, see General Valve and Piping Arrangements in Vaults, in this section. Do not design the altitude valve for direct buried service.

b) Access Openings. Provide two openings, an equipment access opening directly over the center of the altitude valve for removal of the altitude valve and a personnel access opening located between the altitude valve and the bypass piping or offset to one side. If only the altitude valve is located within the vault, locate the personnel access opening in such a way that there are no obstructions to climb up and down the ladder.

c) Piping Layout. Provide valves on each side of the altitude valve for maintenance or removal of the valve. Design a bypass line with a closed plug or gate valve around the altitude valve. WSSC will provide guidance on the type of valves to be used.

d. Pressure Reducing Valves (PRV).

1) WSSC will provide project specific requirements when the installation of a pressure reducing valve is necessary.

2) In most cases, pressure reducing valves are designed for connecting a higher pressure zone to a lower pressure zone.

3) A pressure reducing valve is used whenever a water pipeline of high working pressure needs to be reduced to a lower working pressure.

4) In most cases when a pressure reducing valve is required, the installation of a pressure relief valve will also be required, see requirements for Pressure Relief Valves, in this section.

5) Pressure reducing valves can be designed to operate in three ways.

a) The first way is to reduce the head in a transmission main connecting to a distribution system or reinforce the low pressure zone during periods of high demands. Typically, only one pressure reducing valve is installed with bypass piping.

b) The second way is to install two pressure reducing valves; a larger one to handle peak flows or fire flows and a smaller one to handle low flows. Usually the smaller valve is adjusted for a discharge pressure setting of five (5) psi above the setting of the larger valve so that the smaller valve will handle the low flow requirements. The larger valve opens only when demands exceed the capacity of the smaller valve, causing the pressure to drop to the pressure setting of the larger valve.

c) The third way is for use with water house connections. When the working pressure in the distribution main is over eighty (80) psi (static), the installation of a pressure reducing valve on the water house connections is required. This pressure reducing valve is typically installed after the meter, inside the house/building. For requirements, see The Plumbing Code.

d) Pressure reducing valves can be designed to operate in other ways not listed above, such as in cases when the design requires a device to control surges or to reverse the direction of the pipe flow. If the above types of conditions are encountered, follow the requirements stated in this section.

6) Pressure reducing valve and piping arrangements.

a) Piping layout.

(1) See requirements under General Valve and Piping Arrangements in Vaults, in this section and the following requirements:

(a) For pressure reducing valve sizes 12-inch and smaller diameter, see Standard Details W/4.2, W/4.3 and W/4.4.

(b) For pressure reducing valve sizes larger than 12-inch, provide details on the drawings. Design the vault to house the pressure reducing valve and appurtenances. For additional requirements, see General Valve and Piping Arrangements in Vaults, in this section.

(c) Do not design a pressure reducing valve for direct buried service.

(d) Restrain all joints, see Standard Detail W/4.4.

b) Vault design.

(1) For pressure reducing valve sizes 12-inch and smaller diameter, see Standard Details W/4.2 and W/4.3.

(2) Top slab design for pressure reducing valve vaults.

(a) For 4-inch diameter pressure reducing valves, provide top slab with opening over valve; see Standard Details W/4.2, W/4.3 and W/5.23.

(b) For 6-inch to 12-inch diameter pressure reducing valves, provide opening over valve for valve removal, see Standard Details W/4.2, W/4.3 and W/5.22.

(3) Soil investigations for determining groundwater elevations must be provided at the location of the pressure reducing valve vault, see General Valve and Piping Arrangements in Vaults in the section.

(4) For pressure reducing valve sizes larger than 12-inch, see General Valve and Piping Arrangements in Vaults in this section and requirements under WSSC Design Guideline 28-ME-DG-03, "Mechanical and Electrical Design Guidelines for Control Valves Vaults in the Water Distribution System that are to be Electrically Operated and Remotely Controlled".

c) Valves.

(1) Pressure reducing valve.

(a) Provide 3-inch and larger pressure reducing valves with flanged ends and a pressure rating designed similar to gate valves (Class 125 or 250 valves); see Part One, Section 18 (Pipeline Valves). For smaller than 3-inch pressure reducing valves, provide threaded ends in accordance with National Pipe Threads (NPT).

(b) Indicate on the Drawing the pressure reducing valve setting information, see Standard Detail W/4.4.

(2) Other Valves.

(a) Provide gate valves on each side of the pressure reducing valve to be located in the vault, for maintenance or removal of the pressure reducing valve.

(b) Provide bypass line with a closed gate valve around the pressure reducing valve. Typically the pressure reducing valve is located off the water pipeline and a gate valve is installed between the two branch connections of the pressure reducing valve.

(c) Provide corporation stops on each side of the pressure reducing valve, in the vault, see Standard Details W/4.2 and W/4.3.

d) Access Openings.

(1) Equipment access opening for pressure reducing valves.

(a) For 4-inch to 10-inch pressure reducing valves, provide an aluminum hatch in the top slab of the vault, see Standard Detail W/5.22 and W/5.23 for opening sizes.

(b) For 12-inch pressure reducing valves, provide an aluminum hatch in the top slab of the vault see Standard Detail W/5.22 for opening size.

(c) Locate the opening in the top slab of the vault directly over the center of the pressure reducing valve or as shown on Standard Detail W/5.22 and W/5.23. When two (2) pressure reducing valves are designed to be installed in the vault, provide an opening over the larger valve.

(2) Personnel access openings are to be located in the top slab of the vault in such a way that there are no obstructions to climb up and down the ladder steps.

(a) Provide an aluminum hatch for personnel access, rated for H20 loading, see Standard Details W/4.2 and W/4.3, and Part Three, Section 16, Design of Pipeline Structures.

(b) If two pressure reducing valves are designed, provide opening located between the valves; see Standard Details W/4.2 and W/4.3.

(3) Location of access openings, see General Valve and Piping Arrangements in Vaults in this section.

e) Vault Location.

(1) Locate the vault as follows:

(a) Vault shall not be located in roadway.

(b) Vault access openings shall be within ten (10) feet of edge of the roadway and outside the road right of way.

(c) Vault shall not be located in low areas (ditches, swales, etc.).

(2) If possible, provide access drive for off street parking of maintenance personnel.

e. Pressure Relief Valves (Relief Valve).

1) WSSC will provide project specific requirements when the installation of a pressure relief valve and vault is necessary.

2) In most cases pressure relief valves are designed to protect the water pipeline against excessive pressure.

3) A pressure relief valve should be used for the following conditions:

a) When the water pipeline has a pressure reducing valve connection from a higher pressure zone.

b) At a water pumping station on the discharge side of the pumps.

4) Determine the appropriate location for the pressure relief valve. Design the pressure relief valve hydraulically, so that the opening of the valve will occur relatively gradually to prevent pressure shock or water hammer conditions. Part of this design should include the distance between the pressure relief and pressure reducing valves, to eliminate the possibility of pressure shock or water hammer conditions causing the other valve to activate. This condition may cause the two valves to start opening and closing due to drastic fluctuations in pipeline pressure. When the valves are designed to be hydraulically distant, the piping system itself can help dampen the pressure change seen by both valves.

5) Pressure relief valve and piping arrangements.

a) For pressure relief valve sizes 6-inch and smaller, see Standard Detail W/4.5. Indicate pressure relief valve settings on the drawings along with a profile view of the pressure relief discharge piping.

b) For pressure relief valve sizes larger than 6-inch, provide details on the drawings. Design the vault to house the pressure relief valve and appurtenances. For additional requirements, see General Valve and Piping Arrangements in Vaults, in this section. Do not design the pressure relief valve for direct buried service.

c) Restrain all joint(s) on pressure relief piping and also provide thrust blocking on all fittings from the pressure relief valve to the flap valve.

d) Provide adequate cover over the pressure relief piping, see Part One, Section 4 (Selection of Pipe Material).

e) Piping Layout.

(1) See requirements under General Valve and Piping Arrangements in Vaults, in this section and the following requirements:

(a) For pressure relief valve sizes 6-inch and smaller diameter, see Standard Detail W/4.5.

(b) For pressure relief valve sizes larger than 8-inch, provide details on the drawings. Design the vault to house the pressure relief valve and appurtenances. For additional requirements, see General Valve and Piping Arrangements in Vaults, in this section.

(c) Do not design the pressure relief valve for direct buried service.

(d) Restrain all joints, from the mainline tee to the discharge outlet.

f) Vault design.

(1) For pressure relief valve sizes 6-inch and smaller diameter, see Standard Detail W/4.5.

(2) Soil investigation for determining groundwater elevation must be provided at the location of the pressure relief valve vault, see General Valve and Piping Arrangements in Vaults in this section.

(3) For pressure relief valve sizes larger than 8-inch, see General Valve and Piping Arrangements in Vaults in this section and requirements under WSSC Design Guideline 28-ME-DG-03, "Mechanical and Electrical Design Guidelines for Control Valves Vaults in the Water Distribution System that are to be Electrically Operated and Remotely Controlled".

g) Valve Design.

(1) Pressure relief valve.

(a) Provide 3-inch and larger pressure relief valves with flanged ends and a pressure rating designed similar to gate valves (Class 125 or 250 valves), see Part One, Section 18 (Pipeline Valves).

(b) Indicate on the Drawing, the pressure relief valve setting information; see Standard Detail W/4.5.

(2) Provide corporation stops on the pressure side of the pressure relief valve, in the vault, see Standard Details W/4.5.

h) Access Openings.

(1) Equipment access opening in the vault for pressure reducing valves larger than 8-inch: Design the access opening in the top slab of the vault so that it is large enough to remove the pressure relief valve. Place the opening directly over the center of the pressure reducing valve.

(2) Personnel access opening shall be located in such a way that there are no obstructions to climb up and down the ladder steps.

(a) Provide an aluminum hatch for personnel access, rated for H20 loading, see Standard Details W/4.5, and Part Three, Section 16, Design of Pipeline Structures.

(3) Location of access openings, see General Valve and Piping Arrangements in Vaults in this section.

i) Vault location.

(1) Locate the vault as follows:

(a) The vault shall not be located in a roadway.

(b) Vault access openings shall be within ten (10) feet of edge of the roadway and outside the road right of way.

(c) The vault shall not be located in low areas (ditches, swales, etc.).

(2) If possible, provide an access drive for off street parking of maintenance personnel.

j) Discharge from the pressure relief valve.

(1) Design the discharge from the pressure relief valve to release to the atmosphere. Make adequate provisions to dispose of the discharged water.

(2) Under no circumstances shall the discharge piping be connected directly into a storm drain pipe or sanitary sewer pipe and/or any other type of storm drain or sanitary sewer structure (inlet, manhole, etc.).

(3) Provide a flap valve and end wall at the point of discharge, see Standard Detail W/4.6.

(4) The discharge piping must drain by gravity from the pressure relief valve to the end wall.

(5) Include protection of the channel against erosion caused by the discharge of water from the pressure relief valve into an open channel, see Standard Detail W/4.6. If discharge point is located near a ditch, stream, etc., see Part Three, Section 9 (Pipeline Stream Crossings). Provide design calculations showing that the stream and channel have the capacity to handle the volume of discharged water without causing downstream flooding, erosion or damage.

f. Swing Check Valves.

1) In most cases, check valves are used when the design requires an automatic valve to prevent backflow. However they are not adequate to prevent backflow of contaminated water or potable water from another system into the WSSC water system.

2) Check valves are mainly used in water pumping stations. The location of the check valve should be on the discharge side of the pumps to control the water pressure in the pipeline when the pumps are off and thereby preventing water from flowing back through the pumps.

3) Check valves can also be designed for used at the connection point between two different pressure zone pipelines. In this case, when the higher pressure zone pipeline pressure drops below the lower pressure zone pipeline, the check valve will open and allow water from the lower pressure zone to flow into the higher pressure zone. When the higher pressure zone goes back to the normal higher pressure, the check valve will close.

4) Determine the appropriate location for the check valve and submit. After location is determined, WSSC will provide the required sizes and the type of check valve to be used.

5) Check valve and piping arrangements.

a) Design a vault to house the check valve and appurtenances, for additional requirements, see General Valve and Piping Arrangements in Vaults, in this section. Do not design the check valve for direct buried service.

b) Equip check valves with a lever and weight for controlling the operation of the valve. No spring operated check valves will be permitted.

c) Access Opening.

(1) Provide an equipment access opening in the top slab of the vault, directly over the center of the check valve. Provide an opening large enough to allow for removal of the check valve.

(2) Provide a personnel access opening in the top of the slab of the vault, located in such a way that there are no obstructions to climb up and down the ladder.

g. Backflow Preventers.

1) Backflow preventers are required when the design has a direct connection between the WSSC water system (potable) and other water systems or equipment containing water or unknown substancees, including but not limited to the following:

a) Fire sprinkler service connection

b) Fire hydrant meter

c) Irrigation system

d) Commercial and industrial connections

2) See requirements for installing and testing backflow preventers in The Plumbing Code.

3) During the design, determine if the design requires a backflow preventer to be installed.

h. Butterfly Valves.

1) WSSC will determine if the design requires the use of butterfly valves in lieu of gate valves and will provide design requirements. Typically, butterfly valves are not permitted.

2) See requirements under Design Guideline 28-ME-DG-03, "Mechanical and Electrical Design Guidelines for Control Valves Vaults in the Water Distribution System that are to be Electrically Operated and Remotely Controlled".

i. Eccentric Plug Valves.

1) In most cases, plug valves are used as the bypass valve in altitude valve vaults and in some cases for pressure reducing valve vaults.

2) Plug valves can be used for direct buried service, see Part One, Section 18 (Pipeline Valves).

3) The plug rotates and has a passageway or port through it. The plug valve requires a one-quarter turn to move from the fully open to fully closed position. Plug valves may be used for throttling the flow of water through the pipeline.

4) WSSC will determine if the design requires the installation of plug valves.

5) Determine the appropriate location for the plug valve and submit design for approval.

6) Plug valve and piping arrangements.

a) Design a vault to house the plug valve and appurtenances. For additional requirements, see General Valve and Piping Arrangements in Vaults, in this section. For information on using plug valves for direct buried service, see requirements for gates valves, Part One, Section 18 (Pipeline Valves).

b) Eccentric plug valves shall have the plug stored in the upper quadrant of the valve body when the valve is fully open. The plug would then have to rotate downward to close. Show on the drawing the location of the plug seat when closed on the drawings.

c) Orient the plug so that the seat is opposite the high pressure side of the piping when in the closed position.

d) Access Opening.

(1) Provide an equipment access opening in the top slab of the vault directly over the center of the plug valve. The opening must be large enough to allow for removal of the plug valve.

(2) Provide a personnel access opening in the top slab of the vault in such a way that there are no obstructions to climb up and down the ladder or manhole steps. If the design requires two (2) parallel valves and piping, provide the opening between the valves.

e) Piping Layout.

(1) For requirements for vault piping when using eccentric plug valves, see gate valves, Part One, Section 18 (Pipeline Valves). Also see altitude and pressure reducing valves, in this section.

(2) The ends of the plug valves are to have flanged ends for vault installation and mechanical joint ends for direct burial installation.

j. Line Stop.

1) When shutdowns are determined to be impossible, line stops can be designed to temporarily shut down the existing water pipeline, see the Specification for requirements. Special thrust restraint will be required to restrain the line stop, see Part Three, Section 27 (Thrust Restraint Design for Buried Piping).

2) WSSC will determine if the design requires the installation of line stop.

3) Line stops provide a way to insert a temporary plug into an existing water pipeline through a tapping tee, stopping the flow of water to facilitate repairs, maintenance or connections without disrupting service.

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AWWA Free Water Audit Software: Reporting Worksheet

WAS v5.0
American Water Works Association
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? Click to access definition
+ Click to add a comment

Water Audit Report for: City of Cleveland Heights
Reporting Year: 2013 | 1/2013 - 12/2013

Please enter data in the white cells below. Where available, metered values should be used; if metered values are unavailable please estimate a value. Indicate your confidence in the accuracy of the input data by grading each component (n/a or 1-10) using the drop-down list to the left of the input cell. Hover the mouse over the cell to obtain a description of the grades

All volumes to be entered as: MILLION GALLONS (US) PER YEAR

To select the correct data grading for each input, determine the highest grade where the utility meets or exceeds all criteria for that grade and all grades below it.

<----------- Enter grading in column 'E' and 'J' ---------->

WATER SUPPLIED

	Grade	Value	Unit	Master Meter and Supply Error Adjustments: Grade	Pcnt	Value	Unit
Volume from own sources:	n/a		MG/Yr				MG/Yr
Water imported:	3	3,149.000	MG/Yr	1		-182.224	MG/Yr
Water exported:	1	52.000	MG/Yr	1		-133.751	MG/Yr
WATER SUPPLIED:		3,145.473	MG/Yr				

Enter negative % or value for under-registration
Enter positive % or value for over-registration

AUTHORIZED CONSUMPTION

Click here: ? for help using option buttons below

	Grade	Value	Unit	Pcnt	Value	Unit
Billed metered:	4	1,196.592	MG/Yr			
Billed unmetered:	n/a		MG/Yr			
Unbilled metered:	3	20.000	MG/Yr			
Unbilled unmetered:		39.318	MG/Yr	1.25%		MG/Yr

Default option selected for Unbilled unmetered - a grading of 5 is applied but not displayed

AUTHORIZED CONSUMPTION:		1,255.910	MG/Yr

Use buttons to select percentage of water supplied OR value

WATER LOSSES (Water Supplied - Authorized Consumption)

1,889.563 MG/Yr

Apparent Losses

	Grade	Value	Unit	Pcnt	Value	Unit
Unauthorized consumption:		7.864	MG/Yr	0.25%		MG/Yr

Default option selected for unauthorized consumption - a grading of 5 is applied but not displayed

	Grade	Value	Unit	Pcnt	Value	Unit
Customer metering inaccuracies:	3	45.564	MG/Yr	3.61%		MG/Yr
Systematic data handling errors:	3	215.000	MG/Yr		215.000	MG/Yr
Apparent Losses:		268.428	MG/Yr			

Real Losses (Current Annual Real Losses or CARL)

Real Losses = Water Losses - Apparent Losses:	1,621.135	MG/Yr
WATER LOSSES:	1,889.563	MG/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 1,948.881 MG/Yr

= Water Losses + Unbilled Metered + Unbilled Unmetered

SYSTEM DATA

	Grade	Value	Unit
Length of mains:	3	170.0	miles
Number of active AND inactive service connections:	4	15,925	
Service connection density:		94	conn./mile main
Are customer meters typically located at the curbstop or property line?		No	
Average length of customer service line:	3	20.0	ft
Average operating pressure:	3	85.0	psi

(length of service line, beyond the property boundary, that is the responsibility of the utility)

COST DATA

	Grade	Value	Unit
Total annual cost of operating water system:	4	$13,018,449	$/Year
Customer retail unit cost (applied to Apparent Losses):	6	$7.00	$/100 cubic feet (ccf)
Variable production cost (applied to Real Losses):	10	$4,348.00	$/Million gallons

☐ Use Customer Retail Unit Cost to value real losses

WATER AUDIT DATA VALIDITY SCORE:

*** YOUR SCORE IS: 40 out of 100 ***

A weighted scale for the components of consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION:

Based on the information provided, audit accuracy can be improved by addressing the following components:

1: Water imported
2: Billed metered
3: Unbilled metered

AWWA Free Water Audit Software v5.0 — Reporting Worksheet 1

AWWA Free Water Audit Software: System Attributes and Performance Indicators

Water Audit Report for: City of Cleveland Heights
Reporting Year: 2013 | 1/2013 - 12/2013

***** YOUR WATER AUDIT DATA VALIDITY SCORE IS: 40 out of 100 *****

System Attributes:

Apparent Losses:	268.428	MG/Yr
+ Real Losses:	1,621.135	MG/Yr
= **Water Losses:**	**1,889.563**	MG/Yr
Unavoidable Annual Real Losses (UARL):	116.68	MG/Yr
Annual cost of Apparent Losses:	$2,513,283	
Annual cost of Real Losses:	$7,048,695	Valued at **Variable Production Cost** Return to Reporting Worksheet to change this assumpiton

Performance Indicators:

Financial:	Non-revenue water as percent by volume of Water Supplied:	62.0%	
	Non-revenue water as percent by cost of operating system:	75.4%	Real Losses valued at Variable Production Cost
Operational Efficiency:	Apparent Losses per service connection per day:	46.18	gallons/connection/day
	Real Losses per service connection per day:	278.90	gallons/connection/day
	Real Losses per length of main per day*:	N/A	
	Real Losses per service connection per day per psi pressure:	3.28	gallons/connection/day/psi
	From Above, Real Losses = Current Annual Real Losses (CARL):	1,621.14	million gallons/year
	Infrastructure Leakage Index (ILI) [CARL/UARL]:	13.89	

* This performance indicator applies for systems with a low service connection density of less than 32 service connections/mile of pipeline

AWWA Free Water Audit Software v5.0 | Performance Indicators 2

AWWA Free Water Audit Software: Water Balance

WAS v5.0

Water Audit Report for:	City of Cleveland Heights	
Reporting Year:	2013	1/2013 - 12/2013
Data Validity Score:	40	

Own Sources (Adjusted for known errors) 0.000	Water Exported 185.751			Billed Water Exported	
	Water Supplied 3,145.473	Authorized Consumption 1,255.910	Billed Authorized Consumption 1,196.592	Billed Metered Consumption (water exported is removed) 1,196.592	Revenue Water 1,196.592
				Billed Unmetered Consumption 0.000	
			Unbilled Authorized Consumption 59.318	Unbilled Metered Consumption 20.000	Non-Revenue Water (NRW) 1,948.881
				Unbilled Unmetered Consumption 39.318	
		Water Losses 1,889.563	Apparent Losses 268.428	Unauthorized Consumption 7.864	
				Customer Metering Inaccuracies 45.564	
				Systematic Data Handling Errors 215.000	
Water Imported 3,331.224			Real Losses 1,621.135	Leakage on Transmission and/or Distribution Mains *Not broken down*	
				Leakage and Overflows at Utility's Storage Tanks *Not broken down*	
				Leakage on Service Connections *Not broken down*	

AWWA Free Water Audit Software v5.0 Water Balance 3


AWWA Free Water Audit Software:
Dashboard
WAS v5.0
American Water Works Association.
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The graphic below is a visual representation of the Water Balance with bar heights propotional to the volume of the audit components
Water Audit Report for: City of Cleveland Heights
Reporting Year: 2013 1/2013 - 12/2013
Data Validity Score: 40
Show me the VOLUME of Non-Revenue Water
Show me the COST of Non-Revenue Water
Total Cost of NRW =$9,186,678
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Water Exported
Water Imported
Volume From Own Sources
Water Supplied
Authorized Consumption
Water Losses
Billed Auth. Cons.
Unbilled Auth. Cons.
Apparent Losses
Real Losses
Revenue Water
Non Revenue Water
Cost $
8,000,000
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
Unbilled metered (valued at Var. Prod. Cost)
Unbilled unmetered (valued at Var. Prod. Cost)
Unauth. consumption
Cust. metering inaccuracies
Syst. data handling errors
Real Losses (valued at Var. Prod. Cost)
AWWA Free Water Audit Software v5.0
Dashboard 4

AWWA Free Water Audit Software: Grading Matrix

The grading assigned to each audit component and the corresponding recommended improvements and actions are highlighted in yellow. Audit accuracy is likely to be improved by prioritizing those items shown in red

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
WATER SUPPLIED											
Volume from own sources:	Select this grading only if the water utility purchases/imports all of its water resources (i.e. has no sources of its own)	Less than 25% of water production sources are metered, remaining sources are estimated. No regular meter accuracy testing or electronic calibration conducted.	25% - 50% of treated water production sources are metered, other sources estimated. No regular meter accuracy testing or electronic calibration conducted.	Conditions between 2 and 4	50% - 75% of treated water production sources are metered, other sources estimated. Occasional meter accuracy testing or electronic calibration conducted.	Conditions between 4 and 6	At least 75% of treated water production sources are metered, or at least 90% of the source flow is derived from metered sources. Meter accuracy testing and/or electronic calibration of related instrumentation is conducted annually. Less than 25% of tested meters are found outside of +/- 6% accuracy.	Conditions between 6 and 8	100% of treated water production sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted annually, less than 10% of meters are found outside of +/- 6% accuracy	Conditions between 8 and 10	100% of treated water production sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually, with less than 10% found outside of +/- 3% accuracy. Procedures are reviewed by a third party knowledgeable in the M36 methodology.
Improvements to attain higher data grading for "Volume from own Sources" component:		to qualify for 2: Organize and launch efforts to collect data for determining volume from own sources	to qualify for 4: Locate all water production sources on maps and in the field, launch meter accuracy testing for existing meters, begin to install meters on unmetered water production sources and replace any obsolete/defective meters.		to qualify for 6: Formalize annual meter accuracy testing for all source meters; specify the frequency of testing. Complete installation of meters on unmetered water production sources and complete replacement of all obsolete/defective meters.		to qualify for 8: Conduct annual meter accuracy testing and calibration of related instrumentation on all meter installations on a regular basis. Complete project to install new, or replace defective existing, meters so that entire production meter population is metered. Repair or replace meters outside of +/- 6% accuracy.		to qualify for 10: Maintain annual meter accuracy testing and calibration of related instrumentation for all meter installations. Repair or replace meters outside of +/- 3% accuracy. Investigate new meter technology; pilot one or more replacements with innovative meters in attempt to further improve meter accuracy.		to maintain 10: Standardize meter accuracy test frequency to semi-annual, or more frequent, for all meters. Repair or replace meters outside of +/- 3% accuracy. Continually investigate/pilot improving metering technology.
Volume from own sources master meter and supply error adjustment:	Select n/a only if the water utility fails to have meters on its sources of supply	Inventory information on meters and paper records of measured volumes exist but are incomplete and/or in a very crude condition; data error cannot be determined	No automatic datalogging of production volumes; daily readings are scribed on paper records without any accountability controls. Flows are not balanced across the water distribution system: tank/storage elevation changes are not employed in calculating the "Volume from own sources" component and archived flow data is adjusted only when grossly evident data error occurs.	Conditions between 2 and 4	Production meter data is logged automatically in electronic format and reviewed at least on a monthly basis with necessary corrections implemented. "Volume from own sources" tabulations include estimate of daily changes in tanks/storage facilities. Meter data is adjusted when gross data errors occur, or occasional meter testing deems this necessary.	Conditions between 4 and 6	Hourly production meter data logged automatically & reviewed on at least a weekly basis. Data is adjusted to correct gross error when meter/instrumentation equipment malfunction is detected; and/or error is confirmed by meter accuracy testing. Tank/storage facility elevation changes are automatically used in calculating a balanced "Volume from own sources" component, and data gaps in the archived data are corrected on at least a weekly basis.	Conditions between 6 and 8	Continuous production meter data is logged automatically & reviewed each business day. Data is adjusted to correct gross error from detected meter/instrumentation equipment malfunction and/or results of meter accuracy testing. Tank/storage facility elevation changes are automatically used in "Volume from own sources" tabulations and data gaps in the archived data are corrected on a daily basis.	Conditions between 8 and 10	Computerized system (SCADA or similar) automatically balances flows from all sources and storages; results are reviewed each business day. Tight accountability controls ensure that all data gaps that occur in the archived flow data are quickly detected and corrected. Regular calibrations between SCADA and sources meters ensures minimal data transfer error.
Improvements to attain higher data grading for "Master meter and supply error adjustment" component:		to qualify for 2: Develop a plan to restructure recordkeeping system to capture all flow data; set a procedure to review flow data on a daily basis to detect input errors. Obtain more reliable information about existing meters by conducting field inspections of meters and related instrumentation, and obtaining manufacturer literature.	to qualify for 4: Install automatic datalogging equipment on production meters. Complete installation of level instrumentation at all tanks/storage facilities and include tank level data in automatic calculation routine in a computerized system. Construct a computerized listing or spreadsheet to archive input volumes, tank/storage volume changes and import/export flows in order to determine the composite "Water Supplied" volume for the distribution system. Set a procedure to review this data on a monthly basis to detect gross anomalies and data gaps.		to qualify for 6: Refine computerized data collection and archive to include hourly production meter data that is reviewed at least on a weekly basis to detect specific data anomalies and gaps. Use daily net storage change to balance flows in calculating "Water Supplied" volume. Necessary corrections to data errors are implemented on a weekly basis.		to qualify for 8: Ensure that all flow data is collected and archived on at least an hourly basis. All data is reviewed and detected errors corrected each business day. Tank/storage levels variations are employed in calculating balanced "Water Supplied" component. Adjust production meter data for gross error and inaccuracy confirmed by testing.		to qualify for 10: Link all production and tank/storage facility elevation change data to a Supervisory Control & Data Acquisition (SCADA) System, or similar computerized monitoring/control system, and establish automatic flow balancing algorithm and regularly calibrate between SCADA and source meters. Data is reviewed and corrected each business day.		to maintain 10: Monitor meter innovations for development of more accurate and less expensive flowmeters. Continue to replace or repair meters as they perform outside of desired accuracy limits. Stay abreast of new and more accurate water level instruments to better record tank/storage levels and archive the variations in storage volume. Keep current with SCADA and data management systems to ensure that archived data is well-managed and error free.
Water imported:	Select n/a if the water utility's supply is exclusively from its own water resources (no bulk purchased/ imported water)	Less than 25% of imported water sources are metered, remaining sources are estimated. No regular meter accuracy testing.	25% - 50% of imported water sources are metered; other sources estimated. No regular meter accuracy testing.	Conditions between 2 and 4	50% - 75% of imported water sources are metered, other sources estimated. Occasional meter accuracy testing conducted.	Conditions between 4 and 6	At least 75% of imported water sources are metered, meter accuracy testing and/or electronic calibration of related instrumentation is conducted annually for all meter installations. Less than 25% of tested meters are found outside of +/- 6% accuracy.	Conditions between 6 and 8	100% of imported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted annually, less than 10% of meters are found outside of +/- 6% accuracy	Conditions between 8 and 10	100% of imported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually for all meter installations, with less than 10% of accuracy tests found outside of +/- 3% accuracy.

AWWA Free Water Audit Software v5.0

Grading Matrix 5

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Improvements to attain higher data grading for "Water Imported Volume" component: *(Note: usually the water supplier selling the water - "the Exporter" - to the utility being audited is responsible to maintain the metering installation measuring the imported volume. The utility should coordinate carefully with the Exporter to ensure that adequate meter upkeep takes place and an accurate measure of the Water Imported volume is quantified.)*		to qualify for 2: Review bulk water purchase agreements with partner suppliers; confirm requirements for use and maintenance of accurate metering. Identify needs for new or replacement meters with goal to meter all imported water sources.	To qualify for 4: Locate all imported water sources on maps and in the field, launch meter accuracy testing for existing meters, begin to install meters on unmetered imported water interconnections and replace obsolete/defective meters.		to qualify for 6: Formalize annual meter accuracy testing for all imported water meters, planning for both regular meter accuracy testing and calibration of the related instrumentation. Continue installation of meters on unmetered imported water interconnections and replacement of obsolete/defective meters.		to qualify for 8: Complete project to install new, or replace defective, meters on all imported water interconnections. Maintain annual meter accuracy testing for all imported water meters and conduct calibration of related instrumentation at least annually. Repair or replace meters outside of +/- 6% accuracy.		to qualify for 10: Conduct meter accuracy testing for all meters on a semi-annual basis, along with calibration of all related instrumentation. Repair or replace meters outside of +/- 3% accuracy. Investigate new meter technology; pilot one or more replacements with innovative meters in attempt to improve meter accuracy.		to maintain 10: Standardize meter accuracy test frequency to semi-annual, or more frequent, for all meters. Continue to conduct calibration of related instrumentation on a semi-annual basis. Repair or replace meters outside of +/- 3% accuracy. Continually investigate/pilot improving metering technology.
Water imported master meter and supply error adjustment:	Select n/a if the imported water supply is unmetered, with imported water quantities estimated on the billing invoices sent by the Exporter to the purchasing Utility.	Inventory information on imported meters and paper records of measured volumes exist but are incomplete and/or in a very crude condition; data error cannot be determined. Written agreement(s) with water Exporter(s) are missing or written in vague language concerning meter management and testing.	No automatic datalogging of imported supply volumes; daily readings are scribed on paper records without any accountability controls to confirm data accuracy and the absence of errors and data gaps in recorded volumes. Written agreement requires meter accuracy testing but is vague on the details of how and who conducts the testing.	Conditions between 2 and 4	Imported supply metered flow data is logged automatically in electronic format and reviewed at least on a monthly basis by the Exporter with necessary corrections implemented. Meter data is adjusted by the Exporter when gross data errors are detected. A coherent data trail exists for this process to protect both the selling and the purchasing Utility. Written agreement exists and clearly states requirements and roles for meter accuracy testing and data management.	Conditions between 4 and 6	Hourly imported supply metered data is logged automatically & reviewed on at least a weekly basis by the Exporter. Data is adjusted to correct gross error when meter/instrumentation equipment malfunction is detected; and to correct for error confirmed by meter accuracy testing. Any data gaps in the archived data are detected and corrected during the weekly review. A coherent data trail exists for this process to protect both the selling and the purchasing Utility.	Conditions between 6 and 8	Continuous imported supply metered flow data is logged automatically & reviewed each business day by the Importer. Data is adjusted to correct gross error from detected meter/instrumentation equipment malfunction and/or results of meter accuracy testing. Any data errors/gaps are detected and corrected on a daily basis. A data trail exists for the process to protect both the selling and the purchasing Utility.	Conditions between 8 and 10	Computerized system (SCADA or similar) automatically records data which is reviewed each business day by the Exporter. Tight accountability controls ensure that all error/data gaps that occur in the archived flow data are quickly detected and corrected. A reliable data trail exists and contract provisions for meter testing and data management are reviewed by the selling and purchasing Utility at least once every five years.
Improvements to attain higher data grading for "Water imported master meter and supply error adjustment" component:		to qualify for 2: Develop a plan to restructure recordkeeping system to capture all flow data; set a procedure to review flow data on a daily basis to detect input errors. Obtain more reliable information about existing meters by conducting field inspections of meters and related instrumentation, and obtaining manufacturer literature. Review the written agreement between the selling and purchasing Utility.	to qualify for 4: Install automatic datalogging equipment on imported supply meters. Set a procedure to review this data on a monthly basis to detect gross anomalies and data gaps. Launch discussions with the Exporters to jointly review terms of the written agreements regarding meter accuracy testing and data management; revise the terms as necessary.		to qualify for 6: Refine computerized data collection and archive to include hourly imported supply metered flow data that is reviewed at least on a weekly basis to detect specific data anomalies and gaps. Make necessary corrections to errors/data errors on a weekly basis.		to qualify for 8: Ensure that all imported supply metered flow data is collected and archived on at least an hourly basis. All data is reviewed and errors/data gaps are corrected each business day.		to qualify for 10: Conduct accountability checks to confirm that all imported supply metered data is reviewed and corrected each business day by the Exporter. Results of all meter accuracy tests and data corrections should be available for sharing between the Exporter and the purchasing Utility. Establish a schedule for a regular review and updating of the contractual language in the written agreement between the selling and the purchasing Utility; at least every five years.		to maintain 10: Monitor meter innovations for development of more accurate and less expensive flowmeters; work with the Exporter to help identify meter replacement needs. Keep communication lines with Exporters open and maintain productive relations. Keep the written agreement current with clear and explicit language that meets the ongoing needs of all parties.
Water Exported:	Select n/a if the water utility sells no bulk water to neighboring water utilities (no exported water sales)	Less than 25% of exported water sources are metered, remaining sources are estimated. No regular meter accuracy testing.	25% - 50% of exported water sources are metered; other sources estimated. No regular meter accuracy testing	Conditions between 2 and 4	50% - 75% of exported water sources are metered, other sources estimated. Occasional meter accuracy testing conducted.	Conditions between 4 and 6	At least 75% of exported water sources are metered, meter accuracy testing and/or electronic calibration conducted annually. Less than 25% of tested meters are found outside of +/- 6% accuracy.	Conditions between 6 and 8	100% of exported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted annually, less than 10% of meters are found outside of +/- 6% accuracy	Conditions between 8 and 10	100% of exported water sources are metered, meter accuracy testing and electronic calibration of related instrumentation is conducted semi-annually for all meter installations, with less than 10% of accuracy tests found outside of +/- 3% accuracy.

AWWA Free W[illegible] Audit Software v5.0 [illegible]ng Matrix 6

Grading >>>	n/a	1	2	3	4	5	6	7	8	9	10
Improvements to attain higher data grading for "Water Exported Volume" component: *(Note: usually, if the water utility being audited sells (Exports) water to a neighboring purchasing Utility, it is the responsibility of the utility exporting the water to maintain the metering installation measuring the Exported volume. The utility exporting the water should ensure that adequate meter upkeep takes place and an accurate measure of the Water Exported volume is quantified.)*		to qualify for 2: Review bulk water sales agreements with purchasing utilities; confirm requirements for use & upkeep of accurate metering. Identify needs to install new, or replace defective meters as needed.	To qualify for 4: Locate all exported water sources on maps and in field, launch meter accuracy testing for existing meters, begin to install meters on unmetered exported water interconnections and replace obsolete/defective meters		to qualify for 6: Formalize annual meter accuracy testing for all exported water meters. Continue installation of meters on unmetered exported water interconnections and replacement of obsolete/defective meters.		to qualify for 8: Complete project to install new, or replace defective, meters on all exported water interconnections. Maintain annual meter accuracy testing for all exported water meters. Repair or replace meters outside of +/- 6% accuracy.		to qualify for 10: Maintain annual meter accuracy testing for all meters. Repair or replace meters outside of +/- 3% accuracy. Investigate new meter technology; pilot one or more replacements with innovative meters in attempt to improve meter accuracy.		to maintain 10: Standardize meter accuracy test frequency to semi-annual, or more frequent, for all meters. Repair or replace meters outside of +/- 3% accuracy. Continually investigate/pilot improving metering technology.
Water exported master meter and supply error adjustment:	Select n/a only if the water utility fails to have meters on its exported supply interconnections.	Inventory information on exported meters and paper records of measured volumes exist but are incomplete and/or in a very crude condition; data error cannot be determined. Written agreement(s) with the utility purchasing the water are missing or written in vague language concerning meter management and testing.	No automatic datalogging of exported supply volumes; daily readings are scribed on paper records without any accountability controls to confirm data accuracy and the absence of errors and data gaps in recorded volumes. Written agreement requires meter accuracy testing but is vague on the details of how and who conducts the testing.	Conditions between 2 and 4	Exported metered flow data is logged automatically in electronic format and reviewed at least on a monthly basis, with necessary corrections implemented. Meter data is adjusted by the utility selling (exporting) the water when gross data errors are detected. A coherent data trail exists for this process to protect both the utility exporting the water and the purchasing Utility. Written agreement exists and clearly states requirements and roles for meter accuracy testing and data management.	Conditions between 4 and 6	Hourly exported supply metered data is logged automatically & reviewed on at least a weekly basis by the utility selling the water. Data is adjusted to correct gross error when meter/instrumentation equipment malfunction is detected; and to correct for error found by meter accuracy testing. Any data gaps in the archived data are detected and corrected during the weekly review. A coherent data trail exists for this process to protect both the selling (exporting) utility and the purchasing Utility.	Conditions between 6 and 8	Continuous exported supply metered flow data is logged automatically & reviewed each business day by the utility selling (exporting) the water. Data is adjusted to correct gross error from detected meter/instrumentation equipment malfunction and any error confirmed by meter accuracy testing. Any data errors/gaps are detected and corrected on a daily basis. A data trail exists for the process to protect both the selling (exporting) Utility and the purchasing Utility.	Conditions between 8 and 10	Computerized system (SCADA or similar) automatically records data which is reviewed each business day by the utility selling (exporting) the water. Tight accountability controls ensure that all error/data gaps that occur in the archived flow data are quickly detected and corrected. A reliable data trail exists and contract provisions for meter testing and data management are reviewed by the selling Utility and purchasing Utility at least once every five years.
Improvements to attain higher data grading for "Water exported master meter and supply error adjustment" component:		to qualify for 2: Develop a plan to restructure recordkeeping system to capture all flow data; set a procedure to review flow data on a daily basis to detect input errors. Obtain more reliable information about existing meters by conducting field inspections of meters and related instrumentation, and obtaining manufacturer literature. Review the written agreement between the utility selling (exporting) the water and the purchasing Utility.	to qualify for 4: Install automatic datalogging equipment on exported supply meters. Set a procedure to review this data on a monthly basis to detect gross anomalies and data gaps. Launch discussions with the purchasing utilities to jointly review terms of the written agreements regarding meter accuracy testing and data management; revise the terms as necessary.		to qualify for 6: Refine computerized data collection and archive to include hourly exported supply metered flow data that is reviewed at least on a weekly basis to detect specific data anomalies and gaps. Make necessary corrections to errors/data errors on a weekly basis		to qualify for 8: Ensure that all exported metered flow data is collected and archived on at least an hourly basis. All data is reviewed and errors/data gaps are corrected each business day.		to qualify for 10: Conduct accountability checks to confirm that all exported metered flow data is reviewed and corrected each business day by the utility selling the water. Results of all meter accuracy tests and data corrections should be available for sharing between the utility and the purchasing Utility. Establish a schedule for a regular review and updating of the contractual language in the written agreements with the purchasing utilities; at least every five years.		to maintain 10: Monitor meter innovations for development of more accurate and less expensive flowmeters; work with the purchasing utilities to help identify meter replacement needs. Keep communication lines with the purchasing utilities open and maintain productive relations. Keep the written agreement current with clear and explicit language that meets the ongoing needs of all parties.
AUTHORIZED CONSUMPTION											
Billed metered:	n/a (not applicable). Select n/a only if the entire customer population is not metered and is billed for water service on a flat or fixed rate basis. In such a case the volume entered must be zero.	Less than 50% of customers with volume-based billings from meter readings; flat or fixed rate billing exists for the majority of the customer population	At least 50% of customers with volume-based billing from meter reads; flat rate billing for others. Manual meter reading is conducted, with less than 50% meter read success rate, remainding accounts' consumption is estimated. Limited meter records, no regular meter testing or replacement. Billing data maintained on paper records, with no auditing.	Conditions between 2 and 4	At least 75% of customers with volume-based, billing from meter reads; flat or fixed rate billing for remaining accounts. Manual meter reading is conducted with at least 50% meter read success rate; consumption for accounts with failed reads is estimated. Purchase records verify age of customer meters, only very limited meter accuracy testing is conducted. Customer meters are replaced only upon complete failure. Computerized billing records exist but only sporadic internal auditing conducted.	Conditions between 4 and 6	At least 90% of customers with volume-based billing from meter reads; consumption for remaining accounts is estimated. Manual customer meter reading gives at least 80% customer meter reading success rate; consumption for accounts with failed reads is estimated. Good customer meter records exist, but only limited meter accuracy testing is conducted. Regular replacement is conducted for the oldest meters. Computerized billing records exist with annual auditing of summary statistics conducting by utility personnel.	Conditions between 6 and 8	At least 97% of customers exist with volume-based billing from meter reads. At least 90% customer meter reading success rate; <u>or</u> at least 80% read success rate with planning and budgeting for trials of Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) in one or more pilot areas. Good customer meter records. Regular meter accuracy testing guides replacement of statistically significant number of meters each year. Routine auditing of computerized billing records for global and detailed statistics occurs annually by utility personnel, and is verified by third party at least once every five years.	Conditions between 8 and 10	At least 99% of customers exist with volume-based billing from meter reads. At least 95% customer meter reading success rate; <u>or</u> minimum 80% meter reading success rate, with Automatic Meter Reading (AMR) or Advanced Metering Infrastructure (AMI) trials underway. Statistically significant customer meter testing and replacement program in place on a continuous basis. Computerized billing with routine, detailed auditing, including field investigation of representative sample of accounts undertaken annually by utility personnel. Audit is conducted by third party auditors at least once every three years.

AWWA Free Water Audit Software v5.0 Grading Matrix 7