Appendix A-5

Cathodic Protection Grout Maintenance

Appendix A-5

Cathodic Protection Grout Maintenance

Background

The Ellis Avenue Pipeline is cathodically protected using a sacraficial anode. An anode is located at each Legacy Well site. The anode is made of zinc and buried underground, vertically and encased inside a 4-inch PVC sleeve. Hydrated bentonite mud is placed in the annular space between the 4-inch PVC and the zinc anode. Over time the mud level in the PVC drops and the mud sometimes dry's out. A PM work order is issed biannually to replenish or rehydrate the mud.

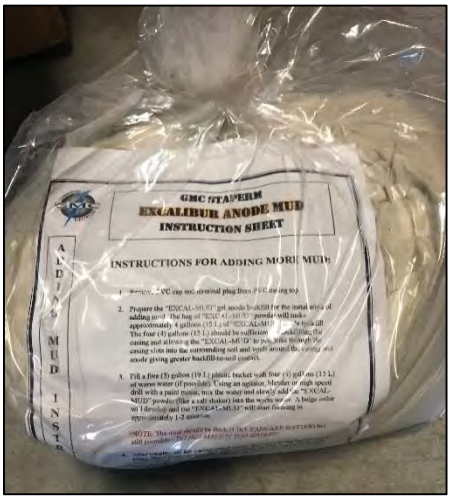
How to Replenish Mud

- Secure mud powder from the Barrier Shop (clear bag – manufacturer = Excaliber)
- Place dry powder in 5-gallon bucket and mix with water using drill motor attachment for stirring or by hand with a piece of rod or pipe.
- Carefully move wires off to one side.
- Once mud is mixed and resembles pancake batter, pour the mud into the annular space between the PVC and anode. Fill up to the vent notch but do not fill higher than the notch inside the PVC.
- Gently center the wires inside the PVC
- Replace the PVC cap
- Replace the cast iron can lid

To Hydrate Mud

- Remove can lid
- Remove PVC cap and carefully move test wires to one side
- Add water
- Stir mud / water combination carefully with tile probe or rod or piece of rebar
- Gently center the wires inside the PVC
- Replace the PVC cap
- Replace the cast iron can lid

Note: sometimes a hard clump may be presnt. If so, remove the clump, smash clump into powder, place powder inside the PVC and add water, stir gently.



Bag of dry powder. The dry powder is mixed with water to generate the replenishment mud that surrounds the sacrificial anode.

Cathodic protection anode cover. Each Legacy Well has an anode located near the vault.

The cathodic protection sacrificial anode. Test wires are seen near the surface and connect to the anode. The IRSO carefully pours the mud around the anode inside the PVC sleeve.

Appendix A-6

Laser Turbidity Monitoring Stations – Standard Operating Procedures

Appendix A-6

Laser Turbidity Monitoring Stations – Standard Operating Procedures

Staff operates and maintains three Hach FT-660 Laser Turbidimeters with SC200 controllers .

Staff maintains a log book for each instrument to document the field visit and to assist in correlating the data after the download.

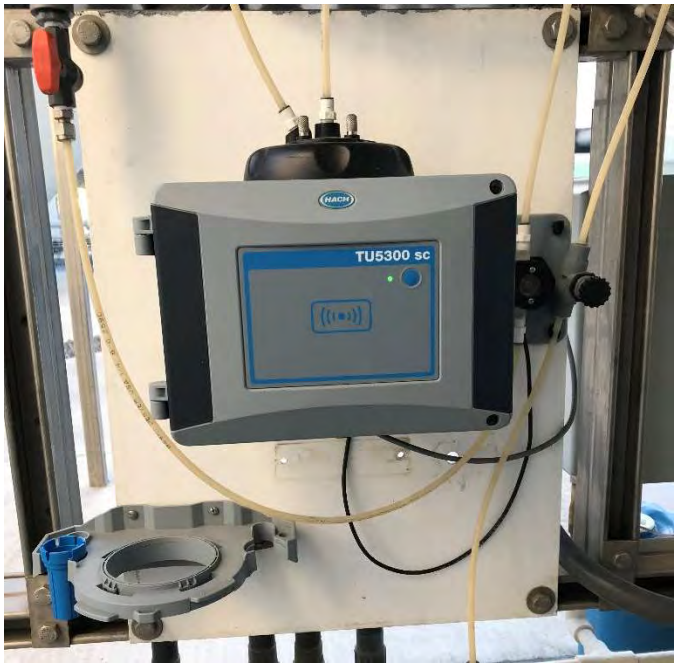
During routine site visits please:

- enter in the log book the date and time (from the SC200), and the value present on the instrument display.
- The roto-meter (flow meter) is recording the flow entering the FT-660, enter this value.

Laser Turbidity Maintenance (Monthly with Barrier Operation support)

Observe the flow-meter; its normal flow rate at MBI-1 is about0.25 liters per minute. Maintain flow during this cleaning.

- On a weekly basis or at least monthly, carefully lift off the head and set it in a safe space to the side.
- Stop the flow of water from the source.
- Observe the sediment in the pot if any.
- Remove sensor vile with the blue plastic tool. Unscrew vile counterclockwise.
- Clean Vile with the squeege tool(it looks like a not driver with a rubber end).
- Wipe the lens with Kem-wipes, carefully!
- Screw vile on with blue tool, make sure the O-ring is still in-tact.
- Observe the value increasing and note the value lowering to a more reasonable value. This could take up to 10 minutes. Note in the log book all activity.



The manufacturer's operation manual for this instrument can be found at:

Double click on the Hach image to obtain the manual for the sc200 controller

Double click on the FT 660 image to obtain the manual

Use the link below to access the manual for the TU 5300 sc unit:

https://images.hach.com/asset-get.download.jsa?code=202423

Specifications of interest

Range 0-5NTU with +10% over-range limits

Accuracy + or – 3 % of the reading or + or - 5mNTU

Resolution .001 on the lowest range

Calibration frequency every 3 months (or per regulation) we use 6 months

Sample requirements flow 0.25 to 0.50 liters/minute (1.6 to 11.9 gph)

Appendix A-7

By-Pass Filter Monitoring

Appendix A-7

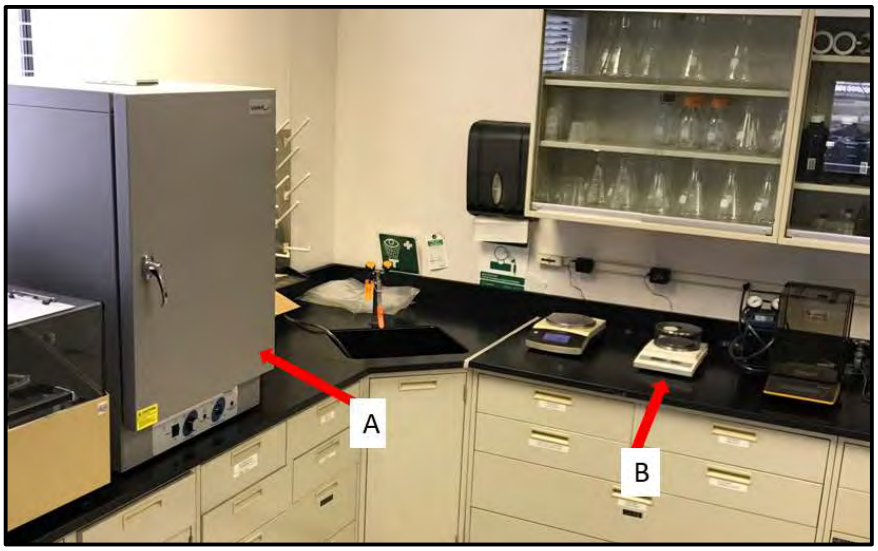
By-Pass Filter Monitoring

Background

The by-pass filter test study is used to determine the amount of solids that are present in the water flowing from the plant to the injection wells. A pair of filters, (one 5 micron and one 1 micron) are used to capture solids in the water and are placed in various locations through the distribution system.

Operation

New filter elements are weighed using the Area 145 Research Center laboratory scale and labeled with location by the IRSO. Install the filter elements in the cartridge housing, water passes first through the 5 micron followed by the 1 micron. After 200,000 gallons passed through the filters (or plugged conditions) the filters are taken off-line. The IRSO removes the filters and places them in the Research Center Lab to drip dry. After the filters are drip dried, the IRSO uses the laboratory oven set at "level 3" to dry the filter elements completely. Once completely dry, the filter elements are weighed (in grams) using the laboratory scale shown in the image below. The difference between the before weight and the after weight is the amount of solids that have been captured.



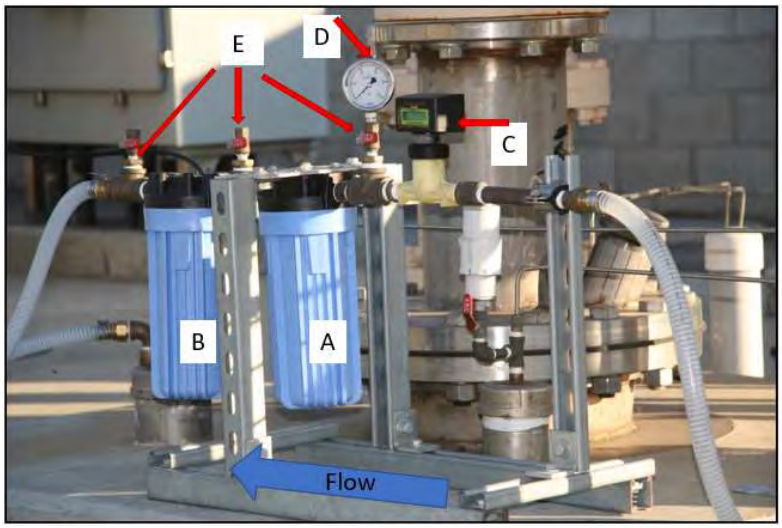
Area 145 Research Center Laboratory. Filter elements are dried in the oven **(A)** and weighed on the scale **(B)**.

The by-pass filter skid has one gauge with three individual valves to measure the differential pressure drop across each filter.

Pressure readings are taken by opening the influent valve (vent any air using the valve under the gauge) record the reading. Close the influent and open the mid-fluent valve, record the reading, close the mid-fluent valve, open the effluent valve, record the reading.

The flow rate through the filters is adjusted to 5 gpm, if possible. The flow meter can be switched to flow or totalizer by pressing slightly on the face plate button (mode/reset button) on the flow meter

momentarily, to switch between them. Track the total by noting the value on the field sheet. The totalizer will only read to 99,999 gallons. Holding down on the reset will reset the totalizer to “0”. Note on the field sheet when the totalizer has been reset.



Bypass Filter Skid. **(A)** 5 micron filter housing, **(B)** 1 micron filter housing, **(C)** flow totalizer, **(D)** removable pressure gauge, **(E)** pressure measuring ports.

The totalized flow should be reset when the total has reached 70,000 to 80,000 gallons to avoid a rollover to zero. The bypass filters at 5 gpm total approximately 7,000 gallons per day.

Flow passes through the filters continuously for approximately 200,000 to 250,000 gallons.

Please complete the following upon a field visit.

- Date
- Time
- Inlet pressure (5mc)
- Outlet pressure (between the 5 and 1 mc filters)
- Outlet pressure (1mc)
- Flow Rate
- Totalized flow (slightly press momentary to switch between rate and total) Holding this down will clear the totalizer.

Bypass Filter System

Location:_____

Start weight (g)

Well totalized this run

PLEASE RESET and NOTE on SHEET. Totalizer will stop at 99,999.

Filter Totalized | end wt# | 5 | 1

		5-micron filter Pressure (psi)		1-micron filter Pressure (psi)				
Date	Time	Inlet	Outlet	Inlet	Outlet	Flow (gpm)	Total (gallons)	Comments

Figure 1 Typical field worksheet for the by-pass filter study.

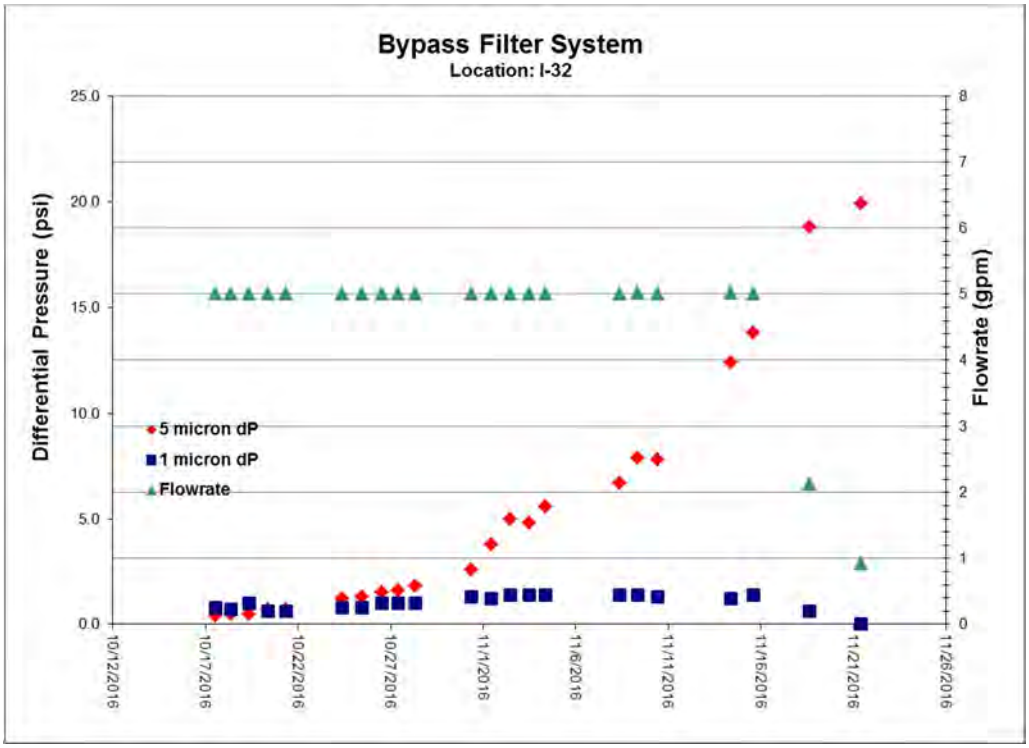


Figure 2 Typical graph depicting 23 field visits during the completed filter run.

Appendix A-8

Corrosion Monitoring Station Operation

Appendix A-8

Corrosion Monitoring Station Operation

Background

The IRSO is responsible for operating the District's corrosion monitoring system housed in the RO Building. The corrosion monitoring system is comprised of two parts 1) traditional corrosion coupons and 2) real-time Linear Polarization Resistance (LPR) monitoring.

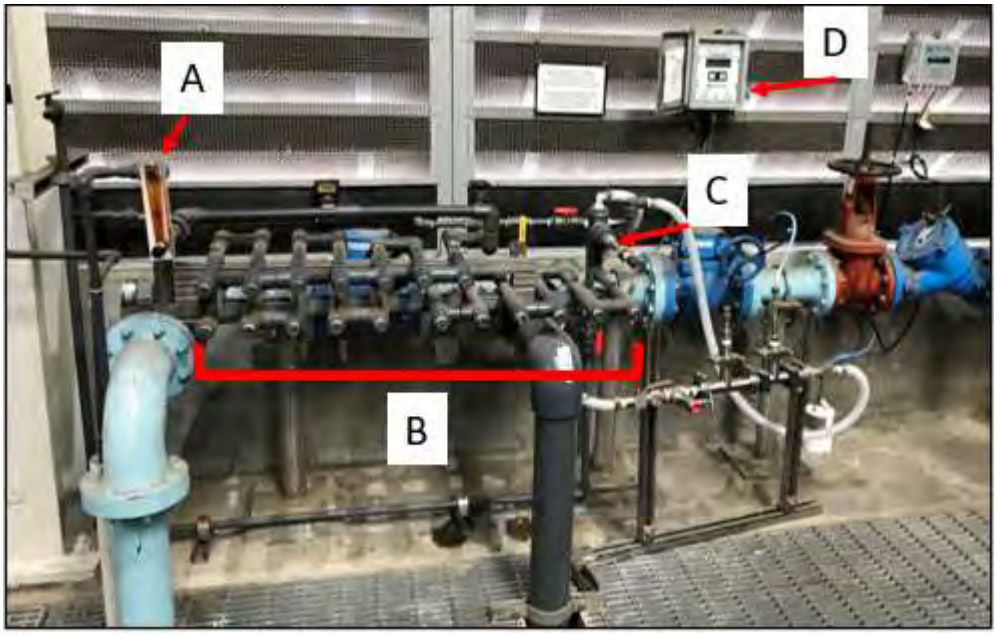
Traditional Corrosion Coupons

Traditional corrosion coupons of known alloy types similar to the metal types used in the distribution system. Alloys included are summarized in the table below:

Alloy	Representative Facility
Mild Steel: C1018 and A516	GWRS Pipeline shell, portions of Barrier Pipeline
Copper: CDA 110	RO pump motor cooling tubing
Ductile Iron: DC	Ellis Avenue Pipeline
Stainless Steel: 304	Blank injection well casing
Stainless Steel: 316L	Injection well screens

The coupons are weighed at the Metal Sample Company before the IRSO loads the coupons into a PVC serpentine circulating flow at 5 gpm. Water continuously passes through the serpentine. One coupon of each alloy is removed from the serpentine after 3 month, 6 months and annually by the IRSO. The coupons are then sent to Metals Samples Company in Munford, Alabama using prelabeled envelopes provided by Metal Samples Company via Fed Ex. Metals Samples Company removes all of the corrosion, weighs the coupon and subtracts from the preloaded weight to determine the corrosion rate. The results from Metal Samples are compiled in a 3-ring binder maintained by the Injection Well Supervisor.

The District has two corrosion monitoring stations: 1) circulates Reverse Osmosis Permeate (ROP) or unstabilized water that has already passed through the reverse osmosis (RO) process and 2) final product water (FPW) or stabilized RO water. The ROP station is located in the western RO building basement. The FPW station is located along the eastern wall of the main floor of the RO building as shown in the figure below.



Corrosion Monitoring Station – FPW **(A)** Meter measuring influent flow rate **(B)** traditional coupon serpentine, the endcaps unthread to receive the coupons **(C)** LPR Probe **(D)** LPR download interface unit (Hoffman Box).

Linear Polarization Resistance (LPR) data download

Downloading LPR Data (downloaded monthly)

1. Connect the (optiport) cable to the Hoffman Box (data logger) and the computer (USB port on the right-hand side of computer is “Com 3”
2. Open “Metal Sample” software on computer and select “Instrument Download Center.”
3. 3. Select MS3500 (left-hand column of computer screen)
4. Select “connect” (left-hand column of computer screen). “Port Status” (bottom left) should change from “off” to “on”.
5. Wake up instrument by hitting either “1” or “2” on the data logger control panel.
6. Scroll to “Upload to PC” and select enter (the number “2”).
7. On data logger select “upload to PC” (red data should populate on computer screen)
8. After all data is downloaded (red numbers stop moving), select SAVE (left-hand side of computer screen). Save as a “.cvs” file to computer desk top drive referencing the date in the file name.

Purge LPR Data from Datalogger

1. Wake up data logger by selecting “1” or “2” on the data logger control panel.
2. Scroll to and select “Enter Probe I.D.”, then enter “2.”
3. Select “Delete All Readings”, then hit “2.”
4. Select “Delete From Probe ID” and manually enter “6220”, then hit “2.”
5. Select “LPR3A”, then hit “2.”

6. Scroll to “G10180” (this is the alloy type), hit “2.”
7. Hit “enter” or “2” through all parameters until the data logger displays “Measure Probe” message.
8. When “Measure Probe” screen is displayed you are done
9. Double check by selecting “view stored data” on the data logger control panel. There should be no stored data at this time. If there is stored data, repeat steps 1 through 8 above.

Storing Data File

1. Move data file from computer desktop drive to the following H:drive location: H:\documents\WaterProd\Barrier\Real Time Corrosion Monitoring\ FPW Data

***Note*:** Make sure the download date is part of the file name

Close up image of LPR download interface unit (Hoffman Box).

Appendix A-9

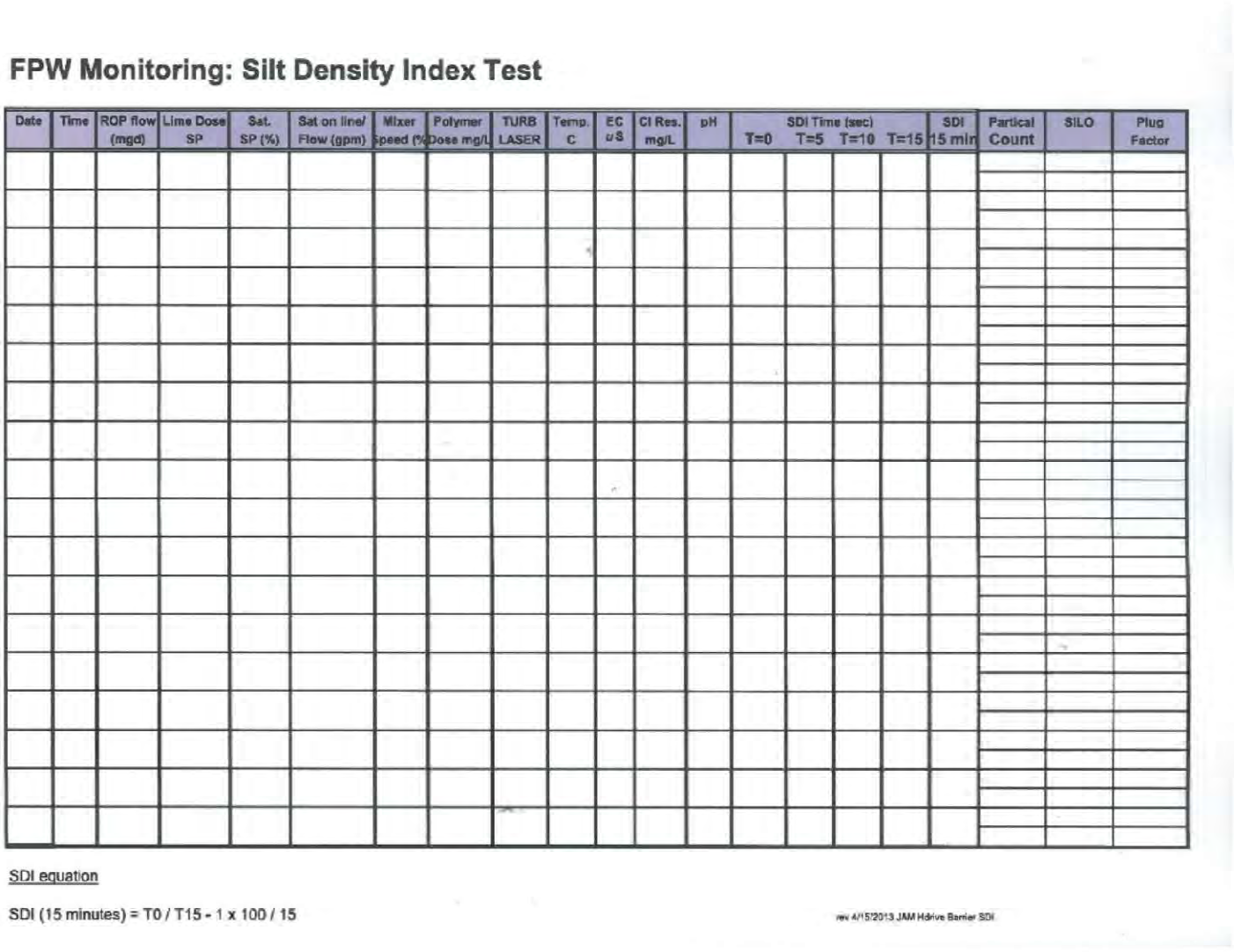
Silt Density Index Test Procedures

Appendix A-9

Silt Density Index Test Procedures

Silt Density Index (SDI) measurements are collected by the IRSO once a week at the Product Water quality monitoring station and at Mid Basin Injection Well MBI-1 (Edinger Avenue @ the Santa Ana River). The SDI readings help the operations group understand the fouling potential of the GWRS finished product water. The SDI equipment is contained in a small plastic box with a handle and stored in the Barrier shop. The SDI filters are stocked in the warehouse.

In addition to the SDI reading, the IRSO completes a Finished Product Water Monitoring Data sheet and transfers information from the sheet to a database. This module will guide the IRSO through the steps to complete the data sheet and provide a pathway to the data base for data entry. The "FPW Monitoring: Silt Density Index Test" is electronically located here:
H:\OCWD\Operations\Water Production\Water Production Shared\WaterProd\Barrier\Forms\SDI_FPW
An image of this sheet is shown below:



FPW Monitoring: Silt Density Index Test

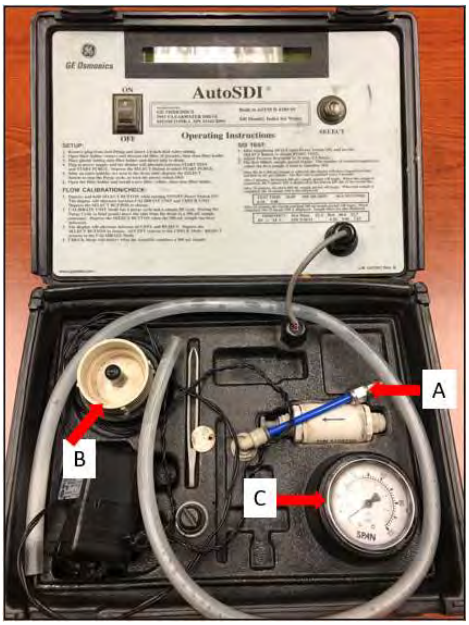
Date	Time	ROP flow (mgd)	Lime Dose SP	Sat. SP (%)	Sat on line/ Flow (gpm)	Mixer Speed (%	Polymer Dose mg/L	TURB LASER	Temp. C	EC uS	Cl Res. mg/L	pH	SDI Time (sec) T=0	T=5	T=10	T=15	SDI 15 min	Partical Count	SILO	Plug Factor

SDI equation

SDI (15 minutes) = T0 / T15 - 1 x 100 / 15

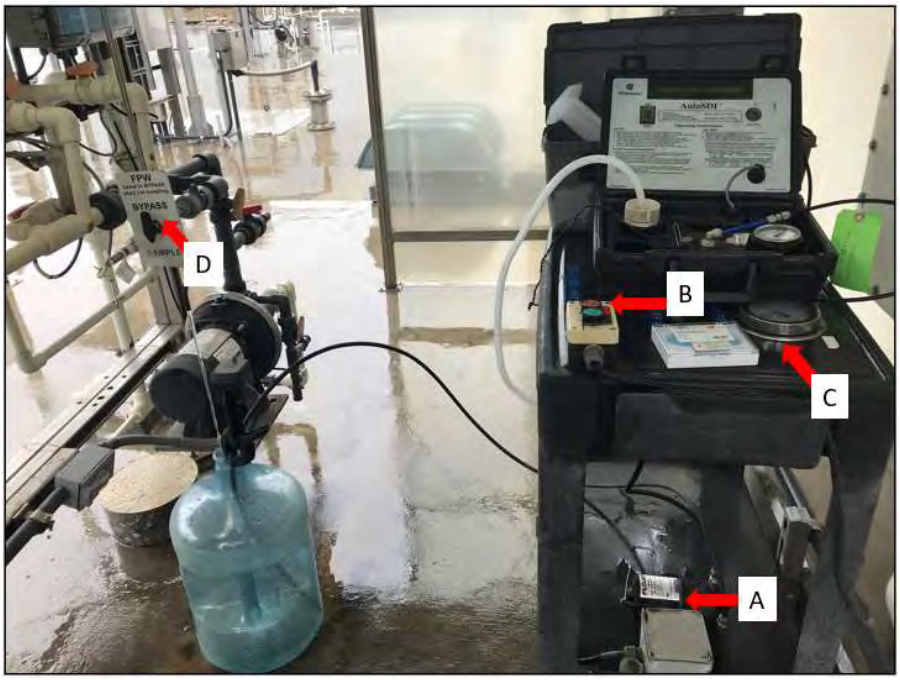
rev 4/15/2013 JAM Hdrive Barrier SDI

SDI Auto Sampler Test Procedure



Auto SDI unit. **(A)** influent line **(B)** filter housing **(C)** Auto SDI influent pressure gauge.

- Connect source water to the auto sampler (Figure 1).
  A) If source water is over 30 PSI connect directly to the auto sampler.
  B) If source water is less than 30 PSI run water into a container and use the pump system on the standard SDI test skid to create 30 PSI. (Figure 2)



AutoSDI unit set up for readings at FPW on GWRS campus. At this location source water is less than 30psi so an auxiliary pump system is used. Note the source water is delivered from the storage container into the auxiliary pump unit and into the AutoSDI unit using black tubing. **(A)** Auxiliary pump unit **(B)** auxiliary pump control **(C)** pressure gauge from auxiliary pump **(D)** FPW source water valve.

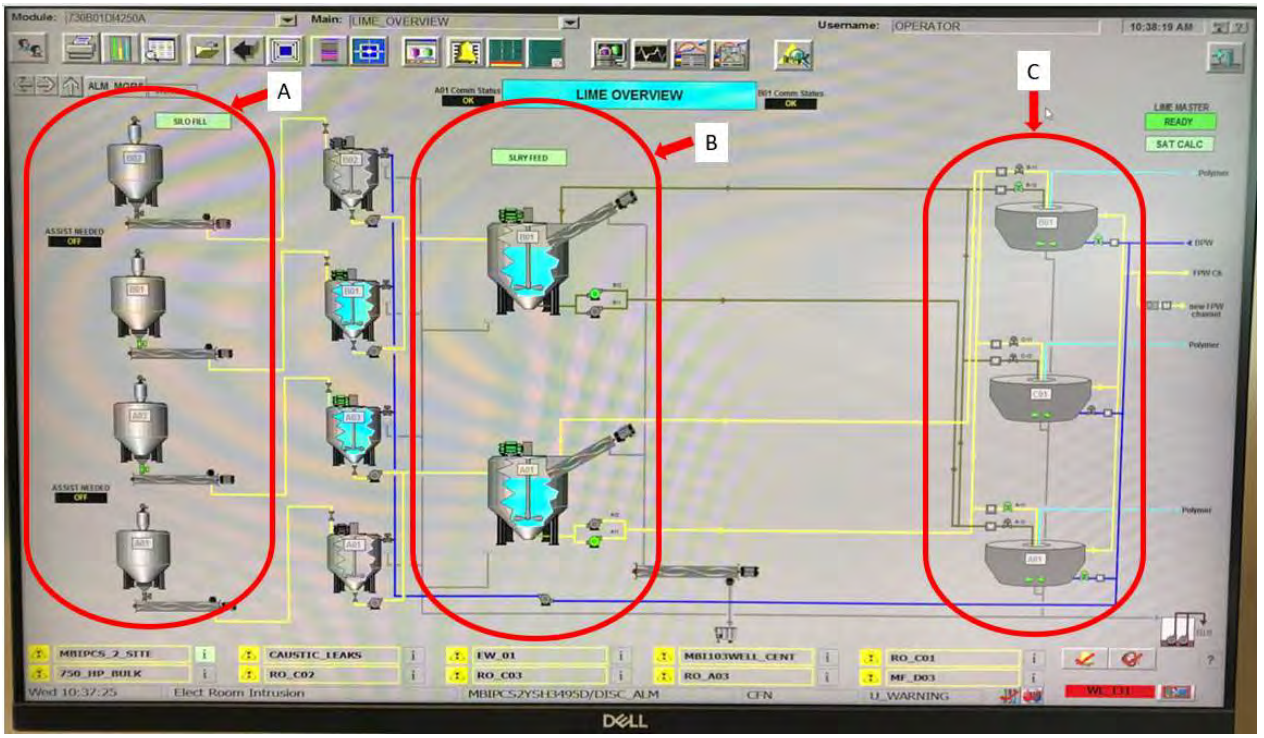
- Check to see that there is no filter in the filter housing and connect discharge hose to the housing outlet stub.
- Plug in the power cord.
- Turn on the auto sampler with the toggle switch and it will display start test and purge alternately, push the select button when it displays purge and gently shake the auto SDI kit to remove any air in the unit and filter housing. When the air changes to all water press the select switch again to stop the purge mode.
- Open the filter housing and install a .45-micron filter using the tweezers provided in the kit, it should come out of the filter pack and go into the housing without being flipped. This will ensure that the shiniest side of the filter paper is facing the incoming flow of water.
- Center the filter paper with the tweezers and screw the filter housing together it only needs to be tight enough to make a little water come out of the filter housing discharge stub. Reopen filter housing and readjust the paper if it is not centered. Then screw the lid down again (a little water may come out again).
- Wait for the display to say start test and then press the select button. The auto sampler will perform all the steps of the test by timing 0,5,10 and15 minutes and running 500 ml of water at each interval. The times displayed should be increasing during each interval or else the filter is being bypassed.
- During the test, record various water quality parameters on the SDI form log found at: H:\OCWD\Operations\Water Production\Water Production Shared\WaterProd\Barrier\Forms\SDIformlog. Record the following: particle counter flowrate, (use a timer and graduated cylinder the flow rate should be 100 ml/min (+/- 3ml) and take high and low particle readings from its display during the test. Open the Finished Product Water Quality instrument cabinet and record: the turbidity reading on the display, water temperature, conductivity, chlorine residual, and pH readings.

Finished Product Water Quality instrument cabinet

- While the 15 minute SDI test is occurring, the IRSO should also visit the saturator area. and note the secchi disc information from the data sheet on the clipboard at the top of the saturator. Also observe the conditions of operating saturators. Note the condition of the blanket on the top of the saturator, also look for suspended solids (jellyfish) and the condition of the cloud at the bottom. Wind and precipitation should also be noted. All of these observations are noted in the "comments" column of the database found at: H:\OCWD\Operations\Water Production\Water Production Shared\WaterProd\Barrier\Forms\SDI_FPW
- When the auto sampler shows test done enter the 0,5,10,15-minute times and the 15-minute SDI value and the plug factor then record them on the form. Note the plug factor value.

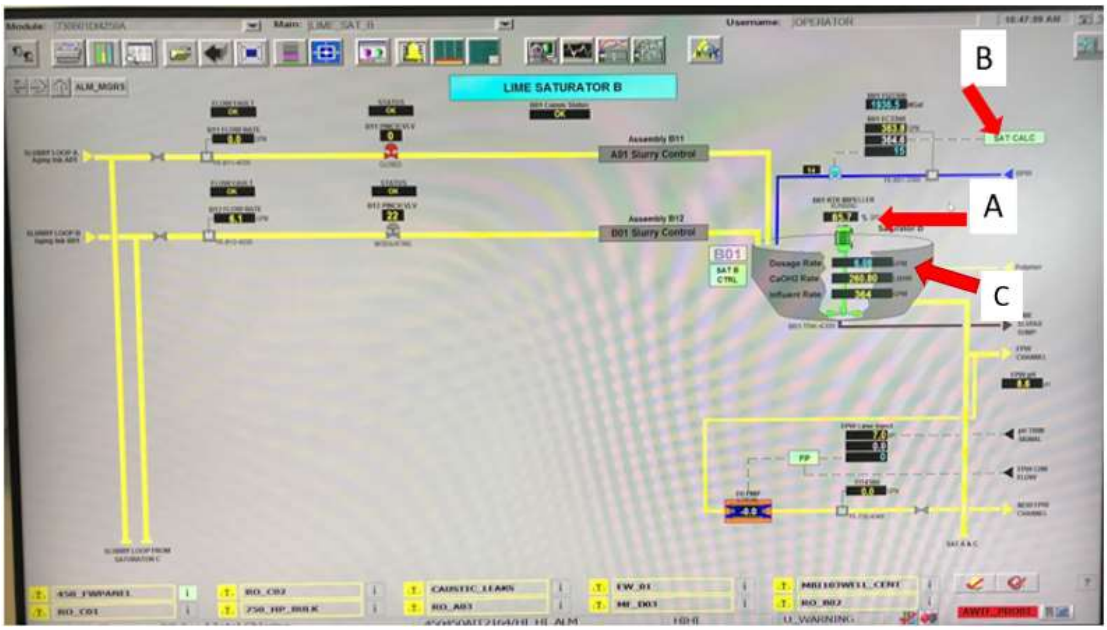
Following the SDI test, the IRSO completes the remaining Finished Product Water Monitoring data sheet by performing the following using Delta V.

- In Delta V navigate to the Process Overview page and select the tan box near the bottom center of the page entitled "Lime Addition" and the following screen will populate:

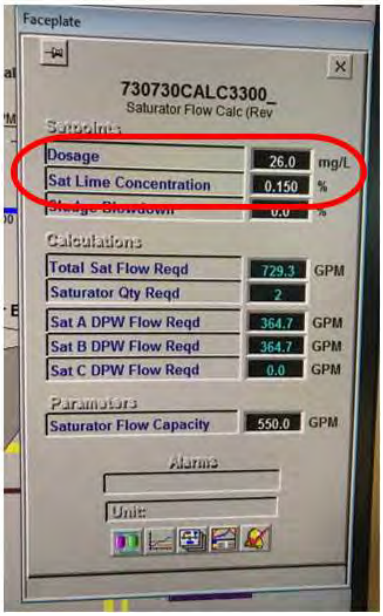


Operating silos can be seen along left margin as indicated in red oval “A”. Operating silos are the silos not labeled “off” and have a green valve at the base of the silo. Operating saturators have blue water inside the saturator graphic as shown in red oval “B”.

- Select one of the saturator icons in red oval “C” and the following screen will populate.

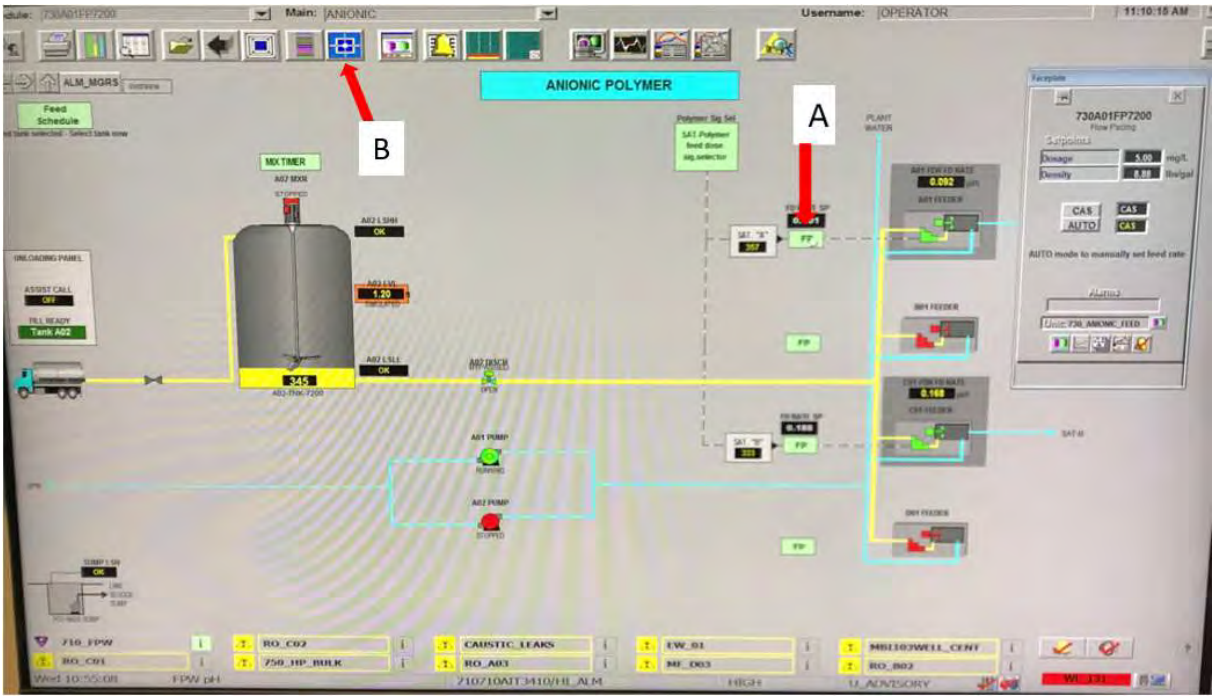


The **mixer speed (%)** can be viewed in the window labeled with red arrow “A” above. The saturator flow **(Sat on-line/ Flow (gpm**)) can be seen at the red arrow “C”. Select “SAT CALC” tab as shown by red arrow “B” and the following face plate will populate:

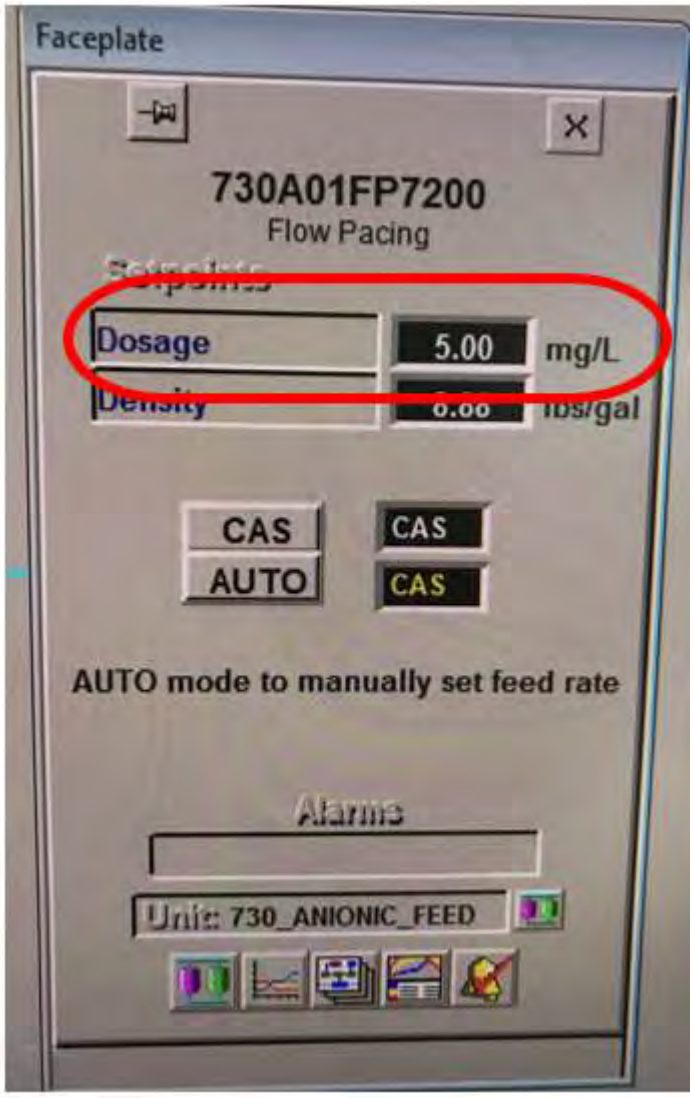


Lime dose and saturator **SP %** information is shown inside the red oval.

- To obtain the polymer dose information navigate back to the “Process Overview” page and click on the tan box entitled "Anionic Polymer” located near the bottom center of the page and the following screen will populate.



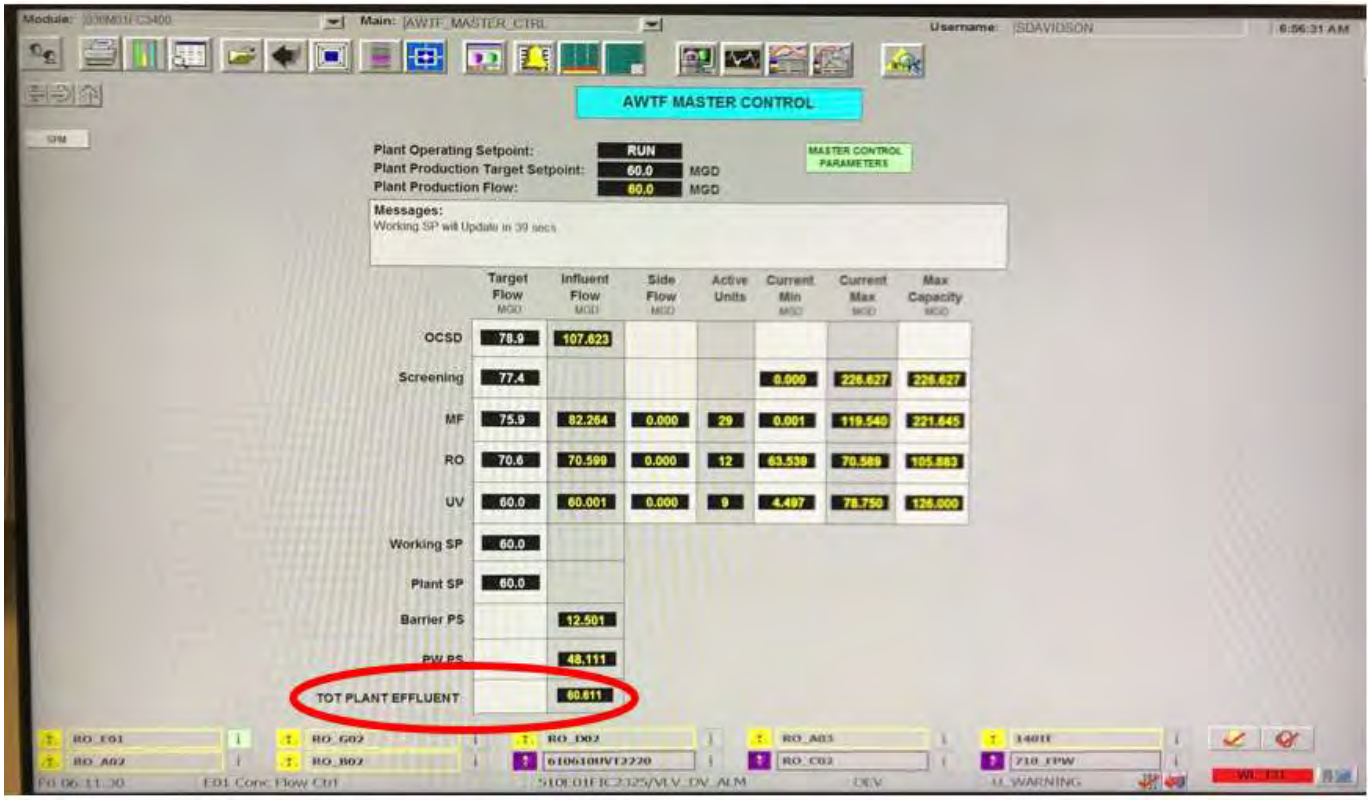
For the saturator of interest select the green box labeled “FP” and the following faceplate will populate:



The **polymer dose (mg/L)** can be seen inside the red oval in the image above.

- Record values for all four feeders to show which ones are online and offline.

- Exit the faceplate above and select the icon at the top of the screen as indicated by red arrow “B” as show on the Anionic Polymer screen above and the following screen will populate:



The **ROP flow (mgd)** can be seen inside the red oval.

- Enter all data from the “FPW Monitoring: Silt Density Index Test” form into the SDI data base found here:

  H:\OCWD\Operations\Water Production\Water Production Shared\WaterProd\Barrier\SDI

Appendix A-10

Import Water Connection – SEB (OC-44) Flow Control-Delta V

Appendix A-10

Import Water Connection – SEB (OC-44) Flow Control Delta V

Background

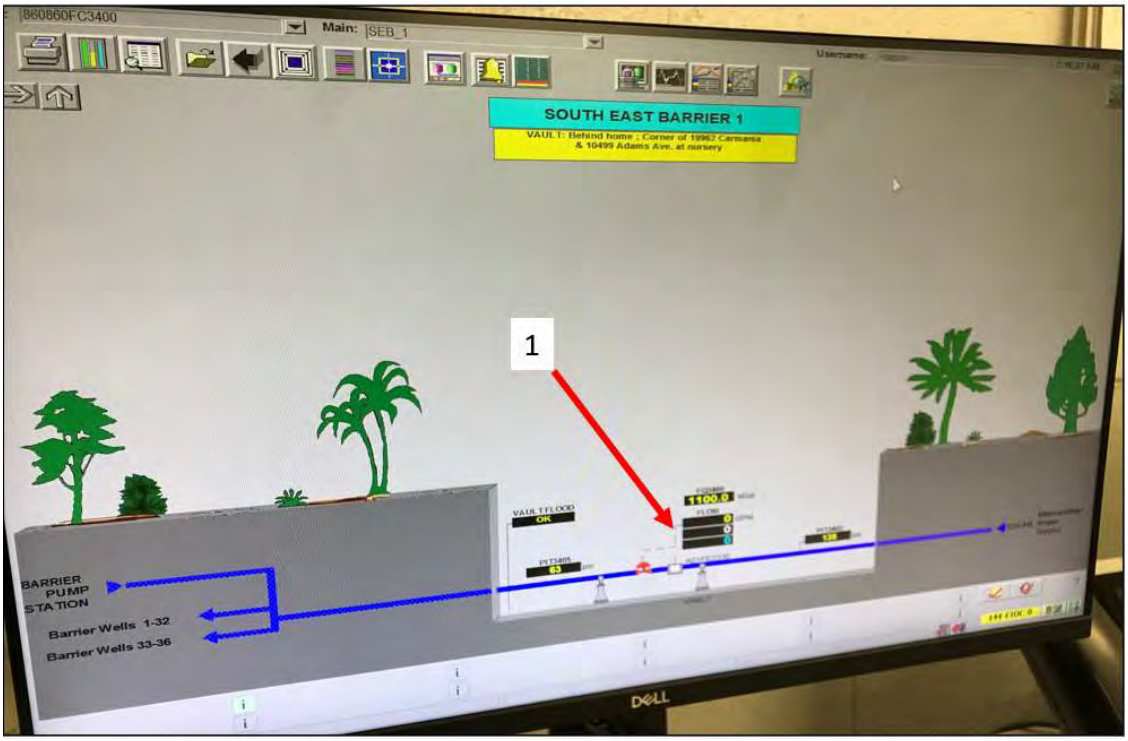
The District has an import water connection from MWD to the Barrier through OC-44, which flows into the South East Barrier Pipeline. This connection is to be used as a back-up to the City of Fountain Valley import water connection. Between September 30 and May 1 the IRSO should seek approval from their supervisor prior to taking OC-44 flow into the Barrier. The OC-44 connection can flow up to 6,000 gallons gpm and is controlled through Delta V. The following procedure describes how to control flow from OC-44 in Delta V.

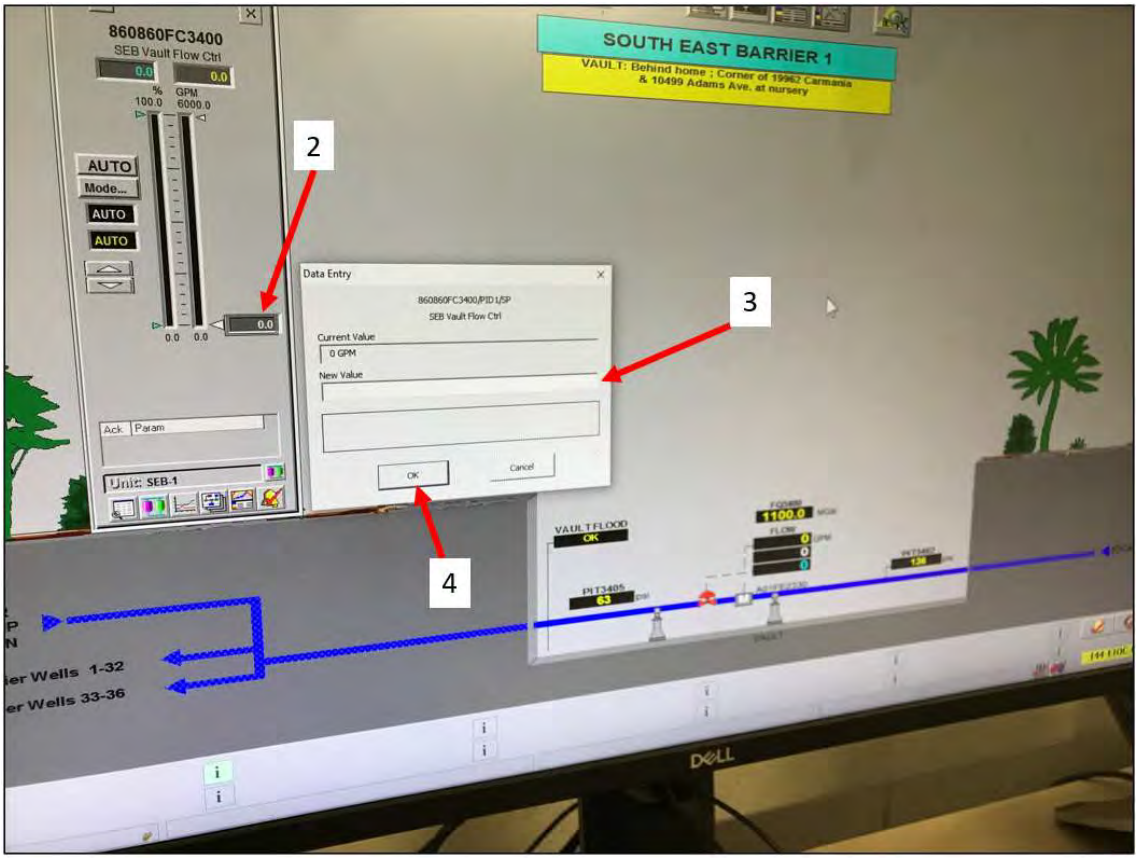
Procedure

- In Delta V bring up the Barrier Overview Page entitled "Barrier Wells" and a map showing all the injection wells appears. Locate "SEB-1" in the lower right-hand corner of the screen and click it.
- The "South East Barrier 1" screen populates. On this screen click the FQ 3400 flow entry box as shown in #1 on image below, a detailed faceplate will populate.
- From this detailed faceplate, select and click the sliding scale button shown in #2 on the second image below.
- The SEB Vault flow control data entry box will populate. Enter the desired flow rate in gpm where the #3 is shown on the second image below.
- Click "OK" where #4 is shown on the second image below.

Note:

The IRSO tries to use import flow to stay ahead of what is leaving the pipeline by a differential of about 200 gpm until stability is reached. The IRSO strives to maintain a pipeline pressure of 60 psi at the GWRS treatment facility.


860860FC3400
Main: SEB_1
SOUTH EAST BARRIER 1
VAULT: Behind home ; Corner of 19962 Carmania & 10499 Adams Ave. at nursery
1
VAULTFLOOD
OK
1100.0
BARRIER PUMP STATION
Barrier Wells 1-32
Barrier Wells 33-36
DELL


860860FC3400
SEB Vault Flow Ctrl
SOUTH EAST BARRIER 1
VAULT: Behind home ; Corner of 19962 Carmania & 10499 Adams Ave. at nursery
2
3
4
AUTO
Mode...
Data Entry
860860FC3400/PID LSP
SEB Vault Flow Ctrl
Current Value
0 GPM
New Value
OK
Cancel
Ack
Param
Unit: SEB-1
VAULTFLOOD
OK
1100.0
Barrier Wells 1-32
Barrier Wells 33-36
DELL

Appendix A-11

Imported Water Connection – City of Fountain Valley Flow Control SOP

Appendix A-11

Imported Water Connection – City of Fountain Valley Flow Control SOP

Background:

The first choice of import supply to the Barrier is always the City of Fountain Valley (CFV) connection. This is for political purposes. CFV flow tops out at 800 gpm. MWD's OC-44 connection along the South East Barrier (SEB) Pipeline is another imported water connection that is available to the IRSO after using the CFV connection. The CFV connection is drinking water, that supplies the GWRS Air Gap. The connection can also supply the barrier through a pressure control valve (Cla-Val).

Procedures:

- **In the event of a plant shutdown:**
    - Get all but a few wells offline as soon as possible, leaving 100 gpm running. I-2 and I-21 wells can be targeted to stay online to achieve this flow target.
    - In Delta V, on the Fountain Valley City Water page, enter a set point of 200 gpm for the controller (controller should be in "auto" mode).
    - Next, manually reduce the barrier pressure via Delta V in no more than 5 psi increments from 60 psi to 53 psi. The lower barrier pressure set point will allow the Fountain Valley connection Cla-Val to open and establish flow.
    - After you are stable at 200 gpm, increase the flow in 100 gpm increments, allowing stabilization with each flow change. Max flow is 800 gpm (at the request of Fountain Valley, subject to change) **NOTE**: **Your flow should be 200 gpm higher than the combined well flows at minimum.**
    - With the CFV connection online, you can secure the barrier pumps to stop FPW distribution until the plant can be restarted.
    - Make a courtesy call to the City of Fountain Valley to inform them of the usage. (Production manager Tom Grose: 714-593-4615)

- **Restarting the Plant**

    - Once the plant is restarted and the barrier pipeline pressure is approximately 45-60 psi, the barrier pump can be set to match the pipeline pressure and brought online (refer to Appendix A-20).

    - After a few wells have been restarted, the barrier pressure can be set to 60 psi and placed in auto. This will cause the CFV connection Cla-Val pilot to take control and close the valve in response to the pressure setting.

    - With the barrier pressure back to its' normal operating pressure of 60 psi, you can now enter a 0 (zero) gpm set point for the CFV connection controller via Delta V.

    - Restart any remaining wells to get back to pre-shutdown levels, the Lag 1 and Lag 2 barrier pumps will start automatically as needed.

Fountain Valley Flow Controller (VC-22-D) tied to Delta V faceplate (120120FC5791)

(FLOW CONTROLLER INSTRUCTIONS CAN BE FOUND INSIDE THE PANEL AT THE FOUNTAIN VALLEY CONNECTION)

Note: written instruction for the manual operation of the Cla-Val VC 22-D controller is inside the enclosure that the controller is mounted to.

- Delta V flow controller 120120FC5791 should always be set to "auto."

- Fountain Valley flow controller needs to be in "auto" in order to take commands from Delta V. The controller is in AUTO if the button labeled MANUAL is not illuminated red. If the MANUAL button is red, then it is in manual mode and will only take flow set points from the controller, ignoring Delta V.

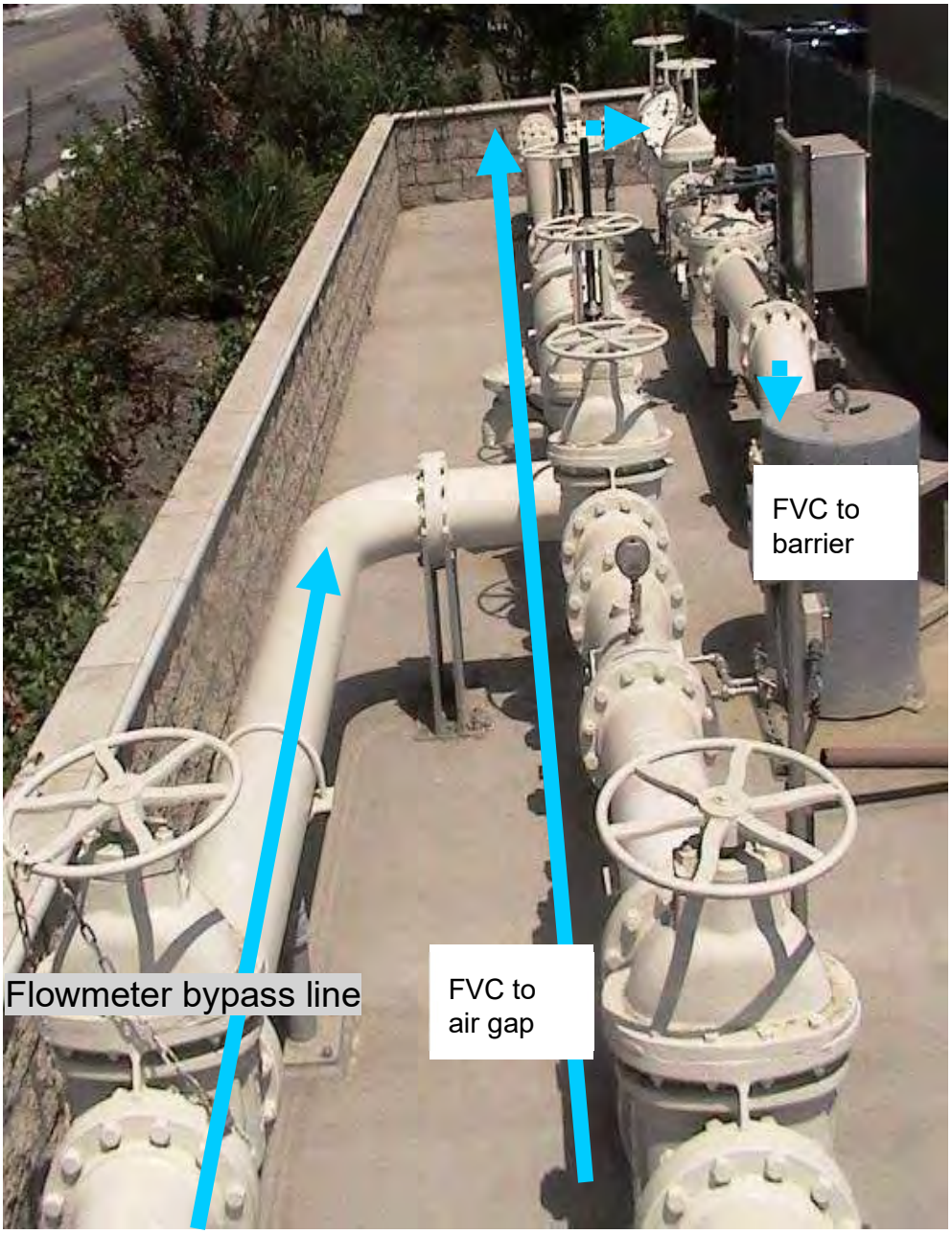
- If the controller is in MANUAL, you will need to press the MANUAL button. It will request a password: use the up / down arrow keys to change the display value to 21. keep pressing the up button until 21 is displayed. It will then read CORRECT, confirming the password entry.

- Now, you can press the MANUAL button to set the state of the controller to either MANUAL (lit red) or AUTO (not lit red).

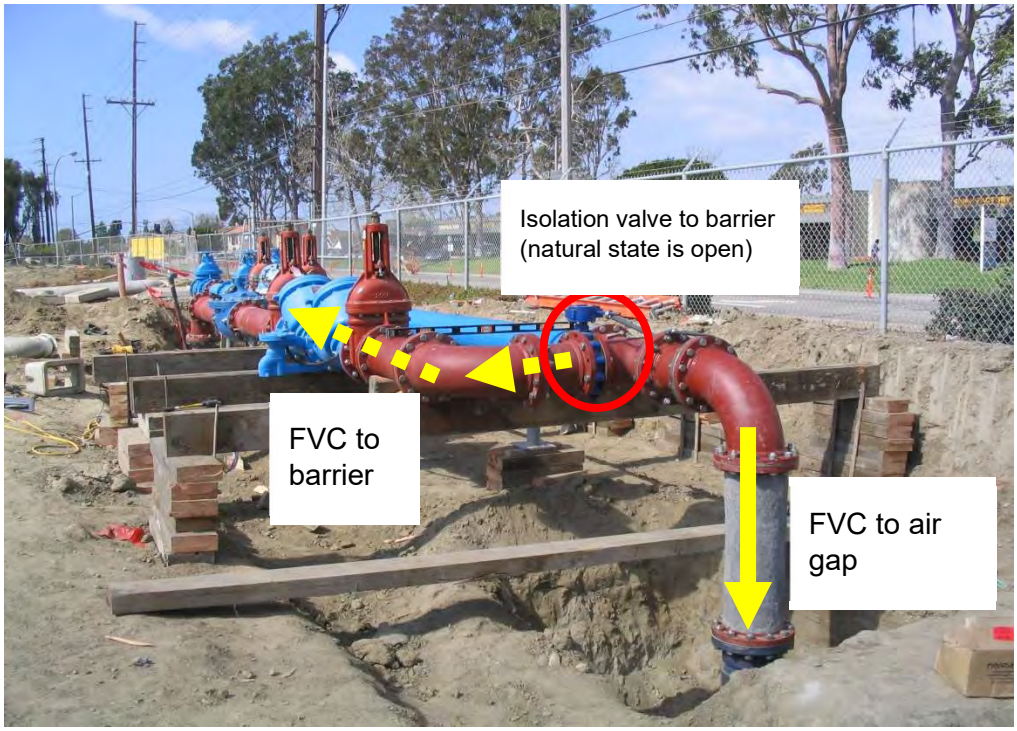
- The controller also needs to be in RSP mode to respond to Delta V commands. Press the SET PT button: it will ask for a password. Use the up/down arrow keypad to change the display value to 21. Text will appear to inform you the password is correct.

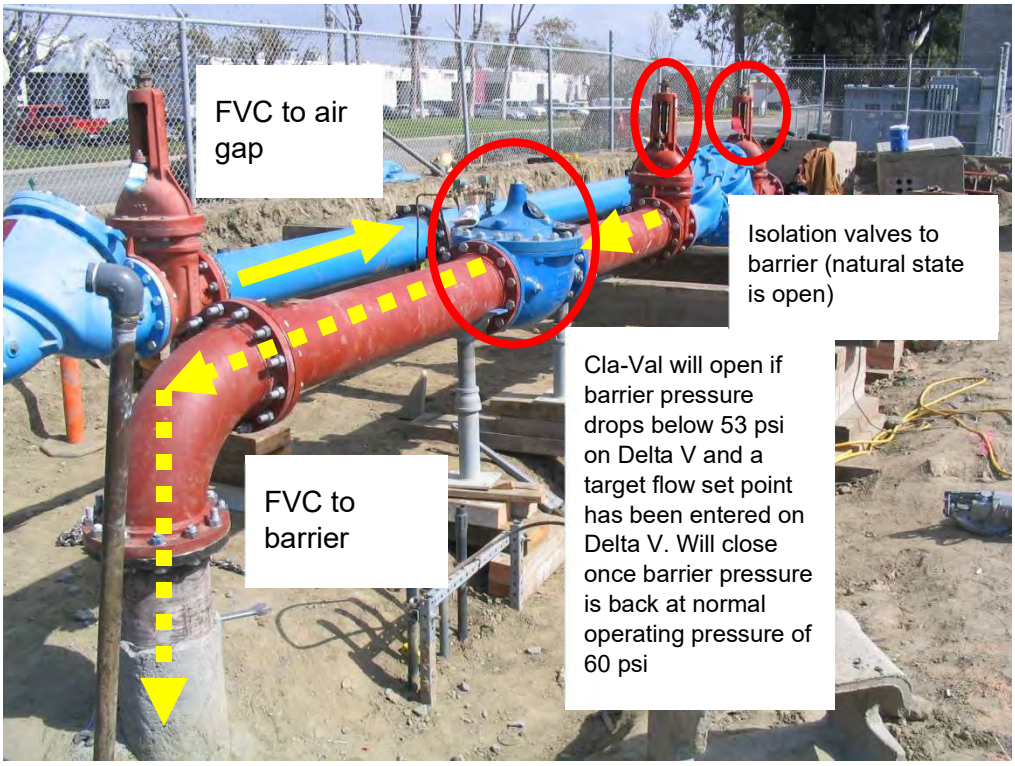
- Now the SET PT button can be pressed again to display SP or RSP. The SET PT button will be lit red. If it is not on SP or RSP, hit the display.

- button to toggle between settings.



CFV water supply to Air Gap PS (and can also supply Barrier through pressure reducing and pressure control valve and its own backflow device. Currently shutoff. Used while plant was being built and could replace or supplement OC-44, but it would be well water to well vs. surface water to well)


Isolation valve to barrier (natural state is open)
FVC to barrier
FVC to air gap


FVC to air gap
Isolation valves to barrier (natural state is open)
Cla-Val will open if barrier pressure drops below 53 psi on Delta V and a target flow set point has been entered on Delta V. Will close once barrier pressure is back at normal operating pressure of 60 psi
FVC to barrier

Cla-Val controller VC-22-D Flow Controller

Written instructions for this controller can be found inside the enclosure that the controller is mounted to. The on-line manual for the Cla-Val VC-22-D can be downloaded at:

www.cla-val.com/electronic-products

click on the following links:

1. Valve Controllers
2. VC-22D
3. Technical Manual
4. VC-22D IOM Manual

- The Delta V Fountain Valley City Water gpm controller should always be set to “auto” (faceplate 120120FC5791). This allows the ability to enter a flowrate setpoint and remotely command the valve to open

Appendix A-12

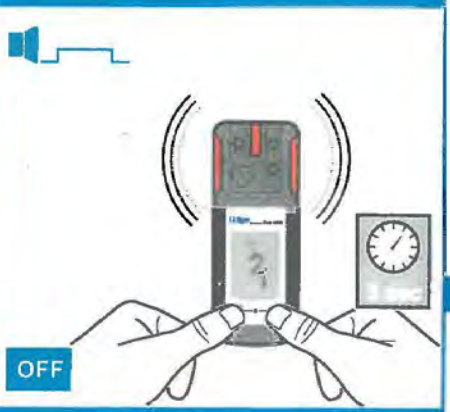
4 Gas Meter Owner's Manual

Dräger X-am 1700/2000/2500/5000/5100/5600

Dräger

Der Betrieb des Gerätes setzt die genaue Kenntnis und Beachtung der Gebrauchsanweisung des Gerätes voraus. Diese Kurzanleitung ersetzt nicht die Gebrauchsanweisung des Gerätes!

Any use of the device requires full understanding and strict observation of the Instructions for Use of the device. This Quick User Guide does not replace the Instructions for Use of the device!



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Dräger X-am® 2500
(MQG 0011)
Software 7.n (≥ 7.0)
Dräger. Technology for Life®

1 For your safety

- Before using this product, carefully read these Instructions for Use and those of the associated products.
- Strictly follow the instructions for Use. The user must fully understand and strictly observe the instructions. Use the product only for the purposes specified in the intended use section of this document.
- Do not dispose of the Instructions for Use. Ensure that they are retained and appropriately used by the product user.
- Only trained and competent users are permitted to use this product.
- Comply with all local and national rules and regulations associated with this product.
- Only trained and competent personnel are permitted to inspect, repair and service the product as detailed in these Instructions for Use (see chapter 5 on page 34). Further maintenance work that is not detailed in these Instructions for Use must only be carried out by Dräger or personnel qualified by Dräger. Dräger recommend a Dräger service contract for all maintenance activities.
- Use only genuine Dräger spare parts and accessories, or the proper functioning of the product may be impaired.
- Do not use a faulty or incomplete product. Do not modify the product.
- Notify Dräger in the event of any component fault or failure.

Safe coupling with electrical device
Electrical connections to devices which are not listed in these Instructions for Use should only be made following consultation with the respective manufacturers or an expert.

Use in areas subject to explosion hazards
Devices or components for use in explosion-hazard areas which have been tested and approved according to national, European or international Explosion Protection Regulations may only be used under the conditions specified in the approval and with consideration of the relevant legal regulations. The devices or components may not be modified in any manner. The use of faulty or incomplete parts is forbidden. The appropriate regulations must be observed at all times when carrying out repairs on these devices or components.

1.1 Definitions of alert icons

The following alert icons are used in this document to provide and highlight areas of the associated text that require a greater awareness by the user. A definition of the meaning of each icon is as follows:

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

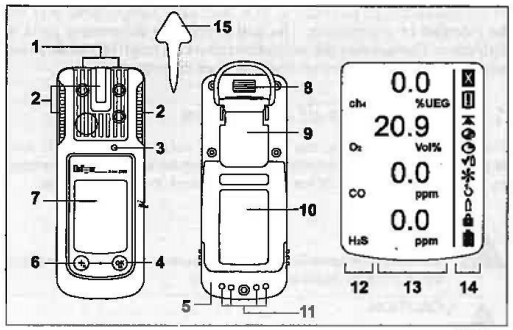
Indicates a potentially hazardous situation which, if not avoided, could result in physical injury, or damage to the product or environment. It may also be used to alert against unsafe practices.

NOTICE

Indicates additional information on how to use the product.

2 Description

2.1 Product overview



1 Gas entry
2 Alarm LED
3 Horn
4 **[OK]** key
5 Power pack
6 **[+]** key
7 Display
8 IR interface
9 Fastening clip
10 Model plate
11 Charging contacts
12 Measured gas display
13 Measuring value display
14 Special symbols
15 Tool for sensor change

Special symbols:

- Fault message
- Warning
- Display peak value
- Display TWA
- Show STEL
- Bump test mode
- Fresh air calibration
- 1-button adjustment
- Single-gas adjustment
- Password necessary
- Battery 100 % full
- Battery 2/3 full
- Battery 1/3 full
- Battery empty

2.2 Intended use

Portable gas detection instrument for the continuous monitoring of the concentration of several gases in the ambient air within the working area and in explosion-hazard areas.
Independent measurement of up to 4 gases, in accordance with the installed Dräger sensors.

Areas subject to explosion hazards, classified by zones
The instrument is intended for the use in explosion-hazard areas of Zone 0, Zone 1 or Zone 2 or in mines at risk due to fire damp. It is intended for use within a temperature range of –20 °C to +50 °C, and for areas in which gases of explosion groups IIA, IIB or IIC and temperature class T3 or T4 (depending on the batteries and rechargeable battery) may be present. If used in mines, the instrument is only to be used in areas known to have a low risk of mechanical impact.

Areas subject to explosion hazards, classified by divisions.
The instrument is intended for use in explosion-hazard areas according to Class I & II, Div. 1 or Div. 2 within a temperature range of –20 °C to +50 °C, and for areas where gases or dusts of groups A, B, C, D, E, F, G and temperature class T3 or T4 may be present (depending on the rechargeable battery and batteries).

WARNING

CSA requirement: Measured values over the full scale value may indicate an explosive atmosphere.

Only applies for class II certification. CSA standard C22.2 no. 152 does not contain any requirements for class II hazard areas. Therefore this device was not tested for class II by the CSA. The sensor may become blocked and not measure the gas correctly or not warn the user that gas measurement is not possible.

WARNING

CSA requirement: The sensitivity must be tested every day before first use using a known concentration of the gas being measured corresponding to 25 to 50 % of the full concentration value. The accuracy must be 0 to +20 % of the daily value. The accuracy may be corrected via calibration.

NOTICE

CSA requirement: Only the combustible gas detection portion of this instrument has been assessed for performance.
The instrument has not been classified by the CSA for use in mines.

2.3 Approvals

Copies of the name plate and the declaration of conformity are provided in the enclosed supplementary documentation (order no. 90 33 890).
Do not stick anything on the name plate on the gas detector. The technical suitability tests are valid for the X-am 2500 gas detection instrument and the calibration cradle. The explosion-protection approvals are only valid for the X-am 2500 gas detection instrument; the calibration cradle must not be used in the Ex zone.
The BVS 10 ATEX E 080 X technical suitability test is based on the adjustment with the target gas.

3 Configuration

NOTICE

Only trained persons are permitted to carry out modifications to the instrument configuration.

To individually configure an instrument with standard configuration, the instrument must be connected to a PC via the USB infrared cable (order no. 83 17 409). The configuration work is carried out using the PC software Dräger CC-Vision. The PC software Dräger CC Vision can be downloaded from the following web address free of charge: www.draeger.com/software.

- Change configuration: see Technical Manual.

Standard instrument configuration:

Dräger X-am® 2500 [1]	
Bump test mode [2]	Extended bump test
Fresh air calibration [2]	ON
Operating signal [2 3]	ON
Capture range	ON
Switch off [2]	allowed
LEL factor [2] (ch_4)	4.4 (vol. %) (4.4 Vol. % corresponds to 100 %LEL)
STEL [2 4 5] (short-term average)	STEL function - disabled Average value duration = 15 minutes
TWA [2 5 6] (shift average)	TWA function - disabled Average value duration = 8 hours
Alarm A1 [7]	can be acknowledged, non-latching, pre-alarm, rising flank
Alarm A1 at O_2 sensor [7]	cannot be acknowledged, latching, like main alarm, falling flank
Alarm A2 [7]	cannot be acknowledged, latching, main alarm, rising flank

1) X-am® is a registered trademark of Dräger.
2) Different settings can be selected to meet customer requirements on delivery. The current setting can be checked and changed with the Dräger CC Vision software.
3) A periodic short flashing indicates the operating capacity of the instrument. If there is no operating signal, correct operation cannot be guaranteed.
4) STEL: average value of an exposure over a short period, generally 15 minutes.
5) Interpretation only if the sensor is designed for this.
6) TWA: shift averages are workplace limit values for generally eight hours per day of exposure for five days a week during a working life.
7) Latching and acknowledgement of alarms A1 and A2 can be configured with the Dräger CC Vision PC software.

Selecting or disabling the capture ranges (only applies for the measuring mode):
The capture range is selected in the measuring mode (factory setting) and permanently disabled in calibration mode.
The CC-Vision PC software can be used to select or disable the capture ranges for the measuring mode.

3.1 Instrument settings

The following parameters can be changed on an instrument:

Name	Range
Password	Numerical range (3-digit)
Operating signal LED [1]	Yes / No
Horn operating signal [1]	Yes / No
Switch-off mode	"switch-off allowed" or "switch-off prohibited" or "switch-off prohibited at A2"
Shift length (TWA) [2]	60 - 14400 (in minutes) (Setting for exposure alarm)
Short-term exposure level (STEL) [3 4]	0 - 15 (in minutes) (Setting for exposure alarm)

1) At least one of the two operating signals must be switched on.
2) Corresponds to averaging time and is used to calculate the TWA exposure value.
3) Interpretation only if the sensor is designed for this.
4) Corresponds to averaging time and is used to calculate the STEL exposure value.

3.2 Sensor settings

The following parameters can be changed on the sensors:

Name	Range
Alarm threshold A1 (in measuring unit)	0 - A2
Alarm threshold A2 (in measuring unit)	A1 – measuring range end value
Interpretation type[1]	Inactive, TWA, STEL, TWA+STEL
Alarm threshold STEL (in measuring unit)[1]	0 – measuring range end value
Alarm threshold TWA (in measuring unit)[1]	0 – measuring range end value

1) Interpretation only if the sensor is designed for this.

3.3 Check of parameters

To ensure that the values were correctly transferred to the gas detection instrument:

1. Press the **data from X-am 1/2/5x00** in Dräger CC Vision.
2. Check parameters.

4 Operation

4.1 Preparations for operation

WARNING

To reduce the risk of ignition of a flammable or explosive atmosphere, strictly adhere to the following warning statements:

Only use power pack types ABT 01xx, HBT 00xx or HBT 01xx. See the marking on the rechargeable battery for permitted rechargeable batteries and the corresponding temperature class.

Substitution of components may impair intrinsic safety.

- Before using the instrument for the first time, insert a charged NiMH T4 power pack or batteries approved by Dräger, see chapter 4.9.1 on page 30.
- The instrument is now ready for operation.

4.2 Switching on the instrument

1. Hold down the **[OK]** key for approx. 3 seconds until the countdown **» 3 . 2 . 1 «** shown on the display has elapsed.
   - All the display segments, including the visual, audible and vibration alarms, are activated for a short time.
   - The software version is displayed.
   - The instrument performs a self-test.
   - The sensor that is up next for adjustment is displayed with the remaining days until the next adjustment, e.g. **ch4 %LEL CAL 20.**
   - The time until the bump test interval elapses is displayed in days, e.g. **bt 123.**
   - All alarm thresholds A1 and A2 as well as (TWA)[1] and (STEL)[1] for all toxic gases (e.g. H_2S or CO) are displayed consecutively.

   During the sensor warm-up phase:
   - The display for the measured value flashes
   - The special symbol »⊟« is displayed.
   - No alarms are issued during the warm-up phase.
   - The red LEDs flash.
   - The gas detector is ready to measure when the measured values no longer flash and the red LEDs are no longer illuminated. The special symbol »⊟« may continue to be displayed if corresponding warnings (e.g. not yet ready for calibration) are active (to view the warnings, see the technical manual).
2. Press the OK key to cancel the display of the activation sequence.

4.3 Switching off the instrument

- Press and hold the OK key and [+] key at the same time until the countdown **3 . 2 . 1** shown in the display has elapsed.
  Before the instrument is switched off, the visual, audible and vibration alarms are activated for a short time.

4.4 Before entering the workplace

WARNING

Before any measurements relevant to safety are made, check the adjustment with a bump test, adjust if necessary and check all alarm elements. If national regulations apply, a bump test must be performed according to the national regulations. Faulty adjustment may result in incorrect measuring results, with possible serious consequences.

CAUTION

The CatEx sensor is intended for measurements of flammable gases and vapours mixed with air (i.e. O_2 content ≈ 21 vol.%). Incorrect measured values may be displayed in the case of oxygen deficient or oxygen enriched environments.

NOTICE

If the gas detector is used for offshore applications, a distance of 5 m to a compass must be complied with.

1. Switch on the instrument. The current measured values are shown in the display.

1) Only when activated in the instrument configuration. Delivery condition: not activated.

2. Observe any warning ⚠ or fault ⊠ messages.
   ⚠ The instrument can be operated normally. If the warning message does not disappear automatically during operation, the instrument must be serviced after the end of use.
   ⊠ The instrument is not ready to measure and requires maintenance.
3. Check that the gas inlet opening on the instrument is not covered or dirty.

WARNING

Explosion hazard! To reduce the risk of ignition of a flammable or explosive atmosphere, strictly adhere to the following warning statements:

- Fractions of catalytic poisons in the measuring gas (e.g. volatile silicium, sulphur, heavy metal compounds or halogenated hydrocarbon) can damage the Cat Ex sensor. If the CatEx sensor can no longer be calibrated to the target concentration, the sensor must be replaced.
- In case of measurements in oxygen-deficient atmosphere (<12 vol.-% O_2) the CatEx sensor may show incorrect displays; in this case, a reliable measurement with a CatEx sensor is not possible.
- In an oxygen enriched atmosphere (>21 vol.-% O_2), the explosion protection cannot be guaranteed; remove instrument from the explosion-hazard area.
- High off-scale readings may indicate an explosive concentration.

4.5 During operation

- During operation, the measured values for every measured gas are displayed.
- In the event of an alarm, the corresponding displays, including the visual, audible and vibration alarms, are activated, see chapter 4.6 on page 28.
- If a measuring range is exceeded or not reached, the following displays are shown instead of the measured value display:

  » ⌜⌜ « **(measuring range exceeded) or**

  » ⌞⌞ « **(below measuring range) or**

  » ⌜⌟ « **(blocking alarm)**

- If an O_2 sensor is fitted and this sensor measures an O_2 concentration of below 12 vol.-%, an error is indicated with » - « on the ex-channel instead of a measured value if the measured value is below the pre-alarm threshold.
- After the measuring range of the TOX measuring channels has been exceeded temporarily (up to one hour), checking the measuring channels is not necessary.

NOTICE

Special states in which there is no measuring operation (quick menu, calibration menu, warm-up of sensors, password input) are indicated by a visual signal (slow flashing of the alarm LED ⌐¬⌐¬⌐¬⌐¬).

WARNING

If the DrägerSensor CatEx 125 PR is used in the gas detector, a zero point and span calibration must be carried out after experiencing an impact load that results in a non-zero display when exposed to fresh air. This warning does not apply if the DrägerSensor CatEx 125 PR Gas is used.

4.6 Identifying alarms

An alarm is displayed visually, audibly and through vibration in a specific pattern.

NOTICE

At low temperatures the legibility of the display can be improved by switching on the backlight.

4.6.1 Concentration pre-alarm A1

Intermittent alarm:

- Alternating display of **A1** and measured value. Not for O_2!
- The pre-alarm A1 is not latching and stops when the concentration has dropped below the alarm threshold A1.
- In case of A1, a single tone is audible and the alarm LED flashes.
- In case of A2, a double tone is audible and the alarm LED flashes twice.
- Acknowledge pre-alarm: Press the OK key. Only the audible alarm and the vibration alarm are switched off.

4.6.2 Concentration main alarm A2

WARNING

Risk of fatal injury! Leave the area immediately. A main alarm is self-retaining and cannot be acknowledged or cancelled.

Intermittent alarm:

- Alternating display of **A2** and measured value.
  For O_2: **A1** = lack of oxygen
  A2 = excess oxygen

After leaving the area, when the concentration has dropped below the alarm threshold:

- Press the OK key. The alarm messages are switched off.

If the measuring range is exceeded significantly at the CatEx channel (very high concentration of flammable materials), a blocking alarm is triggered. This CatEx blocking alarm can be manually acknowledged by switching the instrument off and on in fresh air.

4.6.3 STEL / TWA exposure alarm

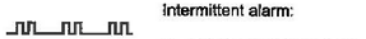
CAUTION

Health hazard! Leave the area immediately. After this alarm, the deployment of personnel is subject to the relevant national regulations.

NOTICE

The STEL alarm can be triggered with a maximum delay of one minute.

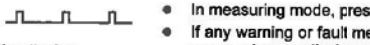
Intermittent alarm:



- Display **A2** and (STEL) or respectively (TWA) and measured value alternating:
- The STEL and TWA alarm cannot be acknowledged or cancelled.
- Switch off the instrument. The values for the exposure evaluation are deleted after the instrument is switched on again.

4.6.4 Battery pre-alarm

Intermittent alarm:



- Flashing special symbol on the right side of the display.
- Acknowledge pre-alarm: Press the OK key. Only the audible alarm and the vibration alarm are switched off.
- The battery still lasts approx. 20 minutes after the first battery pre-alarm.

4.6.5 Battery main alarm

Intermittent alarm:

- Flashing special symbol on the right side of the display:
- The battery main alarm cannot be acknowledged or cancelled.
- The instrument is automatically switched off again after 10 seconds.
- Before the instrument is switched off, the visual, audible and vibration alarms are activated for a short time.

4.6.6 Instrument alarm

Intermittent alarm:

- Special symbol displayed on the right side of the display:
- The instrument is not ready for operation.
- Contact maintenance or Draeger Service to rectify the problem.

4.7 Info Mode

4.7.1 Activating the Info mode

- In measuring mode, press the OK key for approx. 3 seconds.
- If any warning or fault messages exist, the corresponding note or error codes are displayed (see Technical Handbook).
  Press the OK key successively for the next display. The peak values and the exposure values TWA and STEV will be displayed.
- If no key is pressed for 10 seconds, the instrument returns automatically to measuring mode.

4.7.2 Info Off mode

- Press the [+] key when the instrument is turned off.
  The name of the gas, measuring unit, and measuring range limit value are displayed for all channels.
- Press the [+] key again to exit the Info Off Mode (or via timeout).

4.8 Calling the Quick Menu

- In measuring mode, press the [+] key three times.
- If functions in the quick menu are activated using the PC software "Dräger CC Vision", you can select these functions using the [+] key. If no functions have been activated in the quick menu, the instrument remains in measuring mode.

Possible functions:

1. Bump test (configuration for bump test, see technical manual)
2. Fresh air calibration
3. Delete peak values
4. Display pump information, see technical manual
5. Activate or deactivate pump, see technical manual

- Press the OK key to activate the selected function.
- Press the [+] key to cancel the active function and to switch to measuring mode.
- If no key is pressed for 60 seconds, the instrument returns automatically to measuring mode.

4.9 Common user tasks

4.9.1 Replacing the batteries / rechargeable batteries

WARNING

Explosion hazard! To reduce the risk of ignition of a flammable or explosive atmosphere, strictly adhere to the following warning statements:
Do not throw used batteries into fire or try to open them by force.
Do not replace or charge batteries in potentially explosive areas.
Do not use new batteries with used batteries, and do not mix batteries from different manufacturers or of different types.
Remove batteries before maintenance work.
Batteries / rechargeable batteries are part of the Ex approval.

Only the following types may be used:

- Alkaline batteries – T3 – (non rechargeable!)
  Panasonic LR6 Powerline
  Varta Type 4106 [1] (power one) or
  Varta Type 4006 [1] (industrial)
- Alkaline batteries – T4 – (non rechargeable!)
  Duracell Procell MN1500 [1]
- NiMHy rechargeable batteries – T3 – (rechargeable)
  GP 180AAHC [1] (1800 mAh) max. 40 °C ambient temperature.

Only charge NiMH power packs T4 (type HBT 0000) or T4 HC (type HBT 0100) with the appropriate Dräger charger. Charge NiMH single cells for ABT 0100 battery holder as directed by the manufacturer. Ambient temperature during charging: 0 to +40 °C.

1) Not part of the BVS10 ATEX E 080X and PFG 10 G 001X technical suitability test.

1. Switching off the instrument: Press and hold OK key and [+] key simultaneously.
2. Loosen the screw on the power pack and remove the power pack.
- Battery holder (order no. 83 22 237): Replace alkaline batteries or NiMHy rechargeable batteries. Ensure correct polarity.
- NiMH power pack T4 (Type HBT 0000) / T4 HC (Type HBT 0100): replace complete power pack.

3. Insert the power pack into the instrument and tighten the screw, the instrument switches on automatically.

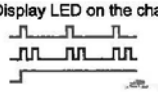
4.9.2 Charge instrument with NiMH power pack T4 (Type HBT 0000) / T4 HC (Type HBT 0100)

WARNING

Explosion hazard! To reduce the risk of ignition of a flammable or explosive atmosphere, strictly adhere to the following warning statements:
Do not charge underground or in explosion hazard areas! The chargers are not designed in accordance with the regulations for fire damp and explosion protection.
Charge NiMH power packs T4 (type HBT 0000) or T4 HC (type HBT 0100) with the appropriate Dräger charger.
Ambient temperature during charging: 0 to +40 °C.

- Insert the switched off instrument into the charger module.

Display LED on the charger module:



To protect the battery charge only in the temperature range of 5 to 35 °C. Outside this temperature range, the charging process is automatically interrupted and automatically continued after the temperature range has been reached again. The charging time is typically 4 hours. A new NiMH power pack reaches its full capacity after three complete charge / discharge cycles. Never store the instrument for extended periods without being connected to a power source (maximum of 2 months) because the internal buffer battery will drain.

4.9.3 Carry out manual bump test

NOTICE

The automatic bump test with the Bump Test Station is described in the Technical Handbook.

1. Prepare a test gas cylinder, the volume flow must be 0.5 l/min and the gas concentration must be higher than the alarm threshold concentration that is to be tested.
2. Connect the test gas cylinder with the calibration cradle (order no. 83 18 752).

WARNING

CSA requirement: carry out a bump test before use. It should be carried out in the measuring range 25-50 % of the full scale value, whereby the displayed measured value may deviate from the actual measured value by 0-20 %. Accuracy may be corrected via calibration.

CAUTION

Never inhale the test gas. Health hazard!
Observe the hazard warnings of the relevant Safety Data Sheets.

3. Switch on the instrument and insert it into the calibration cradle – press downwards until it engages.
4. Open the test gas cylinder valve to let test gas flow over the sensors.

5. Wait until the instrument displays the test gas concentration with sufficient tolerance –
   Ex: ±20 % of the test gas concentration [1]
   O_2: ±0.6 vol. %[1]
   TOX: ±20 %. of the test gas concentration [1]
   If the alarm thresholds are exceeded, the instrument displays the gas concentration in alternation with **A1** or **A2** depending on the test gas concentration.
6. Close the test gas cylinder valve and remove the instrument from the calibration cradle.

NOTICE

To check the measured value response times, apply t90 test gas to the X-am via the calibration cradle. Check the results in accordance with the information in the table in the enclosed supplementary documentation (order no. 90 33 890) until 90 % of the end display is reached.

NOTICE

After the bump test (menu), the display shows a printer icon even if there is no printer connected to the bump test station.

If the displays are outside of the above-mentioned ranges:

- Have the instrument adjusted by the service personnel.

1) During application of the Dräger mixed gas (order no. 68 11 130) the displays should be within this range.

4.9.4 Calibration

Calibration may not be possible due to instrument and channel errors.

NOTICE

Dräger recommends using the extended bump test for cross calibrations (Dräger X-dock technical manual).

Carrying out the fresh air calibration

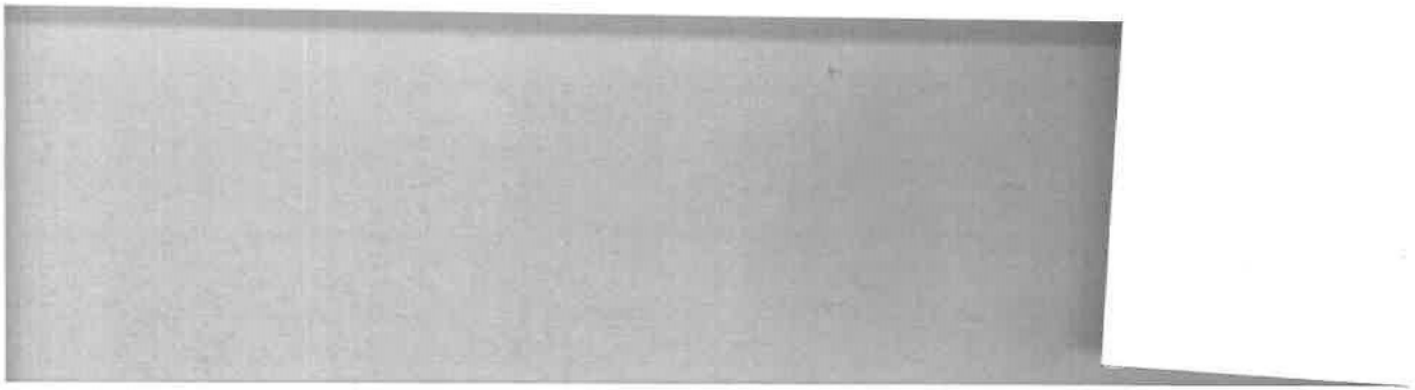
Calibrate the instrument to fresh air, free of measured gases or other interfering gases. During the fresh air calibration the zero point of all sensors (with the exception of the DrägerSensor XXSO_2) are set to 0. In the case of the DrägerSensor XXS O_2, the display is set to 20.9 vol. %.

1. Switch on instrument.
2. Press the [+] key 3 times, the symbol for fresh air calibration ✲ appears.
3. Press the OK key to start the fresh air calibration function.
   - The measured values flash.

   When the measured values have stabilized:
   a. Press the [OK] key to perform the calibration.
      The display containing the current gas concentration changes with the display **OK**.
   b. Press the OK key to exit the calibration function or wait for approx. 5 seconds.

If a fault has occurred during the fresh air calibration:

a. The fault message ⊠ appears and – – is displayed for the respective sensor instead of the measured value.
b. In this case, repeat the fresh air calibration.
   If necessary, have the sensor replaced by qualified personnel.



Adjusting the sensitivity for an individual measuring channel

- The span calibration can be carried out selectively for individual sensors.
- In the case of the span calibration, the sensitivity of the selected sensor is set to the value of the test gas used.
- Use a standard test gas.

Allowed test gas concentration:

Ex: 40 to 100 %LEL

O_2: 10 to 25 vol. %

CO: 20 to 999 ppm

H_2S: 5 to 99 ppm

Test gas concentrations of other gases: see Instructions for Use of the respective DrägerSensors.

1. Connect the test gas cylinder with the calibration cradle.
2. Vent the test gas into a fume cupboard or into the open air (with a hose connected to the second connector of the calibration cradle).

CAUTION

Never inhale the test gas. Health hazard!
Observe the hazard warnings of the relevant Safety Data Sheets.

3. Switch on the instrument and insert it into the calibration cradle.
4. Press the [+] key and keep it pressed for 5 seconds to open the calibration menu, enter the password (password on delivery = 001).
5. Use the [+] key to select the single gas adjustment function. The symbol for span calibration ⓘ flashes.
6. Press the OK key to start the channel selection. The display flashes the gas of the first measuring channel, e.g. **ch4 %LEL**.
7. Press the OK key to start the calibration function of this measuring channel, or use the [+] key to select another measuring channel (O_2 - vol. %, H_2S - ppm or CO - ppm, etc.). The test gas concentration is displayed.
8. Press the OK key to confirm the test gas concentration or use the [+] key to change the test gas concentration and complete the process by pressing the OK key. The measurement value flashes.
9. Open the test gas cylinder valve to let gas flow over the sensor with a volume flow of 0.5 l/min. The displayed, flashing measurement value changes to the value according to the supplied test gas.

When the displayed measurement value is stable (after at least 120 seconds):

a. Press the OK key to perform the calibration. The display containing the current gas concentration changes with the display **OK**.
b. Press the OK key or wait for approx. 5 seconds to end the adjustment of this measuring channel. The next measuring channel is displayed for adjustment if necessary. After the adjustment of the last measuring channel, the instrument changes to the measuring mode.
c. Close the test gas cylinder valve and remove the instrument from the calibration cradle.

If a fault has occurred during the span calibration:

- The fault message ⓧ appears and - - is displayed for the respective sensor instead of the measured value.
- In this case, repeat the calibration.
- Change the sensor if necessary.

Notice for the adjustment of the ex-channel to nonane as a measuring gas:

- During the adjustment of the ex-channel, propane can be used as a substitute test gas.
- When using propane to adjust the ex-channel to nonane, the display must be set to twice the used test gas concentration.

Notice for the use in subsurface mining:

- For the adjustment of the ex-channel to the measuring gas methane, the display of the instrument must be set to a value of 5 % (relative) higher than the test gas concentration.

Automatic fresh air calibration in the charging cradle (CatEx sensor only):
Calibrate the gas detector to fresh air, free of measured gases or other interfering gases. If the function is selected, a fresh air calibration of the CatEx sensor is performed automatically as soon as the gas detector is inserted in the charging cradle.
This function can be selected or disabled using the CC-Vision PC software.

No calibration takes place if the warm-up is not yet complete:

- Alarm LED is illuminated red.
- The acoustic signal sounds twice followed by three short tones and the gas detector switches off.

Once the fresh air calibration has been successfully completed:

- Alarm LED is illuminated red.
- The acoustic signal sounds once followed by three short tones and the gas detector switches off.

If a fault has occurred during the fresh air calibration:

- The fault message ⊠ appears and – – is displayed for the respective sensor instead of the measured value.
- In this case, repeat the fresh air calibration.
  If necessary, have the sensor replaced by qualified personnel.

5 Maintenance

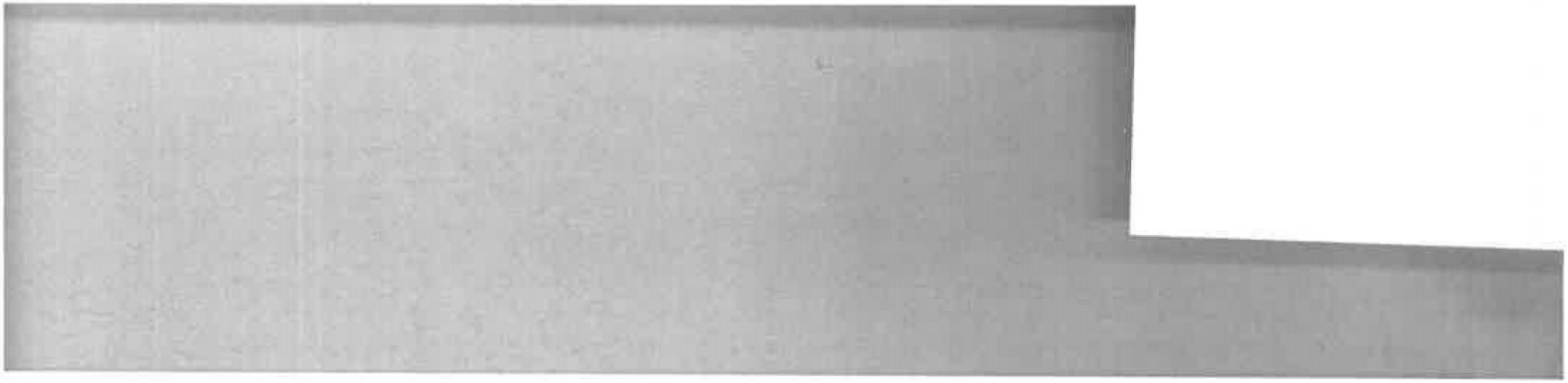
5.1 Maintenance table

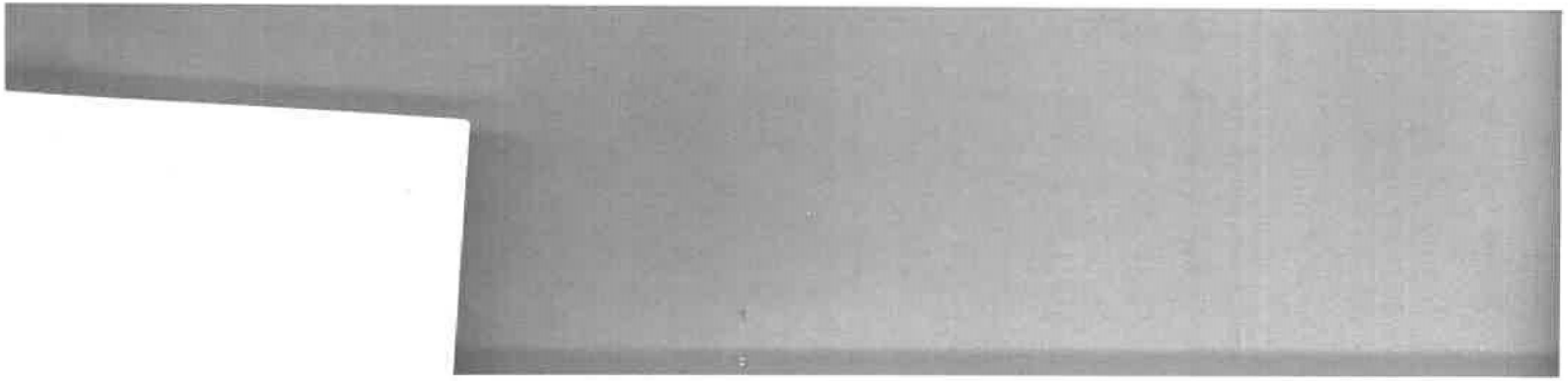
The instrument should be inspected and serviced once a year by suitably qualified persons. Comparisons:

- EN 60079-29-2 – Gas detectors - Selection, installation, use and maintenance of detectors for flammable gases and oxygen
- EN 45544-4 – Electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours - Part 4: Guide for selection, installation, use and maintenance
- National regulations

Recommended calibration interval for measuring channels Ex, O_2, H_2S, SO_2, NO_2 and CO: 6 months. Calibration intervals of other gases: see Instructions for Use of the respective DrägerSensors.

See the Technical Manual for details of spare parts.





5.2 Cleaning

The instrument does not need any special care.

- Dirt and deposits can be removed from the instrument by washing it with cold water. A sponge can be used for wiping if necessary.

CAUTION

Abrasive cleaning tools (brushes etc.), cleaning agents and cleaning solvents can destroy the dust and water filters.

- Carefully dry the instrument with a cloth.

6 Storage

- Dräger recommends storing the instrument in the charger module (order no. 83 18 639).
- Dräger recommends checking the charge of the power supply at least every three weeks if the instrument is not stored in the charger module.

7 Disposal

This product is not permitted to be disposed of with household waste. This is indicated by with the adjacent icon. You can return this product to Dräger free of charge. For information please contact the national marketing organisations and Dräger.

Batteries and rechargeable batteries are not permitted to be disposed of as household waste. This is indicated by the adjacent icon. Dispose of batteries and rechargeable batteries as specified by the applicable regulations and dispose of at battery collection centres.

8 Technical data

Excerpt: See the Technical Handbook for details[1]

Ambient conditions: during operation and storage
Temperature class T4 (–20 to +50 °C):
NiMH power packs type: HBT 0000, HBT 0100
Power pack type: ABT 0100
with alkaline single cell type: Duracell Procell MN 1500[2], Duracell Plus Power MN 1500[2)]

Temperature class T3 (–20 to +40 °C):
Power pack type: ABT 0100
with NiMH single cell type: GP 180AAHC[2)]
with alkaline single cell type: Panasonic LR6 Powerline

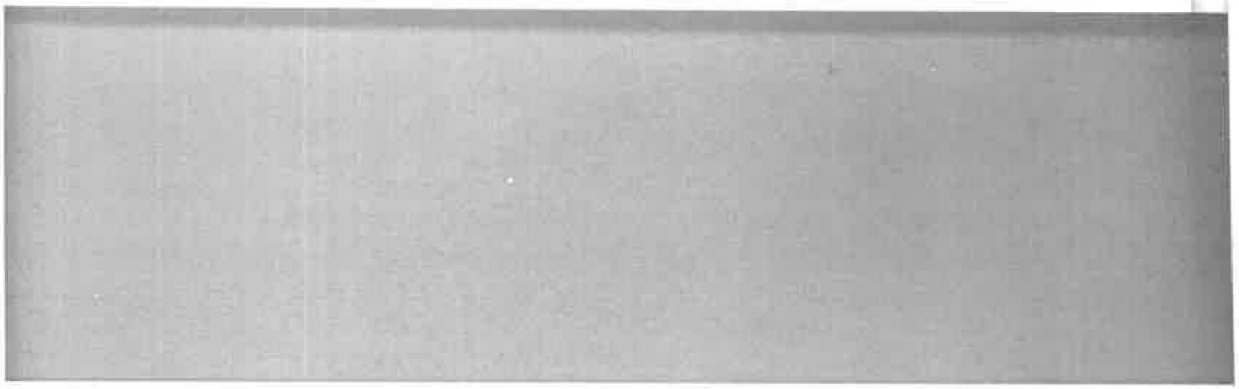
Temperature class T3 (0 to +40 °C):
Power pack type: ABT 0100
with alkaline single cell type: Varta 4006[2)], Varta 4106[2)]

Temperature range over a short period [2)]:
–40 to +50 °C
Maximum of 15 minutes with NiMH power pack T4 (HBT 0000) or T4 HC (HBT 0100)
Requirement: storage of the instrument at room temperature (+20 °C) for at least 60 minutes in advance.

Air pressure	700 to 1300 hPa
Humidity	10 to 90 % (to 95 % short-term) rel. hum.
Position of use	any
Storage time	
X-am 2500	1 year
Sensors	1 year

Electrical classification	IP 67 for instrument with sensors
Alarm volume	Typically 90 dB (A) at 30 cm distance
Operating time:	
Alkaline battery	Typically 12 hours under normal conditions
NiMH power pack: T4 (HBT 0000)	Typically 12 hours under normal conditions
T4 HC (HBT 0100)	Typically 13 hours under normal conditions
Dimensions	approx. 130 x 48 x 44 mm (H x W x D)
Weight	approx. 220 to 250 g
Refresh interval for display and signals	1 s

1) Technical manual, instructions for use/data sheets of the sensors used can be downloaded at www.draeger.com/ifu.
The CC-Vision PC software can be downloaded at www.draeger.com/software.
2) Not part of the BVS 10 ATEX E 080 X and PFG 10 G 001 X technical suitability tests.



Appendix A-13

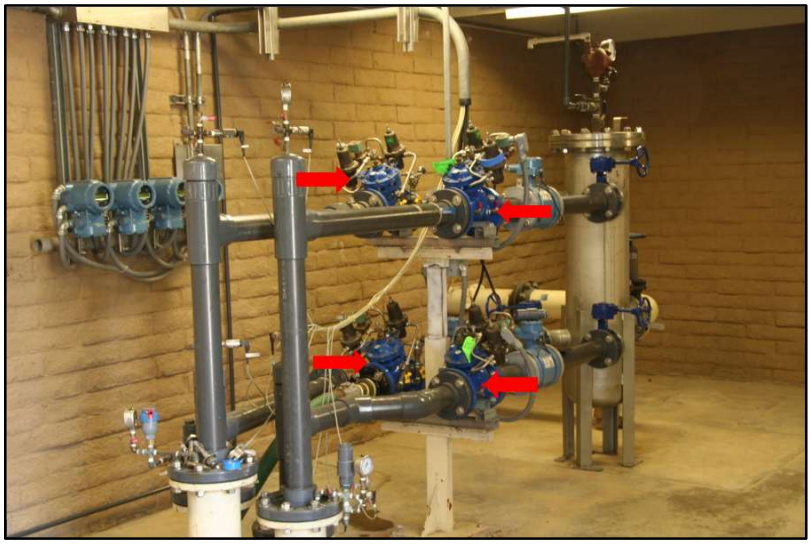
Legacy Well 3-inch Pressure Reducing Valve – Operating Instructions and Manufacturer Provided Information

Legacy Well 3-inch Pressure Reducing Valve – Operating Instructions and Manufacturer Provided Information

All Legacy Wells are equipped with 3” 700 series Bermad Pressure Reducing Valves (PRV) for control.

The valves that we use are 3” angle pattern valves made by Bermad. They are equipped with two pilot systems and a feature that provides remote start and stop the well by sending a signal to a solenoid. The solenoid has a manual option that can be easily moved from auto to manual. The main feature is that the valve once understood is non-fallible and stupid. You, the operator tells it what to do and if you have set it correctly and maintain its operation the well should run for two years before it needs maintenance.

The basic PRV that we use has an upstream and downstream pilot. Water supply to the valve must have a system valve up stream of the valve. Injection flow comes out of the splitter box to a butterfly valve, followed by a magnetic flow meter with proper up stream diameters to ensure accuracy.



Legacy Well I-4. Red arrows indicate the location of the 3-inch Bermad pressure reducing valve (PRV).

Downstream Pilot
Water enters the pilot system through a small “y” strainer that has a blow down valve to ensure the water to the pilots is clean and free of debris. These require manual blow down as often as weekly or monthly. This feature will help maintain clean water to the small clearances in the pilot system. After the strainer, the water enters the upstream pilot. The upstream pilot is backed out to zero tension for initial settings. The water must travel through the solenoid valve in the manual position. From here the downstream pilot controls the main valve. Start by having this pilot backed out with zero tension. The opening speed valve is on top of the valve cover. This valve is primarily set at 1.5 turn’s open. The closing speed valve is located on the bottom of the upstream pilot assembly. This valve is set at ¾ to 1 turn out from the closed position. These settings should get the valve to open.

Turn the downstream pilot inward adding tension to the pilot until the desired downstream pressure is achieved (as seen on the well header pressure gauge). Here is where the well dictates the flow. Start by using 5 psi and go from there. The main valve is now opening, and water is beginning to flow into the well. The well-head has a pressure gauge that we read to set our PRV. Setting the downstream pilot may take some time. As the water begins to flow pressures may fluctuate.

With the PRV in operation, slowly open or close the upstream butterfly valve and observe the valve stem and the pressure gauge. By closing or starving the valve of water, you should see the stem raise to attempt to achieve the 5-psi that you pre-selected. This is where the IRSO will now be in the “trial by fire mode.” There is a certain amount of failure that must occur to gain the experience to know that the closing speed of the PRV is directly affecting the downstream pilot and vice versa. This sweet spot is achieved after several days of constant ever vigilant entries and adjustments until the “ah ha” moment occurs. It is now assumed that the downstream pilot has control and now we need to set the upstream pilot.

Upstream Pilot
This feature will tend to stop the flow of water or reduce the flow if the main line pressure in the system ceases to flow. Without this feature the pipeline will drain. Improperly set pilots may increase the potential of completely draining the distribution system. As the system pressure reduces or ceases to flow the upstream pilot will act to close the main valve.

Adjusting the upstream pilot with the system in full operation will change as the system pressure changes with well flow or system pressure changes.

With the well in operation and with good control of the downstream pressure, add tension to the up-stream pilot until you observe the stem begin to lower or well-head pressure starts to fall and watch for flow rate decreasing. Slowly turn inward until the valve closes or just before the valve begins to close. This is where we see the pilot up stream begin to take control. Now back this out somewhere between ¾ to 1 turn out. This value relates to our operation of a spring range of 0-300 and this amounts to about a 15-psi differential. This is all set up on spring tension and each spring has a manufactures value of “psi per turn.” It is important to note the influent pressure and the operation pressure in the system. The barrier pump station is normally set at 60 psi and the line pressure is reduced at the inlet to the splitter boxes with an orifice plate that shoots for 30 psi at the inlet of the pressure reducing valve. The butterfly valve upstream of the PRV is used for final adjustments to reach 30 psi at the inlet.

BERMAD
Water Control Solutions
Application Engineering

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WW-720

Pressure Reducing Control Valve

(Size Ranges: 2"- 4" and 6"- 14")

Installation

Operation

& Maintenance

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info@bermad.com • www.bermad.com

1. DESCRIPTION

The Model 720 Pressure Reducing is an automatic control valve (powered by pipe-line pressure) designed to hydraulically reduce a higher upstream pressure to a lower constant downstream pressure regardless of fluctuating demand and/or varying upstream pressure. It is a pilot controlled, hydraulically operated, diaphragm actuated globe valve in either the oblique (Y) or angle pattern design.

2. PRINCIPAL OF OPERATION

A 2-way pressure-reducing pilot (Model #2 or #2PB) controls the Model 720. The pilot senses the downstream pressure and modulates opening or closing accordingly. This varies the pressure in the upper control-chamber causing the main valve to throttle thus maintaining constant delivery pressure. When the downstream pressure falls below the pilot setting, the pilot changes position, increasing water flow from the control-chamber to valve's downstream. Pressure in the upper control-chamber decreases, and the main valve modulates open to increase downstream pressure and maintain pilot setting. If the downstream pressure rises above the pilot setting, the pilot changes position, decreasing water flow from the control chamber to valve's downstream. Pressure in the upper chamber increases and the main valve throttles close to decrease downstream pressure to the pilot setting. The pressure-reducing pilot has an adjusting screw to set the desired downstream pressure

3. INSTALLATION

Ensure enough space around the valve assembly for future maintenance and adjustments.
Flush the pipeline to remove dirt, scale, and debris; otherwise the valve may not operate properly.
For future maintenance, install Isolation gate valves upstream and downstream of the Bermad control valve.
Install the valve in the pipeline with the valve flow direction arrow in the actual flow direction. Use the lifting ring provided on the main valve cover for installing the valve.
For best performance, install the valve horizontally with the cover upright. Ensure that the valve actuator can be removed for maintenance.
After installation carefully inspect/correct any damaged accessories, piping, tubing, or fittings.

4. IN LINE STATIC TEST

4.1. Open Valve Static Test

Close cock valve 1 and 2 to isolate the pilot control system. This prevents dirt exposure in the control loop.

Remove the cover plug on the main valve or take off a tube line to the cover. **CAUTION:** This will allow the valve to fully open. Make sure this condition will not cause system damage!
Check for leaks at the flange connection, main line fittings, etc.

4.2. Closed Valve Static Test
Close cock valve 2 and open cock valves 1. This will trap the main valve in a closed position while the pipeline is pressurized.
Vent trapped air in the main valve cover by loosening a tube fitting at the highest point on the cover. Retighten.
Check the valve cover and diaphragm area for leaks. Tighten cover bolts if necessary.

5. START-UP OPERATION

NOTE: There must be flow through the valve to make necessary adjustments. Create system conditions that allow the desired flow to be demanded through the valve by opening a hydrant, relief valve, bypass, etc.

1. Close main valve by closing cock valve 2. Cock valve 1 should be open.
2. Turn adjusting screw on pressure reducing pilot (#2 or #2PB) all the way, counter-clockwise.
   3. Open cock valve 2. Main valve should remain closed.
3. **Slowly** turn the adjusting screw on pressure reducing pilot (#2 or #2PB) clockwise until the desired downstream pressure is achieved.
4. Pause for a few seconds after each adjustment to allow the valve to react & modulate accordingly. Once the pressure setting is achieved, tighten lock nut.

6. PREVENTATIVE MAINTENANCE SCHEDULE

The following procedure suggestions are a maintenance guide. These procedure suggestions will vary depending on the type of fluid and operation conditions.

Description	***Norm***
Clean filter	Annually
Seat inspection	Annually
Seal inspection	Biannually or longer
Indicator Stem freedom of rotation	Annually
Valve freedom of movement	Annually
Sealing	Annually
Needle valve operation	Annually
Pressure gauge	Semi Annually
Cavitation damage	Annually
Inspect and/or replace diaphragm heavy duty	3 year
Inspect and/or replace diaphragm light duty	5 year

7. FIELD MAINTENANCE INSTRUCTIONS

Bermad valves require no lubrication, no packing tightening, and require a minimum of maintenance. A periodic inspection schedule should be established to determine how the flow, the erosion, the dissolved minerals and the suspended particles are affecting the valve.
VALVE OVERHAUL. After about three years of operation, replacement of important parts and diaphragm is recommended. Remove the actuator, clean the valve body from sediments, clean the control tubing entry holes, install a new diaphragm and other Elastomers.
FILTER CLEANING. The filter used in the valve is a Y pattern filter. The filter should be cleaned manually every time the valve is opened for internal inspection.

8. PART LIST

Bermad has a convenient and easy to use Ordering Guide for valve spare-parts and control system components. (See attached pages with spare part list and illustrated parts breakdown).
Bermad Company has a complete inventory of parts. Shipment on any part is made the same day the order is received.
Stocking distributors in many regions also have an inventory of parts. Contact your local representative.

It is not recommended to store spare rubber parts for long periods (e.g. years). Rubber in improper storage conditions can harden, have ozone cracking, grow mold bloom and heat aging. Order new rubber parts when required.

9. TROUBLE-SHOOTING

Symptom	Probable Cause	Action
Valve fails to open	Insufficient inlet pressure.	Check/create inlet pressure.
	No downstream demand.	Create demand/flow.
	Insufficient pressure reducing pilot (#2 or #2PB) spring compression.	Turn adjusting screw on pressure reducing pilot (#2 or #2PB) clockwise (CW) increasing spring compression.
	Cock valve 2 is closed	Open cock valve 2
Valve fails to close.	Filter 4 is plugged.	Perform a filter backwash to clean the filter.
	Needle valve (21 or 5) is plugged or closed.	Clean or adjust needle valve
	Cock valve 1 is closed.	Open cock valve 1.
	Excessive pressure reducing pilot (#2 or #2PB) spring compression.	Turn adjusting screw on pressure reducing pilot (#2 or #2PB) counter clockwise (CCW) decreasing spring compression.
	Debris trapped in main valve.	Remove actuator assembly to inspect/remove debris.
	Diaphragm in main valve leaking	Check by opening cover plug. Continuous flow indicates diaphragm leakage.
Valve fails to regulate	Needle valve (21 or 5) is not properly adjusted.	Factory set at 1.5 turns open. Readjust
	Air trapped in main valve cover or pressure reducing pilot (#2 or #2PB) sense line.	Loosen cover tube fitting at highest point or sense-line tube fittings at pressure reducing pilot (#2 or #2PB). Let air escape. Retighten.

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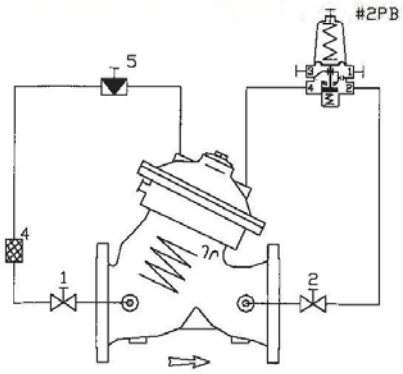
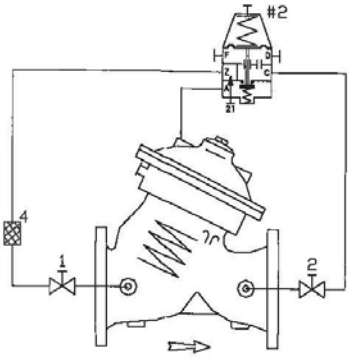
10. CONTROL LOOP DIAGRAM



Size Range: 2"-4"

PARTS LIST

1	2W Cock Valve
2	2W Cock Valve
4	Control Filter
5	Needle Valve
#2PB	2W PB PR Pilot



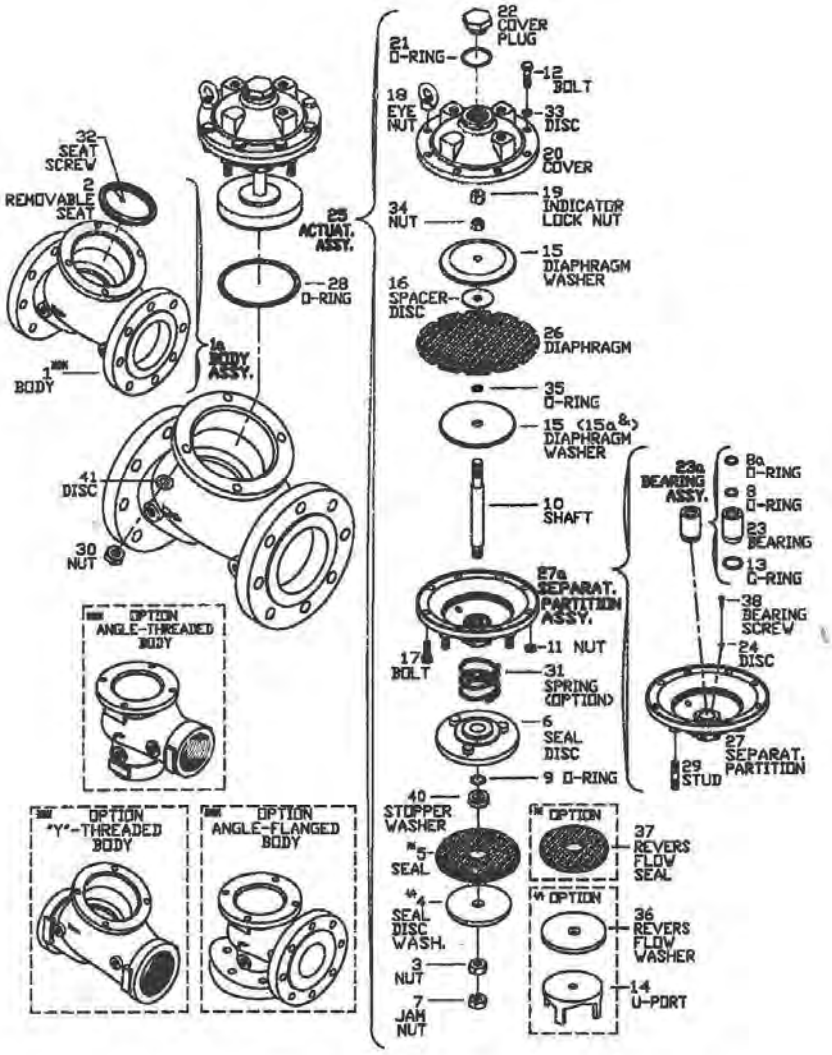
Size Range: 6" -14"

PARTS LIST

1	2W Cock Valve
2	2W Cock Valve
4	Control Filter
#2	2W P.R. Pilot

Diaphragm Actuated Basic Control Valves

Sizes: 3" & 4"R



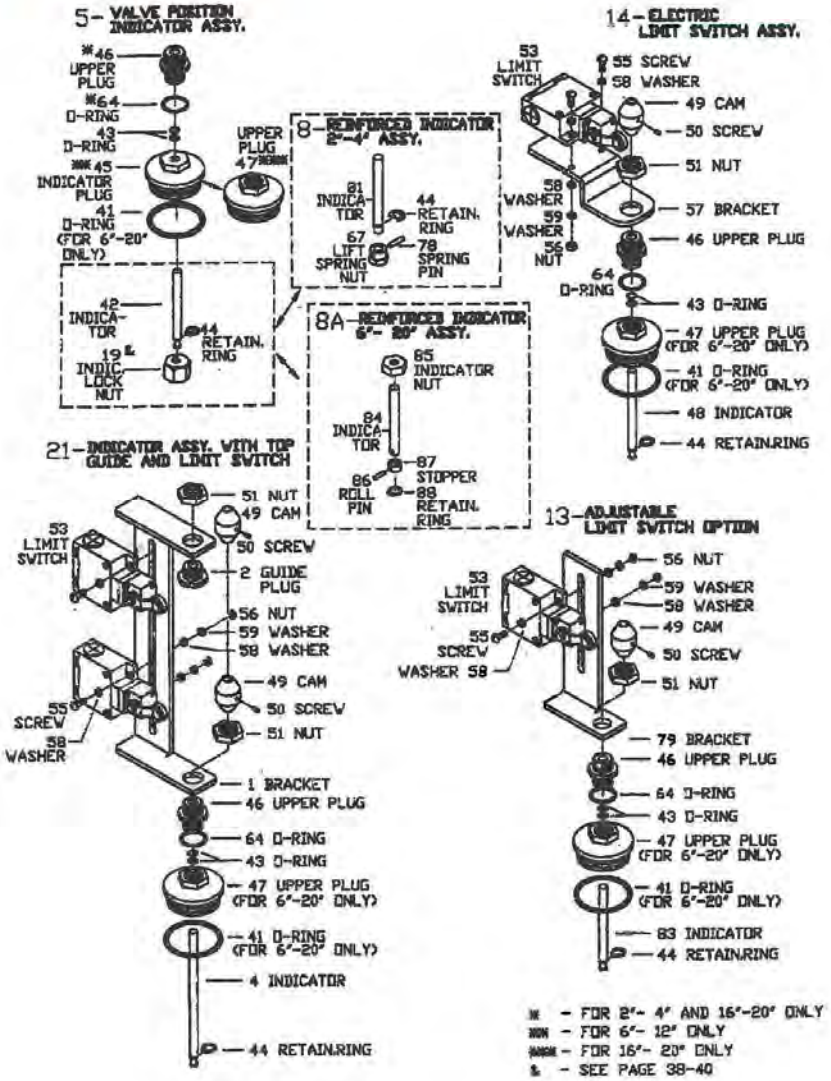
& - FOR HIGH PRESSURE ONLY

¤ - PART NO. 5 ASSEMBLED WITH PART NO. 40

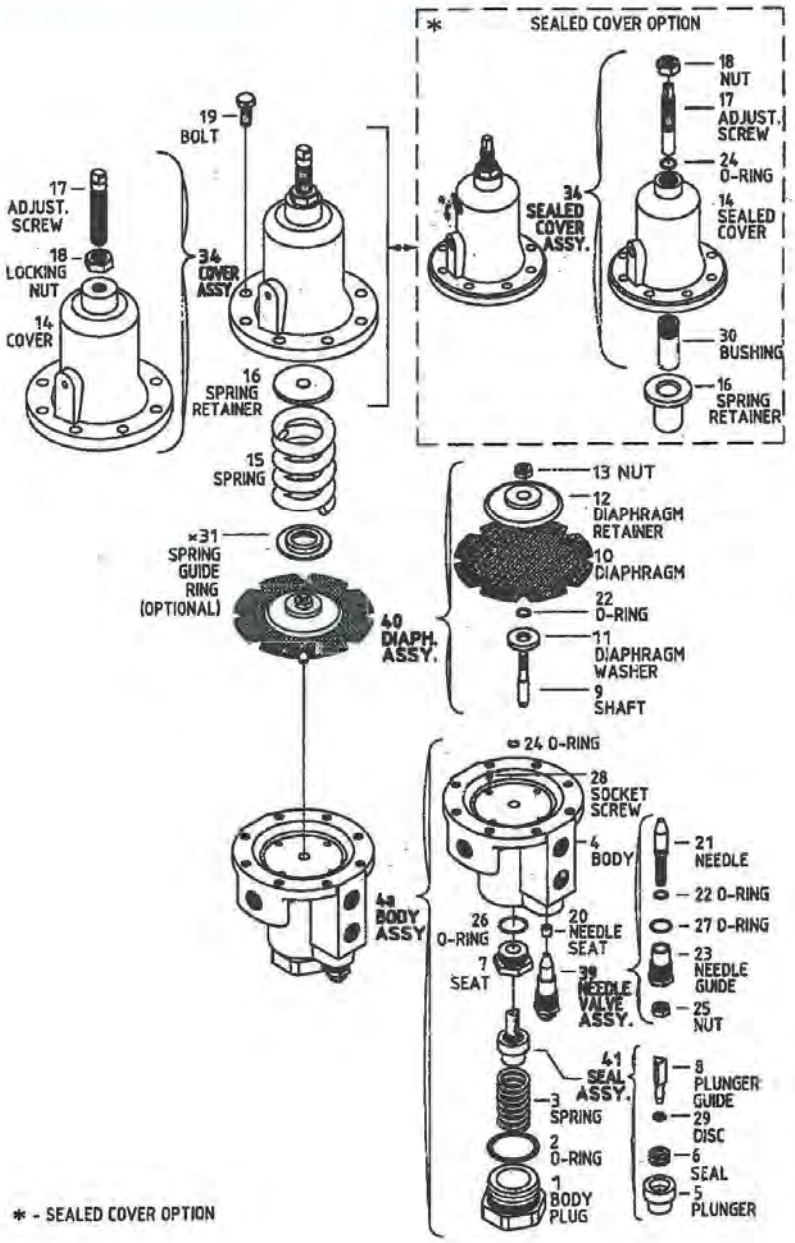
2/05

Main Valves – Indicator Options

Sizes: 1/2"-20"



#2 2-way Pressure Reducing Pilot Valve



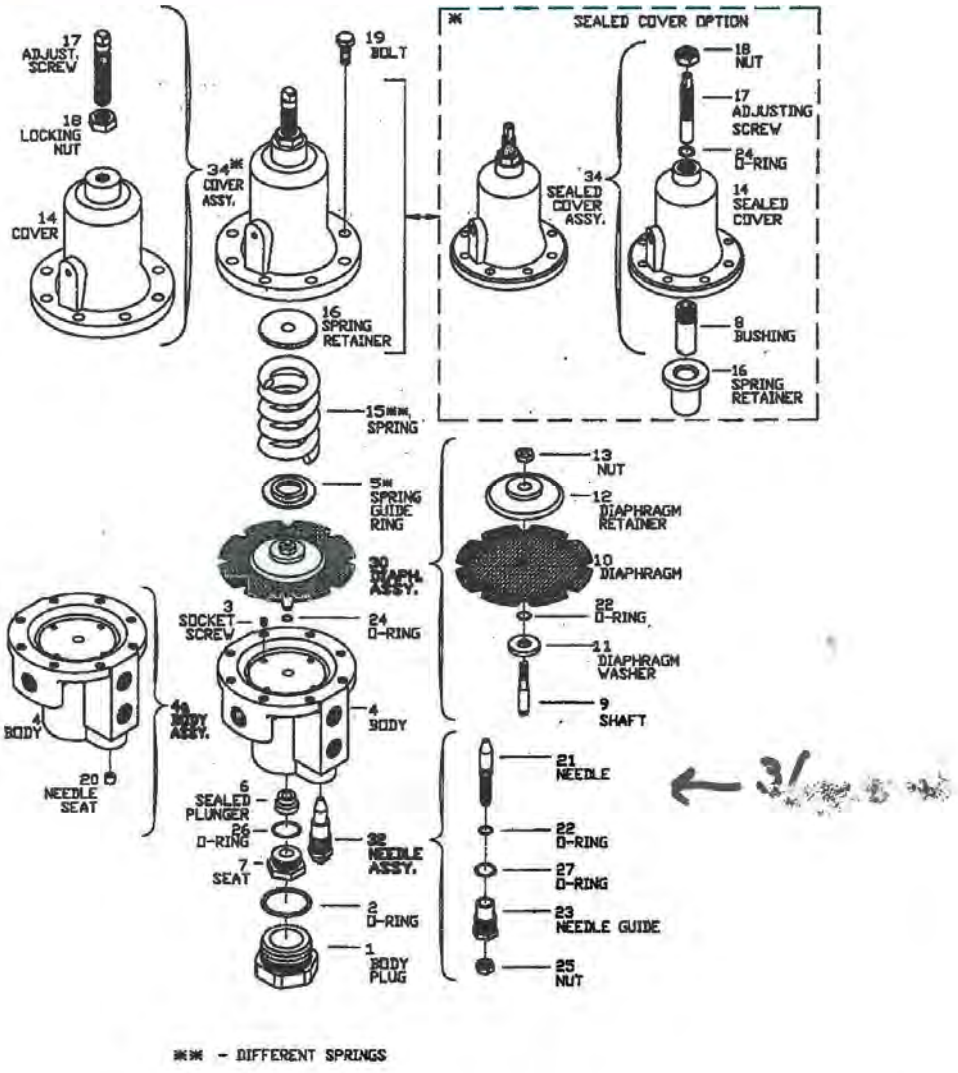
1.5turn

45

* - SEALED COVER OPTION

2/05

#3 2-way Pressure Sustaining Pilot Valve



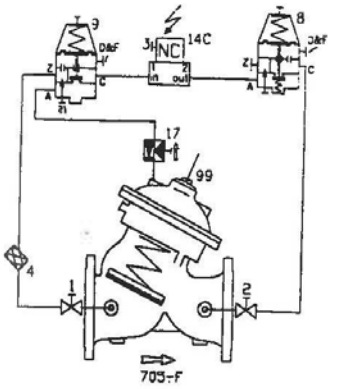
** - DIFFERENT SPRINGS

MODEL 723-55-03-I-MO

Pressure Reducing/Pressure Sustaining Valve w/Opening&Closing Speed Controls, Position Indicator and Solenoid Shut-Off w/Manual Override

PART LIST

1	Cock Valve
2	Cock Valve
3	Manual Override Toggle
4	Control Y- Filter
8	Press. Reducing Pilot Valve #2
9	Press. Relief Pilot Valve #3
14C	2-Way N.C Asco Solenoid w/Manual Operator
17	Opening Speed Needle Valve
21	Closing Speed Needle Valve
99	Position Indicator
705-F	Main Valve



TROUBLESHOOTING

SYMPTOM	CAUSE	REMEDY
Valve Fails to Open	* Insufficient inlet pressure. * No downstream demand. * Insufficient reducing pilot 8 spring compression. * Solenoid 14C not energized. * Excessive sustaining pilot 9 spring compression. * Cock valve 2/Needle valve 17 closed.	* Check/create inlet pressure. * Create demand/flow. * Turn adjusting screw on reducing pilot 8 clockwise CW. * Energize solenoid 14C. * Turn adjusting screw on sustaining pilot 9 counter clockwise CCW. *Open cock valve 2/Needle 17 CCW
Valve Fails to Close	* Filter 4 plugged. * Needle valve 21 plugged or closed. * Cock valve 1 closed. * Solenoid 14C Energized. * Excessive pilot 8 spring compression/ Insufficient pilot 9 spring compression. * Debris trapped in main valve. *Manual override 3 is in operation. ** Diaphragm in main valve leaking.	* Remove filter cap and screen to clean. * Open or adjust needle valve 21. * Open cock valve 1. * De-energize solenoid 14C. * Turn adjusting screw on pilot 8 CCW/ Turn adj. screw on pilot 9 CW. * Remove actuator assembly to inspect/ remove debris. *Turn toggle 3 to automatic position. ** Check by closing cock valves 1 &2 and remove cover plug. Continous flow indicates diaphragm leakage.
Valve Fails to Regulate	* Needle valves 17&21 not properly adjusted. * Air trapped in main valve cover. * Pilots 8 and 9 not adjusted	* Factory set at 1-2 turns open. Readjust 21 then 17 until smooth operation. * Loosen cover tube fitting at highest point. Let air escape. Retighten. * Readjust pilot settings. See Start-Up.

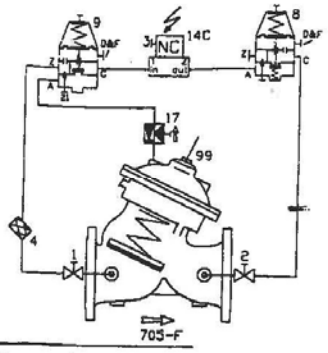
****CAUTION**: Valve will be fully open. Close downstream gate valve or omit this test if this condition may cause system damage.

4070 E. Leaverton Court - Anaheim, CA. 92807

MODEL 723-55-03-I-MO

Pressure Reducing/Pressure Sustaining Valve w/Opening&Closing Speed Controls, Position Indicator and Solenoid Shut-Off w/Manual Override

BERMAD CONTROL VALVES



PART LIST

1	Cock Valve
2	Cock Valve
3	Manual Override Toggle
4	Control Y- Filter
8	Press. Reducing Pilot Valve #2
9	Press. Relief Pilot Valve #3
14C	2-Way N.C Asco Solenoid w/Manual Operator
17	Opening Speed Needle Valve
21	Closing Speed Needle Valve
99	Position Indicator
705-F	Main Valve

DESCRIPTION

The model 723-55-03-I-MO control valve will sustain a minimum preset upstream pressure as well a regulate to maintain a constant preset downstream pressure ,when solenoid 14C is energized, regardless of flow fluctuations created by system demand. The valve is solenoid actuated for electric remote control operation. In addition, the solenoid can be overridden by activating the manual operator toggle 3 to simulate an energized solenoid.

If upstream pressure is greater than the setting of sustaining pilot 9, the pilot opens allowing the main valve to open. Should upstream pressure below the setting of sustaining pilot 9, the pilot closes causing the valve to throttle closed to sustain backpressure upstream.

The valve will also limit maximum downstream pressure to a preset adjustable setpoint regardless of flow rate. Regulating pilot 8 senses downstream pressure and modulates open or closed causing the main valve to throttle limiting the maximum delivery pressure. Should downstream pressure exceed the pilot setting, the pilot closes causing the main valve to throttle closed to regulate downstream.

INSTALLATION

1. Allow enough room around the valve assembly for making adjustments and for future maintenance and disassembly work.
2. Thoroughly flush the pipeline to remove dirt, scale, and debris. Failure to perform this operation may render the valve inoperable.
3. It is recommended that isolation gate valves be installed upsteam and downstream of the Bermad control valve to allow for future maintenance operations.
4. Install the valve in the pipeline with the valve flow arrow on the body casting in the proper direction. Use the lifting eye provided on the main valve cover for raising and lower the valve. Install the valve horizontally with the cover up for best performance. Make certain the valve is positioned so the actuator assembly can be easily removed for future maintenance requirements.
5. After installation carefully inspect/correct any damaged accessories, piping, tubing, or fittings.

WIRING- Check the solenoid specification plate on the top data plate. Check the markings on the side of the coil to verify proper voltage of coil (i.e 120/60=120VAC). Available voltage at the splice to the solenoid must be + or — 10% of the stamped voltage on the coil to function properly. This is also to prevent coil/solenoid burnout. Verify solenoid connections. There are 2 red wires and 1 green/yellow grounding wire. One red wire is power or 'hot' and the other red wire is common (negative on DC systems). Polarity not important. The green/yellow wire is an earth ground or conduit ground wire safety precautions. **Do not** apply power to this wire or it will burn the solenoid/coil.

IN-LINE STATIC TEST

Open Valve Static Test

1. Close cock valve 1 and 2 to isolate the pilot control system. This prevents dirt exposure in the control loop.
2. Remove the cover plug on the main valve actuator. **CAUTION**: This will allow the valve to fully open. Make sure this condition will not cause system damage!
3. Check for leaks at the flange connection, fittings, etc.

Closed Valve Static Test

1. Close cock valve 2 and open cock valve 1. Make sure needle 21 is open 1 full turn CCW from the closed position.
2. Vent trapped air in the main valve cover by loosening a tube fitting at the highest point on the cover. This will trap the main valve in a closed position while the pipeline is pressurized.
3. Check the valve cover and diaphragm area for leaks. Tighten actuator bolts if necessary.

START-UP OPERATION

NOTE: There must be flow through the valve to make necessary adjustments. There must be power available to energize the solenoid to operate the valve via automatic/controller mode. Insure that a downstream demand is created by opening a hydrant, relief valve etc...

* Open the opening speed needle valve 17 at least 2 turns CCW and needle valve 21 at least 1 turn CCW from their closed positions. Close main valve by opening cock valve 1 and closing cock valve 2. Leave manual operator 3 in the automatic position to operate via automatic/controller mode or turn it a 1/4 turn to open the valve if no power is available.

For Pressure Reducing Adjustment:

1. Turn adjusting screw on reducing pilot 8 and sustaining pilot 9 fully counter-clockwise. Open cock valves 1 and 2. Main valve should remain closed.
2. Open upstream gate valve fully but open downstream gate valve only approximately 10% if applicable. Main valve should remain closed.
3. Energize solenoid 14C or operate the override toggle 3 by turning it a 1/4 turn. Slowly turn adjusting screw on reducing pilot 8 clockwise to desired downstream pressure setting and tighten adjusting screw locknut.

For Pressure Sustaining Adjustment:

1. Fully turn adjusting screw on sustaining pilot 9 clockwise. Main valve will close. Open downstream gate valve fully, if applicable.
2. Set the upstream pressure to the desired setting by throttling a gate valve, starting/stopping a pump or opening a bypass upstream to get the desired upstream pressure to set the pilot.
3. Energize solenoid 14C or turn the override toggle 3 by turning it a 1/4 turn.
4. While watching an upstream pressure gauge, slowly turn adjusting screw on pilot 9 counter-clockwise pausing after each 1/2 turn to allow valve to react. When the main valve just starts to open, Stop. Turn the adjustment screw back clockwise a 1/2 turn. This will set pilot 9 approximately 10 psi higher than the desired upstream pressure setting. Check setting by increasing/decreasing upstream pressure. The valve should open when the upstream pressure is above the setting and close when the upstream pressure is below the pilot setting. Turning the adjustment screw CW increases setting and turning CCW decreases. Readjust if necessary.
5. Leave manual operator toggle 3 in the automatic position to operate via controller.

Torque Chart

Part Name	Torque Value in Inch–Pounds	Torque Value in Newton–Meters
terminal block screws	10 ± 2	1,1 ± 0,2
socket head screw	15 – 20	1,7 – 2,3
center screw	5 ± 1	0,6 ± 0,1

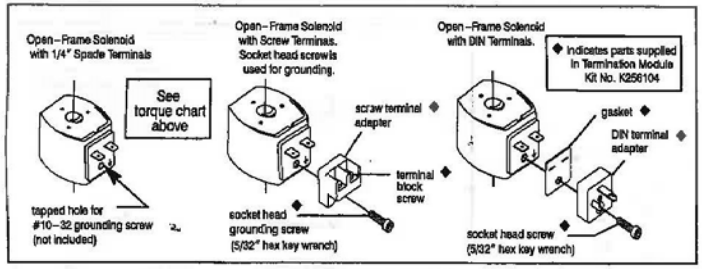


Figure 4. Open–frame solenoids

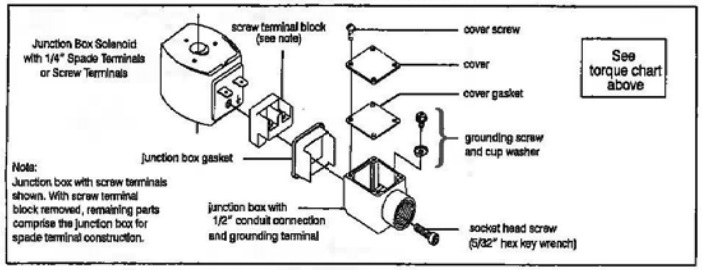


Figure 5. Junction box (optional feature)

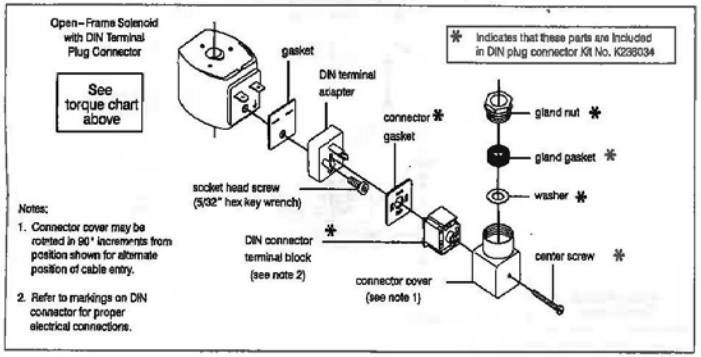


Figure 6. DIN plug connector kit No. K236034 (optional feature)

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Installation & Maintenance Instructions

ASCO Red-Hat II®

OPEN–FRAME, GENERAL PURPOSE, WATERTIGHT/EXPLOSIONPROOF SOLENOIDS

SERIES 8016G

Form No.V6583R7

—SERVICE NOTICE—

ASCO® solenoid valves with design change letter "G" in the catalog number (example: 8210G 1) have an epoxy encapsulated ASCO® Red Hat II® solenoid. This solenoid replaces some of the solenoids with metal enclosures and open–frame constructions. Follow these installation and maintenance instructions if your valve or operator uses this solenoid.

DESCRIPTION

Catalog numbers 8016G1 and 8016G2 are epoxy encapsulated pull–type solenoids. The green solenoid with lead wires and 1/2" conduit connection is designed to meet Enclosure Type 1–General Purpose, Type 2–Dripproof, Types 3 and 3S–Raintight, and Types 4 and 4X–Wttertight. The black solenoid on catalog numbers prefixed "EF" is designed to meet Enclosure Types 3 and 3S–Raintight, Types 4 and 4X–Watertight, Types 6 and 6P–Submersible, Type 7 (A, B, C, & D) Explosionproof Class I, Division 1, Groups A, B, C, & D and Type 9 (E, F, & G)–Dust–Ignitionproof Class II, Division 1, Groups E, F, & G. The Class II, Groups F & G Dust Locations designation is not applicable for solenoids or solenoid valves used for steam service or when a class "H" solenoid is used. See *Temperature Limitations* section for solenoid identification and nameplate/retainer for service. When installed just as a solenoid and not attached to an ASCO valve, the core has a 0.250–28 UNF–2B tapped hole, 0.38 minimum full tnread.

Series 8016G solenoids are available in:

- **Open–Frame Construction**
  The green solenoid may be supplied with 1/4" spade, screw, or DIN terminals (Refer to Figure 4).
- **Panel Mounted Construction**
  These solenoids are specifically designed for panel mounted by the customer through a panel having a .062 to .093 maximum wall thickness. (Refer to Figure 3 and section on *Installation of Panel Mounted Solenoid*).

Optional Features For Type 1 – General Purpose Construction Only

- **Junction Box**
  This junction box construction meets Enclosure Types 2,3,3S,4, and 4X. Only solenoids with 1/4" spade or screw terminals may have a junction box. The junction box provides a 1/2" conduit connection, grounding and spade or screw terminal connections with in the junction box (See Figure 5).
- **DIN Plug Connector Kit No. K236034**
  Use this kit only for solenoids with DIN terminals. The DIN plug connector kit provides a two pole with grounding contact DIN Type 43650 construction (See Figure 6).

OPERATION

When the solenoid is energized, the core is drawn into the solenoid base sub–assembly. **IMPORTANT: When the solenoid is de–energized, the initial return force for the core, whether developed by spring, pressure, or weight, must exert a minimum force to overcome residual magnetism created by the solenoid. Minimum return force for AC construction is 11 ounces, and 4 ounces for DC construction.**

INSTALLATION

Check nameplate for correct catalog number, service, and wattage. Check front of solenoid for voltage and frequency.

⚠ WARNING: Electrical hazard from the accessibility of live parts. To prevent the possibility of death, serious injury or property damage, install the open – frame solenoid in an enclosure.

For Black Enclosure Types 7 and 9 Only

⚠ CAUTION: To prevent fire or explosion, do not install solenoid and/or valve where ignition temperature of hazardous atmosphere is less than 165° C. On valves used for steam service or when a class "H" solenoid is used, do not install in hazardous atmosphere where ignition temperature is less than 180°C. See nameplate/retainer for service.

NOTE: These solenoids have an internal non–resetable thermal fuse to limit solenoid temperature in the event that extraordinary conditions occur which could cause excessive temperatures. These conditions include high input voltage, a jammed core, excessive ambient temperature or a shorted solenoid, etc. This unique feature is a standard feature only in solenoids with black explosionproof/dust–ignitionproof enclosures (Types 7 & 9).

⚠ CAUTION: To protect the solenoid valve or operator, install a strainer or filter, suitable for the service involved in the inlet side as close to the valve or operator as possible. Clean periodically depending on service conditions. See ASCO Series 8600, 8601, and 8602 for strainers.

Temperature Limitations

For maximum valve ambient temperatures, refer to chart. The temperature limitations listed, only indicate maximum application temperatures for field wiring rated at 90°C. Check catalog number prefix and watt rating on nameplate to determine maximum ambient temperature. See valve installation and maintenance instructions for maximum fluid temperature. NOTE: For steam service, refer to *Wiring* section, *Junction Box* for temperature rating of supply wires.

Temperature Limitations For Series 8016G Solenoids for use on Valves Rated at 6.1, 8.1, 9.1, 10.6, or 11.1 Watts

Watt Rating	Catalog Number Coil Prefix	Class of Insulation	Maximum † Ambient Temp.
6.1, 8.1, 9.1, & 11.1	None, FB, KF, KP, SF, S?, SC, & SD	F	125°F (51.7°C)
6.1, 8.1, 9.1, & 11.1	HB, HT, KB, KH, SS, ST, SU, & ST	H	140°F (60°C)
10.6	None, KF, SF, & SC	F	104°F (40°C)
10.6	HT, KH, SU, & ST	H	104°F (40°C)

†Minimum ambient temperature –40°F (–40° C).

Positioning

This solenoid is designed to perform properly when mounted in any position. However, for optimum life and performance, the solenoid should be mounted vertically and upright to reduce the possibility of foreign matter accumulating in the solenoid base sub–assembly area.

Wiring

Wiring must comply with local codes and the National Electrical Code. All solenoids supplied with lead wires are provided with a grounding wire which is green or green with yellow stripes and a 1/2" conduit connection. To facilitate wiring, the solenoid may be rotated 360°. For the watertight and explosionproof solenoid, electrical fittings must be approved for use in the approved hazardous locations.

Additional Wiring Instructions For Optional Features:

- **Open–Frame solenoid with 1/4" spade terminals**

For solenoids supplied with screw terminal connections use #12–18 AWG stranded copper wire rated at 90°C or greater. Torque terminal block screws to

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10 ± 2 in–lbs [1,0 ± 1,2 Nm]. A tapped hole is provided in the solenoid for grounding, use a #10–32 machine screw. Torque grounding screw to 15 –20 in–lbs [1,7 – 2,3 Nm]. On solenoids with screw terminals, the socket head screw holding the terminal block to the solenoid is the grounding screw. Torque the screw to 15 – 20 in–lbs [1,7 – 2,3 Nm], with a 5/32" hex key wrench.

- **Junction Box**

The junction box is used with spade or screw terminal solenoids only and is provided with a grounding screw and a 1/2" conduit connection. Connect #12–18 AWG standard copper wire only to the screw terminals. Within the junction box use field wire that is rated 90°C or greater for connections. For steam service use 105°C rated wire up to 50 psi or use 125°C rated wire above 50 psi. After electrical hookup, replace cover gasket, cover, and screws. Tighten screws evenly in a crisscross manner.

- **DIN Plug Connector Kit No.K236–034**

1. The open–frame solenoid is provided with DIN terminals to accommodate the DIN plug connector kit.
2. Remove center screw from plug connector. Using a small screwdriver, pry terminal block from connector cover.
3. Use #12–18 AWG stranded copper wire rated at 90°C or greater for connections. Strip wire leads back approximately 1/4" for installation in socket terminals. The use of wire–end sleeves is also recommended for these socket terminals. Maximum length of wire–end sleeves to be approximately 1/4". Tinning of the ends of the lead wires is not recommended.
4. Thread wire through gland nut, gland gasket, washer, and connector cover.

NOTE: Connector cover may be rotated in 90° increments from position shown for alternate positioning of cable entry.

5. Check DIN connector terminal block for electrical markings. Then make electrical hookup to terminal block according to markings on it. Snap terminal block into connector cover and install center screw.
6. Position connector gasket on solenoid and install plug connector. Torque center screw to 5 ± 1 in–lbs [0,6 ± 1,1 Nm].

NOTE: Alternating current (AC) and direct current (DC) solenoids are built differently. To convert from one to the other, it may be necessary to change the complete solenoid including the core and solenoid base sub–assembly, not just the solenoid. Consult ASCO.

Installation of Solenoid

Solenoids may be assembled as a complete unit. Tightening is accomplished by means of a hex flange at the base of the solenoid. The 3/4" bonnet construction (Figure 1) must be disassembled for installation and installed with a special wrench adapter.

Installation of Panel Mounted Solenoid (See Figure 3)

Disassemble solenoid following instruction under *Solenoid Replacement* then proceed.

3/4" Valve Bonnet Construction

1. Install retainer (convex side to solenoid) in 1.312 diameter mounting hole in customer panel.
2. Then position spring washer over plugnut/core tube sub–assembly.
3. Install plugnut/core tube sub–assembly through retainer in customer panel. Then replace solenoid, nameplate/retainer and red cap.

15/16" Valve Bonnet Construction

1. Install solenoid base sub–assembly through 0.69 diameter mounting hole in customer panel.
2. Position spring washer on opposite side of panel over solenoid base sub–assembly then replace.

Solenoid Temperature

Standard solenoids are designed for continuous duty service. When the solenoid is energized for a long period, the solenoid becomes hot and can be touched by hand only for an instant. This is a safe operating temperature.

MAINTENANCE

⚠ WARNING: To prevent the possibility of death, serious injury or property damage, turn off electrical power, depressurize solenoid operator and/or valve, and vent fluid to a safe area before servicing.

Cleaning

All solenoid operators and valves should be cleaned periodically. The time between cleaning will vary depending on medium and service conditions. In general, if the voltage to the solenoid is correct, sluggish valve operation, excessive noise or leakage will indicate that cleaning is required. Clean strainer or filter when cleaning the valve.

Preventive Maintenance

- Keep the medium flowing through the solenoid operator or valve as free from dirt and foreign material as possible.
- While in service, the solenoid operator or valve should be operated at least once a month to insure proper opening and closing.
- Depending on the medium and service conditions, periodic inspection of internal valve parts for drainage or excessive wear is recommended. Thoroughly clean all parts. Replace any worn or damaged parts.

Causes of Improper Operation

- **Faulty Control Circuit:** Check the electrical system by energizing the solenoid. A metallic *click* signifies that the solenoid is operating. Absence of the *click* indicates loss of power supply. Check for loose or blown fuses, open–circuited or grounded solenoid, broken lead wires or splice connections.
- **Burned–Out Solenoid:** Check for open–circuited solenoid. Replace if necessary. Check supply voltage; it must be the same as specified on nameplate/retainer and marked on the solenoid. Check ambient temperature and check that the core is not jammed.
- **Low Voltage:** Check voltage across the solenoid leads. Voltage must be at least 85% of rated voltage.

Solenoid Replacement

1. On solenoids with lead wires disconnect conduit, coil leads, and grounding wire.

NOTE: Any optional parts attached to the old solenoid must be reinstalled on the new solenoid.

2. Disassemble solenoids with optional features as follows:

- **Spade or Screw Terminals**

Remove terminal connections, grounding screw, grounding wire, and terminal block (screw terminal type only).

NOTE: For screw terminals, the socket head screw holding the terminal block serves as a grounding screw.

- **Junction Box**

Remove conduit and socket head screw (use 5/32" hex key wrench) from center of junction box. Disconnect junction box from solenoid.

- **DIN Plug Connector**

Remove center screw from DIN plug connector. Disconnect DIN plug connector from adapter. Remove socket head screw (use 5/32" hex key wrench), DIN terminal adapter, and gasket from solenoid.

3. Snap off red cap from top of solenoid base sub–assembly.
4. Push down on solenoid. Then using a suitable screwdriver, insert blade in slot provided between solenoid and nameplate/retainer. Pry up slightly and push to remove. Then remove solenoid from solenoid base sub–assembly.
5. Reassemble using exploded views for parts identification and placement.

Disassembly and Reassembly of Solenoids

1. Remove solenoid, see *Solenoid Replacement*.
2. Remove finger washer or spring washer from solenoid base sub–assembly.
3. Unscrew solenoid base sub–assembly.

NOTE: Some solenoid constructions have a plugnut/core tube sub–assembly, bonnet gasket and bonnet in place of the solenoid base sub–assembly. To remove bonnet use special wrench adapter supplied in ASCO Rebuild Kit. For wrench adapter only, order ASCO Wrench Kit No.K218948.

4. The core is now accessible for cleaning or replacement.
5. If the solenoid is part of a valve, refer to basic valve installation and maintenance instructions for further disassembly.
6. Reassemble using exploded views for identification and placement of parts.

ORDERING INFORMATION FOR ASCO SOLENOIDS

When Ordering Solenoids for ASCO Solenoid Operators or Valves, order the number stamped on the solenoid. Also specify voltage and frequency.

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Torque Chart

Part Name	Torque Value in Inch–Pounds	Torque Value in Newton–Meters
solenoid base sub–assembly	175 ± 25	19,8± 2,8
valve bonnet (3/4" bonnet construction)	90 ± 10	10,2 ± 1,1
bonnet screw (3/8" or 1/2" NPT pipe size)	25	2,8
bonnet screw (3/4" NPT pipe size)	40	4,5

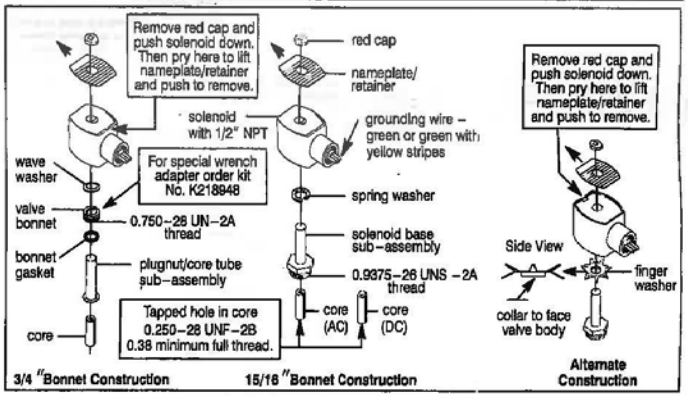

Figure 1. Series 8016G solenoids

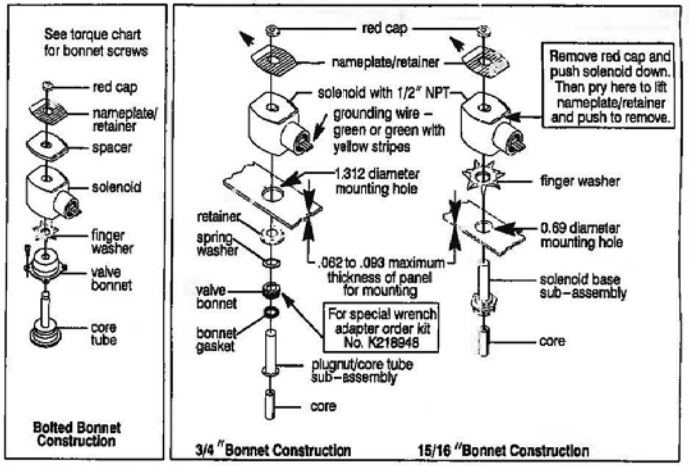

Figure 2. Series 8016G solenoid

Figure 3. Series 8016G panel mounted solenoids

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INSTALLATION AND MAINTENANCE INSTRUCTIONS

TEMPORARY SUPPLEMENT
FOR MANUAL OPERATOR

BULLETINS
8210
8211

ASCO

FORM NO. V6031

IMPORTANT: This sheet has been added temporarily to show the new dual gasket arrangement for manual operators used on Bulletins 8210 and 8211. This temporary sheet, Form No. V6031 will supplement Installation and Maintenance Instruction Form No.'s V5427, V5590, V5825, V5847 and V5848.

WARNING: Depressurize valve and turn off electrical power supply.

1. Disassemble manual operator in an orderly fashic paying careful attention to location and placement c parts.
2. Remove stem pin, stem, stem spring and stem gaske
3. Replace new gaskets on stem.
4. On older construction valves using only one gaske install one new gasket and discard the other. (Se Figure 2).
5. Reassemble in reverse order of disassembly payin careful attention to exploded views provided fc identification and placement of parts.

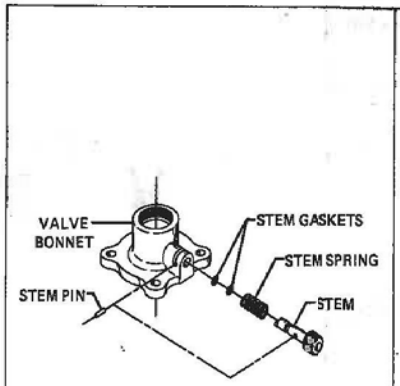

Figure 1. View of Manual Operator Disassembled

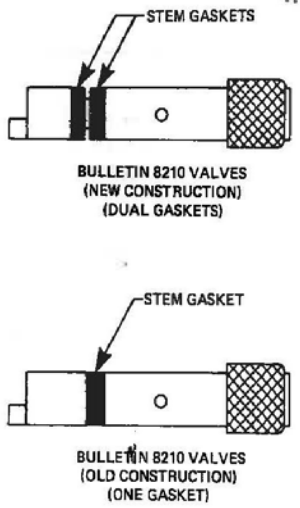

Figure 2.

Form No. V6031 PRINTED IN U.S.A. 1979 Automatic Switch Co.

ASCO Valves ASCO

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INSTALLATION AND MAINTENANCE INSTRUCTIONS

TEMPORARY SUPPLEMENT
FOR MANUAL OPERATOR

BULLETIN
8222

ASCO

FORM NO. V6031

IMPORTANT: This sheet has been added temporarily to show the new dual gasket arrangement for manual operators used on Bulletin 8222. This temporary sheet, Form No. V6031, will supplement Installation and Maintenance Instructions, Form No. V5452.

WARNING: Depressurize valve and turn off electrical power supply.

1. Disassemble manual operator in an orderly fashion paying careful attention to location and placement of parts.
2. Remove stem pin, stem, stem spring and stem gasket.
3. The new dual gasket arrangement consists of two (2) color coded gaskets. The GOLD dot gasket is **VITON*** material. The RED dot gasked is ethylene propylene material.
4. When replacing new dual gaskets on the stem, be sure to place them in their proper sequence. **IMPORTANT: The VITON gasket (with the GOLD dot) must be the "OUTER" gasket and the ethylene propylene gasket (with the RED dot) must be the "INNER" gasket.** (See Figure 2)
5. For older construction valves, using only one gasket, the ethylene propylene gasket (with the RED dot) should be used.
6. Reassemble in reverse order of disassembly paying careful attention to exploded views provided for identification and placement of parts.

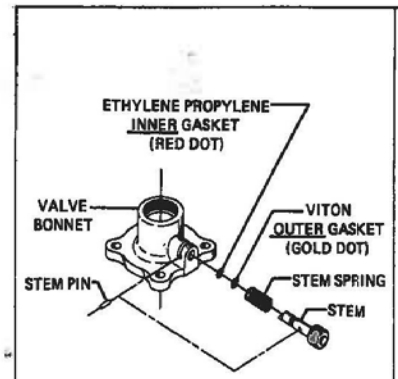

Figure 1. View of Manual Operator Disassembled

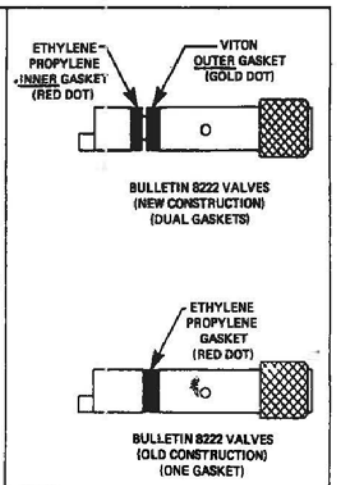

Figure 2.

*DuPont's trademark

Form No. V6031 PRINTED IN U.S.A. 1979 Automatic Switch Co.

ASCO Valves ASCO

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07/15/2021

Appendix A-14

Legacy Well Delta V Operations

Appendix A-14

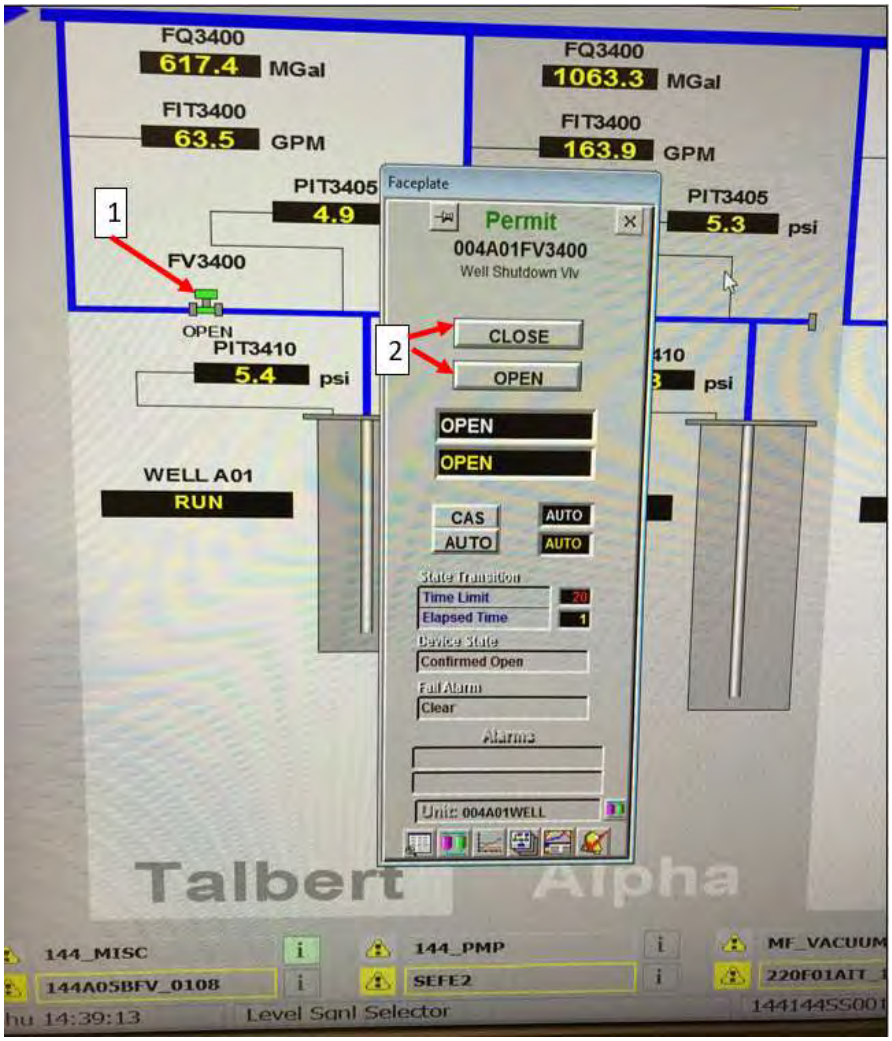
Legacy Well Delta V Operations

Background

Legacy Wells are limited in their remote-control capabilities. Using the GWRS process control software – Delta V, the IRSO can start or stop a Legacy Well. The IRSO is not able to make flow adjustments remotely, a field visit is required.

How to start or stop a Legacy Well in Delta V

- In Delta V, navigate to and select the desired Legacy Well.
- Locate the green valve shown below with red arrow #1and click on it.
- The Detailed faceplate will appear. In this detailed face plate select “open or close”.



Appendix A-15

Baski Valve Factory Information

InFlex™ Flow Control Valve (FCV™)

U.S. Patents 5,316,081 and 6,273,195

Baski, Inc. made the world's first downhole flow control valve in 1992, which was installed in Highlands Ranch, CO for Centennial Water and Sanitation District. Since then, Baski has manufactured over 200 FCVs, which have been installed mostly in the western US.

For overview product and application information, click here to download our most recent Catalog 6 (PDF). Its pages 22-25 provide an introduction to our FCV™, technical drawings, and specification worksheets.

For us to determine which FCV™ will be best for your application, please download the FCV worksheet. Fill it out with as much information as you have available, and email it to us.

The InFlex™ Flow Control Valve (FCV™) is a fluid-actuated valve that permits pumping water to the surface or regulating the flow of water from the surface into the well, while using the same column pipe and maintaining a column of water in it at all times. The

The table below gives some common examples of the applications each size FCV can be used in. However, each installation is unique. To determine which size FCV is best for your application, please fill out our FCV Worksheet and email it to us.

FCV Sizing Examples

Casing Size	Valve OD	Column Pipe	Flow
nominal [inch]	maximum [inch]	nominal [inch]	typical [gpm]
8	6-5/8	4 or 5	0 - 400
10	8-5/8	6	800
12	10-3/4	8	1,400
16	12-3/4	10	2,000
20	16	12	3,000
22	18	14	3,500
24	20	16	4,000
28	24	18 or 20	5,000

Flow Rate Discussion: Flow Rate [gpm] = C_V × Squareroot(Head [feet])
The flow rate through a given valve is proportional to the square root of th
The driving head is the sum of the injection pipeline pressure in feet of wa
distance down to the injection water level in the well minus the head loss
pipe. Baski customizes the flow coefficient (C_V) range of each valve to th
application (its column pipe size and driving head). Flow control results fr
C_V between 0 (closed) and the valve's maximum (open).

For more information on aquifer storage and recovery (ASR), please refer to **Groundwater Recharge and Wells - A Guide to Aquifer Storage Recovery by R. David G. Pyne.**

InFlex™ FCV™ may be used in conjunction with a submersible pump or a vertical turbine pump for Aquifer Storage and Recovery (ASR) and Aquifer Thermal Energy Storage (ATES) applications. Advantages of the InFlex™ FCV™ include:

Impressive Performance

Testing at the factory and field use of the InFlex™ FCV™ confirm that it effectively adjusts and holds desired injection rates. Because of its unique design features, including no sliding seals to fail, it is the most durable and versatile valve on the market.

Cavitation-Free Design

The key to the successful control of the injection water through this valve is its long, adjustable, annular-gap flow path through a series of circular annular orifices. This flow path provides non-cavitating head loss that is easily controlled by changing the gap between the annular orifices and the rubber element. Stainless steel channels are a part of the adjustable flow system and stabilize the rubber element as it is pushed down and stretched by the inflation liquid.

Impossible to Sand-lock

By design, there is no place for sand to collect; therefore, the InFlex™ FCV™ cannot sand lock. It is impossible for the rubber element to "stick" at any time during pumping or injection, as there are no sliding surfaces to become "stuck" due to sand-locking.

Wear-resistant

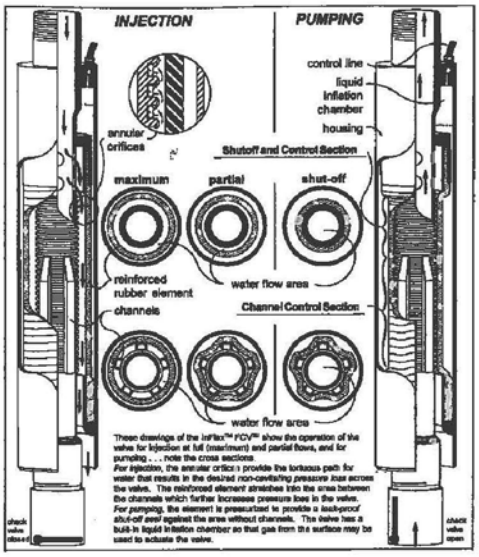
The InFlex™ FCV™ is extremely wear-resistant due to its rubber control element, similar to slurry pumps which are rubber lined to reduce wear. Due to its low-velocity, cavitation-free flow, the InFlex™ FCV™ resists sand and silt far better than conventional valve designs. Conventional valves have all of their pressure loss (at high velocities) across only one orifice stage, leading to wear from suspended solids and erosion with cavitation.

Ask about our 5-year limited warranty

The InFlex™ FCV™ utilizes a reinforced rubber element, the only "moving" part. This element is an adaptation of the element that has been successfully used in our inflatable downhole packers in demanding open-hole conditions for over three decades. All metal parts of the valve are constructed of stainless steel. Other more corrosion-resistant alloys are optional for aggressive environments.

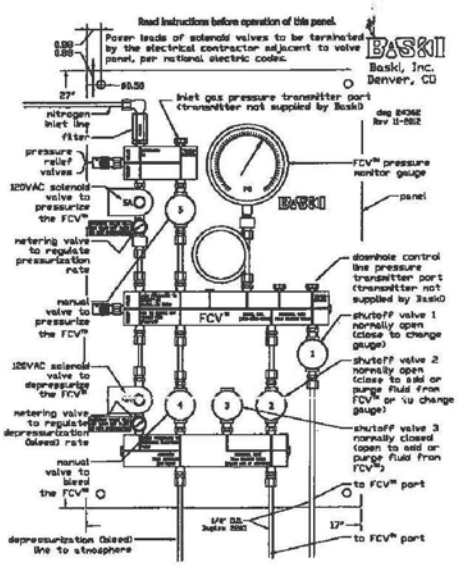
Wide Range of Injection Capacities

Our InFlex™ FCV™ offers injection capacities of 10,000 gpm and higher with driving heads of 20 to 3,000 feet. All of the valves are infinitely adjustable from drip-tight shut-off to maximum flow. Furthermore, their maximum flow rate can be limited by using two control lines.



You can download a PDF of the drawing above here.

Automatic/Manual Control Panel



Use free Adobe Reader® to view and print the PDF documents available on this website. 

Our automatic/manual control panel is designed to allow a single user to adjust the inflation pressure of the FCV either remotely with a PLC or SCADA system, or manually with the incorporated needle valves.

For automatic control, there are two solenoid valves on the panel that can be tied into the user's existing PLC or SCADA system.

On the standard control panel, these solenoid valves are normally closed, 10 watt valves that are operated with two wire leads. The standard coils are 120V AC, but other voltages (such as 24V DC) can be substituted to match the power available on site.

Paired with both solenoid valves are two metering valves with vernier handles. These metering valves can be used in conjunction with the solenoid valves to fine tune the control of the inflation pressures. Essentially, the metering valves determine how much nitrogen gas is passed through for each pulse of the solenoid valve. This allows you to have different rates of inflation and deflation.

For manual operation, large needle valves are positioned in a parallel path to the solenoid valves, which allow the user to control the inflation and deflation right at the panel. Manual control is often convenient during start up and/or diagnostic testing of the operations.

A large 4.5" pressure gauge installed on the panel allows the operator to see read the downhole inflation pressure while making any manual adjustment, or to double check against other digital readouts from the SCADA system.

While Baski does not provide any pressure transmitters or pressure transducers, there are multiple locations on the control panel that are available for the user to install their own transmitters to monitor the various pressures on the panel. Typically, customers will install two different transmitters on the panel. One on the middle manifold block and one on the upper manifold block (see drawing for locations). The transmitter on the middle block would monitor the real time inflation pressure of the FCV. The transmitter on the upper block will monitor the inlet pressure coming from the nitrogen regulator or manifold assembly.

The control is built on a powder-coated steel backpanel which is a standard NEMA size backpanel measuring 27" tall and 17" wide. The panel has mounting holes for installation into an enclosure or on a wall.

Baski, Inc. | T: (303) 789-1200 or (800) 552-2754 | F: (303) 789-0900
Manufacturing/Shipping Address: 4002 S Clay St., Englewood CO 80110
info@baski.com

Appendix A-16

Procedures for Operating a Modern Well

Appendix A-16

Procedures for Operating a Modern Well

Background:

All Modern Wells are equipped with Baski down-well flow control valves. These Baski Valves allow the IRSO to start, stop and change flow remotely using the process control system software - Delta V. This section describes Modern Well operation using Delta V.

Definitions:

a. FV7070: Well Flow Baski Valve. The water flow to each well is controlled by the inflation level of the Baski Valve. Nitrogen gas (N_2) is increased to the valve to reduce flow into the well while releasing gas from the valve will allow more water into the well, thus deflating the gland.

b. FV3400: Control tab that high and low flow setpoints and sets the maximum water level rise into the casing during injection.

c. Pulse: Set time (in seconds) that the FV7070 (Baski Valve) will OPEN or CLOSE per Cycle.

d. Cycle: Set time (in seconds) before next Pulse OPEN or CLOSED of Baski Valve (FV7070)

e. Normal: One of two timer modes for FV7070 (Baski Valve) operation. This mode is more conservative and will result in smaller changes in rate with longer periods of time between changes. Normal is used when well is at setpoint – idle.

f. Rapid: One of two timer modes for FV7070 (Baski Valve) operation. This mode will be for shutting of the well quickly. Delta V will go into Rapid mode if loss of, level, pressure or flow information.

g. Baski: I-26 through I-36 wells are equipped with this type of valve. N_2 gas is used to control the well flow by changing the inflation level of the valve.

Baski Valve Start Procedure:

1. Select the Baski Well to be started, note the white board in the control room for wells that are available for injection. Some wells are offline due to "other" constraints. The Barrier Ops clipboard (Seawater Barrier Daily Logsheet) is a good place to see what is running currently.

2. In Delta V navigate to and select the desired well and open the Detail Faceplate for FV7070 ("Detail"). Under the Timers section; Change the **Normal Pulse to 10 seconds** and the **Normal Cycle to 30 seconds**.

3. Reset "First Out" alarm on Detail Faceplate (typ. "MOV Not Open")

4. Change the Well Control Mode from OFF to FLOW_LEVEL. A red banner will appear on the lower portion of the screen.

5. Select "Confirm".

6. Delta V will now send a series of commands to the well to fill the drop pipe of the well before allowing the Baski Valve to Open (I-29 – I-36 only, I-24 – I28 not applicable).
   Steps:

   - The MOV will crack open (appears on screen as light blue color)
   - The MOV opens fully after the water flow drops below a pre-set value to ensure the drop pipe is full (Air has been removed from the line)
   - A wait period will pass as the MOV valve opens
   - FV7070 will now begin the pulse open cycles.

   The current step will be described in the "Info" section of the control banner at the bottom of the screen.

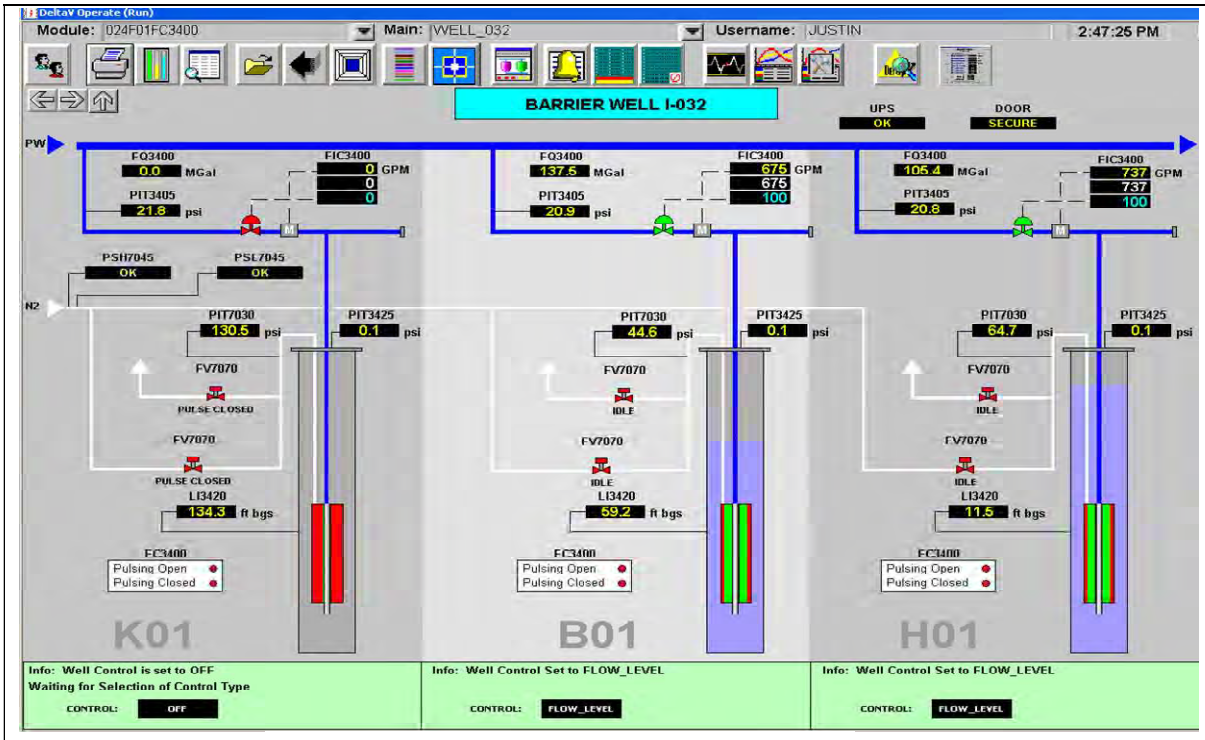
   Note: It can take several minutes for the well to register flow.

   If the well fails ("Sequence Failure"), the well should be re-started (click "OK"). Increase pulse timer to get Baski Valve to open sooner so it doesn't time out (15 or 20 seconds) If the failure repeats try a faster setting – 15/30, the well can time out. If the well still fails switch the well to "OFF".

7. When the FC3400 banner no longer shows the green circle next to Pulse Open and/or FV7070 is "idle", the timers should be returned to their original settings (typically 1 sec or 2 sec, Normal Pulse with 60 sec Normal Cycle).
8. *(Use "Coastal Seawater Barrier Daily" log to confirm normal timer settings.)*

How to stop Modern Well flow

- Navigate to the desired well in Delta V
- Notice the green banner at the bottom of the page
- Within the green banner locate the black box click on black box and select “off”
- Hit “ok”
- Click on FV7070, faceplate will populate
- In lower left-hand corner select the “details” icon (full bottom, full left)
- Change timers to 10 / 30 (or select the rapid button for 10/30).
- At this point the well is off-line and ready to be restarted with the correct timer setting
- Record changes in well flow on the Coastal Seawater Barrier Daily Log Sheet



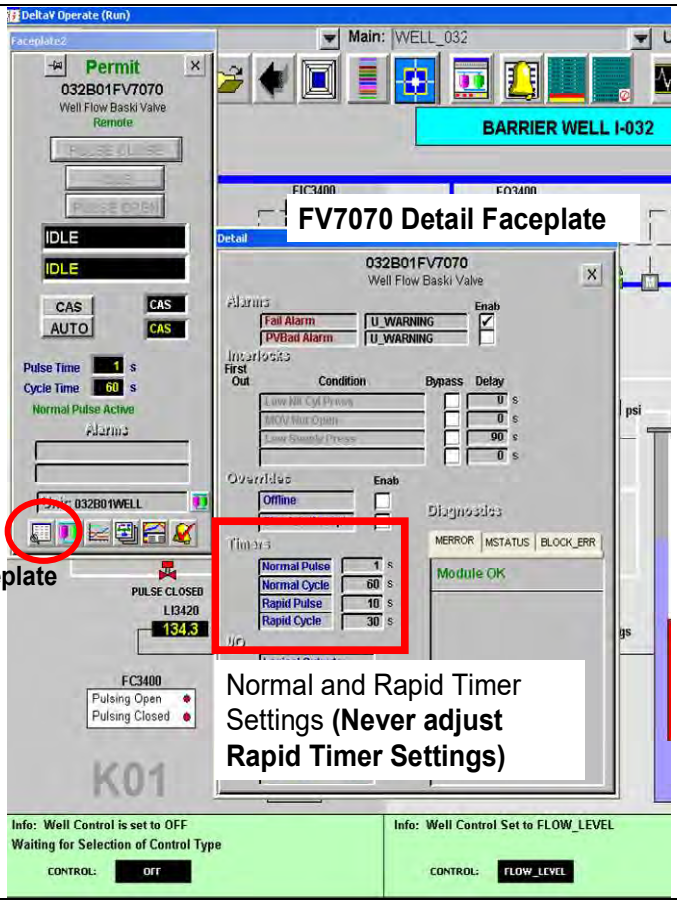
Typical Baski Well Site screen shot.

There are three wells per site (K, B, H), each penetrating a different aquifer. Note: The K well is OFF (MOV is red, Control mode is OFF and the well bladder is displayed in solid red).

Identifies the mode of operation of the well. A single left-click of the mouse on the mode will bring up the Faceplate with options.

FV7070 Faceplate2 (accessed by a single left mouse click on FV7070.

To access Detail Faceplate



ORANGE COUNTY WATER DISTRICT

COASTAL SEAWATER BARRIER DAILY LOGSHEET

Page of

Date:

Time:

Day:

BPS FLOW

BPS PSI

Timer Settings (Dec 2008)
Normal Pulse / Normal Cycle

	Well No.	Flow	FLOW SET POINTS Low	FLOW SET POINTS High	Current Water Level	Hand Level	High Set Point WL	Influent PSI	Inflation PSI	Timers	Flange Pressure	Flange PSI Set Pt.	Display Level
	24F									3/30			
	24K									3/30			
	25F									3/30			
LO	26H									1/60			
	26L									1/60			
LO	26K									1/60			
LO	27H									1/60			
	27A									1/60			
LO	27K									1/60			
	28H									1/60			
LO	28A									1/60			
	28K									1/60			
LO	29H									1/60			
LO	29A									1/60			
	29K									1/60			
	30K									1/60			
LC	30B									1/60			
	30H									1/60			
LO	31H									1/60			
	31B									1/60			
LO	31K									1/60			
	32K									1/60			
	32B									1/60			
LC	32H									1/60			
LO	33M									1/60			
	34M									1/60			
	35M									1/60			
	36M									1/60			

LO = Leaks Open
(Well will tend to increase flow over time until it reaches high flow setpoint).

LC = Leaks Closed
(Well will tend to lose flow over time until it reaches the low flow setpoint).

Total

Delta

Notes/Activity:

How To Trend in Delta V

Trending Background

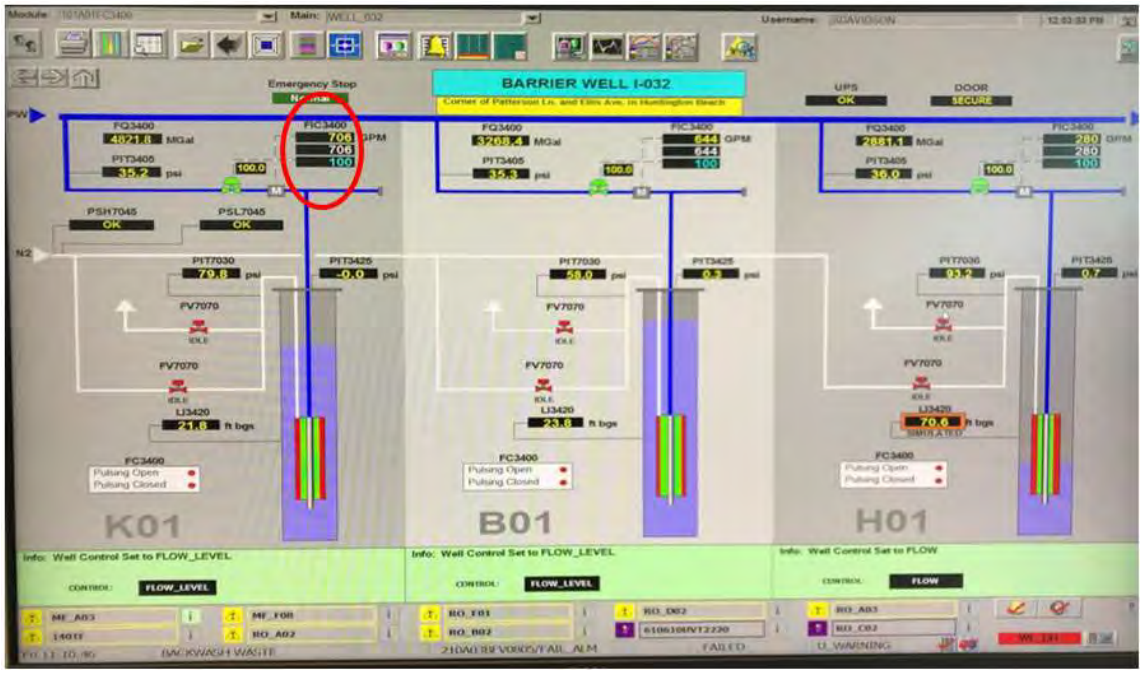
Sometimes it is important for the IRSO to look back in time and observe how certain injection parameters behave. Plotting a graphical representation over time is called trending. The process control software Delta V has a feature that allows the IRSO to trend many operational features including: well flow, well level and well pressure.

This module provides procedures for basic trending. Advanced trending can be developed in-person with the IRSO's supervisor after the skills in this module have been mastered.

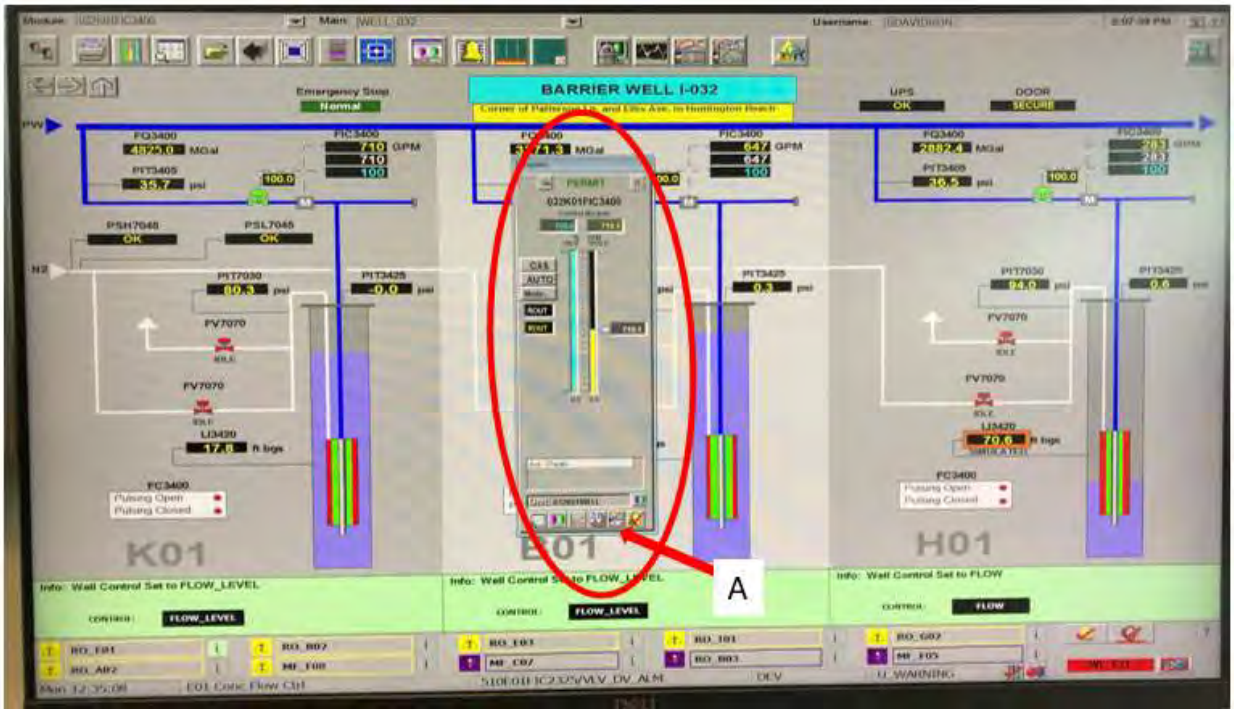
Trending Procedures

From the Delta V OCWD AWTF Control System Page, select the orange rectangle entitled "Area 001-036" and a map showing the location of all the Talbert Barrier Injection wells will appear. Select the well of interest.

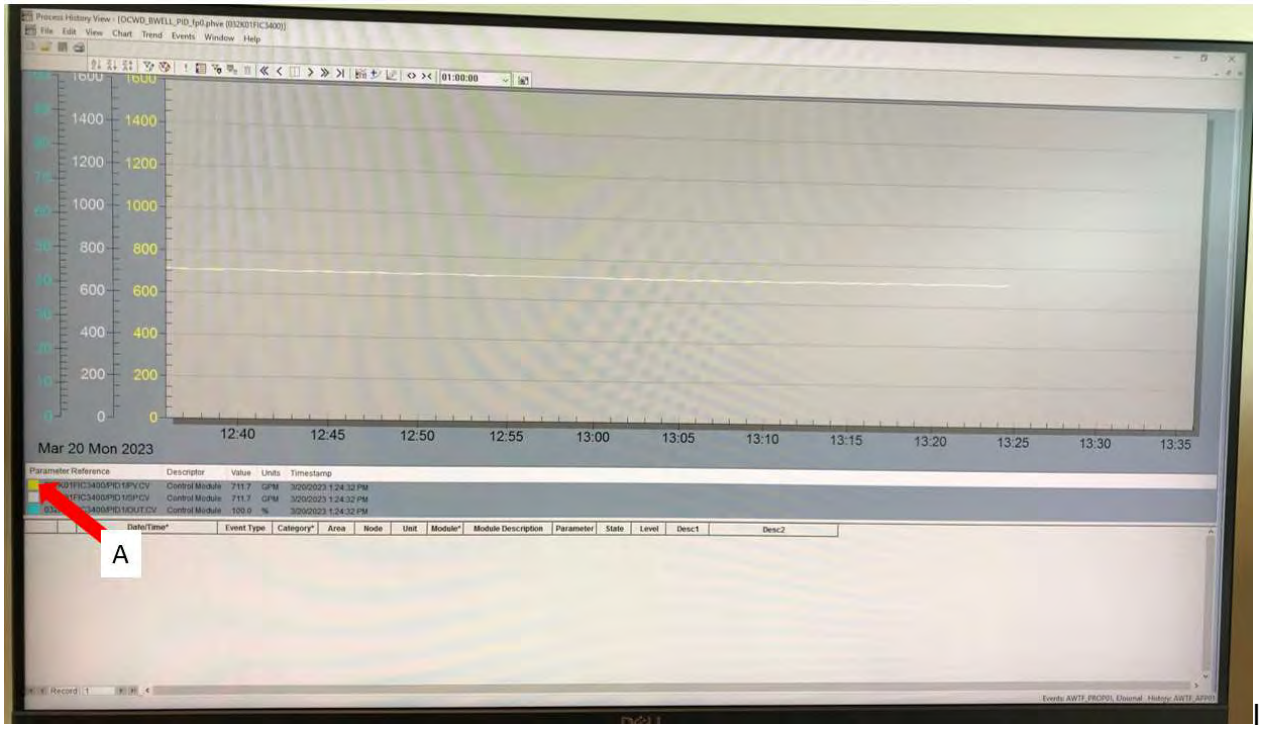
Many parameters can be trended. For this demonstration injection well flow will be used at injection well I-32 K as shown on the screen below. Locate and select the FIC 3400 GPM flow display box (red oval).



Once selected, the 032K01FIC3400 face plate will populate (red oval below). At the bottom of the face plate you will see 6 command icons. Select the icon that is second from the right end (process history view) as shown by the red arrow "A" below:

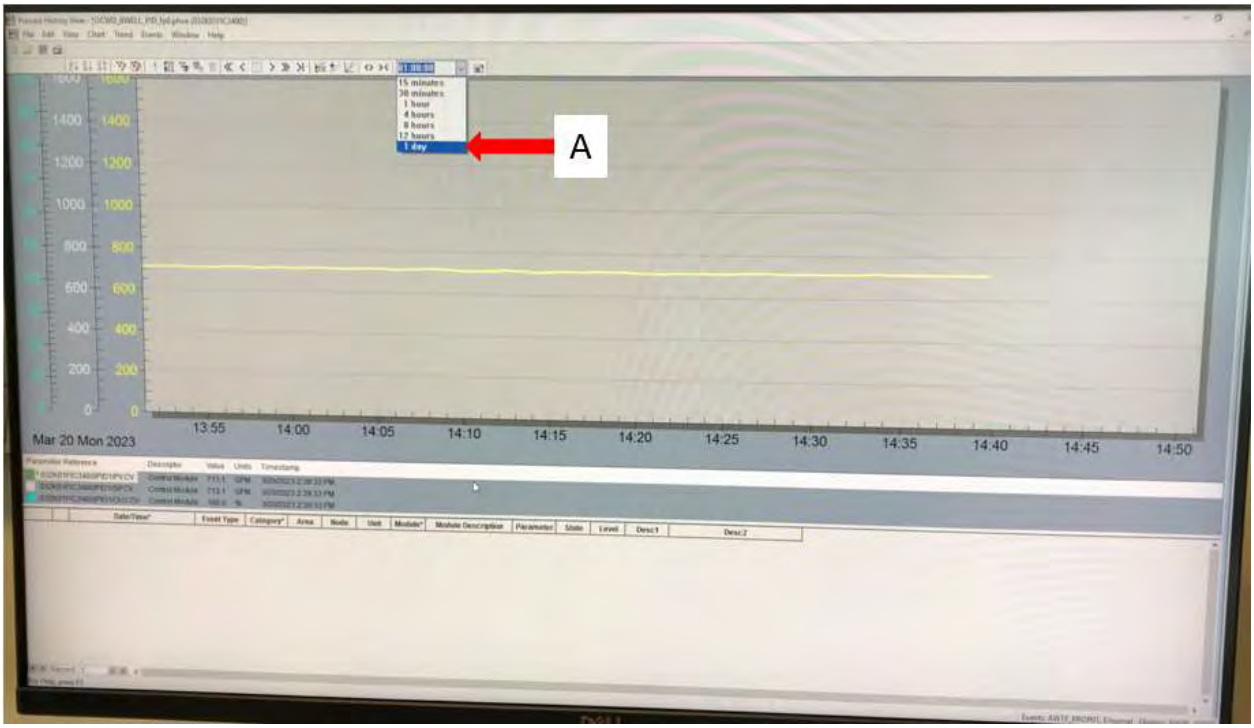


The following screen will appear:

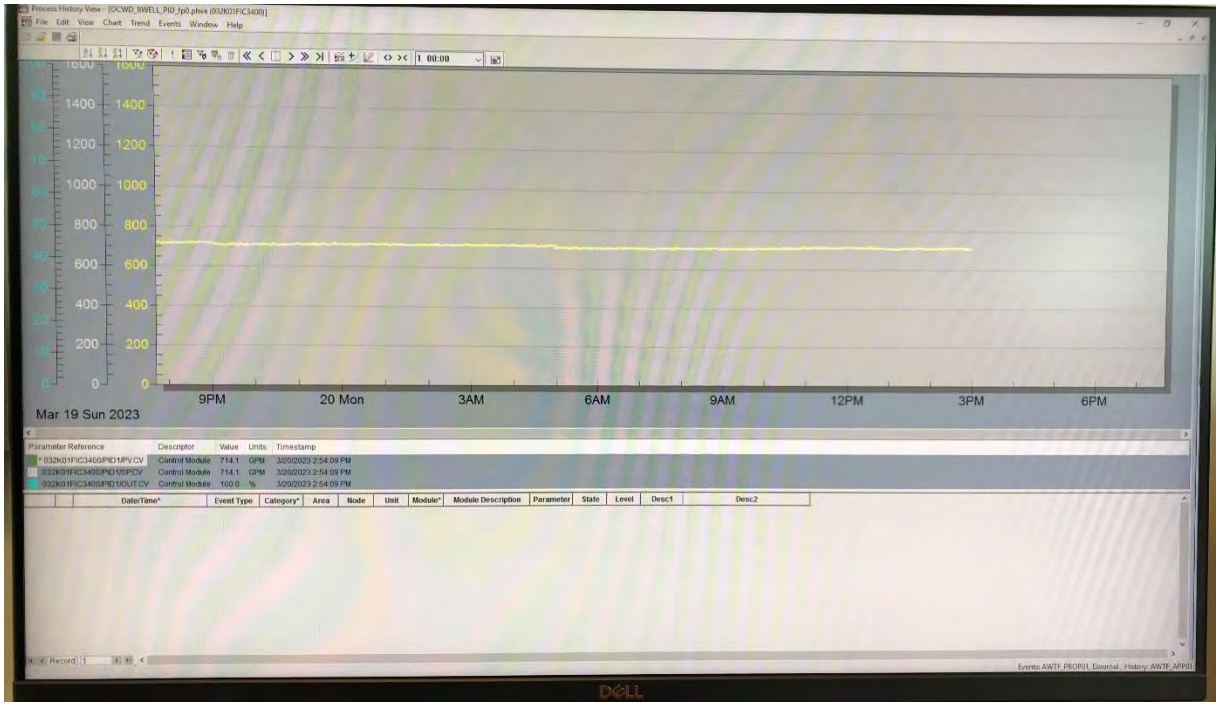


In the lower left hand corner of the screen locate the 0302K01FIC3400/PID 1/PVCV information line and click as indicated with the red arrow “A”. This will darken the line in the graph so it can be seen easier.

Next select the time duration that you would like to trend by focusing on the top of the screen and locating the time duration pulldown menu. For this demonstration 1 day is selected as shown with Red arrow “A”.



Notice once “1 day” is selected the bottom axis (x-axis) shows the time increment of 24-hours as shown below. Also notice that the yellow trend line representing the I-32K flow rate stayed around 700 gpm for the 24 hour period indicating consistent injection during this time period.



We have just completed a trend of the I-32K injection flow rate for the 24-hour time period between 8:00pm March 19 and 8:00pm March 20, 2023.

Multiple parameters can be trended on one plot. For instructions on trending multiple parameters see your supervisor.

Appendix A-17

Modern Well Airlift Backwash Procedures

Appendix A-17
Modern Well Airlift Backwash Procedures

I. Background

Modern Wells are air-lift backwashed by a team of IRSOs to improve well efficiency. Modern Wells are backwashed usually between 30 and 50 million gallons of water injected. Depending on the well this could be a few weeks or a few months. A District owned high-pressure trailer mounted air compressor is used to charge the wells air-line and lift water from the well.

II. Definitions

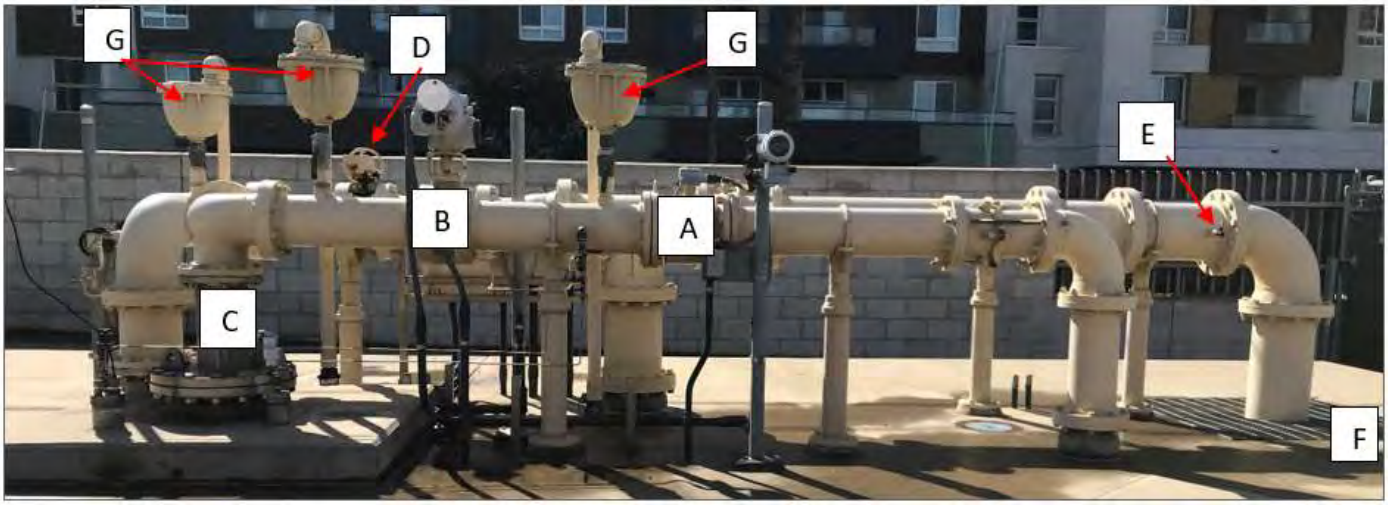


Figure I Modern Well components identified. **A** Magnetic flow meter (station mounted local display visible above and to the right of the meter). **B** Motor operated butterfly valve (MOV). **C** Well-head. **D** Discharge butterfly valve (manually operated). **E** Discharge sample spigot. **F** Storm drain catchment basin. **G** Air-vac.

A closer look is shown on Figure II on the following page.

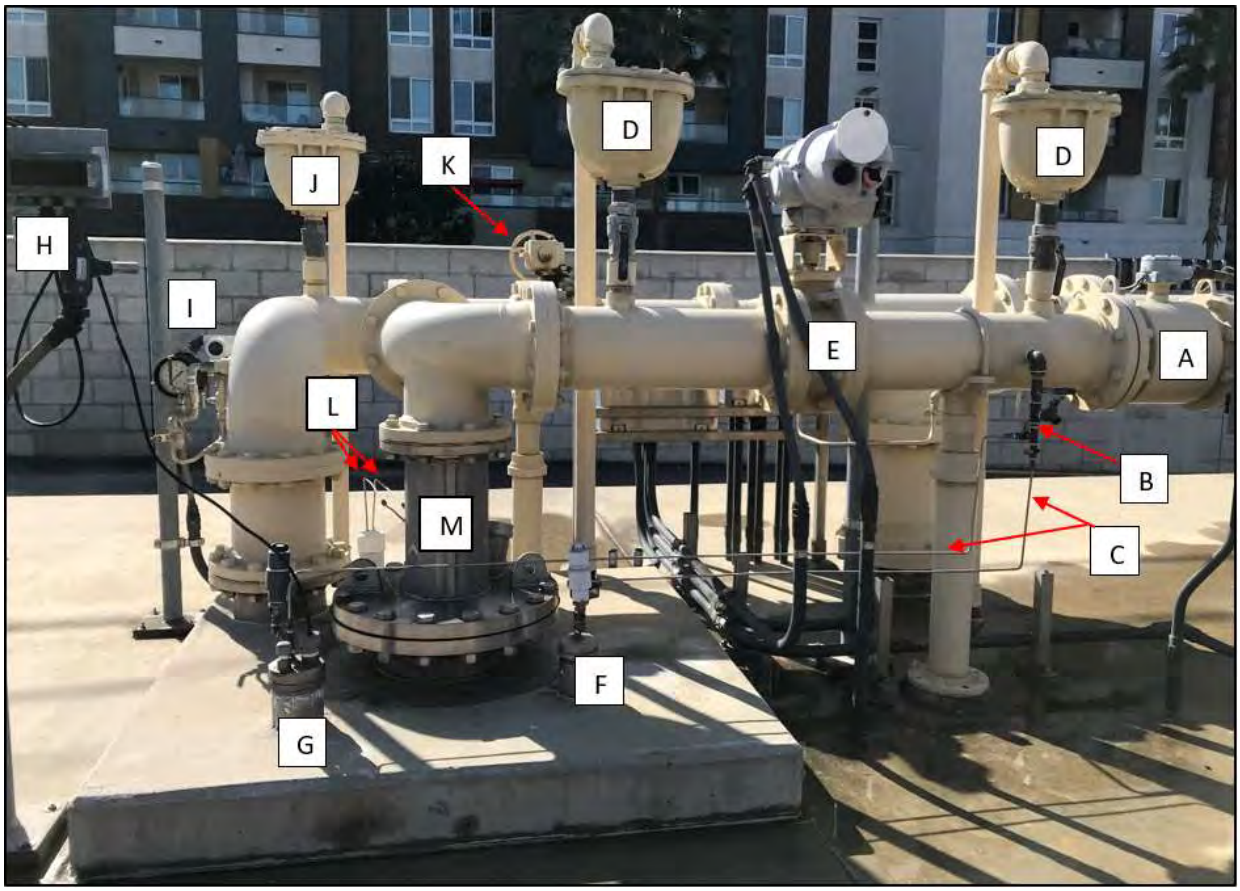


Figure II Details of a Talbert Barrier Modern Injection Well well-head. **A** Magnetic flow meter. **B** Injection influent flow sample spigot. **C** ¼-inch diameter stainless steel tubing used to trickle continuous flow into the gravel feed tube and the camera tube to prevent stagnation and biological growth. **D** Injection influent air vacuum and release valves (2-inch diameter). **E** Motor operated valve (MOV). **F** Gravel feed tube. Cap is ported to receive ¼-inch stainless tubing for trickle flow and a 1-inch air vacuum and release valve. **G** 4-inch diameter camera tube. Camera Tube cap is ported to receive ¼-inch stainless tubing for trickle flow, 1-inch air vacuum and release valve and level sensor cable. A level sensing transducer is submerged below the static water level inside the camera tube. The level sensor cable is visible leaving the camera tube and connecting to a level indication transmitter (LIT). **H** LIT with local injection level display. local injection level displays at all Modern Well sites have been disabled and the display box painted black. **I** Pressure indication transmitter (PIT) with pressure gauge. **J** Backwash discharge air vacuum and release valve (2-inch diameter). **K** Backwash discharge manual butterfly valve. **L** Baski Valve influent and effluent ¼-inch stainless steel tubing connecting a nitrogen cylinder to the Baski Valve. **M** Well-head eductor spool.

III. Modern Well Air-Lift Backwash Procedures

1. From Delta V workstation place well in OFF ,set timers to 10/30
2. Open discharge valve on backwash piping line manually (Figure I, D) (Figure II, K).
3. After ½ hour measure by hand the static water level and record it on the Air-Lift Pumping worksheet (Figure III). This form can be found electronically at H:\OCWD\Operations\Water Production\Water Production Shared\WaterProd\Talbert Barrier Operations and Maintenance Manual\Forms\Air-Lift Pumping Worksheet.

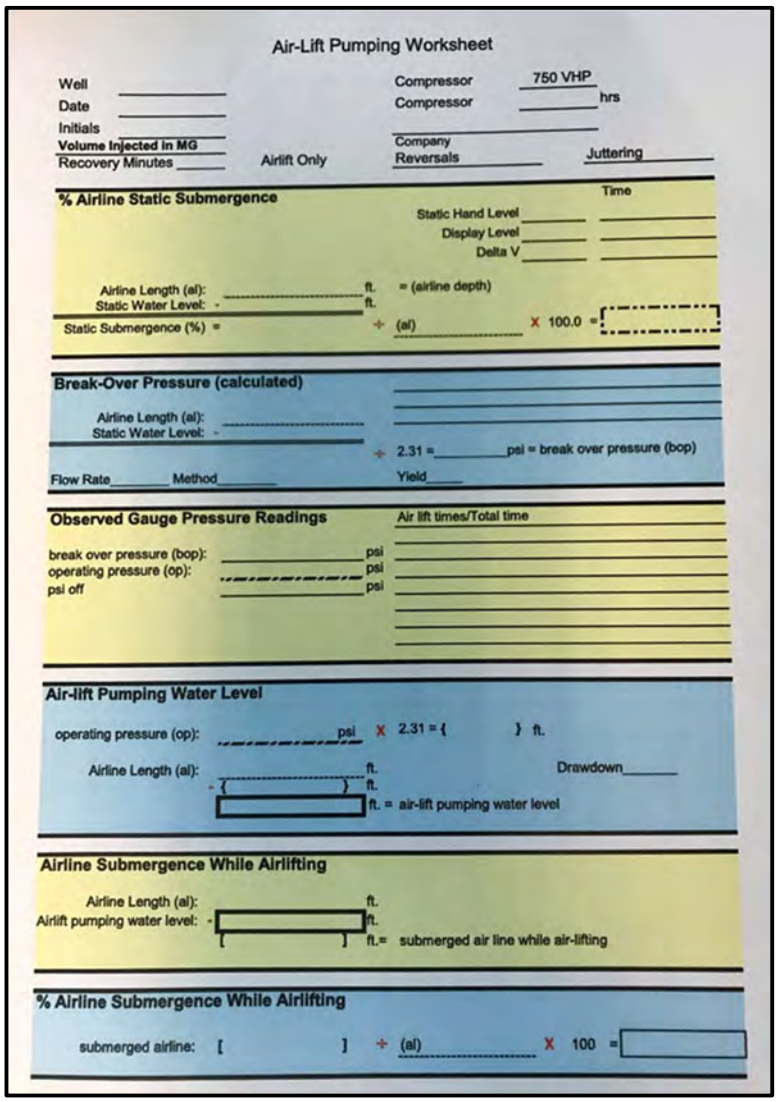


Figure III Air-lift Pumping work sheet. This form can be found at H:\OCWD\Operations\Water Production\Water Production Shared\WaterProd\Talbert Barrier Operations and Maintenance Manual\Forms\Air-Lift Pumping Worksheet.

4. Remove ¼-inch stainless steel bleeder tube from gravel tube cap. Ensure that the cap on the gravel feed tube is tight with Teflon pipe dope. On the camera tube cap If applicable, shut off flow and disconnect bypass filter hose (see Appendix A-7).

Remove cap from camera tube and carefully remove transducer, spool transducer cable neatly and store close by.

- **Important Note:** Modern injection wells utilize either 1) a flush-tread dedicated 2-inch air-line or 2) the camera tube to achieve the submergence required to air-lift pump each modern injection well. Table 1 below shows the current modern injection well air-line schedule for the Talbert Barrier System. Slightly different airline manifold assemblies are used to prepare each type of Modern Well for an air-lift back-wash. The airlift control manifold (airhead), shown in Figure IV, is utilized to air-lift backwash both types of well.

Table 1

3-inch camera tube		2 -inch Dedicate Air-line	
I-26H	I-26K	I-26L	I-27A
I-27H	I-27K	I-28A	I-29A
I-28H	I-28K	I-30H	I-30B
I-29H	I-29K	I-31H	I-31B
I-30K	I-31K	I-32H	I-32B
I-32K		I-33M	I-34M
		I-35M	I-36M

Figure IV Airlift control manifold (airhead). The airhead is used to control the delivery of high-pressure air from the air compressor into the well through the air-line.

5. If the well utilizes the camera tube for backwashing, a 4-inch by 2-inch reducer/tee is used with the airhead (the camera tube upsizes from 3-inch to 4-inches in diameter just below ground surface). Figure IV shows the reducer/tee assembly. Just below

ground surface the camera tube reduces from 4-inch to 3-inch . Thread the reducer/tee to the camera feed tube, use 36” pipe wrench to secure. Carefully spin the airhead onto the reducer/tee as shown in Figure V. Secure tightly using the 36-inch pipe wrench.

Figure V Image of 4-inch by 2-inch reducer/tee. When using the 3-inch camera tube as an airline, this Reducer/tee is used to connect the camera tube (air-line) to the airhead.

Figure VI Airhead attached to the top of a typical 3-inch camera tube using the reducer/tee. Note the location of pressure gauge.

6. Connect airhead to camera tube or dedicated 2-inch airline and spin 2” air hose hammer unions onto airhead, hammer to tighten.
7. Bring the free end of the air hose to the airhead and connect free end of the whip check safety restraint from the airhead to the air hose.
8. For well utilizing the 3-inch camera tube airline, thread the pressure gauge into the ¼” ball valve as shown if Figure VI.

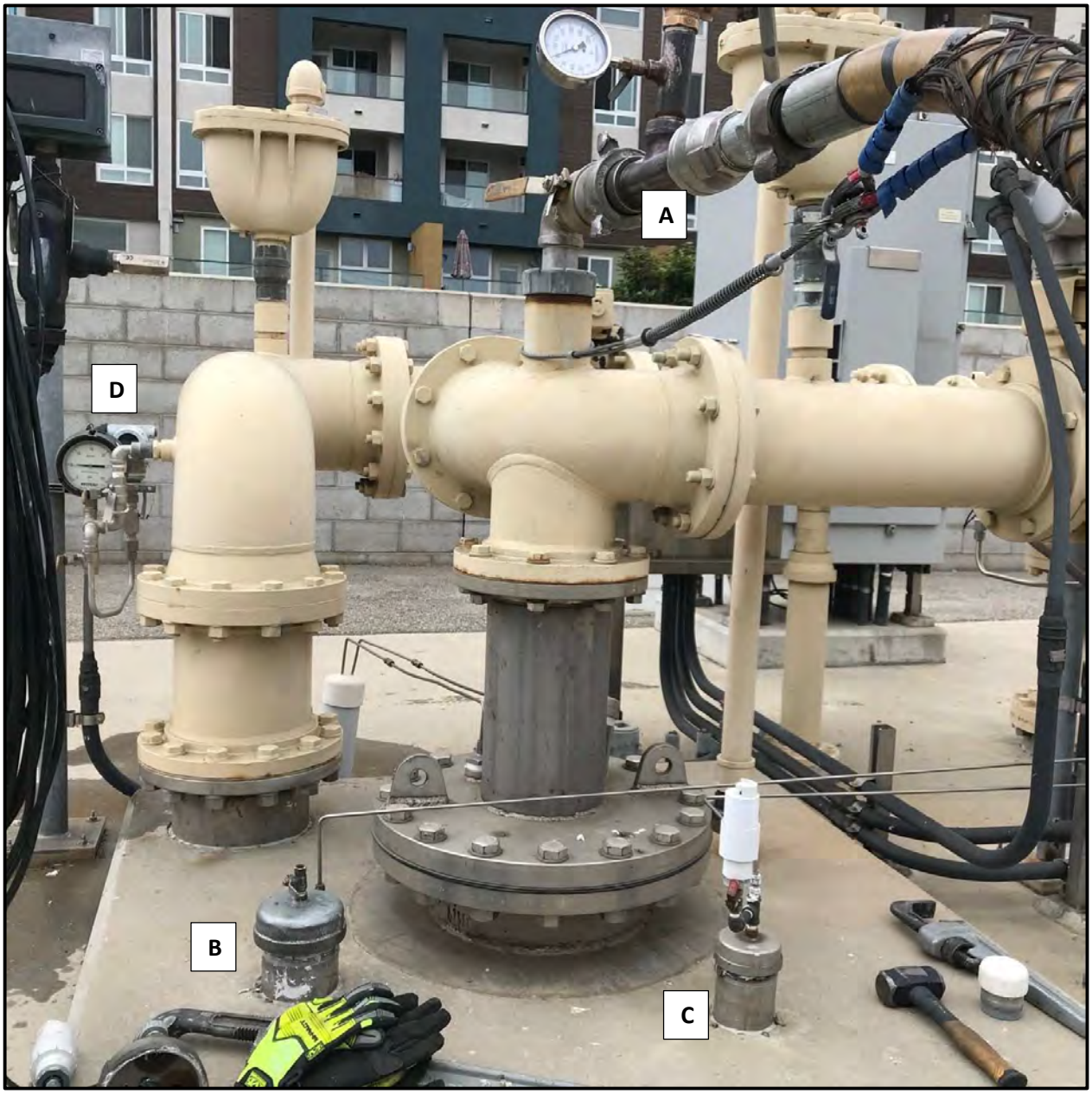
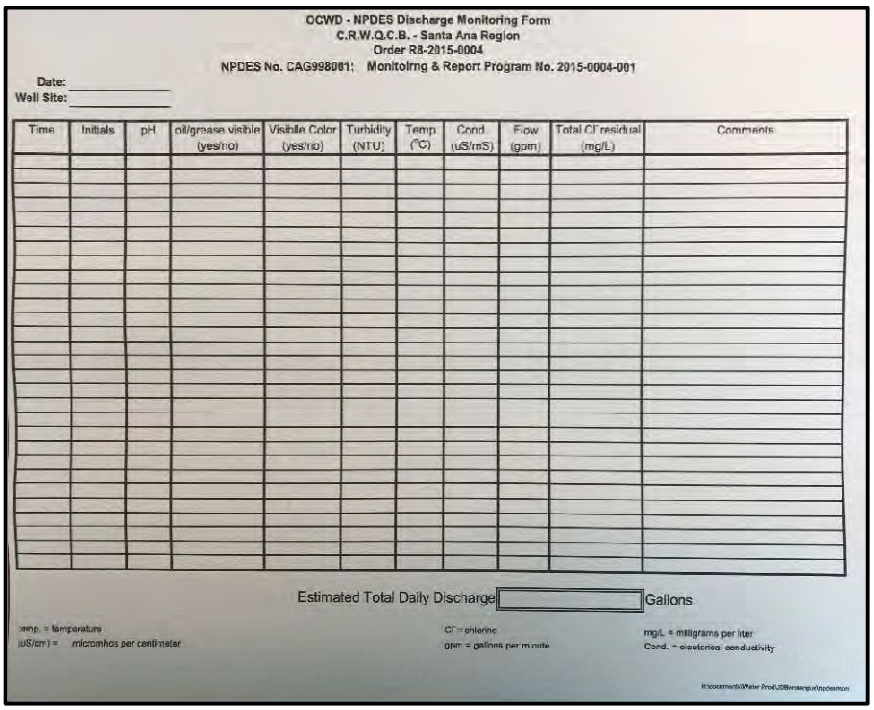


Figure VII Image of injection well I-32H being prepared for air-lift backwashing. **A.** airhead attached to dedicated 2-inch air-line and secured using safety retention cable. The airhead muffler (used to suppress sound during venting) is out of view. **B.** 3-inch camera tube (4-inch above ground) with water level transducer removed and neatly spooled (along the left margin of image), cap secured, 1/4-inch bleeder tubing removed and valve closed. **C.** Gravel feed tube, ¼-inch bleeder valve and ¼-inch valve below the 1-inch plastic air valve should be closed prior to backwashing. **D.** Flange pressure sensor PIT 3425, close ¼-inch valve below sensor prior to backwashing.

9. Close ball valve to flange sensor (PIT3425) and close valve on pressure indicating transmitter 3425.
10. Return to the airlift pumping worksheet (Figure X-1). Complete the rest of the sheet to obtain the airlift pumping water levels and percent submergence. Use hand level for calculations. Obtain depth of airline (Flush thread 2" or camera tube depth) from as-built drawing. Calculate break-over pressure required from worksheet.

11. Recheck all fittings, unions and adapters and confirm that all are tight and secure. Confirm that discharge valve is open.
12. Remove Victaulic blind flange from discharge piping for wells I-26H, L, K.
13. Start and warm up air-compressor (see section IV of this appendix). Slowly open valve on air compressor and charge air hose to air head fitting. Airhead fill valve should be in the closed position.
14. Slowly open airhead fill valve to the required break-over pressure. When break-over pressure is obtained the gauge reading at the surface will dip back 8-10 pounds. Slowly open the valve to attain the required break-over.
15. When the water reaches the surface and exits the discharge airgap. The air compressor will regulate the amount of air required to maintain flow.
16. Once airlifting recheck fittings, valves, and hoses. If there are any leaks of air or water secure/close follow shut down procedure and correct leak.
17. During air-lift back wash operation, monitor discharge per the District's NPDES permit using the NPDES discharge monitoring form. Discharge monitor reading should be taken every 10 minutes. During the backwash monitor water quality (EC, Ph, Chlorine, and settable solids) and record parameters on NPDES discharge form (Figure VIII). This form is located at: H:\OCWD\Operations\Water Production\Water Production Shared\WaterProd\Talbert Barrier Operations and Maintenance Manual\Forms\NPDES Monitoring Form 2016.
18. To shut down the air-lift backwash operation, depressurize the system by opening the vent on the muffler. Secure air flow from the air compressor and keep the valve open on the air head. Vent off air from well and air-line. Confirm system is depressurized. In the case of a 2-inch dedicated air-line open the ¼-inch ball valve on the air head assembly and feel / listen for venting air. In the case of a camera tube air-line confirm the system is depressurized by cracking open the same ¼-inch ball valve on the air head assembly. Note: On the 2-inch dedicated air-line system the camera tube cap must be vented prior to removal by opening the ¼-inch ball valve tapping the top of the 4-inch cap.



OCWD - NPDES Discharge Monitoring Form
C.R.W.Q.C.B. - Santa Ana Region
Order R8-2015-0004
NPDES No. CAG998001; Monitoring & Report Program No. 2015-0004-001

Date: _____
Well Site: _____

Time	Initials	pH	oil/grease visible (yes/no)	Visible Color (yes/no)	Turbidity (NTU)	Temp (°C)	Cond (uS/mS)	Flow (gpm)	Total Cl residual (mg/L)	Comments

Estimated Total Daily Discharge _____ Gallons

Temp. = temperature
(uS/cm) = microhms per centimeter
Cl = chlorine
gpm = gallons per minute
mg/L = milligrams per liter
Cond. = electrical conductivity

Figure X-7 Image of NPDES Discharge Monitoring Form. This form can be found at H:\OCWD\Operations\Water Production\Water Production Shared\WaterProd\Talbert Barrier Operations and Maintenance Manual\Forms\NPDES Monitoring Form 2016.

IV. Air Compressor Operation

In February of 2011 the District purchased a 200 psi 750 cubic foot per minute Ingersoll Rand trailer mounted air compressor to conduct routine “in-house” air-lift backwashing.

To start the compressor:

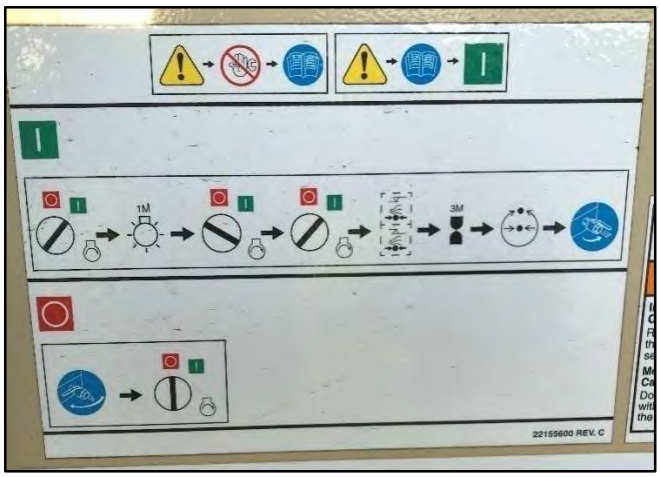
- Open door to expose compressor control panel, see figure below.
- Locate the turn dial in the center of the panel. Turn the dial from the red square with white “O” to the indicator with the green square with the white “I”.
- Wait one minute
- Turn the dial to the right and hold until the engine starts
- Release when the engine starts.

- Monitor gauges, look for irregularities. If irregularities are noticed, shut down the compressor and notify your supervisor.
- Once the engine warms up, the RPM will drop about 200.
- Once the RPMs drop, engage the service air toggle switch (see figure below, switch is identified as “A”). Th engine will idle up briefly and then idle back down (2 minutes).
- At this point the compressor is ready to deliver air to the injection well.

To stop the compressor:

- Turn the dial from the green square with the white “I” to the red square with the white “O” (see photo below) and let the engine cool down.

Control panel for the OCWD portable air compressor used to conduct routine air-lift backwashing at Modern Wells. The “service air” toggle switch (described in starting instructions) is identified by the “A” and red arrow. If the IRSO sees any irregularities with the gauges on this panel, the compressor is to be turned off immediately and the supervisor notified.

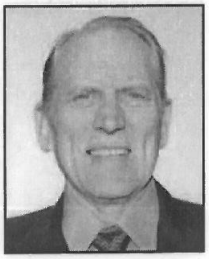


Pictogram on the inside panel of compressor panel door explaining compressor start-up procedures.

V. Breakdown and Securing Modern Well Backwash Operation

After the air-lift pumping is complete the IRSO completes the above cited instructions of air-lift backwashing, in reverse order, ending with restoring Delta V operational status and Baski Valve timers.

Ask Hank!



by Henry Baski

Air-lift after Hydrofracturing

Most of us know air-lifting works as a pumping method for producing water from a well. One of its advantages is that it can handle pumping sandy water. When used after hydrofracturing, air-lifting is ideal for pumping the well to clean it up and confirm its success. Nevertheless, how air-lifting works and its characteristics are generally viewed as "black magic." This article lifts the secret of air-lifting. You might want to save it and the accompanying reprinted "Air-Lift Pumping" table, where my efforts to understand and quantify air-lift pumping are summarized.

The basic principle of air-lift operation is that the aerated column exerts less pressure than the static submergence. In other words, air-lift pumping replaces the static submergence with less pumping submergence. Air-lift production is a function of the annulus area and the ratio between pumping submergence and air pipe depth in percent (see table).

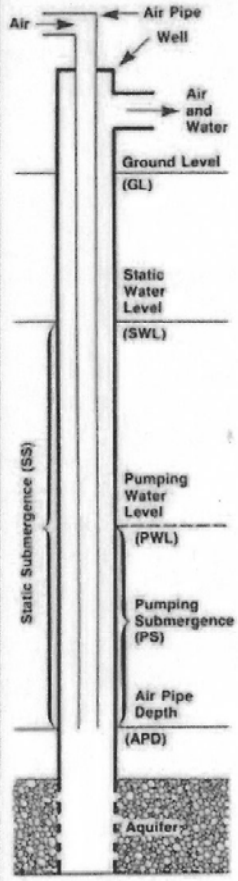
For example, we may replace 200 feet of water submergence with an aerated column of air and water plus friction loss equivalent to 80 feet of water submergence. This results in a pumping drawdown of 120 feet. To maximize the water production, the air pipe O.D. is chosen to be 1/3 the inside diameter of the casing. For a 2" inch injection pipe, I recommend that a 1/2" nominal pipe be inserted for the air and a compressor capacity of 120 cubic feet per minute be used. For a typical single-stage air compressor having an output of 120 psi, the 1/2" pipe can be installed to a depth of 260 feet below water level.

The pumping water level can be determined from the air pressure at the top of the air pipe. It works just like an air line for measuring water levels; however, it is not an exact water level determination due to the friction loss of the air going down the air pipe. An air line or down hole pressure transducer installed with the 1/2" pipe can measure the exact pumping water level. The 1/2" air pipe can be simply a continuous length of polyethylene pipe mounted on a reel. This makes the operation quick and easy. An extra tee at the top of the 2" piping can accommodate the 1/2" polyethylene pipe. There are various options for sealing the 1/2" pipe where it enters the tee.

Hank

Hank Baski may be contacted via e-mail at editorial@worldwidedrillingresource.com

Air-Lift Pumping



Approximate Air-Lift Pumping Capacities (gpm)

Borehole or well	Air Pipe	Pumping Submergence %					Air Compressor Delivery
Pipe Nominal Size (inch)	Tube Actual OD (inch)	10% (gpm)	20% (gpm)	40% (gpm)	60% (gpm)	80% (gpm)	(cfm)
3/8	1/8		0.08	0.3	0.5	0.7	7.4
1/2	3/16		0.17	0.6	1	1.4	12
3/4	1/4		0.4	1.4	2.4	3.4	20
1	3/8		1	3	5	7	31
1-1/2	1/2		3	8	13	18	77
Pipe Nominal Size	Pipe Nominal Size						
2	1/2	0.5	5	15	25	35	120
3	3/4	2.5	15	40	65	90	270
4	1	5	28	75	125	175	470
5	1-1/4	7.5	50	140	230	320	740
6	1-1/2	12	80	225	370	520	1100
8	2	25	150	450	720	1000	1900
10	2-1/2	50	300	800	1300	1800	3000
12	4	75	450	1200	1950	2700	4000
14	4	90	600	1700	2900	4000	5100
16	5	100	800	2400	3900	5500	6600

Air Compressor Requirements

- Pressure rating [psi] must be 20% greater than the Static Submergence [psi].
- Volume rating [cfm or cubic feet per minute] must equal or exceed values from above table for hydrology testing. If the water production surges, i.e. varies in gpm rate, then a GREATER cfm is needed. On the other hand, well development by air-lift pumping is enhanced by surging; therefore, a LOWER cfm is desired for part of the development period.
- Pumping submergence % = (APD - PWL) / APD
- Static Submergence [psi] = APD - SWL

Note: 1 foot of water = 0.433 psi
1 psi = 2.31 feet of water

Appendix A-18

Baski Valve Nitrogen Cylinder Replacement – Standard Operating Procedures

Appendix A-18

Baski Valve Nitrogen Cylinder Replacement – Standard Operating Procedures

During the monthly Modern Well profiling site visit note the cylinder pressure in the Baski Valve nitrogen cylinder. If this pressure is low in the cylinder which is in operation, make a comment and note in the shop on the white board that this needs to be changed.

When a nitrogen cylinder in the Baski instrument cabinet drops to 400 PSI or less; it needs to be replaced. A spare cylinder is stored in the Baski cabinets and can be switched out with the empty one. To change the cylinder, the 70/70 pulse timer settings in Delta V must be set to zero seconds for all wells running on the nitrogen supply at the individual well site. Call a coworker or control to set timers to zero on the Delta V system for the well to be worked on. After the timers are set to zero the valve to the instruments and from the cylinder are closed then the connection from the regulator to the cylinder can be loosened to bleed off pressure in the hose before removing the regulator from the cylinder. Swap cylinders and reconnect the regulator to the fresh cylinder and open the cylinder valve and the instrument valve. Call a coworker or control to reset timers to their original settings.

Return to plant with the empty cylinder and have Janice Kovacevic order a replacement cylinder that will be taken back to the well site and placed into the Baski cabinet as the new spare after it is delivered. Normal operating pressure is approximately 225 psi on regulated side.

Appendix A-19

Talbert Barrier Deficiency List

Talbert Barrier Deficiency List

Injection Wells

Importance	Location	Issue	Potential Remedy	Concern
	I-1	Hole in Lambda casing at approx. 347', Beta & Talbert communicate	Operate all zones simultaneously	unable to control flow underground
	I-2	All screens appear to be cemented	Replace well (OC San Property)	Poor injectivity
	I-3	3-inch pipe stuck at approx. 260'(Beta), cemented screens	Replace well (OC San Property)	Poor injectivity
	I-4	Alpha gravel feed tube (GFT) empites quickly, Talbert GFT cemented, T-A-L communicate	Monitor and replenish gravel in Alpha often, inject into all zones simulatenously	Development of a sink hole
	I-5	Seal integrety issues, communication between multile zones.	Operate all zones simultaneously	unable to control flow underground
	I-6	Seal integrety issues. Alpha comminicates w/surface. Talbert communicates with Alpha.	Operate all zones simultaneously	unable to control flow underground
	I-7	Lambda casing is not plumb, Talbert and Alpha communicate.	Operate all zones simultaneously	unable to control flow underground
	I-8	Vault hatch loose (well requires lane closure to access), vault floor leaks, multi-zone communication	Replace vault hatch lid, do not operate well unless necessary	unable to control flow underground
	I-9	Well seal issues - multi-zone communication, vault takes on quite a bit of seepage flow	Operate all zones simultaneously, monitor flood alarm, swapout sump pump a lot	unable to control flow underground
	I-10	Hole in Lambda GFT at approx 70', seal integrity issues resulting in multi-zone communication.	Monitor and replenish gravel GFT, operate all zones simultaneously	unable to control flow underground
	I-11	Seal integrity issues, communication between multiple zones, cement in Alpha below perfs at 183'	Operate all zones simultaneously	unable to control flow underground
	I-12	Seal integrity issues, communication between zones, Lambda cemented, obstruction in Beta at 245'	Operate all 3 zones simultaneously, unable to remove obstruction at 245' Beta.	unable to control flow underground
	I-13	Seal integrity issues, multi-zone communication, cement in Talbert 88', Alpha 163', 250' Beta	Operate all zones simultaneously, able to core through Talbert cement	unable to control flow underground
	I-14	Seal integrity issues, multi-zone communication, Contractor left 3" fish starting at 217' in Beta well	Operate all zones simultaneously, the fish resricts injectivity in Beta	unable to control flow underground
	I-15	Seal integrity issues, multizone communication. Lumber stuck in the Beta casing at 321'.	Operate all zones simultaneously	unable to control flow underground
	I-16	Seal integrity issues, multizone communication. Rock up to 2' in diameter found in Lambda well	Operate all zones simultaneously, airlifted 2" rocks as best we could,	unable to control flow underground
	I-16	This vault developed an explosive atmoshere in 2005 due to methane intrusion along conduits	Sealed conduit annualt space to eliminate methane intrusion	unable to control flow underground
	I-17	Seal integrety issues, communication between multile zones.	Operate all zones simultaneously	unable to control flow underground
	I-19	Seal integrity issues, multizone communication.	Operate all zones simultaneously	unable to control flow underground
	I-20	Seal integrity issues, multizone communication. Cement air-lifted out of Talbert casing	Operate all zones simultaneously	unable to control flow underground
	I-21	Lambda is only casing in the nest Talbert & Beta do not take appreciable flow		
	I-22	Bent packer at 240' in Lambda that challenges rehab contractors also video camera lost at bottom	Operate all zones simultaneously	
	I-23	Seal integrity issues, multizone communication.	Operate all zones simultaneously	
	I-24	I-24 Both (2) downwell flow control valves failed, well off-line until GWRS expansion is complete	Once accesible for a contractor, these valves will need to be pulled and repaired	
	I-25	No known issues at this time		
	I-26	I-26 H,L,K leaky sole plates	Do not operate wells on flow and pressure. This is a design flaw	
	I-27	No known issues at this time		
	I-28	No known issues at this time		
	I-29	No known issues at this time		
	I-30	Well operates fine but could do more flow if lateral pipeline was to be upsized		
	I-31	K zone has a minor nitrogen leak in the baski valve system downwell	Spend a little bit more in nitrogen for this well	
	I-32	Well operates fine but could do more flow if lateral pipeline was to be upsized		
	I-33	No known issues at this time		
	I-34	No known issues at this time		
	I-35	No known issues at this time		
	I-36	No known issues at this time		
	D-1	Pump is operating with slightly elevated vibration	Plan a project to have the pump pulled and overhauled after final expansion	
	D-3	No known issues at this time		
	D-4	Adjacent blow-off valve buried	unable to blow -off pipeline at D-4	
	D-5	Fish (old pump and pipe) lodged in well above perforations at cocentric casing reduction	Motor disconnected at panel, contractor tried to pull (w/ 50T) fish multiple times	Geology considering use as a monitor well

Note: Most legacy vault concrete is spalling with visible rebar is some vaults.

Distribution Pipeline

Importance	Material	Issue	Potential Remedy	Concern
	CML	approx. 1/2 of system is unlined CML and reacts unfavorably with GWRS water to clog wells	Remove all loose mortar and epoxy line the pipeline.	Pipe rupture, rapid well clog
	CCP	approx 1,000 ft of CCP from the 1960's at intersenction of Ellis @ Ward, very aged.	A design is completd to replace all CCP in system. OCWD Engineer - Fernando	Pipe failure potential
	AC	approx 2,200 ft of AC pipe in Ellis between I-6 and East end of Barrier.	A design is completd to replace this AC pipe run. OCWD Engineer - Fernando	High velocity may cause pipe to break
	AC	approx 100 feet undersized pipe crossing Talbert Channel	Upsize pipe - may require jack and bore installation	High velocity may cause pipe to break
	DI	approx. 1/3 of Barrier system is ductile iron and has never been inspected, pipe approx 15+ years old.	Video inspect ductile iron pipeline - no easy camera access	has never been inspected - 15 years old
	N/A	Mainline blow off valve at I-17 is leaky.	Do not operate	accumulation of material in pipe
	N/A	I-2, I-7, and I-12 latreal valves at the main leak in the fully closed position.	Secure flow from inside the vault at splitter box or well head 3" butterly valves.	Could dribble water onto the Ellis Ave.

Note:
CML = cement mortar lined steel pipe
CCP = concrete cylinder pipe
AC = asbestos cement pipe
DI = ducile iron pipe

Note: This Talbert Barrier deficiency list can be found at:

H:\OCWD\Operations\Water Production\Water Production Shared\WaterProd\Barrier\Talbert Barrier Deficiency List

Appendix A-20

Procedures for Bringing the Barrier Back On-line

Appendix A-20

Procedures for Bringing the Barrier Back On-line

Background:

During normal plant production, the GWRS Barrier Product Water Pump Station (BPWPS) is designed to deliver up to 32 mgd with a sustained discharge pressure of 60 psi leaving the campus. The BPWPS supplies pressure to all 36 Talbert Barrier Injection Well Facilities. Pressure at the well-head is a function of elevation. GWRS treatment plant has been expanded to a peak production capacity of 130 mgd.

Water inflow into the GWRS System can sometimes vary throughout the day and sometime require the IRSO to make adjustments to the well field. When the GWRS treatment plant production rate needs to be lowered below the current output of the BPWPS, wells will need to be secured and/or adjusted downward. Well flows should be restored to previous run conditions (flows, timer settings) when the plant rate is increased. Ideally, Legacy Wells will be the last to be secured.

In general, when responding to plant flow changes, it is best to select wells with the least amount of impact to the M-26 water levels. Wells that inject into the Main aquifer such as Modern Wells "K" and "B" zones. Additionally, because Legacy Wells are not fully automated, it is best to try and adjust Modern Wells first before selecting any Legacy Wells to adjust.

Responding to a GWRS Treatment Plant Reduction in Production

Modern Well sites I-26, through I-36 well sites are good candidates for rate changes. Injection rates at individual wells can change daily. It is important to communicate and document well flow rate changes. The IRSO documents and shares daily flow rate changes on Costal Seawater Barrier Daily Log Sheet and the white board in the GWRS control room. It is important to share which wells are online and which wells can be secured or lowered during plant flow dips.

Flow adjustments for Modern wells I-26 through I-36 are done using Delta V. Modern Well start and stop procedures are all uniform regardless of location. Modern Well start and stop procedures are the focus of this section. To aid in understanding, important Modern Well terminology is defined below.

Definitions:

a. FV7070: Nitrogen gas Flow Baski Valve. The water flow to each well is controlled by the inflation level of the Baski Valve. Nitrogen gas (N_2) is supplied to the valve to reduce flow into the well while releasing gas from the valve will allow more water into the well, thus deflating the gland.

b. Pulse: Set time (in seconds) that FV7070 (Baski Valve) will OPEN or CLOSE per Cycle.

c. Cycle: Wait time (in seconds) before next Pulse OPEN or CLOSED of Baski Valve (FV7070)

d. Normal: One of two timer modes for FV7070 (Baski Valve) operation. This mode is more conservative and will result in smaller changes in rate with longer periods of time between changes. Used when the well is idle.

e. Rapid: One of two timer modes for FV7070 (Baski Valve) operation. This mode is for shutting off the well quickly. The IRSO selects "Rapid" if needed.

f. Baski: I-26 through I-36 wells are equipped with this type of valve. N_2 gas is used to control the well flow by changing the inflation level of the valve.

g. Legacy: I-1 through I-23 wells are equipped with Bermad valves. Note: Legacy wells should be controlled site by site; all well casing in a Legacy Well nest should be all ON or all OFF to prevent water flowing up the gravel pack.

h. Bermad: The type of pressure reducing valve (PRV) used on Legacy Wells.

i. VOV: I-24 and I-25 are equipped with this type of valve. Well flow control is achieved using pressurized hydraulic (mineral) oil and a compressor.

Baski Valve Restart Procedure:

At the beginning of each shift, IRSOs should review notes from the GWRS Treatment plant operators and log entries for the current Barrier flow target and notes on the condition of individual wells.

The IRSO should begin to re-start wells that were shutdown due to plant rate reduction when the AWPF Production Rate reaches 40 mgd and/or the Product Water Pump is being called for using the following procedure:

1. Select the Modern Well to be restarted.

2. In Delta V navigate to and select the desired well and open the Detail Faceplate for FV7070 ("Detail"). Under the Timers section; Change the **Normal Pulse to 10 seconds** and the **Normal Cycle to 30 seconds**.

3. Reset "First Out" alarm on Detail Faceplate (typ. "MOV Not Open")

4. Change the Control Mode from OFF to FLOW_LEVEL. A red banner will appear on the lower portion of the screen.

5. Select "Confirm".

6. Delta V will now send a series of commands to the well to fill the drop pipe of the well before allowing the Baski Valve to Open (I-29 – I-36 only, I-26 – I28 not applicable).
   Steps:

   a. The MOV will crack open (appears on screen as light blue color)
   b. The MOV opens fully after the water flow drops below a pre-set value to ensure the drop pipe is full (Air has been removed from the line)
   c. A wait period will pass during which the MOV opens.
   d. FV7070 will now begin the pulse open cycles.

   The current step will be described in the "Info" section of the control banner at the bottom of the screen.

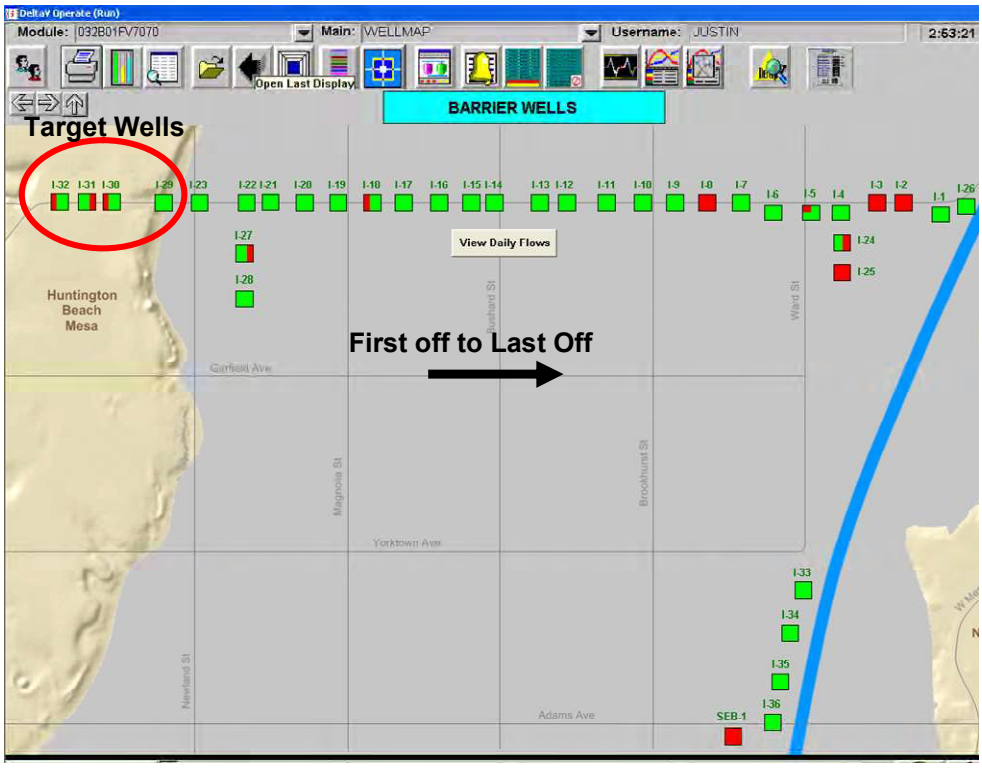
   Note: It can take several minutes for the well to register flow.

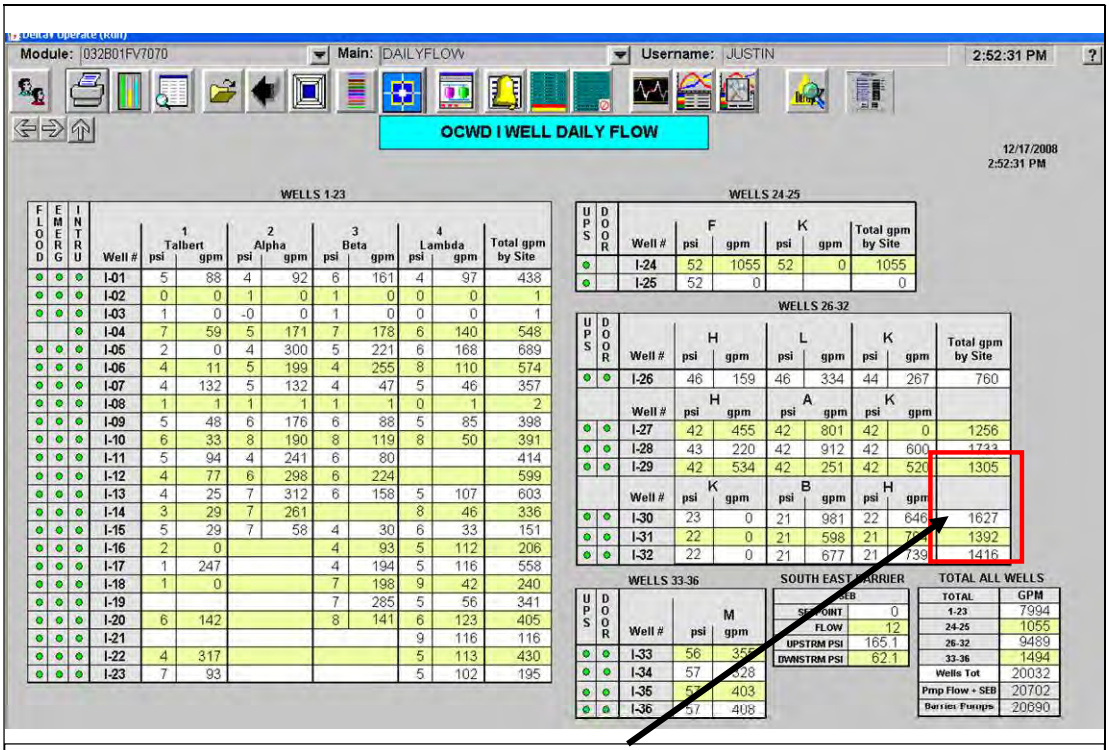
   If the well fails ("Sequence Failure"), the well should be re-started (click "OK"). If the failure repeats, try a faster setting like 15/30, if failure persists switch the well to "OFF".

7. When the FC3400 banner no longer shows the green circle next to Pulse Open and/or FV7070 is "idle", the timers should be returned to their original settings (typically 1 sec or 2 sec, Normal Pulse with 60 sec Normal Cycle).

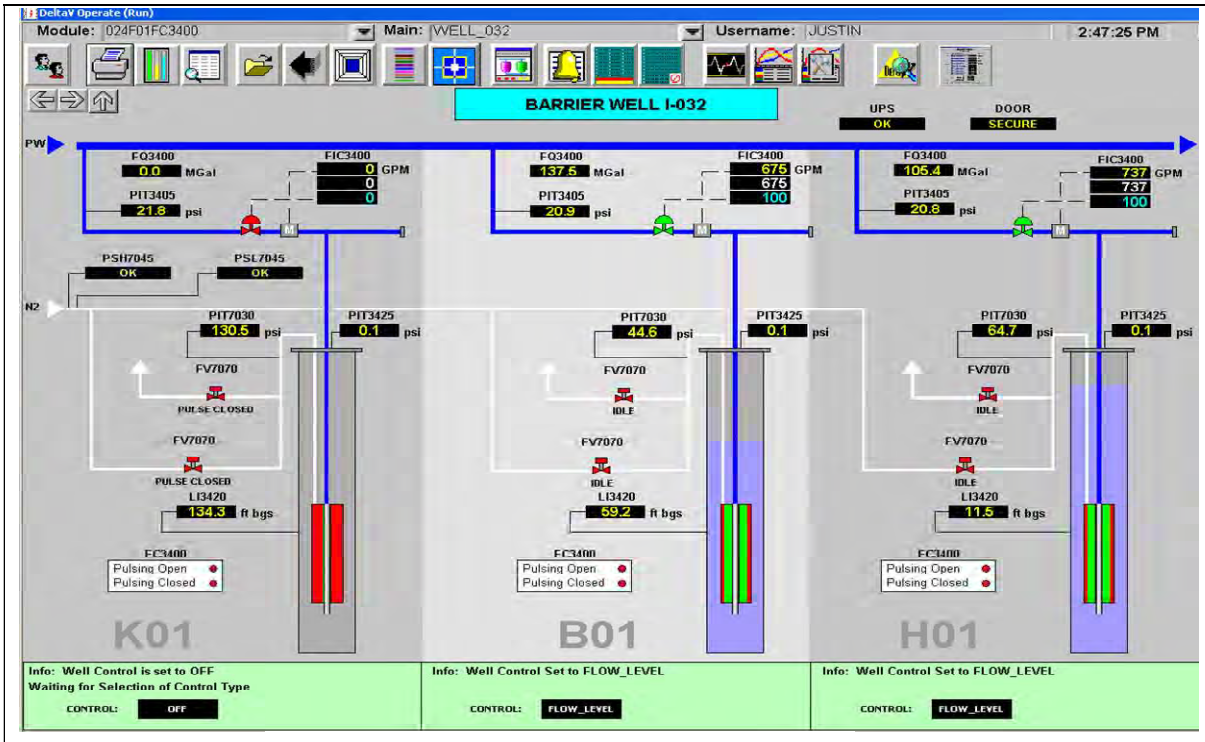
8. *(Use "Coastal Seawater Barrier Daily" log to confirm normal timer settings.)*

How to stop Modern Well and change the form to current





Total flow (gpm) by well site for the Target Wells: I-29, I-30, I-31 and I-32.



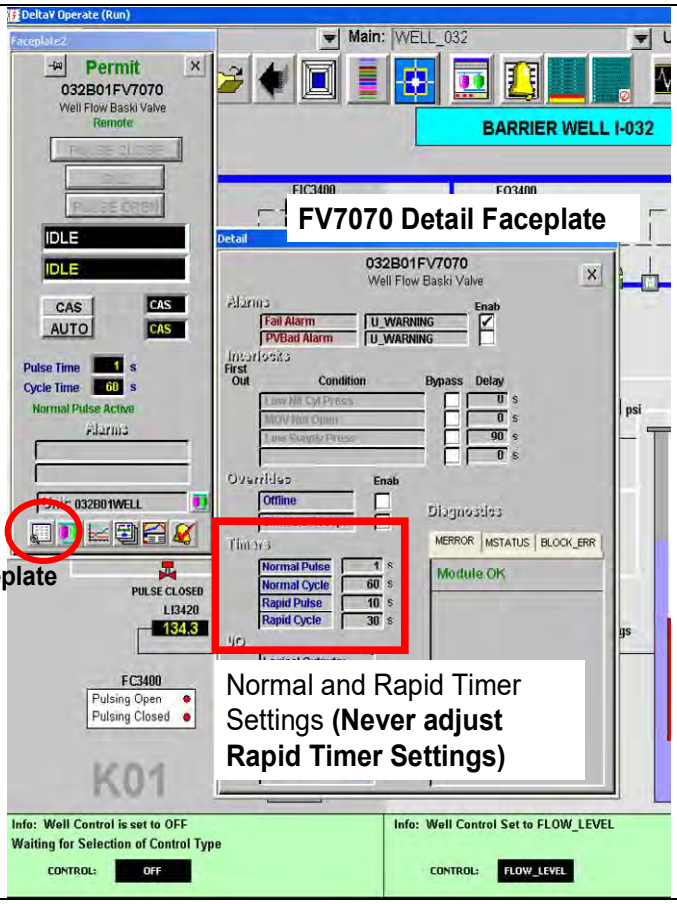
Typical Baski Well Site screen shot.

There are three wells per site (K, B, H), each penetrating a different aquifer. Note: The K well is OFF (MOV is red, Control mode is OFF and the well bladder is displayed in solid red).

Identifies the mode of operation of the well. A single left-click of the mouse on the mode will bring up the Faceplate with options.

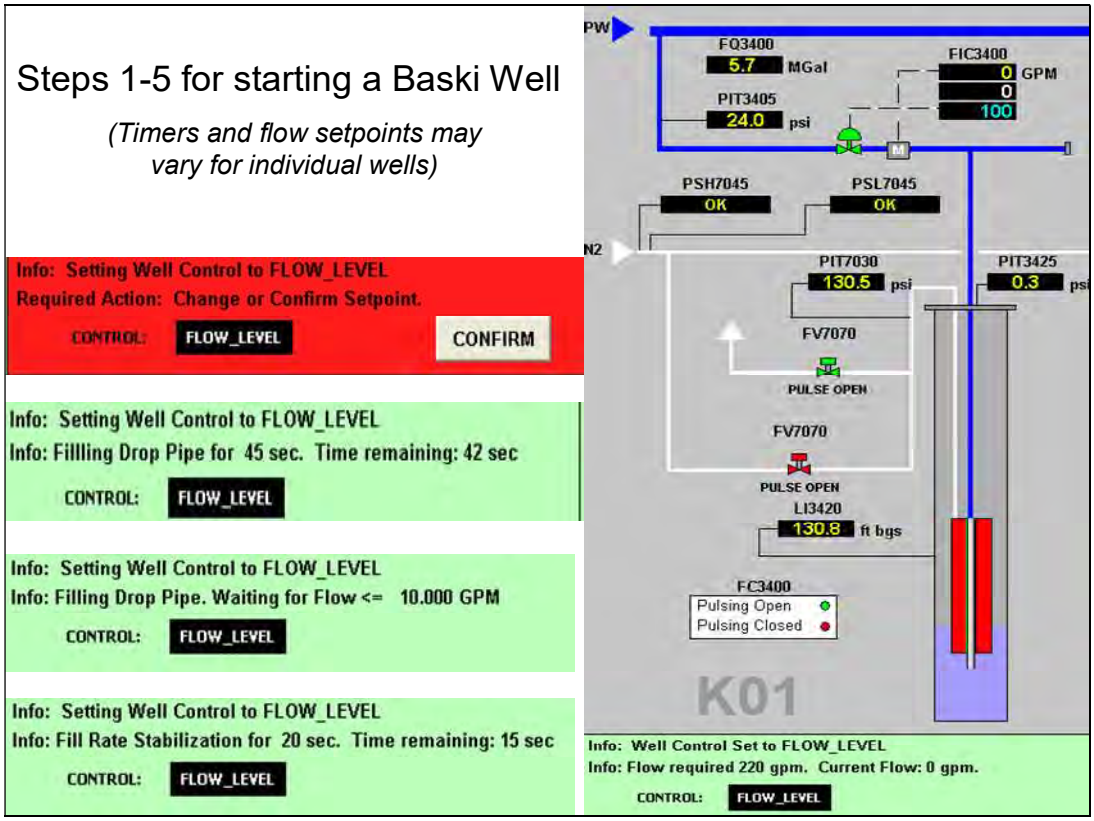
FV7070 Faceplate2 (accessed by a single left mouse click on FV7070.

To access Detail Faceplate



Steps 1-5 for starting a Baski Well

(Timers and flow setpoints may vary for individual wells)



ORANGE COUNTY WATER District
INJECTION WELL DAILY LOG
Plant set point
Date:
Time:
Day:
BPS FLOW
BPS PSI

Timer Setting (Dec 2008)
Normal Pulse/Normal Cycle

Well No.	Flow	FLOW SET POINTS Low	FLOW SET POINTS High	Current Water Level	High Set Point WL	Influent PSI	Inflation PSI	Timers	Flange Pressure	Flange PSI Set Pt.	F
24F											23.90
24K											23.99
25F											23.66
26H											29.32
26L											29.29
26K											29.34
27H											14.33
27A											14.29
27K											14.26
28H											13.48
28A											13.55
28K											13.56
29H											13.43
29A											13.46
29K											13.45
30K											57.70
30B											57.73
30H											57.74
31H											59.99
31B											59.87
31K											59.94
32K											61.18
32B											61.15
32H											61.13
33M											17.56
34M											15.64
35M											14.85
36M											14.16
[illegible]											
FV											
MBA-1											64.86
MBA-2											45.72
MBA-3											50.63
MBA-4											48.90
MBA-5											42.68
EW-1											191.98
[illegible]											

LO – Leaks Open
(Well will tend to increase flow over time until it reaches high flow set point).

LC – Leaks Closed
(Well will tend to lose flow over time until it reaches the low

Appendix A-21

Contact List of Important People

Appendix A-21

Contact List of Important People

Pipeline leak: OCWD Engineer - Fernando Almario - office: (714)378-8220 Cell: (714)721-6380

Baski Valve: Baski Engineer - Nick Hemmingway - office: (303)789-1200 Cell: (303) 901-5559

CLA-VAL: Field Technician - Lance Phillips - Cell: (925)519-2154 lphillips@cla-val.com

Utiliquest/USA: Field Technician - Luis Castro - Cell: (714)829-9792

Bermad Valve: Multiquip. Field Tech. - Travis Murdoch - Cell: (559)223-8728 Travis@muniquipllc.com

ORANGE COUNTY WATER DISTRICT (OCWD)

Primary Contact:

Derrick Mansell, Operations Manager.....714-378-8203
Cell: 714-512-1082
Tony Carreira, Chief Plant Operator. 714-378-3241
Cell: 949-290-4472

Paula Bouyounes (chemical emergencies) 714-392-2294

24 Hr. Number:

Operations Control Room.....714-378-3240
Operations Control Room Emergency.....714-378-3300

If no answer above:

Operations Supervisor's Cell Phone.....714-336-6622
Derrick Mansell, Operations Manager.....Cell: 714-512-1082
Tony Carreira, Chief Plant Operator .....Cell: 949-290-4472

In Emergency, if no answer above:

Mehul Patel, Exec. Director of Operations/GWRS.....Cell: 714-822-4205
(GWRS/GAP always notify)
John Souza, Oper. Shift Supv. .....Cell: 714-244-5851
Steve Clark, Oper. Shift Supv .....Cell: 949-705-7110
Rusty Sutton, Oper. Shift Supv.....Cell: 949-412-2349
Craig Liebzeit, Oper. Shift Supv.....Cell: 562-761-1841
Bob Phillips, Maintenance Manager.....Cell: 714-274-3074
Robert Raley, Process Control/System Manager.....Cell: 714-321-4745
Scott Brandon, I&E Supervisor.....Cell: 714-321-4567
John Bonsangue, Principal Hydrogeologist.....Cell: 714-329-6184
(GWRS/GAP pipeline always notify)
Scott Davidson, Distribution & Injection Well Supervisor .....Cell: 714-766-9375
Fernando Almario, Engineer (GAP only, leave message) .....Cell: 714-721-6380

OCWD Operations is responsible for calling the contacts listed below with a <u>first</u> heads-up call when OCWD first learns of a planned shutdown. Then, call them a <u>second</u> time when a date and time is fixed for the actual shutdown. Of course, when there is an emergency shutdown, call everyone immediately to give them as much time as possible to ready themselves.

GWRS END USER CONTACTS

(FPW Q off to Forebay)

City of Anaheim Canyon Power Plant (CCP)

Primary Contacts (always call all numbers):

Ron Hoffard (rhoffard@anaheim.net).....Office: 714-765-4536
Cell: 714-478-1256
CCP Control Room, days, M-F (leave message if no answer) 714-765-7480
Anaheim Water Operations Dept. 714-765-4560
City of Anaheim 24hr call center 714-765-5109

City of Anaheim ARTIC Transportation Center

Kevin Miako (kmiako@anaheim.net)..... ..... 714-765-5176 ext. 5807
Jason Davis (jdavis@articmgmt.com)..... 714-790-4101
EVA Montejano (emontejano@articmgmt.com)..... 714-790-4102
(Alternate to Jason)
Dion Beckton (engineering@hondacenter.com).....714-704-2480

OCWD Forebay Operations

Don Houlihan, Recharge Operations Supervisor 714-378-3355
Cell: 714-553-5202

GREEN ACRES END USER CONTACTS
Orange County Sanitation District

24-hour number:
Operations Control Room..... Plant 1 - 714-593-7025
Plant 2 - 714-593-7625
April Frost, CPO Plant #1.....714-593-7023
Cell: 714-887-9533
Jon Bradley, CPO Plant #2.....714-593-7600
Cell: 714-686-4399
Jim Spears, Operations Manager.....714-593-7081
Cell: 714-478-3159

City of Newport Beach

Secondary Contact:
Tim Merrill– Water Production Operator..... ..... 949-718-3423/949-933-5761
Paul Heydorff – Water Production Operator..... . .949-718-3424/cell:949-283-7439
Jim Puglisi – Water Production Operator..... .. 949-718-3427/cell:714-309-2158

Primary Contact:
Landin Miller – Water Production Supervisor 949-718-3422
949-644-3011
Cell Phone: 949-400-3216
E-Mail: lmiller@newportbeachca.gov

Toan Van - Water Quality Coordinator.....949-718-3411
949-644-3011
Cell Phone: 714-862-7060
E-Mail: tvan@newportbeachca.gov

Number1 Backup Contact:
Steffen Catron – Field Superintendent II.....949-718-3402
949-644-3011
Cell Phone: 949-795-6103
E-Mail: scatron@newportbeachca.gov

Number 2 Backup Contact:
Mark Vukojevic – Utilities Director.....949-718-3401
949-644-3011
Cell Phone: 714-642-2429
E-Mail: mvukojevic@newportbeachca.gov

Emergency, After-hours, and Weekends:
Primary Duty Pager 949-203-1656
Main Duty Cell Phone 949-795-2139
Big Canyon Reservoir 949-640-6114
NB Police Department 949-644-3717

Irvine Ranch Water District (Only When Intertie is Used)

Primary Contacts:
Gaspar Garza – Recycling Operations Manager 949-453-5826
Cell: 562-481-1511

Jose Zepeda – Director of Recycling Operations 949-453-5572
Cell: 626-755-6823

Ken Pfister – Water Operations Manager 949-453-5772
Cell: 949-743-8573

Back-up Contact:
Wendy Chambers – Executive Director of Operations 949-453-5720

Emergency, After-Hours, Weekends:
24-hour manned phone..... 949-453-5300

City of Fountain Valley

Primary Contacts (always call all numbers):
Kevin Deason, Water Quality Technician.... 714-593-4624
Joe Macias, Distribution Supervisor 714-593-4625
Tom Grose, Production Supervisor.....714-593-4615
(GAP reclaim and FV potable systems)

City of Fountain Valley, cont'd

Mark Sprague, Field Services Manager..... 714-593-4609

Emergency, Fridays, After Hours and Weekends:
Field Administration (Mon-Thur 6:30am-5:00pm)... ..... 714-593-4600/714-593-4603
Public Works Administration 714-593-4433
Fountain Valley Police Dispatch... 714-593-4483
Fountain Valley Fire Dept 714-593-4436
Friday/Saturday Operator Cell (6:30 am-5:00 pm).. 714-951-1122
Sunday Operator Cell (6:30 am-5:00 pm).. 949-742-2125
Standby Duty Man/Water/Sewer/Storm Drains 714-501-6158
Standby Duty Man Street/Landscape/Irrigation 714-392-0656
Standby Duty Man Building Maintenance/Fleet 714-625-6795

City of Costa Mesa

George Cortez 714-925-7439
After hours.....714-754-5252
Work within the City right-of-way and any lane closures:
Michael Guevara.....714-925-7448

City of Santa Ana

Primary Contact:

Juan Lopez.....714-448-9127

Emergency, After Hours and Weekends:

City 24-hour Number.....714-647-3380
City of Santa Ana Police Dept.....714-245-8665
City of Santa Ana Fire Dept.....714-573-6000

Cal Trans

24-hour manned phone.....949-936-3600
Tom Yi.....949-279-8936

Orange County Parks & Trails

For Santa Ana River bank & berm Irrigation Water concerns

James Wooten, Inspector.....714-559-0936
Cell: 714-454-8829
Sue Stoffel, Inspector.....714-559-0936
Cell: 714-448-1956
Mike Miller.....714-679-6673

Mesa Consolidated Water District

Primary Contact:

Tracy Manning, Chief Operating Officer.....Direct Line: 949-207-5468
Office: 949-631-1200
Tyler Jerigan, Assistant Operations Manager.....949-207-5470

Back-up Contact:

Service Department.....949-574-1000

Emergency, After-hours, and Weekends:

Customer Service.....949-631-1200

ACRONYMS AND KEY TERMS

air-vac	air vacuum and release (valve)
b/o	blow-off (valve)
Barrier	Talbert Seawater Intrusion Barrier
Baski Valve	down-well flow control valve
bgs	below ground surface
BPWPS	Barrier Product Water Pump Station
CFV	City of Fountain Valley
cm	corrective maintenance
cml	cement mortar lined (pipe)
Delta V	Process Control system software used to operate the Barrier
EC	electrical conductivity
FPW	Final GWRS product water
GAP	Green Acres Project
GWRS	Groundwater Replenishment System
HP	horse power
I&E	Instrument and Electrical Department at OCWD
IRSO	Injection Recharge System Operator
lateral	a pipe connecting an injection well to the main pipeline
LIT	level indicating transmitter
LPR	Linear Polarization Resistance
MGD	million gallons per day
MOV	motor operated valve
MWD	Metropolitan Water District of Southern California
OC San	Orange County Sanitation District
OC-44	MWD import water connection to the SEB pipeline
OCWD	Orange County Water District
pH	potential hydrogen or percent hydrogen

PIT	pressure indicating transmitter
pm	preventative maintenance
PRV	pressure reducing valve
psi	pounds per square inch
PVC	polyvinyl chloride
RO	Reverse Osmosis
ROP	Reverse osmosis permeate
RP	reduced pressure (back-flow prevention device)
SDI	silt density index
SDI	silt density index
SEB	South-East Barrier
Talbert Barrier	Talbert Seawater Intrusion Barrier
The Basin	the Orange County Groundwater Basin
UPS	uninterruptable power supply
VOV	variable orifice valve
Watchbook	Work Area Traffic Control Handbook

Key Terms

Brine Line: A gravity fed waste discharge line at the GWRS treatment plant that delivers discharge to the ocean.

Eductor: An open ended pipe that delivers injection water down-well and places the injection water below the static water level inside the injection well.

Lateral: Small pipes that branch off of the “Main” pipeline and transfers water a short distance into the injection well.

Main: A large diameter pipeline capable of distributing long distances.

Secure: To stop the flow of a fluid moving in a pipe by closing a valve.

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Groundwater Recharge and Wells: A Guide to Aquifer Storage Recovery, 1995

R. David G. Pyne *

Aquifer Storage and Recovery and Managed Aquifer Recharge Using Wells: Planning, Hydrogeology, Design, and Operation, 2010, Schlumberger Water Services
Robert G. Maliva, Thomas M. Missimer *

***** *Indicates that this book is in the OCWD Barrier Operations Department library*