

**ROYAL OAK MINES INC.  
NWT DIVISION - GIANT MINE**

**Mill Fax No.:** (403) 920-2627  
**Telephone No.:** (403) 669-3733

**FAX TRANSMISSION**

**DATE:** Mar. 7, 1987

**DESTINATION:** Royal Oak Inc., Kirkland, Washington, U.S.A  
**ATTENTION:** Larry Connell

**FAX NO.:** (206) 822-3552

**SENT BY:** Bryan Cross

**NO. OF PAGES:** 6

*(Including Cover Sheet)*

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**COMMENTS:** *I really wish I had a bit more time to study options to your SO<sub>2</sub> Removal Testwork Proposal. One such option might be to add liquid ammonia to cool Cottrell Off-Gas, precipitating ammonium sulphate to be caught along with the arsenic in the Baghouse. The cooling air volume reduction could then be bled back in down stream from the Baghouse restoring the Stack discharge volume, further reducing the SO<sub>2</sub> discharge concentration. This idea might also produce ammonium arsenic compounds, (ammonium arsenite can be a CCA manufacturing intermediate) or such arsenic compounds might not even be captured in the Baghouse.*

*I know we must show the GNWT that we are pursuing options and I hate to sound too negative but I have strong doubts with the proposed test program. The tailings solids showed very slow reaction kinetics with 0.1 M sulphuric acid when the pH was kept near neutral. The 1992 test (Summary attached) showed that dropping the slurry pH from 8.9 to 7 by adding 96.8 ml of acid (to 2 litres containing 390 grams solid) required 24 hours of stirred reaction to recover to pH 8. The day intervals between acid additions particularly show the slow rate of pH recovery, for example from day 3 to 4 the pH came back to 7.85; but from day 4 to 7 it came back to 8.1. Surely the reactions would have been faster had the pH been lowered much more but strong acid conditions would require expensive materials of construction for any full scale treatment.*

*I feel strong agitation not available in a flotation cell would likely be necessary for mass transfer of SO<sub>2</sub> from 1% SO<sub>2</sub> gas in bubbles to the liquid. The SO<sub>2</sub> will not be concentrated at the bubble interface. Consequently, I think we would have unscrubbed SO<sub>2</sub> available immediately. Pure cold water has a solubility of 22.8 gm SO<sub>2</sub>/l and some will react with water forming H<sub>2</sub>SO<sub>3</sub>. Once saturation is reached almost all the gaseous SO<sub>2</sub> will pass straight through the slurry. A small amount will dissolve replacing the dissolved gas that will have reacted with the solids. Dissolved SO<sub>2</sub> and Sulphurous acid will react quite a bit slower than*

ROYAL OAK MINES Inc.

Yellowknife Division  
Giant Mine

To: L. Connell

CC: G. Halverson

From: P. O'Hara

Subject: Acid Consumption Testwork On Mill Tails

Date: February 10, 1992

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On December 9, 1991 a sample of mill tailings was collected and a 2 litre sample was split out for the test. The initial pH was recorded and then the pH was lowered to 7 using 0.1 M sulphuric acid. The sample was agitated overnight and the next day the pH was again recorded then lowered to 7. This process was to continue until equilibrium was reached. Due to the slow time to reach equilibrium the pH was lowered to 6 beginning on the 10th day. The test was stopped after 22 days with the pH being lowered to 6 and returning to the 7.8 range overnight. The results are summarized below:

Day	Initial pH	Sulphuric acid added (mls)	Final pH
0	8.90	96.8	7.00
1	8.00	36.5	7.00
2	7.85	27.2	7.00
3	7.65	19.9	7.00
4	7.85	22.0	7.00
7	8.10	21.1	7.00
8	8.00	24.8	7.00
9	7.85	16.7	7.00
10	7.75	128.3	6.25
11	8.00	172.8	6.10
14	7.35	88.1	6.00
15	7.70	41.4	6.00
18	7.70	49.6	6.10
21	7.75	41.2	6.10
22	7.80	49.8	6.15

Total = 836.2 mls

Weight of solids = 390 grams

## PRICE INQUIRY



To: Royal Oak Mines  
Giant Mine  
Bag 3000  
Yellowknife, NWT  
X1A 2M2

Atten: Brian Cross  
Fax: 403-920-2627  
Phone: 403-669-3733

QTY	UNIT	PRICE	DESCRIPTION	PRICE	DELIVERY
1.	each	3P	01.002.50 15852-1 11051-9 Certified Gas Standard 1.5% Sulfur Dioxide Balance Air Cylinder rental: 30 free days after expired, \$0.36 per day	\$ 293.00	2.5 weeks
2.	each		31.736.66.3 Model # 3510-660 Regulator for Sulfur Dioxide Stainless steel Inlet 3000 psi, Outlet 4-100 psi	\$ 736.00	stock
3.	each		31.000.00 E1-4A101 (list flow here)  Please see the attached	\$ 312.00	stock

**Note:** A \$2.50 PER INVOICE ENVIRONMENTAL SURCHARGE IS APPLICABLE ON ALL SPECIALTY GASES.  
IF YOU HAVE ANY QUESTIONS REGARDING THIS SURCHARGE, PLEASE DO NOT HESITATE TO CONTACT  
OUR OFFICE.

Cylinder Terms:  
Freight on Board  
Tax:  
Terms:

Extra as applicable  
Our dock  
Extra as applicable.  
As set forth in our 1993 and 1996 catalog.  
Please contact our office for more information.

Matheson Gas Products

Beverlie Geldart

12143 68th Street  
Edmonton, Alberta T5B 1P9  
Phone: (403) 471-4036  
Toll Free: 1 (800) 263-2620  
Fax: (403) 471-3117

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MAR-07-1997 13:29

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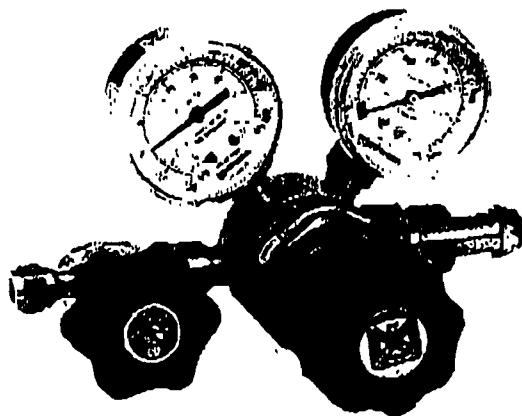
96%

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# Regulators & Gauges

## Model 3510 Series

### Single Stage High Purity Stainless Steel Regulator



The Model 3510 Series regulators provide high purity control for applications where the delivery pressure is monitored.

### Applications

The Model 3510 Series regulators are recommended for use in applications where a slight pressure rise is acceptable due to declining cylinder pressure as gas is withdrawn. Typically these applications include use of the regulators in some semiconductor manufacturing processes, trace analysis, semi-corrosive services and high purity critical laboratory situations. The Model 3510 Series is compatible with gases that are non-corrosive or semi-corrosive in nature.

### Design Features

- \* 316 stainless steel construction
- \* Bonnet ported and threaded to pipe gases away from work area
- \* Can be helium leak certified to  $2 \times 10^{-4}$  scc/sec
- \* Equipped with an outlet diaphragm valve with Integral Gyrolok®  $1/4"$  compression tube fitting
- \* Metal to metal seals throughout
- \* Bonnet threaded for panel mounting as standard
- \* Body screw thread tapped for back mounting
- \* Optional porting

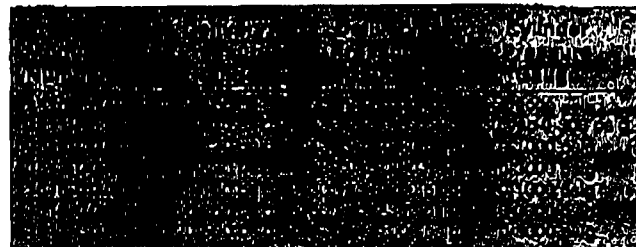
### Materials of Construction

Body:	316 Stainless Steel
Bonnets:	Nickel Plated Brass
Diaphragms:	316 Stainless Steel
Seats:	PFA Teflon®
Seals:	Metal to Metal

### Specifications

Maximum Inlet Pressure:	3000 psig (24,200 kPa)
Maximum Flow Rate:	Model 3510: 650 SCFH (240 SLPM)
(At 2500 psig, N <sub>2</sub> )	Model 3511: 135 SCFH (60 SLPM)
	Model 3512: 210 SCFH (95 SLPM)
	Model 3513: 210 SCFH (95 SLPM)
	Model 3515: 550 SCFH (240 SLPM)
	Model 3516: 1350 SCFH (600 SLPM)
Operating Temperature:	-40 to 185°F (-40 to 74°C)
Body Porting:	1/4" NPT female
Porting Configuration:	2 High, 2 Low
Optional:	3 High, 3 Low
Shipping Weight:	5 lbs

### Models Available



NOTE: Certain CGA limitations may apply.

\* Dome loaded versions of Models 3510, 3511, 3512, 3513, and 3515 available for use with ER-3000 system (see page 265).

### Options

Model Description	Number	Reference
Swagelok® 1/4" Tube Fitting	OPN-0301-SA	
Bonnet Vent Fitting	ADP-0047-BK	
Toe Purge Assembly	4754-CGA	page 326
Cross Purge Assembly	4774-CGA	page 328
Bonnet Panel Mounting Kit	KIT-0204-SA	
Bonnet Vent Adapter	ADP-0016-BA	
to 1/8" FNPT		
Inboard Helium Leak	MSP-0012-XX	page 228
Rate Certification		
Combination Inboard/Outboard	MSP-0013-XX	page 228
Helium Leak Rate Certification		

\* For flow diagrams refer to page 272.

\*\* TOTAL PAGE 02 \*\*

# Rotameters



Flow Measurement  
& Control

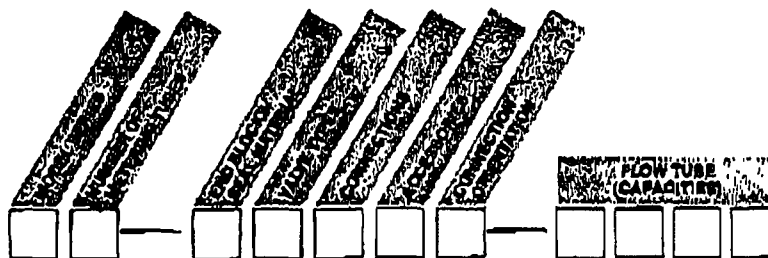
## Flow Tube Capacities for FM-1050 Series Flowmeters, Reference Scales

Tube No.	Float Material	CO <sub>2</sub> Carbon Dioxide (SCCM)	AR Argon (SCCM)	O <sub>2</sub> Oxygen (SCCM)	Air (SCCM)	N <sub>2</sub> Nitrogen (SCCM)	Natural Gas (SCCM)	He Helium (SCCM)	H <sub>2</sub> Hydrogen (SCCM)	Utility Valve Size	HA Valve Size
E910*	Glass	0.34-108	0.23-88	0.25-97	0.13-104	0.29-108	0.47-162	0.26-144	0.56-269	7	1
E100	Glass & Stainless Steel	6.8-200	4.8-140	5.2-145	6-180	6.5-175	9-270	5.3-160	11.7-360	7	2
E200	Glass & Stainless Steel	11-280	7-220	8-240	10-270	10.5-278	14.6-410	9-260	19-560	7	2
E300	Glass & Stainless Steel	36-750	32-690	35-770	38-840	39-850	56-1180	47-1350	99-2500	7	3
E406	Glass & Stainless Steel	72-1450	75-1490	83-1880	88-1800	90-1850	111-2430	183-3680	278-5880	7	4
		(SLPM)	(SLPM)	(SLPM)	(SLPM)	(SLPM)	(SLPM)	(SLPM)	(SLPM)		
E500	Glass & Stainless Steel	0.22-4.4	0.21-4.13	0.24-4.69	0.23-4.5	0.25-5	0.05-6.9	0.51-10.4	0.81-16.2	8	5
E606	Glass & Stainless Steel	0.34-8.8	0.34-6.7	0.38-7.4	0.4-7.6	0.42-7.9	0.53-10	0.81-18.5	1.3-26.4	8	6
E700	Glass & Stainless Steel	0.77-14.4	0.78-14.3	0.85-15.1	0.88-16	0.91-17.2	1.28-22.6	2.39-8	3.09-59.6	9	6
E800	Glass & Stainless Steel	2.05-37.4	2.06-38.1	2.32-43.1	2.4-44	2.47-46	3.21-58.3	5.71-110.7	8.6-161.1	9	6

All flow rates are at 70°F and 14.7 psia

NOTE: Reference tubes are supplied with correlation charts for air and water flow rates at STP. If you require a correlation chart for other gases or liquids, or at pressures or temperatures other than standard, please indicate such when ordering.

\*E100 calibrated correlated reference tube scale only



**Model Number Generator for FM-1050 Series Glass Tube Flowmeters**

**MODEL SERIES**  
 1 = FM-1050 Glass Tube Flowmeter with 150mm tube  
 2 = FM-1050 Glass Tube Flowmeter with 300mm tube

**NUMBER OF MEASURING TUBES**  
 1 = Single Tube Unit  
 2 = Two Tube Unit  
 3 = Three Tube Unit  
 4 = Four Tube Unit

**D BECKS/SEAL MATERIAL**  
 1 = Aluminum with O-Ring Seal  
 2 = Chrome Plated Brass with Buna Seal  
 3 = 316 Stainless Steel with Viton Seal  
 4 = 316 Stainless Steel with Viton Seal  
 5 = 316 Stainless Steel with Viton Seal  
 6 = 316 Stainless Steel with Viton Seal  
 7 = 316 Stainless Steel with Viton Seal  
 8 = 316 Stainless Steel with Viton Seal  
 9 = 316 Stainless Steel with Viton Seal  
 10 = 316 Stainless Steel with Viton Seal

**VALVE TYPE**  
 A = Utility Valve on Inlet  
 B = Utility Valve on Outlet  
 C = High Accuracy Valve on Inlet  
 D = High Accuracy Valve on Outlet  
 E = Valve Plug on Inlet  
 F = Valve Plug on Outlet  
 G = Valve Cavity only  
 H = No Valve/No Plug

**CONNECTIONS**  
 1 = 1/8" NPT Female  
 2 = 1/4" NPT Female  
 3 = 1/2" NPT Female  
 4 = 3/4" NPT Female  
 5 = 1" NPT Female  
 6 = 1 1/2" NPT Female  
 7 = 2" NPT Female  
 8 = 2 1/2" NPT Female  
 9 = 3" NPT Female  
 10 = 3 1/2" NPT Female  
 11 = 4" NPT Female  
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 100 = 48 1/2" NPT Female

**ACCESSORIES**  
 0 = None  
 1 = Bezel & Bracket - Clear Anodized Aluminum  
 2 = Bezel & Bracket - Black Anodized Aluminum  
 3 = Base Plate Assembly  
 4 = Bezel & Bracket - Black Anodized Aluminum  
 5 = Clean for Oxygen Service  
 6 = ±1% Accuracy (Full Scale)

**CONNECTION ORIENTATION**  
 1 = Back In and Back Out

**FLOW TUBE (CAPACITIES)**  
 EXXX = See Capacity Table for FM-1050 Series Flowmeters  
 These are Reference Scale Flowmeters  
 Be sure to request calibration data for the scales you will be measuring

CLAMP.

*sulphuric acid which has a demonstrated slow reaction with Tailings solids.*

*I prefer Kent Morton's idea of setting up the testwork out at the Opacity Shack by the flue. Hopefully we can get the CIL Circuit back together soon for the after roast tailings products and the CIL Tails blend can be the prime target for this testwork. Year round SO2 cyanide destruction, plus any excess lime in the calcine would reduce SO2 going up the stack and also save on ETP costs.*

*Realistically the only way I can see Giant Mine reducing SO2 emissions from 50 to 5 tonnes per day by the year 2006 is by finding a new "elephant" ore zone. Then maybe we could set up a kiln at Pine Point and process the huge piles of limestone overburden there, supplying the necessary daily truckloads needed to neutralize scrubbed SO2.*

*Also find attached a quote for equipment for lab testwork. Have a good day Larry.*