

---

# ***Interchangeability of Gas Detection Tubes and Hand Pumps***

Werner R. Haag, Ph.D.  
***American Industrial Hygiene  
Association Journal***  
***Vol. 62, pp 65-69, 2001***



# Gas Detection Tubes

---

## Question:

Can RAE tubes be used in Gastec or Draeger hand pumps and vice versa?

## Answer:

Gastec - Yes      Draeger - No



# Milestones in better Tube Accuracy

---

- Sliding Scale vs precalibrated printed scale
- Early squeeze bulb pumps lacked accuracy
- Introduction of piston style pumps
- Flow limiting device moves from orifices to the tube itself

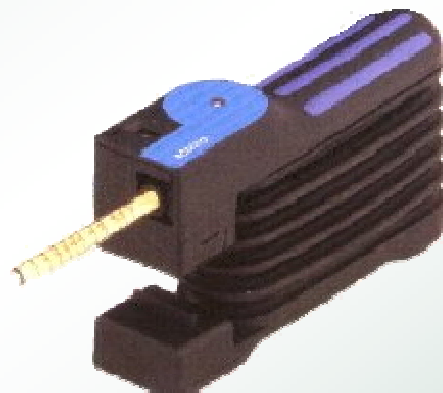


# Modern Tube Types

---

## Low-Vacuum Bellows

- *~7 mm tube o.d.*
- *Larger particles*
- *Examples:*
  - *Draeger Accuro*
  - *MSA Kwik-Draw*



## High-Vacuum Piston

- *~5 mm tube o.d.*
- *Smaller particles*
- *Examples:*
  - *RAE LP-1200*
  - *Gastec GV/100*
  - *Matheson-Kitagawa 8014-400A*



# Pump Designs



WA

# Piston Pump Design

---

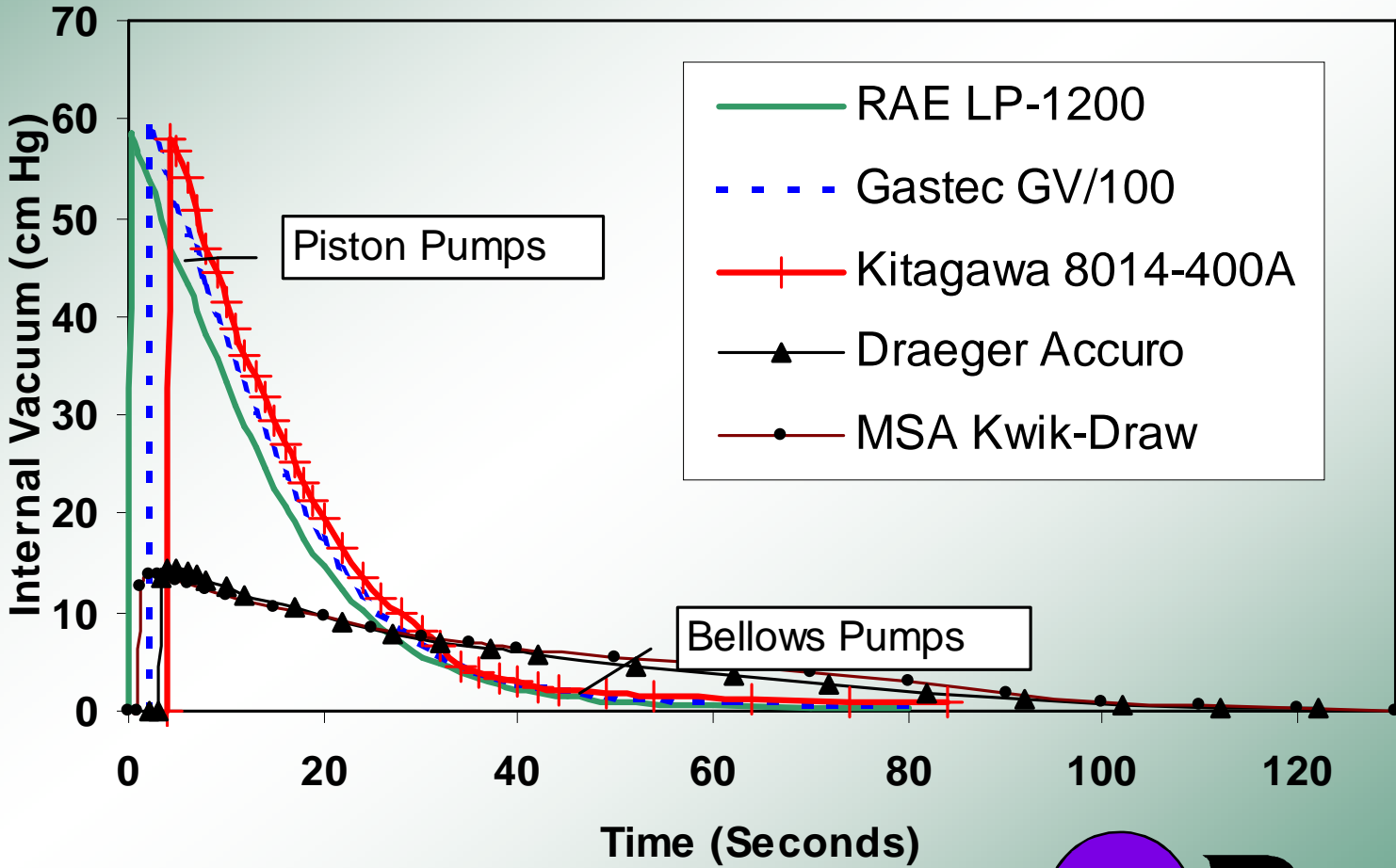
Shaft



Piston

Volume  
Notch

# Pump Flow Characteristics



# System Flow Characteristics

---

	<u>Piston Pumps</u>	<u>Bellows Pumps</u>
Flow Control	Tube	Pump
Pump Vacuum	High	Low
Tube Diameter	5 mm	7 mm



# System Flow Characteristics

---

**Flow rate can affect stain length  
because enough time is needed to:**

- **Allow color reaction to occur  
(High flow = stain too long)**
- **Allow pre-tube reactions to occur  
(High flow = stain too short)**



# Summary of Interchangeability Tests

<u>Tube</u>	<u>Test Gas</u>	<u>Pumps</u>		
		<u>RAE</u>	<u>Gastec</u>	<u>Kitagawa</u>
RAE 100-10	10 ppm NH <sub>3</sub>	11	11	10 (0.5 min)
Gastec 3La	50 ppm NH <sub>3</sub>	51	52	50
RAE 100-20	300 ppm NH <sub>3</sub>	290	310	300
RAE 101-05	5 ppm Benz	5.8	5.6	6.0 (10 min)
RAE 101-20	50 ppm Benz	43	45	44
RAE 102-30	250 ppm CO	230	230	240 (2 min)
RAE 103-40	0.5% H <sub>2</sub> S	0.42%	0.43%	0.43%
<b>RAE 103-10*</b>	25 ppm H <sub>2</sub> S*	29	29	29
<b>Gastec 4LL*</b>	25 ppm H <sub>2</sub> S*	26	27	26
<b>Kitagawa 120SD*</b>	25 ppm H <sub>2</sub> S*	29	29	29

*\*Tests Conducted at Stanford University*



# Summary of Interchangeability Tests

<u>Tube</u>	<u>Test Gas</u>	<u>RAE</u>	<u>Pumps</u>	
			<u>Gastec</u>	<u>Kitagawa</u>
<b><i>RAE 103-10**</i></b>	10 ppm H <sub>2</sub> S**	10	10	10
	20 ppm H <sub>2</sub> S**	20	20	19
	50 ppm H <sub>2</sub> S**	46	47	46
RAE 103-20	100 ppm H <sub>2</sub> S	97	104	107
RAE 103-30	1000 ppm H <sub>2</sub> S	1070	1070	1090
<b><i>RAE 104-50*</i></b>	10% CO <sub>2</sub> *	9.2	9.8	9.6
<b><i>Gastec 2H*</i></b>	10% CO <sub>2</sub> *	9.2	9.6	9.1
<b><i>Kitagawa 126SH*</i></b>	10% CO <sub>2</sub> *	9.5	9.9	9.8

***\*\*Tests Conducted at San Francisco City College***

***\*Tests Conducted at Stanford University***



# Piston Pump Interchangeability

---

- 58 Different mixed tube-pump combinations
- 11 Different chemicals
- Average deviation between pumps: 3.2%
- Max deviation between pumps: 14%
- Average deviation from standard: 6.7%
- Max deviation from standard: 24%



# RAE Interchangeability Statement

---

## Interchangeable Piston Pumps:

- RAE LP-1200
- Gastec GV/100
- Matheson-Kitagawa 8014-400A



## Pumps Must Have Same:

- Volume Accuracy
- Flow Characteristics
- Tube Fit (5 mm = 5 mm)



# RAE Interchangeability Statement

---



=



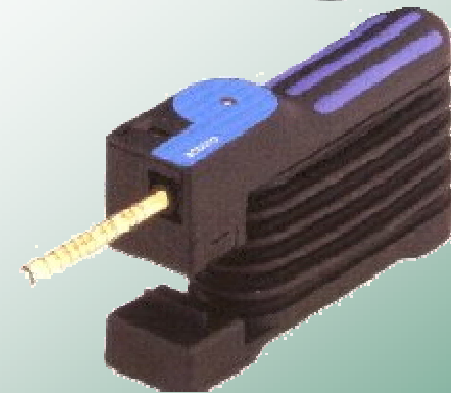
# MSA Interchangeability Statement

## Interchangeable Bellows Pumps:

- MSA Kwik-Draw
- Auer Gas-Tester II H
- Draeger Model 31
- Draeger Accuro

## Pumps Must Have Same:

- Volume Accuracy
- Flow Characteristics
- Tube Fit (7mm= 7mm)



# Summary of Interchangeability Tests

Tube	Test Gas	Dräger MSA			Piston Avg	
		ppm	ppm	min	ppm	min
RAE 100-10	10 ppm NH <sub>3</sub>	11	10	1	11	0.5
RAE 100-20	300 ppm NH <sub>3</sub>	230	240	2.5	300	1
RAE 102-30	250 ppm CO	180	200	7	230	2
Gastec 4LL	25 ppm H <sub>2</sub> S	25	25	2.5	26	1
Dräger H <sub>2</sub> S 2/b	25 ppm H <sub>2</sub> S	31	29	0.5	34	0.4
MSA H <sub>2</sub> S-1	25 ppm H <sub>2</sub> S	24	26	0.5	28	0.4
RAE 104-50	10% CO <sub>2</sub>	9.2	9.3	6	9.5	1
Kitagawa 126SH	10% CO <sub>2</sub>	9.1	9.2	3.5	9.7	1
RAE 107-20	50 ppm SO <sub>2</sub>	49	50	5	50	2
RAE 109-20*	25 ppm NO	8.7	9.2	7	24	2

\*Combination pre-tube & measurement tube.





# MSA Interchangeability Statement

---



# RAE Interchangeability Statement

---



# Agency Approval

---

**Why do several government agencies have statements against interchangeability?**

**All seem to be based on old 1974 study\* using pumps of different design and flow characteristics and mostly are no longer used:**

- **Four orifice limited pumps**
- **one bellows pump**
- **one piston pump**

**\* Cohen, F.H., A study of the interchangeability of gas detector tubes and pumps, *AIHA Journal* 35, 686 (1974).**



# Conclusions

---

- Tubes and pumps are interchangeable if design/performance criteria are the same and appropriate leak checks are performed
- Interchangeability should be guided by pump specifications, not by brand name.
- Because the piston pumps tested are equivalent, any new tube designed to work on the Gastec pump will also work on the RAE or Kitagawa pumps, and vice versa.





Thank you for reading this data sheet.

For pricing or for further information, please contact us at our UK Office, using the details below.



**UK Office**

**Keison Products,**

**P.O. Box 2124, Chelmsford, Essex, CM1 3UP, England.**

**Tel: +44 (0)330 088 0560**

**Fax: +44 (0)1245 808399**

**Email: [sales@keison.co.uk](mailto:sales@keison.co.uk)**

Please note - Product designs and specifications are subject to change without notice. The user is responsible for determining the suitability of this product.