

# ANNUNCIATOR

MARCH 1998



SARNIA



SECTION

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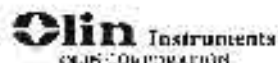
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## Editor's Notes

**ADVERTISERS:** Please note that the deadline for the MAY ANNUNCIATOR is April 15, 1998. Please forward information to the editor by that date in order to have items updated.

**THE DINNER MEETINGS FOR THE 1997/98 SEASON WILL BE HELD AT THE SARNIA GOLF AND CURLING CLUB**

**ISA Sarnia Section**

Box 206, Sarnia ON N7T 7H9

**ISA Sarnia Section BBS**

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## Upcoming Executive Meetings

April 27, 1998 • June 29, 1998

*All regular meetings will be held at 6:30 p.m. at the Sarnia Golf & Curling Club*

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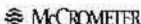
Pressure, level, flow, and temperature transmitters, controllers, recorders, digital control programmers, control valves



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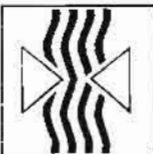
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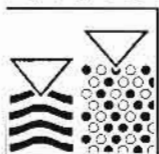
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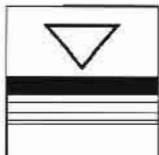


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# ***INTRODUCING...***

## ***Sarnia Section's Newest Member***

***John Eydt***

***B.S.P. Instruments,  
Wallaceburg***



***Position:*** Owner/Salesperson

***Education:*** Eng. Tech - Ryerson,-  
Mechanical/  
Metallurgical

***Background:*** Industrial Metallurgy,  
Lab Instrumentation  
Sales, Process  
Analyzer Sales

***John can be contacted at:***

(Tel) 519-627-8505

(Fax) 519-627-7016

(Email) bsp@kent.net

*For more details about B.S.P. Instruments, see the Advertisement on Page 17.*

***John has been a member of the Sarnia ISA Section before, and we are pleased to welcome him back, as his business interests bring him back into the Sarnia area. On a personal note, John takes an interest in the Sarnia Starfire Hockey and Wallaceburg Minor Hockey leagues.***

***A warm welcome to John as he rejoins the Sarnia Section and re-establishes his presence in the Sarnia area.***

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10



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11



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12



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14



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for Measurement and Control

## President's Corner

I would like to report that we had an excellent turnout for our January dinner meeting. Our speaker, Frank Risse, from Bayer gave an excellent talk on the status of Bayer in the world and the outlook for new projects in Sarnia.

I was very pleased to attend the ISA Presidents winter meeting on behalf of the Sarnia Section. The opportunity to meet and exchange ideas with other sections has confirmed that our section is doing well and I came away with many good ideas that we can try to use to make our section better. Dodging tornadoes was the only negative aspect of the trip.

The executive would like our members to know that we are prepared to donate to a charitable foundation. Last year our donation went towards the purchase of new Audio testing equipment for the Rotary Children's Hospital School.

We have openings on our executive board for anyone who would like to get involved and I would be happy to personally discuss the opportunities with anyone who contacts me.

Our Golf Committee is currently planning our outing for this year. Make sure you plan to attend as we expect that the turnout will be better than last year.

The following dates offered as a reminder of the upcoming ISA meetings and activities;

### DATES

District Meeting in Burlington	May 8-10, 1998
Summer meeting in Montreal	June 20 - 28, 1998
ISA Expo 98	October 19-22, 1998

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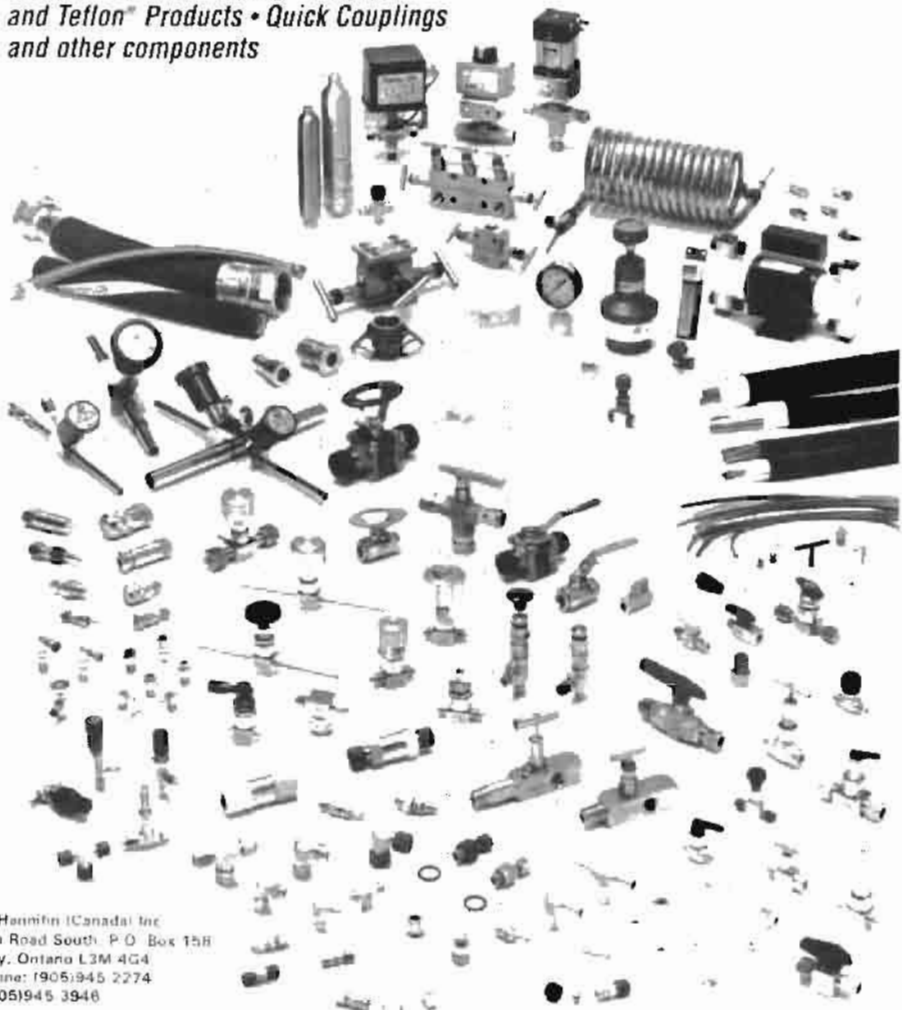
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## **Sarnia Section Executive 1997-98**

<b>Position</b>	<b>Incumbent</b>	<b>Phone</b>	<b>Fax</b>
		(Area Code 519)	
President	Andy Tucker	383-3704	383-8285
Vice-President	TBA		
Past President	Randy Dennie	337-8252 ext. 5871	339-7723
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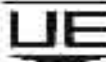
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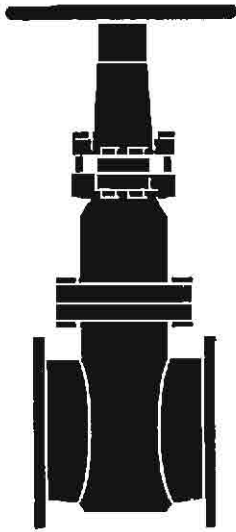
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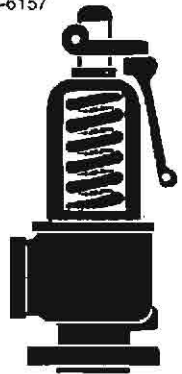
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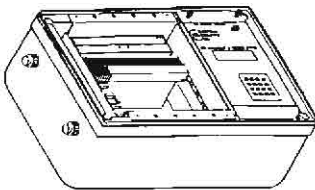


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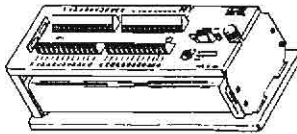
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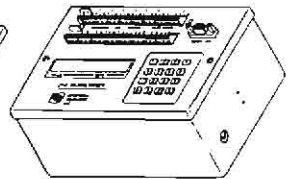
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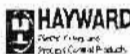
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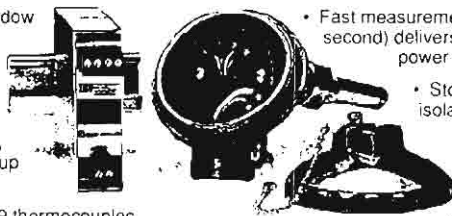
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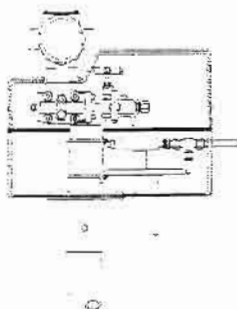
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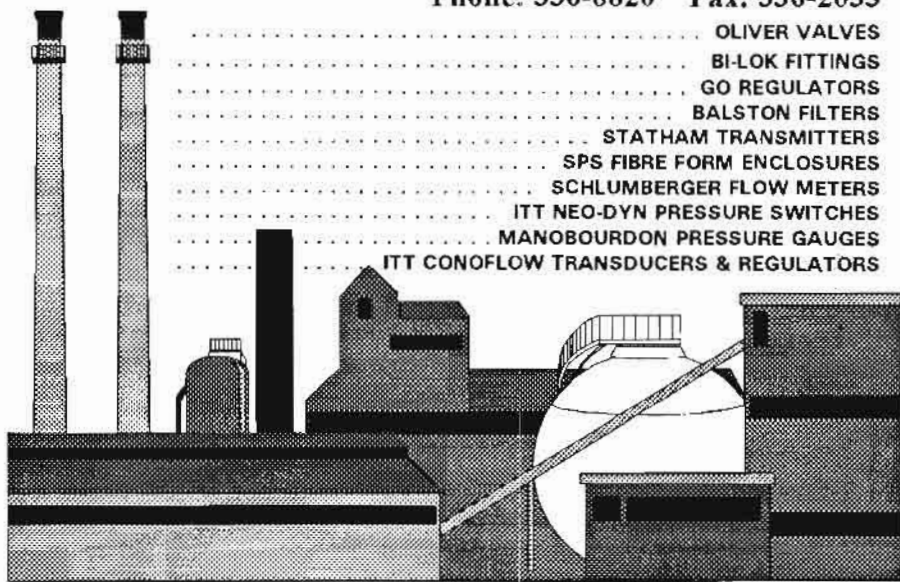
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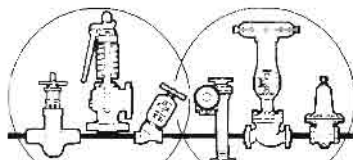
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## COMPUTER CORNER

by: Diana C. Bouchard



Most of you who are "Web enabled" have probably already paid a visit to the main ISA web site at <http://www.isa.org>. In the coming years, you may visit this site a lot more often, as ISA is making an active effort to use Internet technology to communicate more effectively with you the members. By the year 2000, ISA intends to be using the Internet as its standard means of communication with Society leaders, i.e. your Section executive, your District Vice President and District Council, etc. In addition, more and more, documents such as Section officer guides and Section annual report forms will be available to you on the ISA Web site, with paper copies sent only if you ask.

To make all this possible, and to help ISA serve you more quickly and efficiently, ISA is upgrading its computer systems at Headquarters. The new system was approved by the Executive Board in October, is to be installed by mid-1998, then the existing and new systems will be run in parallel until the end of 1998 when the old system will be decommissioned. The new system is designed to support direct interaction (protected by appropriate security, of course) with ISA member information. Before too long, you should be able to make online corrections or updates to the information ISA has on you as a member. Given the number of errors that seem to exist in this information, that should be an interesting possibility indeed! You can also look forward to a major expansion in the amount of information available to you electronically from ISA, and to having at least some of that information customized to your own interest profile.

Let's take a quick tour of the ISA web site to look at some of what it offers! Be aware, though, the site is constantly evolving, so it's worth checking back every few weeks to see "what's new and different."

When you log onto the main ISA site, <http://www.isa.org>, one of the first things you

see is a set of buttons at the top of the page. Each button provides access to a section of the site, as follows:

- Inside ISA
- Search
- Bookstore
- Training
- Directory of Instrumentation
- ISA Magazines
- Tech Talk
- ISA TECH/EXPO
- Standards
- M&C Markets
- For Members Only

Many of these titles are self-explanatory, so I will concentrate my "tour" on areas whose contents are not as obvious.

**Inside ISA** - not the insert you get in your *InTech* (that was my first thought) but rather a list of links that provide you with information on Sections, Divisions, Society Events, volunteer leaders, staff contact information, and a somewhat mixed collection of other ISA stuff.

Under *Sections* you can access a list of ISA Sections arranged alphabetically by state, country, or region, with contact information. There is also a list of ISA Sections and Districts which have put up web sites, with live links. In my experience this list is not entirely up to date and it seems to take a little persistence to have new information put on.

The *Technical Divisions* link gives you access to a page of information on each industry or technology Division. *Volunteer leaders* gives you contact information, including email links, for the members of the ISA Executive Board and their elects. *ISA staff contacts* does the same for the staff at Triangle Park.

*ISA InfoFax* is the access point for a relatively new service through which you can request various pieces of ISA information to be sent to you via fax.

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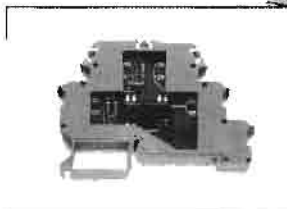
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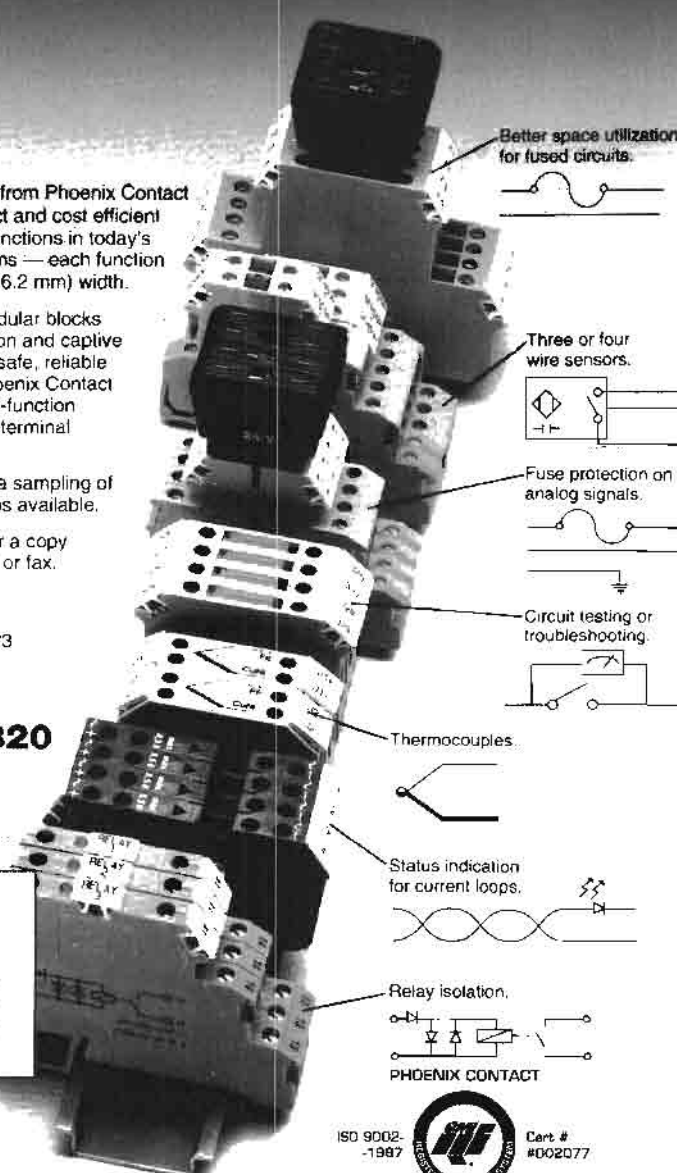
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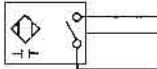
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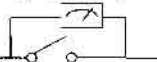
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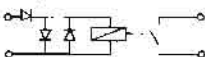
Thermocouples.



Status indication for current loops.



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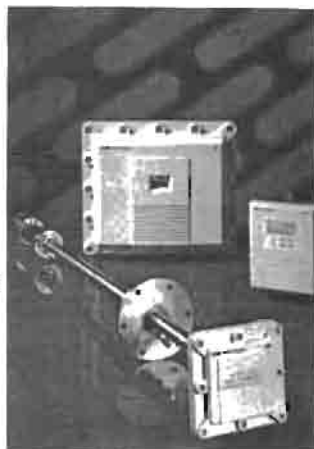


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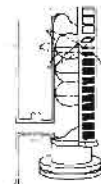
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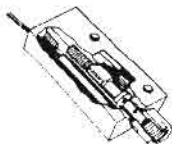
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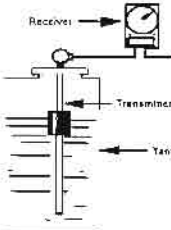


### Flow Switches

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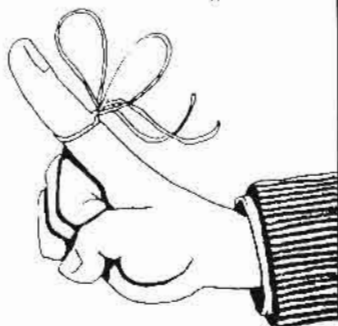
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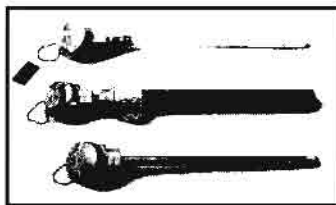
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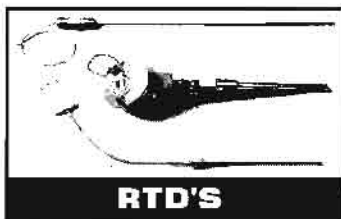
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This form may be used by any interested person wanting to join ISA or ISA International, including students. For assistance, contact ISA Member & Customer Services at (919) 549-8411.

Please type or use block letters. Sign and date below, in Section 3.

# Membership Form



**1** Name \_\_\_\_\_ Title \_\_\_\_\_  
 Company Name \_\_\_\_\_ Division/Works \_\_\_\_\_  
 Postal Code \_\_\_\_\_  
 Check here if you are a  former student and  holds the following degree: \_\_\_\_\_  
 Mailing Address: Home \_\_\_\_\_ Work (NOTE: Student membership must please implement home address)  
 Street Address/PO Box \_\_\_\_\_ MA/State \_\_\_\_\_  
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 State/Province \_\_\_\_\_ Postal Code \_\_\_\_\_ Country \_\_\_\_\_  
 Telephone (include area code or country code) \_\_\_\_\_ FAX \_\_\_\_\_  
 Have you ever been a member of ISA?  Yes  No Previous years of membership \_\_\_\_\_  
 Assign me to the \_\_\_\_\_ section of the section closest to my home address  
 Highest Educational Degree Earned: High School \_\_\_\_\_ Associate \_\_\_\_\_ Bachelor \_\_\_\_\_ Master \_\_\_\_\_ Doctorate \_\_\_\_\_  
 Are you a registered professional engineer? Yes  No  State/Country Registered \_\_\_\_\_  
 Tick here to show we may make your list available to companies whose products or services may interest you. If you do not want your name exchanged, please check this box. We will respect your wishes.

**2** **NOTE:** Sections 2, 3, and 5 must be completed for processing.

Check your primary job function:

- A. General or Corporate Management
- B. Control Systems Engineering
- C. Design Engineering
- D. Production Engineering
- E. Plant Engineering or Maintenance
- F. Software Engineering
- G. Plant Information Systems
- H. Systems Integration
  - 1. Measurement, Testing, Quality or Standards
  - 2. Test and Development
- K. Test and Engineering Support
- L. Operations
- M. Purchasing or Procurement
- N. Education or Training
- O. Marketing or Sales
- P. Other: Describe \_\_\_\_\_

What is the primary site product manufactured or service performed at your company location? \_\_\_\_\_  
 Check here for manufacturing or service at this location.

**3** Signature \_\_\_\_\_  
 Date \_\_\_\_\_

**5** **Dues Payment Information**  
 Please select the level of membership for which applying:

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If paying by credit card, fax to: (919) 549-8280.

**4** **Division Enrollment** — Also enroll me at \$5.00 each in the Divisions checked below. To join Divisions, you must also enroll as a regular or student member.

<input type="checkbox"/> (A) Analysis*	<input type="checkbox"/> (J) Test Measurement*	<input type="checkbox"/> (B) Aerospace Industries*	<input type="checkbox"/> (R) Food & Pharmaceutical Industries*
<input type="checkbox"/> (C) Robotics & Expert Systems	<input type="checkbox"/> (M) Automatic Control Systems*	<input type="checkbox"/> (F) Mining & Metals	<input type="checkbox"/> (T) Textile Industry
<input type="checkbox"/> (D) Computer Technology*	<input type="checkbox"/> (N) Telemetry & Communications	<input type="checkbox"/> (G) Chemical & Petroleum Industries*	<input type="checkbox"/> (U) Automotive & Vehicular
<input type="checkbox"/> (E) Open Systems Interconnection	<input type="checkbox"/> (P) Electro-optics	<input type="checkbox"/> (K) Construction and Design*	<input type="checkbox"/> (W) Water & Wastewater Industries
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<input type="checkbox"/> (I) Maintenance		<input type="checkbox"/> (O) Power Industry*	<input type="checkbox"/> (Z) Marketing & Sales*

\* Students are entitled to one free membership each in the Automation & Technology and Industries & Sciences Divisions. Please choose and mark from the asterisked selections.

**ISA Magazines** - this section of the site has seen a lot of expansion in recent months. Most if not all of the editorial content of InTech, Industrial Computing, and Motion Control is now available to you electronically. Saves searching your office for that back issue! Unfortunately they don't go too far back in time (a common problem in my experience with ALL online versions of magazines), but at least the current stuff is now getting put on as it appears.

**For Members Only** - this is guaranteed to be one of the fastest-growing sections of the ISA site. To get into this area, you need your member number and a password which is simply your last name in capital letters (not all that secure if you ask me, but the decision is theirs, not mine). Thanks to this, I have finally memorized my member number!

Current contents of this area are:

- Current Executive Board Members and Elects only (*requires additional password*)
- Executive Board and Executive Committee Minutes
- Featured Publications
- Gateways (*links to other web resources*)
- Honors and Awards Information
- Leadership Development Programs
- Manual of Organization and Procedures (MOP)
- President's Meetings
- Speaker Directory

Some of these items such as the MOP and back minutes are downloadable files that require the Adobe Acrobat Reader 3.0. ISA is posting an increasing number of documents in this format. The main advantage of Acrobat seems to be that it can reproduce pages of just about any degree of complexity, including multiple fonts, graphics, etc., and that it allows the provision of documents in read-only form (you wouldn't want people modifying old Executive Committee minutes, would you?). The files can get rather large, however (into the megabytes), and I've had some difficulty printing some of the more complex pages.

The main advantages of providing this stuff electronically seem to be ease, speed, and convenience of access (assuming your Web connection isn't working at 22 bytes per second

- that's another problem!) and the possibility of instant updates. I just found out that the new District 13 officer and committee roster missed the not-well-publicized deadline for inclusion in the printed Roster of Society Leaders. Now if that roster were available on the web site, the print version would still be instantly out-of-date, but a reasonably up-to-date version could be posted, say every month, in the For Members Only area. Of course this requires more ISA staff time, which is yet another issue... An important point is that material on the web site is accessible to any member with an Internet connection. In the past, stuff like leadership development course schedules would too often get sent to the DVPs or section presidents and never circulated to people who might be interested in them.

Another issue that is starting to arise is that once material is available on the web site, it may be less available in other forms. For example, the schedule for the most recent ISA President's Meeting in Anaheim was up on the web site a month to a month and a half before ISA TECH 97. However, several people who were attending from District 13 never got a printed schedule in the mail, and in one case I ended up printing out the schedule from the web site and faxing it to the individual concerned. I'm sure this is a transitional problem until we all get web access and enough bandwidth not to spend 45 minutes downloading a file, but in the mean while it's a pain in the neck.

There is also a trend towards providing minutes of committee meetings in a web site area. I find this very positive as the minutes are all accessible in one place instead of dribbling by by mail over a few months after the business meeting. Again the minutes are normally in Acrobat format. The one problem I see with this: I tend to stuff the minutes away in a dark corner of my hard disk without reading them. But then I can do that with paper minutes, too...

Wow, this column is starting to get long. Be sure and explore the ISA web site to find out what's there for you, and visit often because things change so fast in the online world. Next month I'll concentrate on an initiative that is closer to home for most of my readers - the ISA Canada web site.

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# Temperature Measurement

This article is about some common types of temperature sensors, limitations of some of the sensors and Internet sources of temperature measurement information. Most manufacturers of temperature sensors will provide technical information and papers about this subject.

Temperature can be measured by a diverse array of sensors. All of them infer temperature by sensing some change in a physical characteristic. The most popular types are thermocouples, resistive temperature detectors (RTD's), thermistors, infrared detectors, bimetallic devices, liquid expansion devices and change of state devices. This article will focus on the two most popular types, thermocouples and RTD's.

## Thermocouples

Thermocouples consist of two electrical conductors made of different metals that are joined at one end. Changes in temperature at the measurement junction induce a change in electromotive force (emf) between the other ends. Refer to the International Temperature Scale of 1990 (ITS-90) for standardized tables of temperature Vs thermocouple emf values. ISA and ASTM have designated letters for particular types of thermocouples. There are two groups, the base metal thermocouples J, K, T, E and N and the precious metal thermocouples R, S and B. Each type has a characteristic emf Vs temperature curve and application range. The EMF curve is very dependent on the composition of each conductor. Type J and K are the most widely used in industrial applications. Type J (iron Vs copper-nickel (Constantan)) is versatile in that it can be used in both oxidizing and reducing atmospheres up to 1,400°F. Iron rusts at low temperatures where condensation can form. Type K (nickel-chromium(Chromel) Vs nickel-aluminum(Alumel)) can be used up to 2,300°F in an oxidizing or inert atmosphere.

Type K thermocouples exhibit a number of instabilities and inaccuracies, particularly at higher temperatures, changing their emf/temperature characteristics. In reducing atmospheres (lack of oxygen) at temperatures of 1,500 to 1,750°F the positive thermoelement forms a greenish chromic oxide, commonly known as "green rot". This causes a decrease in the electromotive force of the thermocouple. Type K is also subject to aging when exposed to 800 to 1,200°F for a few hours. Temperature cycling above 1,400°F and then below 700°F causes a random error due to changes in the composition (inter-granular structure) of the conductors.

Solutions to the problems of Type K thermocouples include using metal sheathed mineral insulated thermocouples, Stabilized (pre-aged) Type K conductors or Low-Drift (annealed above the operating temperature) Type K conductors depending on the application. Other types of thermocouples, which do not drift such as Type N, could be used in place of Type K to avoid these problems. Quite often the Thermocouple cabling from sensor to control room or multiplexor box is already Type K and would be costly to change to another type of conductor.

Type N (nickel-chromium-silicon(Nicrosil) Vs nickel-silicon(Nisil)) thermocouples exhibit a much greater resistance to oxidation-related drift at high temperatures. In 1986 it was thought that Type N would make Type E, J, K and T obsolete. Type N became popular in Europe and Australia but has not become as popular in North America yet.

## Resistive Temperature Detectors (RTD's)

RTD's contain a sensing element whose resistance changes with temperature. The sensors are usually packaged so they can be placed into a position in the process where it can reach the same temperature. Platinum wire or film RTD's are the most common type in use today. Platinum RTD's are used to measure temperatures from -450 °F to 1200 °F.

(Continued on Page 47)

Sensor selection requires answers to a number of questions:

(Continued from Page 46)

- What is the temperature range to be measured?
- What accuracy of measurement is required?
- What environmental conditions may cause the sensor not to perform?
- What method of signal transmission is to be used?

## Temperature Range

Platinum RTD's are capable of measuring from  $-450^{\circ}\text{F}$  to  $1200^{\circ}\text{F}$ . Thermocouple ranges are  $32$  to  $1400^{\circ}\text{F}$  for Type J,  $-328$  to  $2,300^{\circ}\text{F}$  for Type K,  $-328$  to  $660^{\circ}\text{F}$  for Type T,  $32$  to  $2300^{\circ}\text{F}$  for Type N,  $32$  to  $2640^{\circ}\text{F}$  for Type R and  $1472$  to  $3092^{\circ}\text{F}$  for Type B. Check the accuracy of the thermocouple over the measured range. For example the accuracy of a Type K thermocouple is 2% of reading from  $-328$  to  $-166^{\circ}\text{F}$ ,  $4^{\circ}\text{F}$  from  $-166$  to  $559^{\circ}\text{F}$  and  $\frac{1}{2}\%$  from  $559$  to  $2282^{\circ}\text{F}$ . Look at the sensor signal change over the measured temperature range to see the different sensitivities and non-linearity's.

## Measurement Accuracy

RTD's are manufactured to DIN standards, which have different grades of accuracy which are only specified at  $32^{\circ}\text{F}$ . A 100-ohm RTD which meets Grade A accuracy would be  $100 \pm 0.12$  ohms ( $\pm 0.12\%$ ) at  $32^{\circ}\text{F}$  and Grade B would be  $\pm 0.06\%$ . Higher resolution Platinum RTD's are available which have a resistance of 500 ohms at  $32^{\circ}\text{F}$ .

Thermocouple accuracy is defined as limits of error over a temperature range. The range is specific to the type of thermocouple and has two or more temperature bands each with a specific limit of error. There is more than one accuracy classification for thermocouples. Standard limits of error define the normal accuracy specification. Special limits of error define an accuracy specification of half the normal specification. Manufacturers catalogs and standards contain technical information about each type of thermocouple, including emf/temperature tables and temperature ranges Vs limits of error.

Sensors mounted in thermowells should be spring loaded to press the sensor tip to the bottom of the thermowell for good contact. Oil or grease can be inserted into thermowells for improved contact as long as the operating temperature does not exceed the flash point of the oil or grease.

## Environmental Conditions

Environmental conditions can affect the life and performance of temperature sensors. Thermocouples and RTD's can be supplied with mineral insulation and metal sheath to insulate the conductors and protect them from the environment. The insulation and metal sheath must be rated above the highest operating temperatures. Magnesium oxide is a common insulation material which is suitable for  $-320^{\circ}\text{F}$  to  $1,250^{\circ}\text{F}$ . Common sheath metals include 300 series stainless steel, Inconel, Incoloy and Hastelloy.

The air atmosphere can cause corrosion to the thermocouple wires in the thermocouple head and thermowell if the sensors are not sheathed and sealed. Water can cause Type J iron conductors to rust.

RTD sensors tend to be more fragile than thermocouples. Temperature expansion due to rapid temperature changes and vibration can damage the sensor and wiring. RTD sensors are usually fabricated as wound wire on a core or helical coils in a tube with mineral insulation packing to reduce vibration effects.

## Signal Transmission

The signal transmission system can have a negative effect on the accuracy and reliability of the temperature signal. This is true for thermocouples and RTD's. Thermocouple signals must be transmitted via thermocouple extension wire made from the same material as the thermocouple elements. Use of wire materials other than the thermocouple

(Continued on Page 50)

materials will result in errors where the ambient temperature changes. Voltage drops could also develop which would cause additional errors.

RTD extension wire can cause an error because the resistance of the wire is added to the sensor resistance. 3 and 4 wire RTD's have compensating leads that can be used to eliminate the wire resistance.

## International Standards

IEC-60584	Thermocouples (3 parts)
IEC 751:	Industrial Platinum Resistance Thermometer Sensors.
ANSI-MC96.1	Temperature Measurement Thermocouples.
ASTM E1137-87	Standard Specifications for Industrial Platinum Resistance Thermometers.

## References

- 1) Leewis, Wes. "International Standards for Specifying Temperature Sensors", ISA Edmonton Section, 1990.
- 2) ASTM STP 470B, Manual on the use of Thermocouples in Temperature Measurement.
- 3) Wang, T.P. "Thermocouples for High Temperature Applications", ISA Advances in Instrumentation, Volume 42, 1987.
- 4) Wang, T.P. and Martincavage, J.R. "The Role of Temperature Sensors and High tech Instrumentation on the Bottom Line of the Chemical and Petrochemical Industries", ISA Instrumentation in the Chemical and Petrochemical Industries, 1987.
- 5) "Thermocouple Selection and Maintenance" Intech April 1991.
- 6) Guide to Thermocouple and Resistance Thermometry by TC Ltd, Uxbridge England.

## Internet Technical Information

"How to Select and Use the Right Temperature Sensor" ([www.pyromation.com/pdf/default.htm](http://www.pyromation.com/pdf/default.htm)) Determine which sensor to use, RTD or Thermocouples.

"Temperature Sensors" ([www.sensycon.de/txt/txt\\_21\\_e.htm](http://www.sensycon.de/txt/txt_21_e.htm)) Platinum resistance elements - Introduction, General Assembly, Slot type, Thin film type and low temperature measurements.

Minco Reference Library ([www.minco.com/reflib.htm](http://www.minco.com/reflib.htm))

Omega Technical Reference ([www2.omega.com/reference.html](http://www2.omega.com/reference.html))

Wattlow Reference Data ([www.wattlow.com/ref/index.htm](http://www.wattlow.com/ref/index.htm))

## Manufacturers Web Sites

Search the ISA Directory of Instrumentation at [www.isa.org/directory](http://www.isa.org/directory) for temperature sensor manufacturers.

Acrolab	<a href="http://www.acrolab.com">www.acrolab.com</a>
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## Standards Organizations

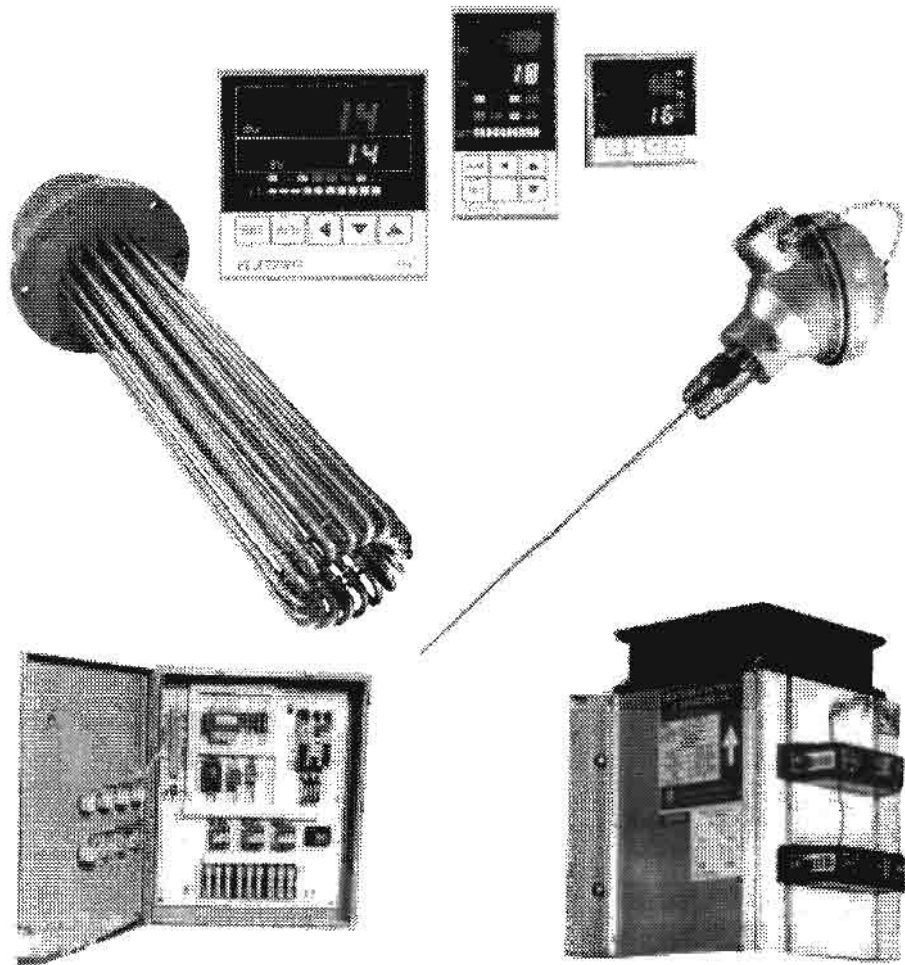
ANSI	<a href="http://www.ansi.org">www.ansi.org</a>
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ISA	<a href="http://www.isa.org">www.isa.org</a>

This article is also posted on the Online Annunciator Web site at: [www.xcelco.on.ca/~btsmith/temper.htm](http://www.xcelco.on.ca/~btsmith/temper.htm)

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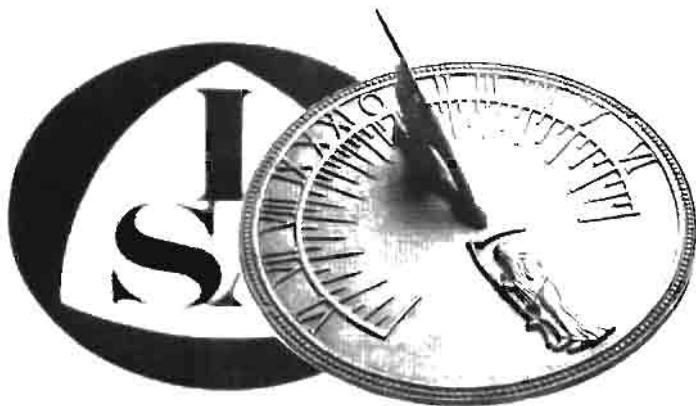
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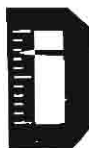
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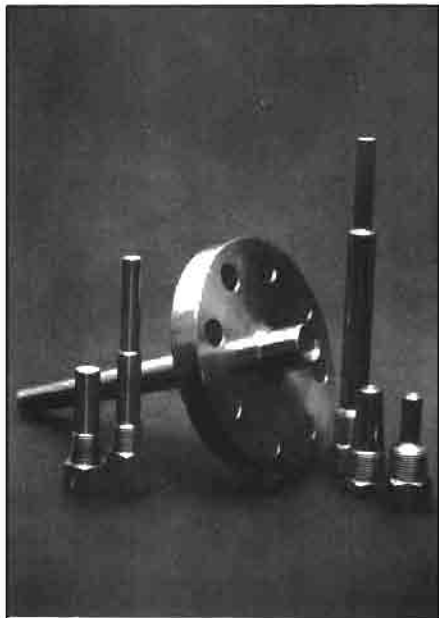


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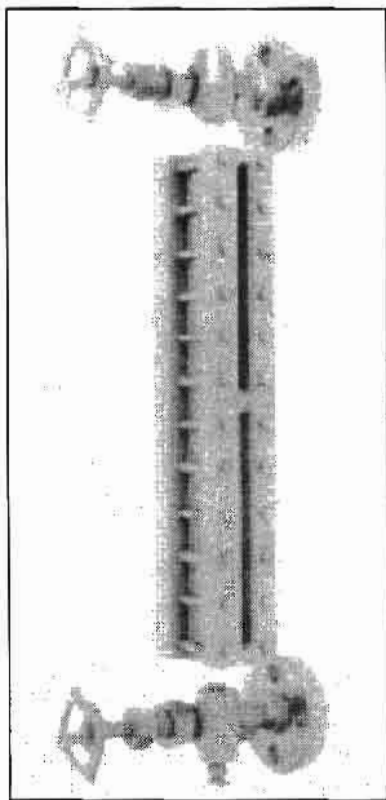


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AEMC  
AFE Technologies Inc.  
AGI - Atlantic Group Inc.  
Aim  
Air Flow  
Air Monitor Corp.  
AiRanger  
Aladco Nu-Check Valves  
Alltemp Sensors  
Alnor Instruments  
Aitek  
Altek  
Amalogic  
American Reliance  
Ametek  
Ametek  
Ametek - Analyzers  
Ametek/Jofra  
Amiad  
Amot Controls  
Amot Controls  
Amprobe  
AMS  
Aoip  
APACS  
API Meters  
Apical Charts  
Apollo  
Appalachian Controls  
Applied System Technology  
ARi  
ARi  
Armatek  
Armtec Industries  
ARO  
ASCO  
ASCO  
ASCO  
ASCO  
Ascoelectric  
ASD  
Ashcroft  
Ashcroft  
Ashford Valve  
Astro  
Athena  
Atomac Ball & Check Valves  
Aurora  
Autotech  
Avcom  
Avo  
AYA

## Local Sales Representative

Alpha Controls & Instrumentation  
Transcat  
Transcat  
Romatec  
Transcat  
Westburne Lytle  
Transcat  
Brian Controls  
Transcat  
Alpha Controls & Instrumentation  
Willer Engineering  
Cambridge Controls  
CTH Industrial Controls  
Heaters Controls & Sensors Ltd.  
Summit Controls Ltd.  
Transcat  
Durham Instruments  
Cancoppas Limited  
Sarnia Piping Specialties  
ProSigma Analytics Inc.  
Transcat  
CTH Industrial Controls  
Controls  
Transcat  
Transcat  
Westech Industrial Ltd.  
Milltronics Limited  
Provincial Controls  
TubeTech Ltd.  
Transcat  
Alpha Controls & Instrumentation  
Transcat  
Transcat  
Transcat  
Brian Controls  
Transcat  
Willer Engineering  
Transcat  
Fioval Equipment Ltd.  
Controls  
Great Lakes Industrial Controls  
Transcat  
Cambridge Controls  
Omnitronix  
Moore Products Co. (Canada) Inc.  
Lisle-Matrix Ltd.  
Provincial Controls  
Romatec  
Controls  
Transcat  
Alpha Controls & Instrumentation  
Heaters Controls & Sensors Ltd.  
Armatek Controls  
BEP Bestobell Canada Ltd.  
Great Lakes Industrial Controls  
Matheson Valves  
TubeTach Ltd.  
WESCO  
Westburne Lytle  
Fioval Equipment Ltd.  
Brian Controls  
Romatec  
Transcat  
BEP Bestobell Canada Ltd.  
ProSigma Analytics Inc.  
Transcat  
Sarnia Piping Specialties  
Great Lakes Industrial Controls  
Davis Controls  
Transcat  
Transcat  
Transcat

**Manufacturer / Tradename**

Azonix  
B&K  
B.N.W.  
B/W Controls  
Babbitt  
Bacharach  
Backos  
Badger Meter Inc.  
Badger Meter Inc.  
Bailey/Fischer & Porter  
Balluff  
Balston Filters  
Barber Colman  
Barber Eng.  
Barksdale  
Barnant  
Barnant  
Barton  
Baumann  
Beacon Electronics  
Beamex  
Bebco Industries  
Beebe  
Beha  
BEI - Baldwin Environmental Inc.  
BEI - Baldwin Environmental Inc.  
Bellofram  
Benedict Computer  
Benke  
Bestobell Steam, Div. of Richards Ind.  
Bestobell Valves  
Beta  
Beta  
Beta Calibrators  
Biccotest  
Biddle  
Biddle/Avo  
Bi-Lok Fittings  
Binmaster  
Bin-Master  
BJM  
BLH Electronics  
Bodenseewerk/Perkin Elmer  
Boiler-Gard  
Bomem  
Bourdon-Sedeme (Manobourdon) Gauges  
Brandt  
Brooklyn Thermometer  
Brooks  
Brown & Sharpe  
Bruittech  
BS & B  
BTG Inc.  
BTG Polymetron  
Burkert  
Burkert  
Burkert  
BW  
Cajon Pipe Fittings  
Cal  
Calculated Instrumnets  
California Analytical  
Can-Ross  
Carle Chromatography  
Carlo Gavazzi  
Carlo Gavazzi-Dupline  
Cash-Acme  
Cashco Canada, Inc.  
Cashco Canada, Inc.  
Castell Interlocks  
CCS - Custom Control Sensors  
Cel Instruments  
Cellex  
Cellex  
Celtek Electronics, Inc.  
Centre Line  
Century Instrument  
Cerabar  
CEWE  
Chandler  
Chatam Controls

**Local Sales Representative**

Transcat  
Transcat  
Flovat Equipment Ltd.  
Ovantum Sales Inc.  
BSP Instruments  
Willer Engineering  
Great Lakes Industrial Controls  
J & M Engineering & Sales Ltd.  
Summit Controls Ltd.  
TubeTech Ltd.  
Davis Controls  
Sarnia Piping Specialties  
Davis Controls  
Ovantum Sales Inc.  
TubeTech Ltd.  
Heaters Controls & Sensors Ltd.  
Transcat  
Armatek Controls  
Lakeside Process Controls  
R.A. Kirby Sales Inc.  
Transcat  
Cantrils  
Transcat  
Transcat  
Novatech  
Willer Engineering  
Romatec  
Transcat  
Westech Industrial Ltd.  
BEP Bestobell Canada Ltd.  
BEP Bestobell Canada Ltd.  
Armatek Controls  
Transcat  
Line Process Controls  
Transcat  
Transcat  
Transcat  
Sarnia Piping Specialties  
Cancoppas Limited  
Regional Process Equipment  
Transcat  
CB Engineering  
CEM Specialties Inc.  
Lisle-Metrix Ltd.  
ProSigma Analytics Inc.  
Sarnia Piping Specialties  
Willer Engineering  
Transcat  
Great Lakes Industrial Controls  
Transcat  
Transcat  
Romatec  
Summit Controls Ltd.  
ProSigma Analytics Inc.  
Line Process Controls  
Ovantum Sales Inc.  
Summit Controls Ltd.  
Brian Controls  
Huron Valve & Fittings  
Davis Controls  
Transcat  
Brian Controls  
SPEC (Sarnia) Limited  
R.A. Kirby Sales Inc.  
Heaters Controls & Sensors Ltd.  
Davis Controls  
Westburne Lytle  
Cambridge Controls  
Provincial Controls  
Great Lakes Industrial Controls  
Industrial Projects Ltd.  
Transcat  
Armatek Controls  
SPEC (Sarnia) Limited  
Cantrils  
Matheson Valves  
Sarnia Piping Specialties  
Endress + Hauser  
Cancoppas Limited  
Transcat  
Heaters Controls & Sensors Ltd.

**Manufacturer / Tradename**

Chemical Systems  
Chemline  
Chemtrol  
Chemtrol  
Chesseil  
Clif Mock  
CM - Century Valve  
Colder  
Columbia Scientific  
CompuFlo III  
Computer Keyboard Systems (CKS)  
Conant Controls Inc.  
Conant Valves  
Conders  
Conerstone  
Conoflow ITT  
Consolidated  
Consolidated Controls  
Con-Tek  
Control Instruments Corp.  
Control Microsystems  
ControlAir Inc.  
ControlAir Inc.  
Cooke  
Cooper Instruments  
Cosa  
Cosa  
CRL  
Crowcon  
Crowcon Gas Detection  
Crystal  
CSI - Microloggers  
Cutler-Hammer  
Cybex  
Cybex  
Dahl  
Danaher Controls  
Danfoss  
Danfoss Mfg. Co. Ltd. - Denmark  
Daniel  
Daniel Industries  
Daniel Industries Canada  
Data Industrial Corporation  
Data Precision  
Datacom Technologies  
Datatest  
Datatran  
Datexel  
Davenport  
Dekorun Unitherm  
Delavan  
Delphian  
Delphian  
Delta Controls  
Delta F Corporation  
Deltabar  
Delta-M  
Deltapilot  
Deltavalve  
Detector Electronics (Detronics)  
Devar  
DewPro  
Dewrance  
DeZurik  
DGH  
DGS - Dover Gas Technologies  
Dickson  
Digitec  
Digitec  
Digitron  
Dixon  
Dixon, Inc.  
Dopak  
Dow Plastic Lined Piping Products  
DPL Plus  
Dräger  
Drainall  
Druck  
Ducon Environmental Systems  
Durakool

**Local Sales Representative**

R.A. Kirby Sales Inc.  
Floval Equipment Ltd.  
U & I Supply  
WESCO  
Willer Engineering  
Westburne Lytle  
Brian Controls  
Davis Controls  
R.A. Kirby Sales Inc.  
Milltronics Limited  
CB Engineering  
Industrial Projects Ltd.  
Provincial Controls  
Transcat  
Transcat  
Matheson Valves  
Contro Valve Inc.  
Transcat  
Lakeside Process Controls  
Willer Engineering  
Brian Controls  
Cambridge Controls  
WESCO  
Transcat  
Transcat  
Brian Controls  
Transcat  
Cancoppas Limited  
Cancoppas Limited  
Regional Process Equipment  
Transcat  
Campbell Scientific (Canada) Corp.  
WESCO  
CB Engineering  
CB Engineering  
Armatek Controls  
J & M Engineering & Sales Ltd.  
Davis Controls  
Lislie-Metrix Ltd.  
Westech Industrial Ltd.  
Controls  
Controls  
Cambridge Controls  
Transcat  
Transcat  
R.A. Kirby Sales Inc.  
Transcat  
Transcat  
Omnitronix  
Great Lakes Industrial Controls  
Armatek Controls  
BSP Instruments  
Romatec  
CTH Industrial Controls  
ProSigma Analytics Inc.  
Endress + Hauser  
Brian Controls  
Endress + Hauser  
Summit Controls Ltd.  
CB Engineering  
Transcat  
Endress + Hauser  
Contro Valve Inc.  
Floval Equipment Ltd.  
Alpha Controls & Instrumentation  
Veronics Inc.  
Transcat  
Brian Controls  
Durham Instruments  
Transcat  
Transcat  
CTH Industrial Controls  
Westburne Lytle  
Sarnia Piping Specialties  
Milltronics Limited  
Draeger Canada Ltd.  
Great Lakes Industrial Controls  
Transcat  
R.A. Kirby Sales Inc.  
Davis Controls

**Manufacturer / Tradename**

Dwyer  
Dwyer  
Dwyer  
Dwyer DP Gauges/Switches  
Dylon  
Dynamation  
Dynapar  
E.G. & G. Chandler  
E.I.L. Instruments  
Eagle Signal  
EAI  
ECD  
EchoMax  
Echotel Ultrasonic  
EcoFLUX  
ECOM America Ltd.  
Edgetech  
EG & G Berthold  
EG & G Flow Technology Inc.  
EIT  
Elasto-Valve  
Elcometer  
Elcon  
Eldridge  
Eldridge Products  
Electromatic  
Electromatic  
El-O-Matic  
Elremco Timers - England  
Elsag Bailey  
Elsag Bailey Analytical Division  
EMCO  
Empro Shunts  
Endress + Hauser  
Enertrul Shock Absorbers  
Engineered Valves International (E.V.I.)  
Enraf Inc.  
ENU  
Environmental Technologies Group Inc.  
EPD Technology  
Epic  
Erdco  
Erhard Valves - Germany  
Ernst Flow & Level  
ETC  
Etcon  
Euchner  
Eurotherm  
Eurotherm  
Eurotron  
Exact Flow  
Exergen  
Exotherm  
Exper Tune  
Extech  
F.B. Leopold - USA  
F.W. Bell  
Fairchild  
Farris  
Farris Relief Valves  
FCI  
Fieldview  
Fike Canada Inc.  
Fischer & Porter  
Fischer & Porter  
Fisher Controls  
Fisher Reseach  
Fisher Service  
Fisher-Rosemount Petroleum  
Fisher-Rosemount Systems  
Flexibox  
Flow & Level Controls  
Flow Meter Co. - England  
Flowdata Inc.  
Flowline  
Flowseal  
Flow-Tek  
Fluid Data/Amscor  
Fluidic  
Fluke

**Local Sales Representative**

Davis Controls  
Hardie Industrial Services Inc.  
Transcat  
Provincial Controls  
Great Lakes Industrial Controls  
Transcat  
Davis Controls  
R.A. Kirby Sales Inc.  
Transcat  
Davis Controls  
Transcat  
Novatech  
Milltronics Limited  
Provincial Controls  
Moore Products Co. (Canada) Inc.  
R.A. Kirby Sales Inc.  
Alpha Controls & Instrumentation  
Westech Industrial Ltd.  
CB Engineering  
Novatech  
WESCO  
Transcat  
Willer Engineering  
Cancoppas Limited  
Trillum Measurement and Control  
Davis Controls  
Heaters Controls & Sensors Ltd.  
Westburne Lytle  
Lisle-Metrix Ltd.  
Tube Tech Ltd.  
ProSigma Analytics Inc.  
Davis Controls  
Transcat  
Regional Process Equipment  
Provincial Controls  
Westburne Lytle  
Willer Engineering  
Durham Instruments  
Novatech  
Transcat  
Cancoppas Limited  
BEP Bestobell Canada Ltd.  
Lisle-Metrix Ltd.  
Provincial Controls  
Transcat  
Transcat  
Davis Controls  
Heaters Controls & Sensors Ltd.  
Transcat  
BSP Instruments  
R.A. Kirby Sales Inc.  
Heaters Controls & Sensors Ltd.  
Heaters Controls & Sensors Ltd.  
Summit Controls Ltd.  
Transcat  
Lisle-Metrix Ltd.  
Transcat  
Line Process Controls  
Flovat Equipment Ltd.  
Provincial Controls  
Willer Engineering  
Lakeside Process Controls  
Brian Controls  
Elsag Bailey  
Tube Tech Ltd.  
Lakeside Process Control  
Transcat  
Lakeside Process Controls  
Trillum Measurement and Control  
Lakeside Process Controls  
U & I Supply  
Trillum Measurement and Control  
Lisle-Metrix Ltd.  
J & M Engineering & Sales Ltd.  
Davis Controls  
Matheson Valves  
Summit Controls Ltd.  
Armatek Controls  
CB Engineering  
Transcat

**Manufacturer / Tradename**

Fox Industries  
 Foxboro  
 Foxcroft  
 FPP  
 Frontline  
 Fuji  
 Fuji Electric  
 Fuji Electric  
 Fujikin of America Inc.  
 Furon  
 Furon  
 Fuzypro  
 G.W. Dahl  
 Galtek  
 Gamma Silometer  
 Gasco Gas Analysis Systems Company, Inc.  
 Gastech  
 Gastech Instruments  
 Geco Sensors

**Local Sales Representative**

BEP Bestobell Canada Ltd.  
 SPEC (Sarnia) Limited  
 Cancoppas Limited  
 Cancoppas Limited  
 Transcat  
 Heaters Controls & Sensors Ltd.  
 Transcat  
 WESCO  
 Ovantum Sales Inc.  
 Great Lakes Industrial Controls  
 Intertec  
 Heaters Controls & Sensors Ltd.  
 Armatec Controls  
 Romatec  
 Endress + Hauser  
 Novatech  
 Transcat  
 R.A. Kirby Sales Inc.  
 MCO Industries

**Manufacturer / Tradename**

Kobold  
 Kobold  
 Kobold  
 Koch  
 Katron Capacitance  
 Kreyenborg  
 Krohne  
 Krohne  
 K-Sun  
 K-Tek  
 KTM Ball Valves  
 Kuebler Control Eng.  
 Kurz  
 Kurz  
 Kyoritsu  
 Kyowa  
 L & J Technologies  
 L.J. Star Inc.  
 LAGCO Flumes - USA  
 Land  
 Laurel Electronics  
 Laurence  
 LC Meters  
 LCI-Luwa  
 Leader  
 Leaderline  
 Lee-Dickens Ltd. - England  
 Leica  
 Leine & Linde  
 Lem  
 LEOPOLD  
 Leslie  
 LFE API Instruments  
 LFE Instruments - USA  
 LI-COR  
 Linatex  
 Liquid-O-Ring  
 Liquiphant  
 Lloyd  
 LMI  
 LMI  
 Logic Beach  
 Logic Bench  
 Lucas Novasensor  
 Luftran  
 Lumenite Electronic Company  
 M & C Products  
 M point  
 M&G Check Valves  
 M. System  
 M.T.L.  
 M.T.L.  
 M.T.S.  
 MA - Molecular Analytics LLC  
 Macro Sensors  
 Madison  
 Madison Co.  
 Madur Electronics  
 Magnetrol  
 Magnetrol Level & Flow  
 Mech

**Local Sales Representative**

Cancoppas Limited  
 Regional Process Equipment  
 Transcat  
 Romatec  
 Provincial Controls  
 Great Lakes Industrial Controls  
 Moore Products Co. (Canada) Inc.  
 Summit Controls Ltd.  
 Transcat  
 CB Engineering  
 Regional Process Equipment  
 Ovantum Sales Inc.  
 Brian Controls  
 Transcat  
 Omnitronix  
 Omnitronix  
 Line Process Controls  
 J & M Engineering & Sales Ltd.  
 Lisle-Metrix Ltd.  
 Transcat  
 Transcat  
 Great Lakes Industrial Controls  
 SPEC (Sarnia) Limited  
 Great Lakes Industrial Controls  
 Transcat  
 Honeywell  
 Lisle-Metrix Ltd.  
 Transcat  
 Durham Instruments  
 Transcat  
 Lisle-Metrix Ltd.  
 Great Lakes Industrial Controls  
 Transcat  
 Lisle-Metrix Ltd.  
 Campbell Scientific (Canada) Corp.  
 Flobal Equipment Ltd.  
 Great Lakes Industrial Controls  
 Endress + Hauser  
 Omnitronix  
 Novatech  
 U & I Supply  
 Durham Instruments  
 Transcat  
 Durham Instruments  
 Heaters Controls & Sensors Ltd.  
 J & M Engineering & Sales Ltd.  
 CEM Specialties Inc.  
 Endress + Hauser  
 Matheson Valves  
 Alpha Controls & Instrumentation  
 Provincial Controls  
 R.A. Kirby Sales Inc.  
 Novatech  
 Durham Instruments  
 BEP Bestobell Canada Ltd.  
 Ovantum Sales Inc.  
 Novatech  
 Flobal Equipment Ltd.  
 Provincial Controls  
 West

**Manufacturer / Tradename**

Metrix  
Metrix Timers  
Metrohm  
Mettler Toledo (Ingold)  
Micro Motion  
Micro Wire Products  
Micropilot  
MicroRanger  
Mid-West Instrument  
Mid-West Instrument  
Mihjets  
Mihproducts Division  
Mikron  
Mikron  
MillFlo  
Milltronics  
Milton Roy - Liquid Metronics Division  
Milwaukee  
MiniRanger Plus  
Mitac  
Mitsubishi  
Mitutoyo  
MKS  
Mobrey  
Modutec  
Monarch  
Monitek  
Monitor Labs  
Monitor Labs  
Moore  
Moore  
Moore Industries  
Moore Products  
M-Tek  
MTL Intrinsic Safe Barriers  
Mueller  
Multicap  
Multiglass  
MultiRanger Plus  
Mycro  
Myron L  
Nassau Instrument  
National Meter  
NBS  
NDT International  
Neilsen-Kuljian  
Neles-Jamesbury  
NemaSoft  
NICE  
Nilcor  
Nivocompact  
Nivosonic  
Norriseal Butterfly Valves  
Norstat  
Northern Vibrator  
Noshok  
Novatech Engineering Group  
Numatics Cylinders  
Numatics F/R/LS  
Numatics Solenoid Valves  
Nupro Valves  
Nusonics  
Oakton  
O'Brien Corporation  
OCM III  
Ogden  
Ogden  
Ohmart Vega  
Oil Gear  
Oilgear  
Olin Instruments  
Oliver Valves  
Optek  
Optex  
Optima  
Opto 22  
Orange Research DP Switch  
Orbe Knife Gates Valves  
Orion  
OSI Semitronic

**Local Sales Representative**

Transcat  
Lisle-Metrix Ltd.  
Transcat  
Westech Industrial Ltd.  
Rosemount Instruments  
SPEC (Sarnia) Limited  
Endress + Hauser  
Miltronics Limited  
Brian Controls  
Hardie Industrial Services Inc.  
SPEC (Sarnia) Limited  
SPEC (Sarnia) Limited  
Armatek Controls  
Transcat  
Miltronics Limited  
Miltronics Limited  
U & I Supply  
Flovial Equipment Ltd.  
Miltronics Limited  
CTH Industrial Controls  
Davis Controls  
Transcat  
Transcat  
BEP Bestobell Canada Ltd.  
Transcat  
Transcat  
Willer Engineering  
Brian Controls  
Romatec  
Moore Products Co. (Canada) Inc.  
Summit Controls Ltd.  
Armatek Controls  
Transcat  
Transcat  
Provincial Controls  
Great Lakes Industrial Controls  
Endress + Hauser  
Great Lakes Industrial Controls  
Miltronics Limited  
Moore Products Co. (Canada) Inc.  
Transcat  
Transcat  
Transcat  
Transcat  
Transcat  
Transcat  
Summit Controls Ltd.  
Davis Controls  
Cancoppas Limited  
Contro Valve Inc.  
Endress + Hauser  
Endress + Hauser  
Sarnia Piping Specialties  
Davis Controls  
Flovial Equipment Ltd.  
IMO Industries  
Novatech  
Provincial Controls  
Provincial Controls  
Provincial Controls  
Huron Valve & Fittings  
Armatek Controls  
Transcat  
CB Engineering  
Miltronics Limited  
Durham Instruments  
Heaters Controls & Sensors Ltd.  
TubeTech Ltd.  
Armatek Controls  
BEP Bestobell Canada Ltd.  
Veronics Inc.  
Sarnia Piping Specialties  
R.A. Kirby Sales Inc.  
Heaters Controls & Sensors Ltd.  
Westech Industrial Ltd.  
CB Engineering  
Provincial Controls  
Regional Process Equipment  
Transcat  
CTH Industrial Controls

# SWAGELOK® Tube Fittings

## ...your widest selection of sizes, shapes, and materials

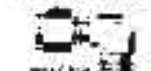
High-strength performance, low in-service cost!  
 Traditional sizes of 1/8" to 2"  
 metric sizes from 1x25 mm to 10x100 mm  
 available in sizes to NPT or BSP (ISO) threads  
 of iron, stainless steel and plastic  
 locally available from Authorized Sales & Service Representatives



Male Connector



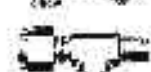
Female NPT or BSP



Male NPT or BSP



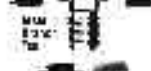
45° Male Elbow



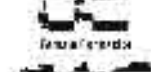
90° Male Elbow



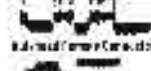
90° Tee



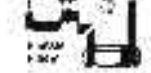
90° Tee with O-ring



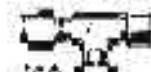
90° Tee with O-ring



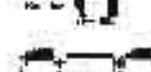
90° Tee with O-ring



90° Tee with O-ring



90° Tee with O-ring



90° Tee with O-ring



90° Tee with O-ring



180° Elbow



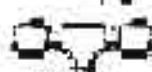
Flaring Tee



90° Tee with O-ring



90° Tee with O-ring



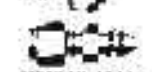
90° Tee with O-ring



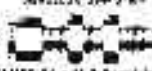
90° Tee with O-ring



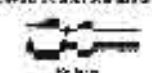
90° Tee with O-ring



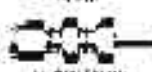
90° Tee with O-ring



90° Tee with O-ring



90° Tee with O-ring



90° Tee with O-ring



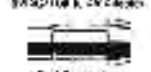
90° Tee with O-ring



90° Tee with O-ring



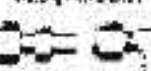
SWAGELOK 1/2" or 3/4"



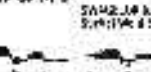
Flare Connector



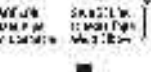
Flaring Tee



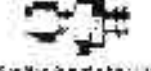
90° Tee with O-ring



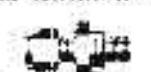
90° Tee with O-ring



90° Tee with O-ring



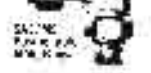
90° Tee with O-ring



90° Tee with O-ring



90° Tee with O-ring



90° Tee with O-ring



90° Tee with O-ring



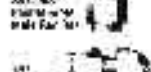
90° Tee with O-ring



90° Tee with O-ring



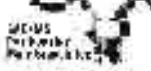
SWAGELOK Tee with O-ring



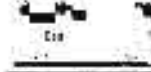
SWAGELOK Tee with O-ring



SWAGELOK Tee with O-ring



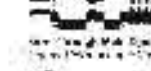
SWAGELOK Tee with O-ring



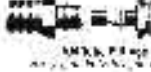
SWAGELOK Tee with O-ring



SWAGELOK Tee with O-ring



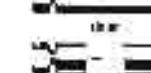
SWAGELOK Tee with O-ring



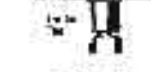
SWAGELOK Tee with O-ring



SWAGELOK Tee with O-ring



SWAGELOK Tee with O-ring



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