FTI FLOW TECHNOLOGY™

Linear Link® TCI

Temperature-Compensated Flowmeter Interface

Description

The Linear Link® TCI (Temperature-Compensated Interface) represents a new, sophisticated electronics platform for flowmeter linearization and viscosity/density correction. Intended to meet the demanding requirements of the aerospace, automotive and process manufacturing industries, the Linear Link® TCI provides significant improvements in flowmeter accuracy — even under extreme temperature conditions.

LINEAR LINK f TCI

The Linear Link® TCI's unique approach combines in a single instrument, temperature compensation with linearization, signal conditioning, user-selectable outputs and a wide input power voltage range. The Linear Link® TCI extends a flowmeter's useful measurement range while enhancing its low range resolution by measuring the time duration between rotor blades. The resulting volumetric flow rate is a direct relationship to this time duration, which is output using a running average update of the frequency.

The Linear Link® TCI system is complemented by a user-friendly configuration program — Visual Link™ — which is used to configure the system and recall previously configured data.

Benefits

- Improved flowmeter accuracy
- Elimination of multiple electronic devices
- Reduced installation costs
- Complete interchangeability of flowmeters
- Stored calibration data supports ISO 9000 procedures
- Easy interface to data acquisition system
- Flow rate and temperature output available from one device

Linear Link® TCI
Temperature-Compensated Flowmeter Interface

Features

- Linearizes outputs to ±0.1% of reading
- Online viscosity/K-factor correction
- Temperature output
- Multiple outputs: raw frequency, digital, analog, RS232
- Fast 20 mS response
- User-defined K-factor
- 9–32 volts power
- Compact size — remote or direct flowmeter mounting
- Rotor blade frequency averaging to minimize measurement variations
- User-defined offset frequency at zero flow for error detection
- Strouhal-Roshko compensation
- Mass flow rate output
- Stores and recalls configuration and calibration data
- User-friendly configuration software compatible with Windows® 95 or newer operating system

How It Works

Period Measurement with Averaging

The Linear Link® TCI uses a precision, period-based measurement method to measure the time duration between the turbine flowmeter rotor blades while providing a user-selectable speed of response. Period-based measurement enhances the resolution in the low flow range of the turbine meter where linearization is critical. One period can be measured to minimize response time or several periods can be averaged to smooth the output in a pulsating flow. A running average is updated every period with the least current frequency being discarded as the most current frequency is acquired. These features accurately extend the range capability equal to the repeatable range of the flowmeter.

Compensation

The Linear Link® TCI's innovative, temperature-compensated linearization technique reduces viscosity effects on K-factors by establishing fluid viscosity through online temperature measurements and proper calibration methods. Linearization can be calculated by selecting either linear interpolation or cubic spline equations. Fast output is achieved through a matrix method which is indexed by a temperature/viscosity compensation input. The Linear Link® TCI accepts a temperature signal from either an external or an internal RTD pickoff sensor. Up to 20 temperature data points can be entered to linearize the temperature sensor.

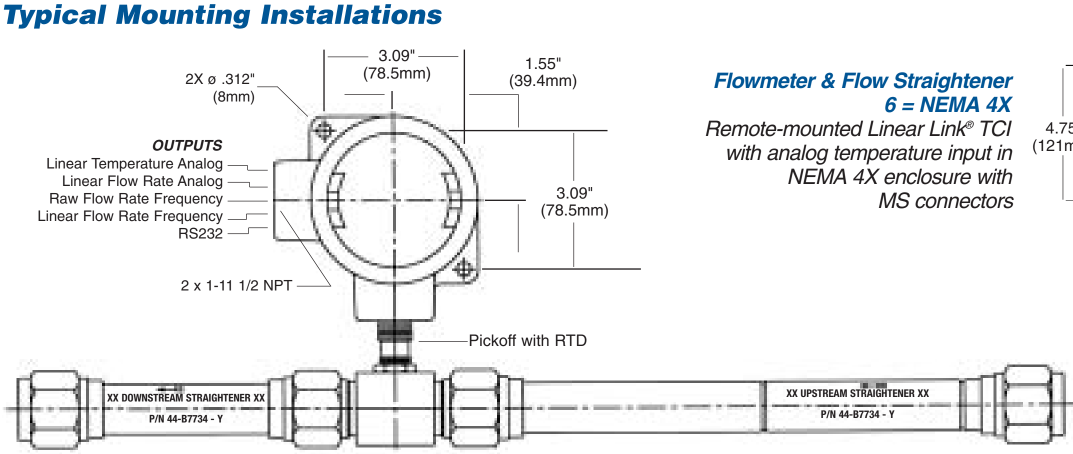
Strouhal-Roshko Correlation

The Linear Link® TCI compensation technique utilizes equations developed to characterize flowmeters over a wide operating temperature. The Strouhal-Roshko correlation is used to improve flowmeter accuracy by making corrections for material expansion or contraction due to temperature variations. The Strouhal-Roshko correlation is utilized to improve flowmeter measurement accuracy when the actual temperature of the installation varies significantly from the calibration condition.

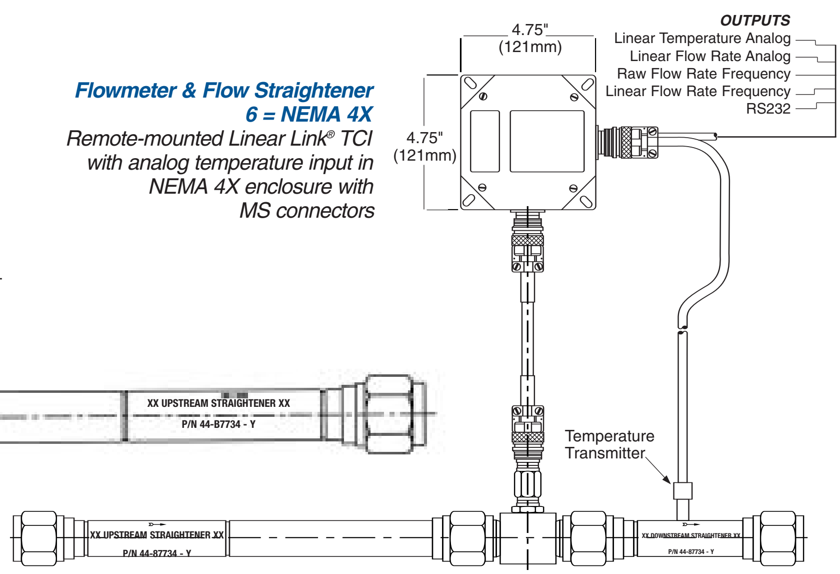
Mass Flow Rate Output

Density of the process fluid is established with a known temperature/density table which resides inside the Linear Link® TCI. The temperature sensor signal is used by this table to determine the fluid density which, in turn, is multiplied by the volumetric flow rate to establish the mass flow rate. Up to 20 data points relating temperature to density can be entered.

Typical Mounting Installations



Flowmeter & Flow Straightener with Integral RTD
9 = Class I, Division 1, Groups A, B, C & D
Explosion-proof housing with Linear Link® TCI and RTD mounted integrally on top of flowmeter



Flowmeter & Flow Straightener
6 = NEMA 4X
Remote-mounted Linear Link® TCI with analog temperature input in NEMA 4X enclosure with MS connectors

Calibration Interface

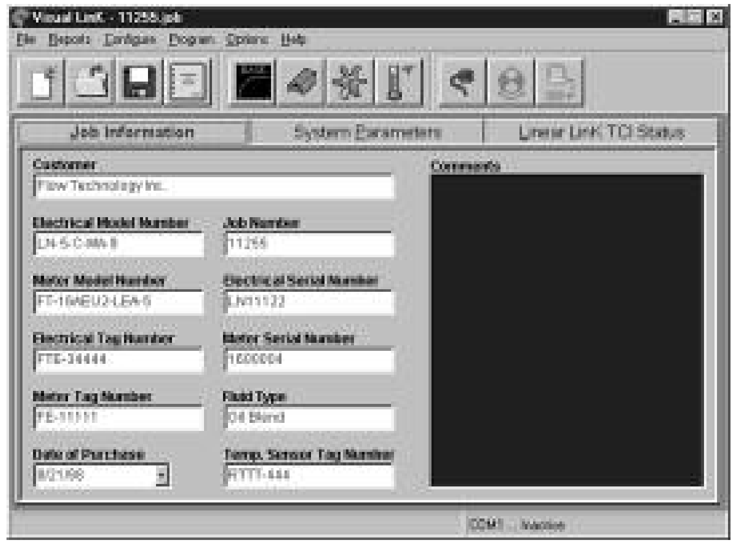
The Visual Link™ software, with its intuitive, user-friendly PC interface, functions as a powerful calibration tool which allows the user to enter calibration and fluid property data, as well as configure the input and output signals. The software uses a toolbar with icons arranged in logical sequence to simplify the configuration of the TCI. The calibration and configuration data is stored in the Linear Link® TCI and can be recalled and viewed with the Visual Link™ software, allowing the user to have a record of the previous calibration along with a history of the instrument.

The Linear Link® TCI is configured by reading in calibration and fluid property data from a flowmeter calibration electronic data file, or entering the data manually. The date of the most recent calibration, the date of the next calibration, and comments may be stored. This feature supports ISO 9000 documentation procedures.

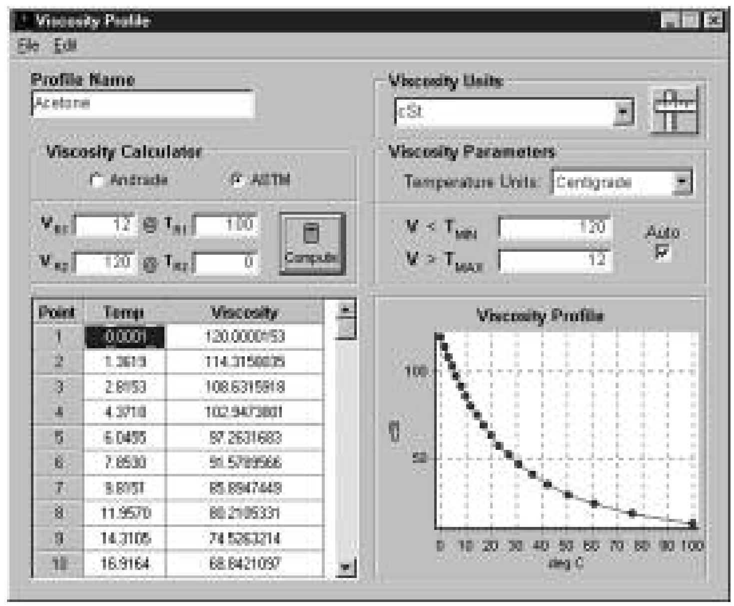
Data for kinematic viscosity and fluid density for the liquid being measured can also be selected from a library file or entered manually. The system utilizes either an Andrade or an ASTM correlation to perform viscosity calculation. Flowmeter calibration files can be read and displayed simultaneously to assist with editing a Universal Viscosity Curve. The data can then be displayed on a graph in real-time for verification, or edited as needed for optimum characterization of the flowmeter.

The temperature sensor data is stored in a table which includes 2 endpoints for zero and span, or multiple points for linearization, up to a maximum of 20 points. The tables can be configured for either a temperature transmitter or direct RTD sensor. The temperature sensor data can be edited and displayed graphically in real-time.

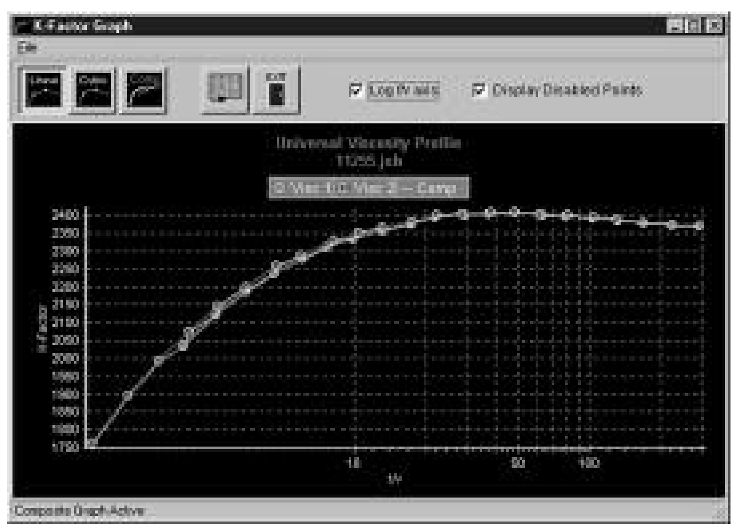
Visual Link™ is a calibration tool which also provides fluid viscosity and density profiles, unit conversion for volume, viscosity and temperature, as well as other useful functions which support flow measurement. The software is designed to operate on any system that supports a Windows® 95 or newer operating system. If using Windows® 95, 98 or Me European versions, please consult the factory.



Main Menu



Fluid Viscosity Table



Universal Viscosity Curve

Specifications

	Model # Code	Specifications
Input Power		
24 VDC nominal	3	9–32 VDC, 0.1 amps max., 900 mW @ 9 VDC (excluding 4–20 mA)
24 VDC nominal	5	10–32 VDC, 0.1 amps max., 1.0 W @ 10 VDC (excluding 4–20 mA) (required for I.S. Approval)
Note: 15–32 VDC power required for 4–20 mA output.		
Flowmeter Input Type		
Magnetic	A	
Frequency range:		1 Hz – 4 kHz
Impedance:		Greater than 5 K ohms
Sensitivity:		20 mV p-p
Pulse	B	
Frequency range:		1 Hz to 4 kHz
Impedance:		5.8 K ohms to +5 VDC
Schmitt Trigger Buffer		
Voltage (STB):		Low: 0–1 VDC; High: 4–5 VDC
Input Maximum:		0–10 VDC, 1 Hz–4 kHz
RF	C	
Frequency range:		5–3500 Hz
Inductance:		1 mH
Oscillator frequency:		45–55 kHz
Temperature Input Type		
RTD	0	
Temperature range:		-148° F to +752° F (-100° C to +400° C)
Type:		100 ohm Platinum
Voltage	1	0–10 VDC
0 VDC =		Minimum Temperature
10 VDC =		Maximum Temperature
Current	2	4–20 mA
4 mA =		Minimum Temperature
20 mA =		Maximum Temperature
Voltage	3	0–5 VDC
0 VDC =		Minimum Temperature
5 VDC =		Maximum Temperature
Linearization		
Flowmeter K-factor		
Number of Points:		2–100
Interpolation Method:		Linear or cubic spline (selectable)
Correlation:		Strouhal-Roshko (per NIST publication)
Temperature		
Number of Points:		2–20
Interpolation Method:		Linear
Viscosity		
Number of Points:		2–20
Interpolation Method:		Linear
Correlation:		ASTM D341-93, Andrades Equation or user-defined

	Specifications
Density	
Number of Points:	2–20
Interpolation Method:	Linear
Outputs	
Frequency (Flow Rate)	
Flow Rate Raw Frequency:	0–5 VDC pulse
Flow Rate Linearized Frequency:	0–5 VDC pulse (1–3500 Hz)
Impedance:	2.2 K ohms
Transmission Distance:	250 ft. maximum
Analog Voltage (Flow Rate & Temperature)	0–10 VDC or 0–5 VDC (user-specified/ factory-set)
Linearized, scaled zero offset:	Less than 10 mV
Analog Current (Flow Rate & Temperature)	4–20 mA
Linearized, scaled maximum load:	R_{load} = (supply voltage – 4)/0.02
RS232 (Volume/Mass Flow, Temperature, Other)	
Baud Rate:	9600, 19200, 38400, 56800
Update Rate:	0.5/sec., 1.0/sec., or 2.0/sec.
Data Bits:	8
Stop Bit:	1
Parity:	None
Performance	
Accuracy	
Linearized Frequency:	0.1% of reading or better
Linearized Analog:	0.1% of full scale or better
RTD:	±1° C (does not include RTD uncertainty)
Analog Input (Temperature):	12 Bit A/D
Linearization Latency	9–20 mS + period of input
Environment	
Temperature	
Operating:	-40° F to +185° F (-40° C to +85° C)
Storage:	-67° F to +257° F (-55° C to +125° C)
Humidity	0 to 85% RH non-condensing
Enclosure	NEMA 4X; Class I, Division 1 & 2, Group A, B, C, & D; dust-tight aluminum
Communication	
Interface	RS232, serial USART connection to personal computer (with serial cable)
Baud	
Output:	9600, 19200, 38400, 56800
Programming:	19.2 K
Data Bits:	8
Stop Bit:	1
Parity:	None
Approvals	
Intrinsically Safe (pending)	FM, CSA, CENELEC EEx ia IIC T4
CE	EN50081-2, EN50082-2, EN55011

Model Numbering System

L N T – ☐ – ☐ ☐ – ☐ ☐ ☐ ☐ – ☐ ☐ ☐

Basic Model No.

Power

3 = 9–32 VDC
5 = 12-32 VDC
(Option 5 is low power consumption for intrinsically safe approval)

Flowmeter Input

A = Magnetic
B = Pulse
C = RF Carrier

Temperature Input

0 = RTD
1 = 0–10 VDC
2 = 4–20 mA
3 = 0–5 VDC

Outputs (Linearized & Compensated)

F1 = Frequency Output (0–5 VDC) Square Wave for Flow Rate
V1 = Analog Voltage (0–10 VDC) for Flow Rate and Temperature
V2 = Analog Voltage (0–5 VDC) for Flow Rate and Temperature
MA = Analog Current (4–20 mA) for Flow Rate and Temperature
Note: Options V1, V2 and MA include flowmeter frequency output

Enclosure

– 0 = No Enclosure (n/a with pickoff version)
B6 = NEMA 4X with 1/2" NPT Conduit Connections
B7 = NEMA 4X with MS Connectors (MS3106)
– 9 = Class I, Division 1, Groups A, B, C & D
A7 = Dust-tight Alumimum with MS Connectors

Approvals

Blank = No Approvals
CE = CE Mark
CIS = CE & Intrinsically Safe (pending)
IS = Intrinsically Safe, FM, CSA & CENELEC EEx ia IIC T4 (pending)
_ _ _ = Three-Digit Special Code (factory-assigned)

Specifications are for reference only and are subject to change without notice.

Local Representative:

FTI FLOW TECHNOLOGY™

ISO 9001 REGISTERED

8930 S. Beck Avenue, Ste 107, Tempe, Arizona 85284 USA
Tel: (480) 240-3400 • Fax: (480) 240-3401 • Toll Free: 1-800-528-4225
E-mail: ftimarket@ftimeters.com • Web: www.ftimeters.com