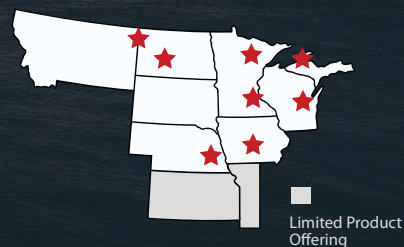




Engineering & Equipment Co.

QUALITY, SERVICE, AND EXPERTISE
SINCE 1958

We engineer your success!



INSTRUMENTATION, HEAT TRACE, AND CONTROL VALVES

SIEMENS

Includes Milltronics, Controlotron, Moore, & Danfoss

- Magnetic, coriolis, clamp-on ultrasonic, & vortex flow meters
- Ultrasonic, radar, capacitance, & guided wave level
- Transmitters
- Rotating paddle, tuning fork & capacitance level switches
- Belt scales, dry solids flowmeters, weighfeeders, & weigh scales
- Gauge, absolute, & differential pressure transmitters
- Valve positioners & damper positioners
- Temperature sensors & transmitters
- Motion sensing & speed switch process protection
- Continuous gas analyzers & tunable diode lasers (TDL) for
- Process Gas and CEMS applications
- Gas chromatographs

METTLER TOLEDO

INGOLD and THORNTON

- Analytical instrumentation for pure water/ pharma applications & industrial process applications
- Solutions for pH, ORP, conductivity/ resistivity, dissolved oxygen, ozone, carbon dioxide, turbidity, optical density & flow
- Analyzers for TOC & real-time microbial detection, chloride/ sulfate, sodium & silica
- Tunable diode laser (TDL) gas analyzers & amperometric gas-phase oxygen sensors



- Electric & steam heat tracing cables, systems, & accessories
- Analyzer tubing bundles
- Instrument trace heating and system design
- Caloritech: Immersion & circulation heaters
- Cata-Dyne: Catalytic heaters for hazardous areas
- Norseman: hazardous area electric heat
- Ruffneck: Electric heat & steam for hazardous areas



Eurotherm.
by Schneider Electric

Signal conditioners, temperature transmitters, digital displays



Moisture, oxygen, and hydrogen sulfide analyzers (H₂S) for natural gas pipelines and many other industries



Liquid and gas analyzers for H₂S, CO₂, total sulfur, hydrocarbons, & oil



Pressure regulators and I/Ps



Custom engineered emissions monitoring for compliance & process improvement



Hi-Flow valves, transmitters, gauges, & switches



Globe body & segmented ball control valves, E body & D body parts, controllers & positioners



Automated bioreactor sampling systems



Calibration gas, precision, mixtures, cylinders, regulators



Advanced thermal detection technology to scan internal body temperatures



Turbine, oval gear, impeller flow meters, magnetic flow meters, BTU calculators and displays



Fiber optic sensing for strain and leak detection, sonar sludge level monitoring, blocked chute protection, and wireless communication



CONTROLS, INC. Explosion proof & general purpose electric fail-safe valve actuation



Heated enclosures, shelters, & safety showers



Flow & energy computers, process indicators & sensors, batch controllers, counters, timers, totalizers, HMI's, & flat panel monitors



Electromagnetic flowmeters, propeller meters, and V-cone flowmeters



Conventional & pilot operated safety relief valves for gas service, featuring "auto seat technology"



High performance & resilient Seated butterfly valves; ball valves



- Intrinsic safety isolators & barriers
- Elpro industrial wireless
- Signal conditioners & surge suppressors
- Ruggedized HMI's for class 1 div 1 environments



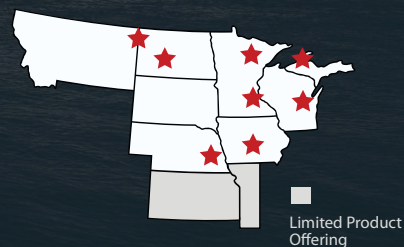
Remote alarm monitoring & lift station control



Engineering & Equipment Co.

QUALITY, SERVICE, AND EXPERTISE
SINCE 1958

We engineer your success!



INSTRUMENTATION, HEAT TRACE, & CONTROL VALVES CONTINUED



Submersible level detectors, lift station retro-fits, & level controls



Flow, level, pressure & temperature displays, indicators, totalizers, transmitter, & batch controllers



RTD's, thermocouples, wells, & temperature transmitters



Tower packing, trays, & mist eliminators



Gas chlorinators, sulphonators, ammoniators, & gas cylinder scales



Industrial weighing solutions for solids and liquids including checkweighers, bench scales, load cells, & truck scales



Inline process refractometers concentration measurement



Industrial grade, gas detection systems



Liquid leak detection systems, wired & wireless web-based monitoring solutions, & raised floor airflow management



Pressure & temperature switches, transmitters, sensors, and controls for safety, alarm and shutdown; wireless gas detection



Globe & eccentric ball control valves



Des Moines, IA
Phone: 800.776.6184
Fax: 952.935.7772

Additional Sales Offices

Bismarck, ND
800.776.6184

Hibbing, MN
218.262.3421

Ishpeming, MI
906.485.6361

Omaha, NE
800.776.6184

Minneapolis
952.938.6504

CONVERSIONS, FORMULAS, & ENGINEERING DATA

Pressure Conversions

1 PSI = 27.71 inches water
1 PSI = 2.0418 in. Hg @ 60F
1 PSI = 51.81 mm Hg @ 60F
1 PSI = .0689 bar
1 PSI = 6.895 kPa
1 inch water = 1.8718 mm Hg
1 inch water = .2489 kPa

Volume Conversions

1 Gallon = .1337 cubic feet
1 Gallon = 231 cubic inches
1 Gallon = .003785 cubic meters
1 Gallon = 3.785 liters
1 Barrel (oil) = 42 gallons
1 Bushel = 1.2445 cubic feet

Volumetric Flow

1 GPM = .227 cubic meters/hour
1 GPM = 3.785 liters per minute

Water Density

At 60 degrees F = 62.371 lbs/ft.
At 60 degrees F = 8.3378 lbs./gal.

Flow Velocity of Water

$V(\text{ft./second}) = .4086 * Q/D * D$
Q is flow in GPM
D is pipe ID in inches

Flow Velocity of Gas

$V = 3.056 * Q/D * D$
V is flow velocity in SFPS
Q is flow in SCFM
D is pipe ID in inches

Volumetric Gas Flow

$SCFM = ACFM * (pf * 520) / (14.7 * Tf)$
Pf = Pressure at flow conditions PSIA
Tf = Temp. at flow conditions Deg. R

Volumetric to Mass Flow of Water

33F water, 8.325 lb./gallon density
 $Q(\text{GPM}) = Q(\text{lbs./hour}) * .002$

Control Valve Sizing

Liquid - $C_v = q * \bar{A} / (g_f / DP)$
Steam - $C_v = W / (2.1 * \bar{A} / (DP(Pf1 + Pf2)))$
Gas - $CV = Q / 963 * \bar{A} / ((G * Tf / DP(Pf1 + Pf2)))$
q is GPM, \bar{A} is Square Root
gf is liquid specific gravity
DP is Differential pressure
W is steam flow rate lbs./hr
Pf1 upstream pressure in psia
Pf2 downstream pressure in psia
Q is gas flow rate

Pressure

PSI (absolute) = PSI (gauge) + 14.696

Steam Data

Gage Press. PSIG	Temp Spec. Deg. F	Volume Cubic ft/minute
0.0	212	26.8
25.3	267.25	10.5
50.3	297.97	6.66
100	337.90	3.88
150	365.99	2.75
200.3	377.89	2.13
250.3	406.13	1.74

Table of Liquid Flows in Schedule 40 Pipe

Pipe Size	GPM at 3 fps	GPM at 15 fps
1	8.086	40.43
1.5	19.026	95.13
2	31.358	156.79
3	69.12	345.6
4	119.046	595.23
6	270.27	1351.35
8	468.748	2343.74
10	738.342	3691.71
12	1044.78	5223.88
16	1651.38	8256.88
24	3761.76	18,808.78