
2" and 3" T-10 Turbo-Meters

Turbine Meters for Accurate Gas Measurement

M-1083
Rev. 4



SENSUS

GENERAL INFORMATION

INTRODUCTION

Invensys Energy Metering 2" and 3" T-10 Turbo-Meters were developed to meet the recognized need for greater accuracy in gas production and transmission measurement. The compact, rugged design of these meters, coupled with their direct digital readouts, provides reliable and accurate field measurement data.

Applications

Invensys Energy Metering Turbo-Meters can be used for varied gas measurement applications falling within their nominal capacity rating of 10,000 CFH (240 MCFD) @ 4 ounces inlet pressure.

Suggested applications are:

- direct well-head measurement on gas wells
- custody transfer
- town border stations
- industrial meter sets
- gas leg of production separators
- test separators
- check meters
- test meters for establishing gas to oil ratios
- compressor fuel gas measurement

Description

Invensys Energy Metering Turbo-Meters are axial flow type gas turbine meters in which the entire gas stream passes through the rotor. As such, recommendations covering the use of T-10 Turbo-Meters are contained in American Gas Association, Transmission Measurement Committee Report No. 7 titled, "Measurement of Fuel Gas by Turbine Meters."

Copies of AGA Report No. 7 may be obtained from:

AGA@pmds.com or
AGA Distribution Center
P.O. Box 79230
Baltimore, MD 21279 0230
Fax: (301) 206-9789
Phone: (301) 617-7819

Or order on-line at
www.aga.org/catalog

METER PERFORMANCE

1. Invensys Energy Metering recommends that all Turbo-Meters be calibrated at their intended operating pressure for optimum accuracy results.

2. For all 2" and 3" T-10 Turbo-Meters that are calibrated at a specified operating pressure (between 25 and 950 PSIG), performance is assured within $\pm 1\%$ error.

3. For all 2" and 3" T-10 Turbo-Meters that are calibrated at atmospheric

pressure (4 oz.) but will be operating at pressures between 25 to 1440 PSIG, typical performance is $\pm 1.5\%$ error.

4. For all 2" and 3" T-10 Turbo-Meters operated below 25 PSIG, a typical performance curve is $\pm 1\%$ over a 5:1 flow range (2,000-10,000 ACFH).

5. The recommended minimum spin-time for 2" and 3" T-10 Turbo Meters is 50 seconds. (less mechanical index).

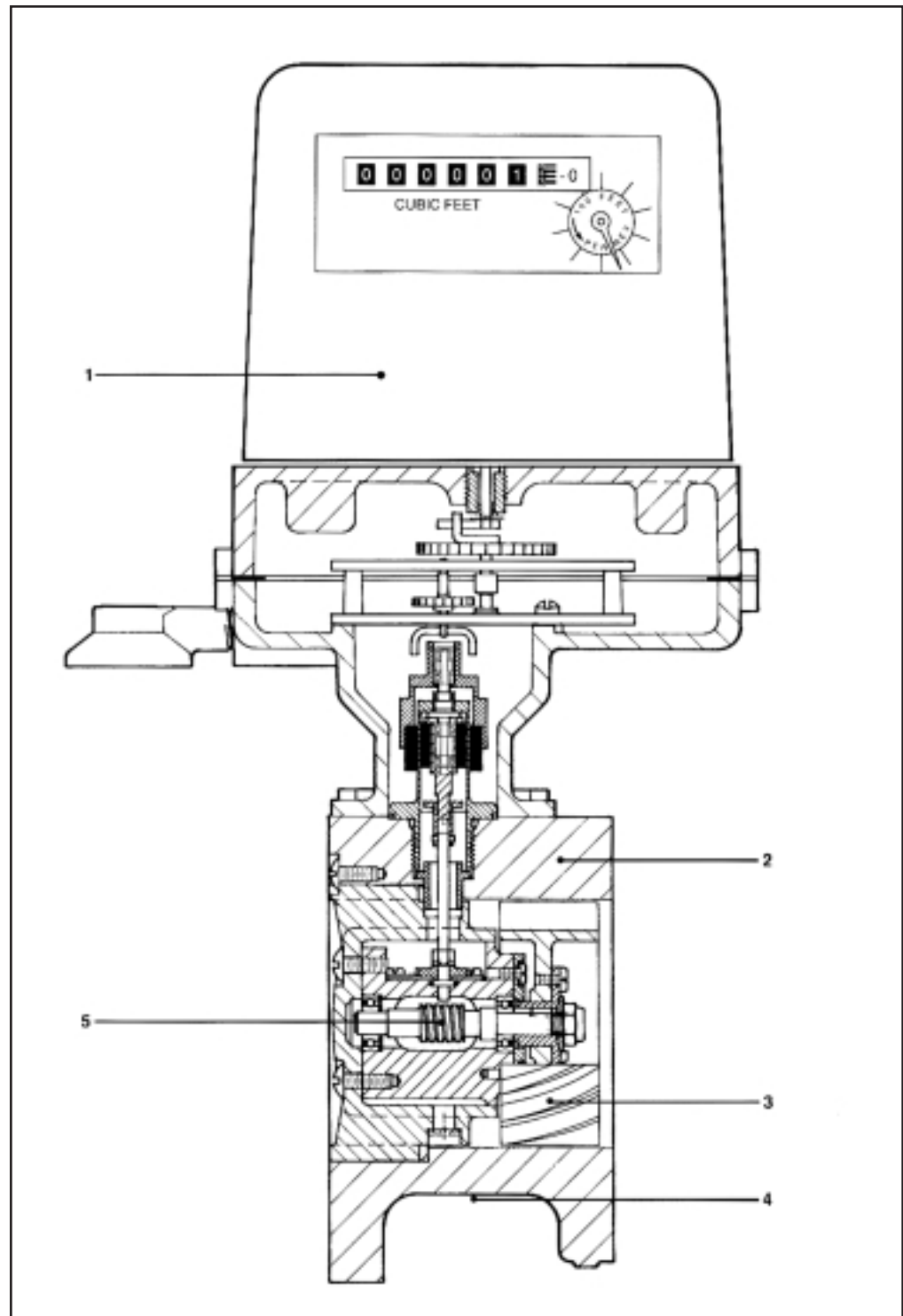
6. Turbo-Meters conform to the installation and maintenance recommendations as outlined in AGA Report No. 7. Any use of optional installations may result in some degradation in meter accuracy.

7. Calibration accuracy and meter performance are not adversely affected when interchanging mechanisms from one body to another.

DESIGN FEATURES

1. Any of a wide variety of mechanical, electro-mechanical or electronic read-out/integrating devices can be direct-mounted to index plate.
2. Cast steel body of wafer configuration with a pressure rating of 1440 PSIG.
3. Improved all-aluminum rotors machined from bar stock and individually balanced for optimum performance.
4. All meters are drilled and tapped for mounting of a drain to remove condensates.
5. Larger shafts and bearings than in previous 2" and 3" Turbo-Meters.
6. External fitting permits shaft bearing lubrication while meter is in operation. (Not Shown)
7. A slot sensor pulser output is available for mounting on the follower magnet. (Not Shown)

See bulletin M-1083-10 for details.



TYPICAL PERFORMANCE DATA

U.S. UNITS— CUBIC FEET

COMPRESS- IBILITY RATIO	METER PRESSURE	MAXIMUM FLOWRATE	MAXIMUM FLOWRATE	MINIMUM FLOWRATE	MINIMUM FLOWRATE	MINIMUM FLOWRATE	MAX./ MIN. FLOW RANGE	EST. PRESS LOSS INCHES W.C.
$s = (Fpv)^2$	PSIG	SCFH	MSCFD	SCFH	MSCFD	ACFH		
1.0000	0.25	10,000	240	2,000	48	2,000	5	4.5
1.0008	5.0	13,000	310	2,020	48	1,336	6	6.0
1.0016	10	17,000	410	2,040	49	1,152	8	7.0
1.0024	15	20,000	480	2,040	49	1,016	10	9.0
1.0040	20	24,000	580	2,050	49	920	12	11
1.0040	25	27,000	650	2,060	49	760	13	12
1.0080	50	44,000	1,060	2,630	63	590	17	20
1.0121	75	61,000	1,460	3,110	75	500	20	28
1.0162	100	79,000	1,900	3,520	84	440	22	36
1.0203	125	97,000	2,330	3,900	94	400	25	43
1.0330	200	150,000	3,600	4,840	116	320	31	68
1.0502	300	224,000	5,380	5,900	142	260	38	101
1.0680	400	301,000	7,220	6,830	164	230	44	135
1.0863	500	379,000	9,100	7,670	184	200	49	171
1.1050	600	461,000	11,060	8,450	203	180	55	207
1.1241	700	545,000	13,080	9,190	221	170	59	245
1.1435	800	632,000	15,170	9,900	238	160	64	285
1.1630	900	722,000	17,330	10,580	254	150	68	325
1.1826	1,000	814,000	19,540	11,240	270	140	72	367
1.2021	1,100	910,000	21,840	11,880	285	130	77	409
1.2212	1,200	1,007,000	24,170	12,500	300	120	81	453
1.2397	1,300	1,106,000	26,540	13,110	315	120	84	498
1.2641	1,440	1,248,000	29,950	13,890	333	110	90	562

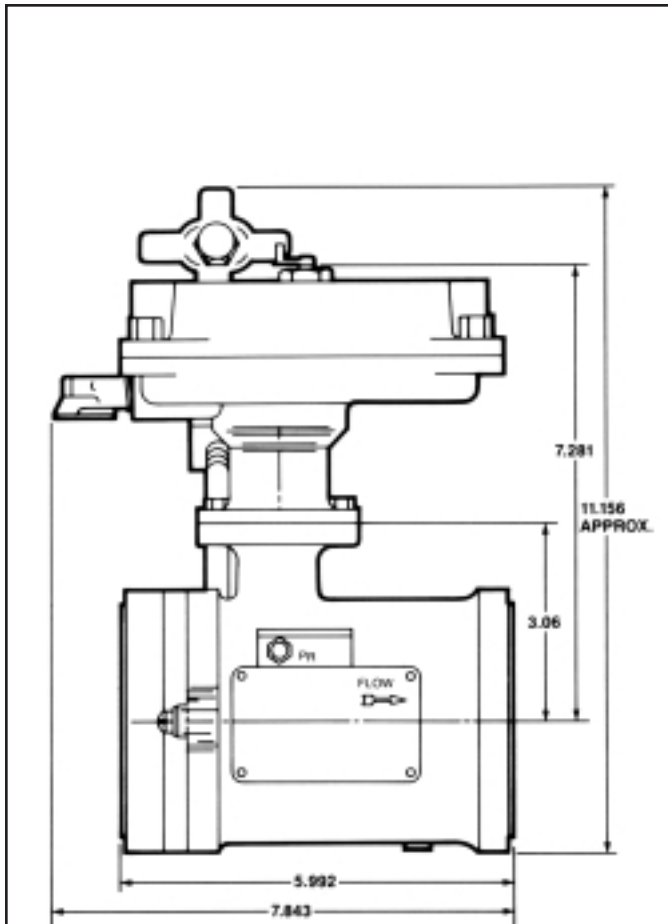
Table is based on base conditions of $P_b = 14.73$ PSIA and $T_b = 60^\circ\text{F}$, and average atmospheric pressure $P_a = 14.48$ PSIA. Table incorporates effect of supercompressibility factor (Fpv) for 0.6 specific gravity natural gas at 60°F and 0% CO_2 and N_2 (per A.G.A. Report No. 8).

S.I. UNITS— CUBIC METERS

COMPRESS- IBILITY RATIO	METER PRESSURE	MAXIMUM FLOWRATE	MAXIMUM FLOWRATE	MINIMUM FLOWRATE	MINIMUM FLOWRATE	MINIMUM FLOWRATE	MAX./ MIN. FLOW RANGE	EST. PRESS LOSS
$s = (Fpv)^2$	kPa	Nm^3/hr	Nm^3/day	Nm^3/hr	Nm^3/day	m^3/hr		kPa
1.0000	1.72	280	7,000	57	1,360	57	5	1.1
1.0008	34	370	9,000	57	1,370	38	6	1.5
1.0016	69	480	12,000	58	1,390	33	8	1.7
1.0024	103	570	14,000	58	1,390	29	10	2.2
1.0040	138	680	16,000	58	1,390	26	12	2.7
1.0040	172	760	18,000	58	1,400	22	13	3.0
1.0080	345	1,250	30,000	75	1,790	17	17	5.0
1.0121	517	1,730	41,000	88	2,110	14	20	7.0
1.0162	689	2,240	54,000	100	2,390	12	22	9.0
1.0203	862	2,750	66,000	110	2,650	11	25	11
1.0330	1,379	4,250	102,000	137	3,290	9	31	17
1.0502	2,068	6,350	152,000	167	4,010	7	38	25
1.0680	2,758	8,530	205,000	193	4,640	7	44	34
1.0863	3,447	10,740	258,000	217	5,210	6	49	43
1.1050	4,137	13,060	313,000	239	5,740	5	55	52
1.1241	4,826	15,440	371,000	260	6,250	5	59	61
1.1435	5,516	17,900	430,000	280	6,730	5	64	71
1.1630	6,205	20,450	491,000	300	7,190	4	68	81
1.1826	6,895	23,060	554,000	318	7,640	4	72	91
1.2021	7,584	25,780	619,000	337	8,080	4	77	102
1.2212	8,274	28,530	685,000	354	8,500	3	81	113
1.2397	8,963	31,330	752,000	371	8,910	3	84	124
1.2641	9,928	35,350	848,000	393	9,440	3	90	140

Table is based on standard conditions of $P_b = 101.325$ kPa and $T_b = 15^\circ\text{C}$, and average atmospheric pressure $P_a = 99.8$ kPa. Table incorporates effect of supercompressibility factor (Fpv) for 0.6 specific gravity natural gas at 15.6°C and 0% CO_2 and N_2 (per A.G.A. Report No. 8).

DIMENSIONS



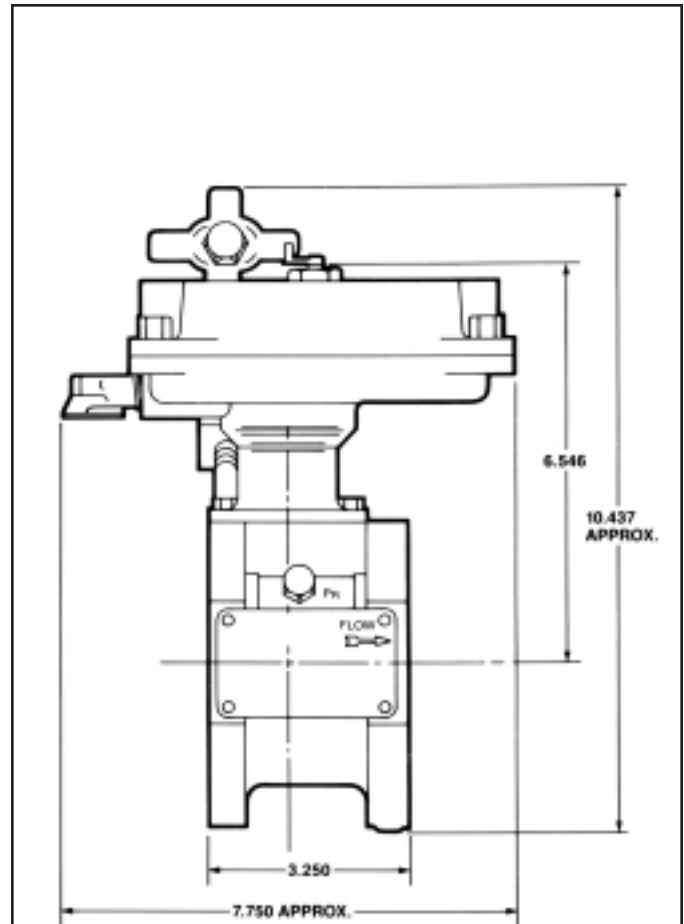
2 INCH T-10 TURBO-METER

Body Material—Cast Steel

**Maximum Rated Working Pressure
(PSIG)**—1440 AND 275

**Meter Shipping Weight
(lbs.)**—21
(kgs.)—10

Dimensions in inches



3 INCH T-10 TURBO-METER

Body Material—Cast Steel

**Maximum Rated Working Pressure
(PSIG)**—1440

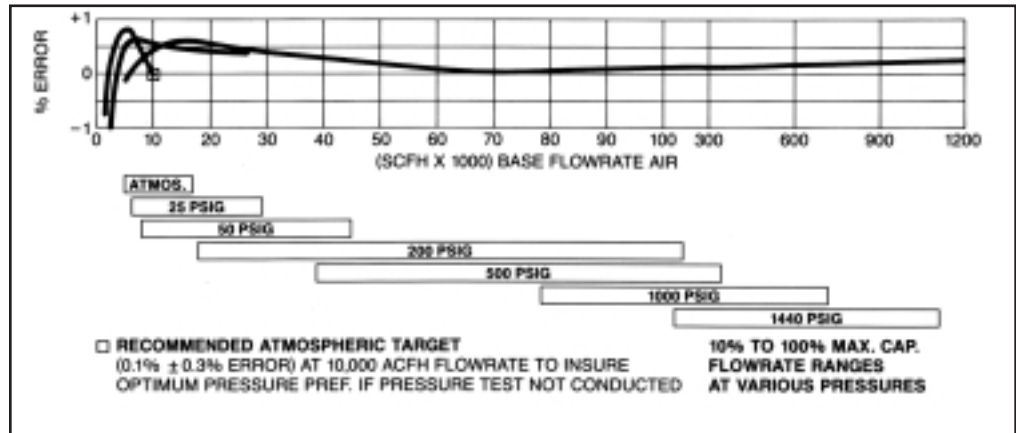
**Meter Shipping Weight
(lbs.)**—19
(kgs.)—9

Dimensions in inches

TYPICAL PERFORMANCE CURVES

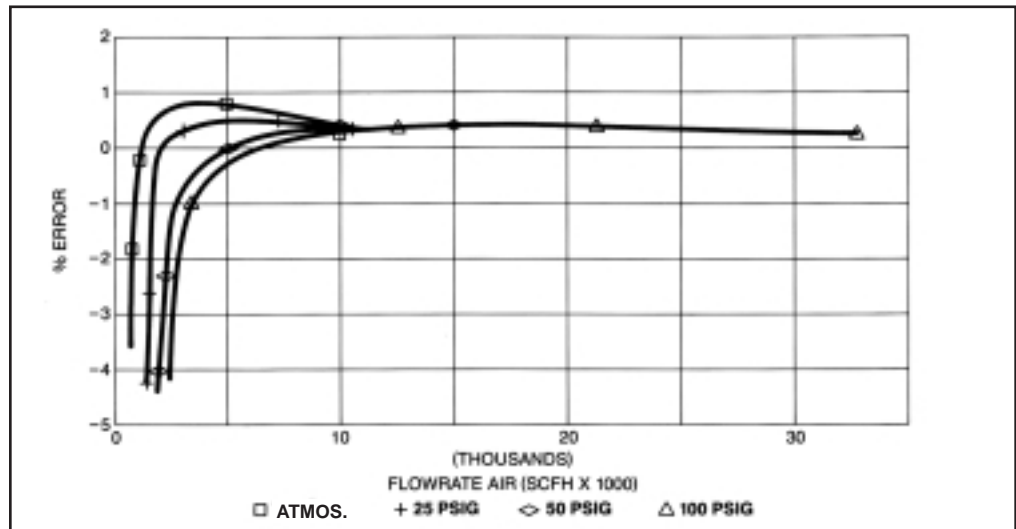
2" T-10 TURBO

TYPICAL ACCURACY PERFORMANCE



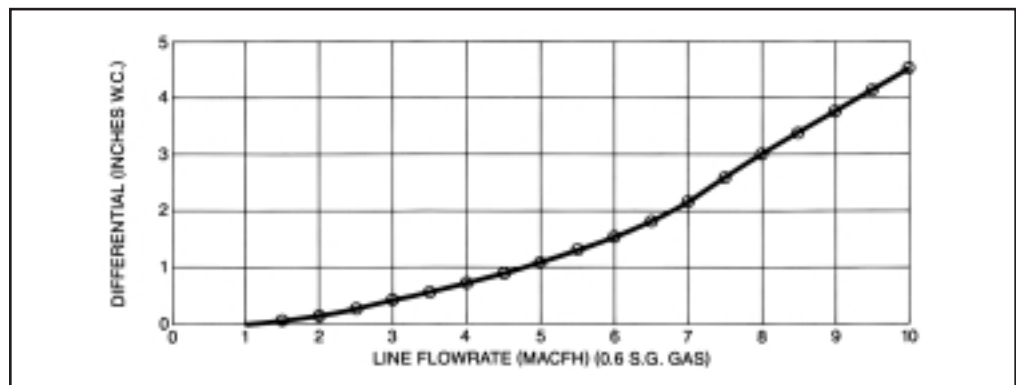
2" T-10 TURBO

TYPICAL EXPANDED LOW FLOW



2" & 3" T-10 TURBO

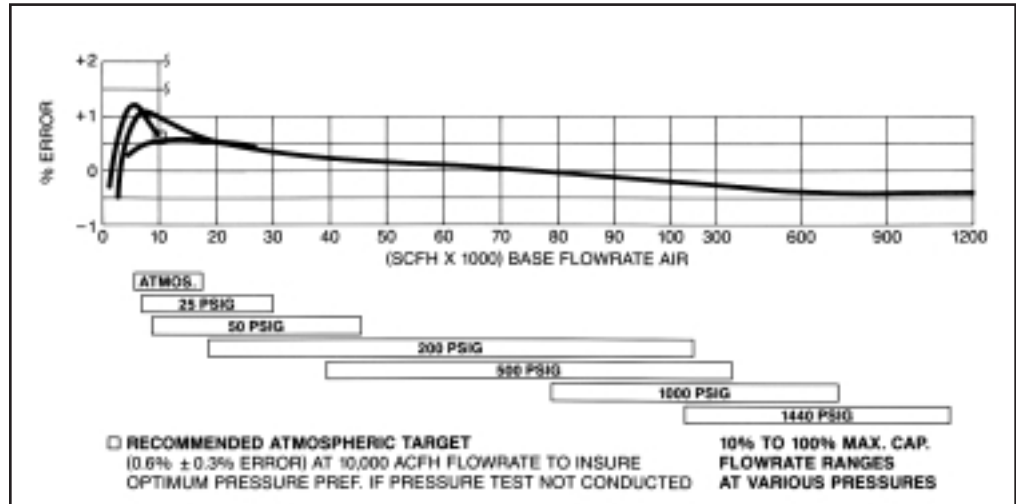
DIFFERENTIAL CURVE (ATMOS. PRESSURE)



TYPICAL PERFORMANCE CURVES

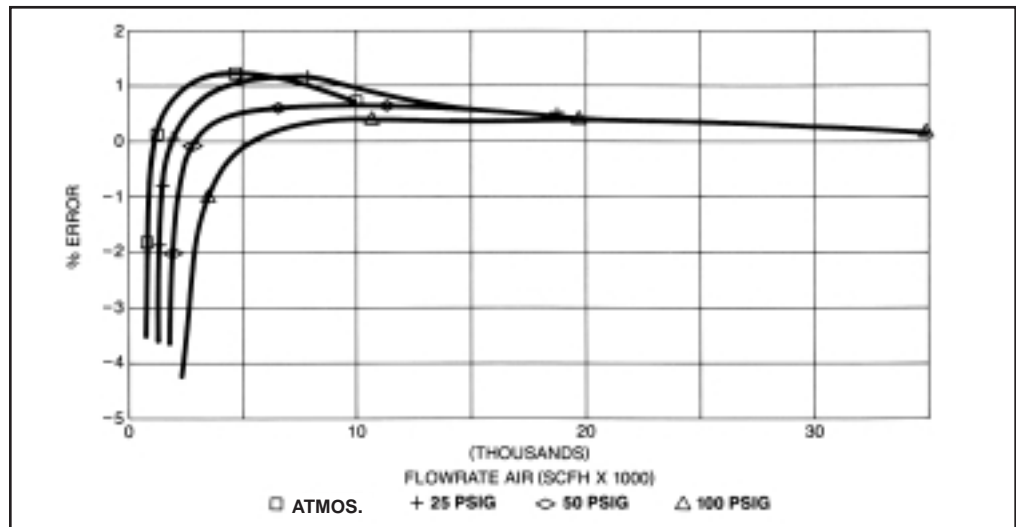
3" T-10 TURBO

TYPICAL ACCURACY PERFORMANCE



3" T-10 TURBO

TYPICAL EXPANDED LOW FLOW



HOW TO ORDER

As a standard, 2" and 3" T-10 Turbo-Meters are equipped with external lubrication fittings, an index plate for readout mounting sand an extender and reducing fitting for attachment of a static pressure line. Definition of the following is required.

1. Readout Options:

- A. None
- B. Vertical Circular Reading (VCR) index with Lexan cover

- C. Vertical Direct Reading (VDR) index with Lexan cover
- D. Vertical Direct Reading (VDR) index with Aluminum Box
- E. VDR index with Slot Sensor Output
- F. Cubic Ft. Output 100 CF/rev. std. or 10 CF/rev. optional
- G. Cubic Meter Output 1 cm/rev. std. or 10 cm/rev. optional

Index-Note: If a meter-mounted recording or integrating instrument is

desired, specify "None" at time of order entry. With this specification, a protective cover plate will be mounted over the meter output dog. Order instrument separately.

2. Slot Sensor Options:

- A. None
- B. With conduit adapter (1/2"- 14 NPT)
- C. With plug-in connector

3. Installation Kit Options (threaded rods as required, nuts and gaskets):

- A. None

- B. 2" T-10 for mounting between ANSI 150 flanges – Number 006-15-373-00

- C. 2" T-10 for mounting between ANSI 300 and 600 flanges — Number 006-15-373-80

- D. 3" T-10 for mounting between ANSI 150 flanges – Number 006-19-373-00

- E. 3" T-10 for mounting between ANSI 300 and 600 flanges – Number 006-19-373-80



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