

TA 7

C6

CER 57-32

COPY 2

EVALUATION OF THE EFFECT OF APPROACH TUBING
SIZE UPON THE CALIBRATION OF
3/4" TURBINE FLOWMETERS

(Under Contract DEN-57-10195)

By

Morton W. Bittinger

conducted for
The Martin Company
Denver Division
Denver, Colorado

through
Colorado State University Research Foundation
Fort Collins, Colorado

ENGINEERING RESEARCH
JUN 28 1957
COLUMBIA READING ROOM

November 1, 1957

CER57MWB32

EVALUATION OF THE EFFECT OF APPROACH TUBING
SIZE UPON THE CALIBRATION OF
3/4" TURBINE FLOWMETERS

(Under Contract DEN-57-10195)

by
Morton W. Bittinger

conducted for
The Martin Company
Denver Division
Denver, Colorado

through
Colorado State University Research Foundation
Fort Collins, Colorado

November 1, 1957

CRR57MWB32



U18401 0591100

EVALUATION OF THE EFFECT OF APPROACH TUBING
SIZE UPON THE CALIBRATION OF
3/4" TURBINE FLOWMETERS

(Under Contract DEN-57-10195)

Tests

Tests have been run on two 3/4-inch flowmeters using 36 inch approach tubes with three internal diameters. The meters and the tube diameters tested were as follows:

<u>Meter</u>	<u>I. D. of approach tubing</u>
1. 3/4"-80-GLMD-1	1. 0.650 inch
2. MT-110 2511	2. 0.584 inch
	3. 0.481 inch

In all tests, the internal diameter of the tubing on the discharge side of the meter was 0.650 inch. The fluid used was MIL-O-5606 ranging in temperature from 68.0 to 82.0°F.

The data obtained from these tests are plotted on the following graphs. Ten to twelve points were obtained over the range from one to fifteen gallons per minute for each of the tubing diameters.

Conclusions

As can be seen from the graphs, no noticeable differences were obtained due to tubing sizes, although the cross sectional area of the approach tubing was reduced 45 per cent. It appears that over this range of tubing sizes for these particular meters, no variation from the calibration curve will be caused by changing the entrance tubing size.

The effect of variation of the viscosity was not tested herein, however it is worth noting that the fluid used is several times more viscous than water.

FLOW METER CALIBRATION
 COLORADO STATE UNIVERSITY
 DATA

METER NO. MT-110 2511 NO. OF PULSES/REV. _____ MANUFACTURED BY: Waugh Engr. Co.
 TYPE OF FLUID: MIL-O-5606 TUBE O.D. 0.750 TUBE I.D. 0.650
 CALIBRATED BY: Videon DATE: 10-22-57 TIME: 2:45 P.M.
 REMARKS: For Engineering Evaluation

RUN NO.	T ₀ SEC.	T _F SEC.	TIME SEC.	CYCLES	CPS	OSC. SCALE	READING	MULTIPLIER	W ₀ LBS.	W _F LBS.	ΔW LBS.	TEMP °F	SPECIFIC WEIGHT	VOLUME GAL.	CPG	GPM	60 CYCLE CHECK	
																	TIME	READING
1	1903	2003	100	40188	401.88	B	40.0	10	1.20	168.40	167.20	72.0	7.1517	23,379	1719.0	14.027	11	660
2	003	103	100	35158	351.58	B	34.8	10	2.00	149.20	147.20	72.0	7.1517	20,583	1708.1	12.350		
3	103	203	100	30090	300.90	B	30.0	10	3.70	130.55	126.85	72.0	7.1517	17,737	1696.5	10.542		
4	203	303	100	25150	251.5	B	25.2	10	2.35	108.65	106.30	72.0	7.1517	14,864	1692.0	8.9183		
5	303	403	100	20078	200.78	B	20.05	10	1.70	87.20	85.50	72.0	7.1517	11.96	1679	7.176		
6	403	503	100	17602	176.02	A	17.49	10	2.45	77.70	75.25	72.0	7.1517	10.52	1673	6.312		
7	503	603	100	15100	151.00	A	15.08	10	2.00	67.00	65.00	72.0	7.1517	9.089	1661	5.453		
8	603	703	100	12618	126.18	A	12.58	10	1.90	56.60	54.70	72.0	7.1517	7.649	1650	4.589		
9	703	803	100	10080	100.80	A	10.00	10	56.60	100.85	44.25	72.0	7.1517	6.187	1629	3.712		
10	803	903	100	7554	75.54	A	7.52	10	2.10	35.90	33.80	72.0	7.1517	4.726	1598	2.836		
11	903	3043	140	7026	50.19	B	50.0	1	35.90	68.70	32.80	72.0	7.1517	4.586	1532	1.965	11	661

TOTAL CYCLES: 220,644
 TOTAL VOLUME: 131.28
 MEAN CYCLES PER GALLON: 1680.7

FLOW METER CALIBRATION
COLORADO STATE UNIVERSITY
DATA

METER NO. MT-110 2511 NO. OF PULSES/REV. _____ MANUFACTURED BY: Waugh Engr. Co.
 TYPE OF FLUID: MIL-O-5606 TUBE O.D. 0.750 TUBE I.D. 0.584
 CALIBRATED BY: Videon DATE: 10-22-57 TIME: 1:00 P.M.
 REMARKS: For Engineering Evaluation

RUN NO.	T _o SEC.	T _F SEC.	TIME SEC.	CYCLES	CPS	OSC. SCALE	READING	MULTIPLIER	W _o LBS.	W _F LBS.	ΔW LBS.	TEMP °F	SPECIFIC WEIGHT	VOLUME GAL.	CPG	GPM	60 CYCLE CHECK	
																	TIME	READING
1	30761	30861	100	40226	402.26	B	40	10	4.10	170.85	166.75	77.0	7.1352	23.370	1721.3	14.022	10	600
2	30861	30961	100	34967	349.67	B	35	10	2.25	148.50	146.25	75.0	7.1418	20.478	1707.5	12.287		
3	30961	31061	100	29210	292.10	B	29.2	10	3.35	127.20	123.85	73.0	7.1485	17.325	1686.0	10.395		
4	31061	31161	100	25010	250.10	B	25.2	10	5.35	111.70	106.35	71.5	7.1533	14.867	1682.2	8.9202		
5	31161	31261	100	20041	200.41	B	20.0	10	2.70	88.35	85.65	72.0	7.1517	11.98	1673	7.188		
6	31261	31361	100	17460	174.60	A	17.5	10	7.05	81.90	74.85	72.0	7.1517	10.47	1668	6.282		
7	31361	31461	100	14952	149.52	A	14.96	10	2.85	67.40	64.55	72.0	7.1517	9.026	1657	5.416		
8	461	561	100	12556	125.56	A	12.50	10	3.20	57.75	54.55	72.0	7.1517	7.628	1646	4.577		
9	561	661	100	10076	100.76	A	10.00	10	57.75	102.20	44.45	72.0	7.1517	6.215	1621	3.729		
10	663	763	100	7514	75.14	A	7.52	10	6.45	40.10	33.65	72.0	7.1517	4.705	1597	2.823		
11	763	903	140	6986	49.90	B	50.0	1	40.10	72.80	32.70	72.0	7.1517	4.572	1528	1.959	11	660

TOTAL CYCLES: 218,998
 TOTAL VOLUME: 130.64
 MEAN CYCLES PER GALLON: 1676.3

FLOW METER CALIBRATION
 COLORADO STATE UNIVERSITY
 DATA

METER NO. MT-110 2511 NO. OF PULSES/REV. _____ MANUFACTURED BY: Naugh
 TYPE OF FLUID: MIL-O-5606 TUBE O.D. 0.750 TUBE I.D. 0.481
 CALIBRATED BY: Huckeby DATE: 10-30-57 TIME: 1:30 PM
 REMARKS: For Engineering Evaluation

RUN NO.	T ₀ SEC.	T _F SEC.	TIME SEC.	CYCLES	CPS	OSC. SCALE	READING	MULTIPLIER	W ₀ LBS.	W _F LBS.	ΔW LBS.	TEMP °F	SPECIFIC WEIGHT	VOLUME GAL.	CPG	GPM	60 CYCLE CHECK	
																	TIME	READING
1	4200	4300	100	35000	350.00	B	35.0	10	1.95	146.85	144.90	79.5	7.1273	20.330	1721	12.198	11	660
2	4300	4400	100	29568	295.68	B	29.6	10	2.80	125.85	123.05	80.5	7.1239	17.273	1712	10.364		
3	4400	4500	100	25200	252.00	B	25.2	10	2.50	108.80	106.30	82.0	7.1192	14.931	1688	8.9585		
4	4500	4600	100	20025	200.25	B	20.05	10	1.90	87.90	86.00	80.5	7.1239	12.072	1659	7.2432		
5	4600	4700	100	17476	174.76	A	17.5	10	2.20	77.90	75.70	80.0	7.1257	10.624	1645	6.3744		
6	4700	4800	100	15120	151.20	A	15.0	10	2.05	67.70	65.65	79.0	7.1289	9.208	1642	5.525		
7	4800	4900	100	12604	126.04	A	12.5	10	2.40	57.40	55.00	78.5	7.1304	7.713	1634	4.628		
8	4900	5000	100	10048	100.48	A	10.0	10	1.40	45.55	44.15	78.0	7.1320	6.190	1623	3.714		
9	5000	5100	100	7404	74.04	A	7.5	10	45.55	78.55	33.00	77.5	7.1336	4.626	1601	2.776		
10	5100	5300	200	12004	60.02	B	60.1	1	5.80	60.30	54.50	77.0	7.1352	7.638	1572	2.291		
11	5300	5500	200	10212	51.06	B	50.1	1	4.50	51.65	47.15	76.0	7.1387	6.605	1546	1.982		
12	5500	5700	200	8180	40.90	B	40.6	1	2.95	41.85	38.90	75.5	7.1402	5.448	1501	1.634		
13	5700	5900	200	6104	30.52	B	30.4	1	3.45	33.95	30.50	76.0	7.1387	4.272	1429	1.282		
14	5900	6200	300	6366	21.22	B	20.1	1	33.95	68.45	34.50	76.0	7.1387	4.833	1317	.9666	11	660

TOTAL CYCLES: 215,311
 TOTAL VOLUME: 131.763
 MEAN CYCLES PER GALLON: 1634.07

TURBINE METER CALIBRATION

DATA

METER NO: 3/4"-80 GMD-1 _____ NO. OF PULSES/REV.: _____
 TYPE OF FLUID: MIL-O-5606 _____ TUBE O.D.: 0.750 _____
 DATE: 10-21-57 _____ TUBE I.D.: 0.650 _____
 CALIBRATED BY: Videon _____ METER SIZE: 3/4" _____
 REMARKS: For Engineering Evaluation _____

RUN NO.	TIME (SEC)	CYCLES	CPS	OSC. SCALE	MULTIPLIER	READING	W _o (LBS.)	W _c (LBS.)	ΔW (LBS.)	TEMP (°F)	SPECIFIC WEIGHT	VOLUME (GAL.)	XXXXG GPM	CPG
1	100	25128	251.28	B	10	25.1	6.55	227.55	221.00	73.0	7.1485	30.916	18.549	812.8
2	100	19988	199.88	B	10	20.0	2.00	177.80	175.80	73.5	7.1468	24.598	14.759	812.6
3	100	17490	174.90	A	10	17.52	2.30	156.10	153.80	73.0	7.1485	21.515	12.909	812.9
4	100	14706	147.06	A	10	14.70	3.50	133.10	129.60	73.0	7.1485	18.130	10.878	811.1
5	100	12428	124.28	A	10	12.42	3.35	113.45	110.10	73.0	7.1485	15.402	9.2411	806.9
6	100	10100	101.00	A	10	10.09	4.55	93.70	89.15	72.5	7.1501	12.468	7.481	810.1
7	100	8002	80.02	A	10	7.975	3.25	73.85	70.60	72.5	7.1501	9.874	5.924	810.4
8	100	5988	59.88	B	1	60.00	1.90	55.75	53.85	72.5	7.1501	7.531	4.519	795.1
9	100	5040	50.40	B	1	50.40	55.75	101.50	45.75	72.5	7.1501	6.399	3.839	787.6
10	100	4038	40.38	B	1	40.30	2.55	39.65	37.10	72.5	7.1501	5.189	3.113	778.1
11	120	3630	30.25	B	1	30.25	39.65	73.90	34.25	72.5	7.1501	4.790	2.395	757.8
12	180	3251	20.32	B	1	20.30	73.90	106.20	32.30	72.5	7.1501	4.517	1.694	719.7
13	300	3034	10.11	A	1	10.00	14.30	50.40	36.10	72.5	7.1501	5.049	1.010	600.9

TOTAL CYCLES: 132,822 _____
 TOTAL VOLUME: 166.38 _____
 MEAN CYCLES PER GALLON: 798.3 _____

FLOW METER CALIBRATION
COLORADO STATE UNIVERSITY
DATA

METER NO. 3/4"-80 GLMD-1

NO. OF PULSES/REV. 0.750

MANUFACTURED BY: _____

TYPE OF FLUID: MIL-C-5606

TUBE O.D. 0.750

TUBE I.D. 0.584

CALIBRATED BY: Videon

DATE: 10-21-57

TIME: _____

For Engineering Evaluation

REMARKS: _____

RUN NO.	T ₀ SEC.	T _F SEC.	TIME SEC.	CYCLES	CPS	OSC. SCALE	READING	MULTI-PLIER	W ₀ LBS.	W _F LBS.	ΔW LBS.	TEMP °F	SPECIFIC WEIGHT	VOLUME GAL.	CPG	GPM	60 C TIME
1			80	20162	252.02	B	25.10	10	5.35	182.75	177.40	72.5	7.1501	24.811	812.6	18.608	
2			100	19968	199.68	B	20.00	10	2.00	177.90	175.90	72.0	7.1517	24.596	811.8	14.757	
3			100	17592	175.92	A	17.60	10	1.25	156.10	154.85	72.0	7.1517	21.652	812.5	12.991	
4			100	14824	148.24	A	14.99	10	3.15	133.70	130.55	72.0	7.1517	18.254	812.1	10.952	
5			100	12578	125.78	A	12.53	10	5.40	116.60	111.20	72.0	7.1517	15.549	808.9	9.329	
6			100	10088	100.88	A	10.09	10	4.40	93.85	89.45	71.5	7.1533	12.505	806.7	7.503	
7			100	8040	80.40	A	8.00	10	1.40	72.60	71.20	71.5	7.1533	9.953	807.7	5.972	
8			100	6038	60.38	B	60.10	1	7.35	61.50	54.15	71.5	7.1533	7.570	797.6	4.542	
9			100	5004	50.04	B	49.80	1	0.45	45.80	45.35	71.5	7.1533	6.340	789.2	3.804	
10			100	4022	40.22	B	40.00	1	45.80	82.60	36.80	71.5	7.1533	5.144	781.9	3.086	
11			120	3644	30.37	B	30.40	1	4.00	38.20	34.20	71.5	7.1533	4.781	762.2	2.391	
12			160	3226	20.16	B	20.10	1	38.20	70.15	31.95	71.5	7.1533	4.466	722.3	1.675	
13			301	2994	9.95	A	10.00	1	70.15	105.65	35.50	71.5	7.1533	4.963	603.3	0.993	

TOTAL CYCLES: 128.180
 TOTAL VOLUME: 160.58
 MEAN CYCLES PER GALLON: 798.21

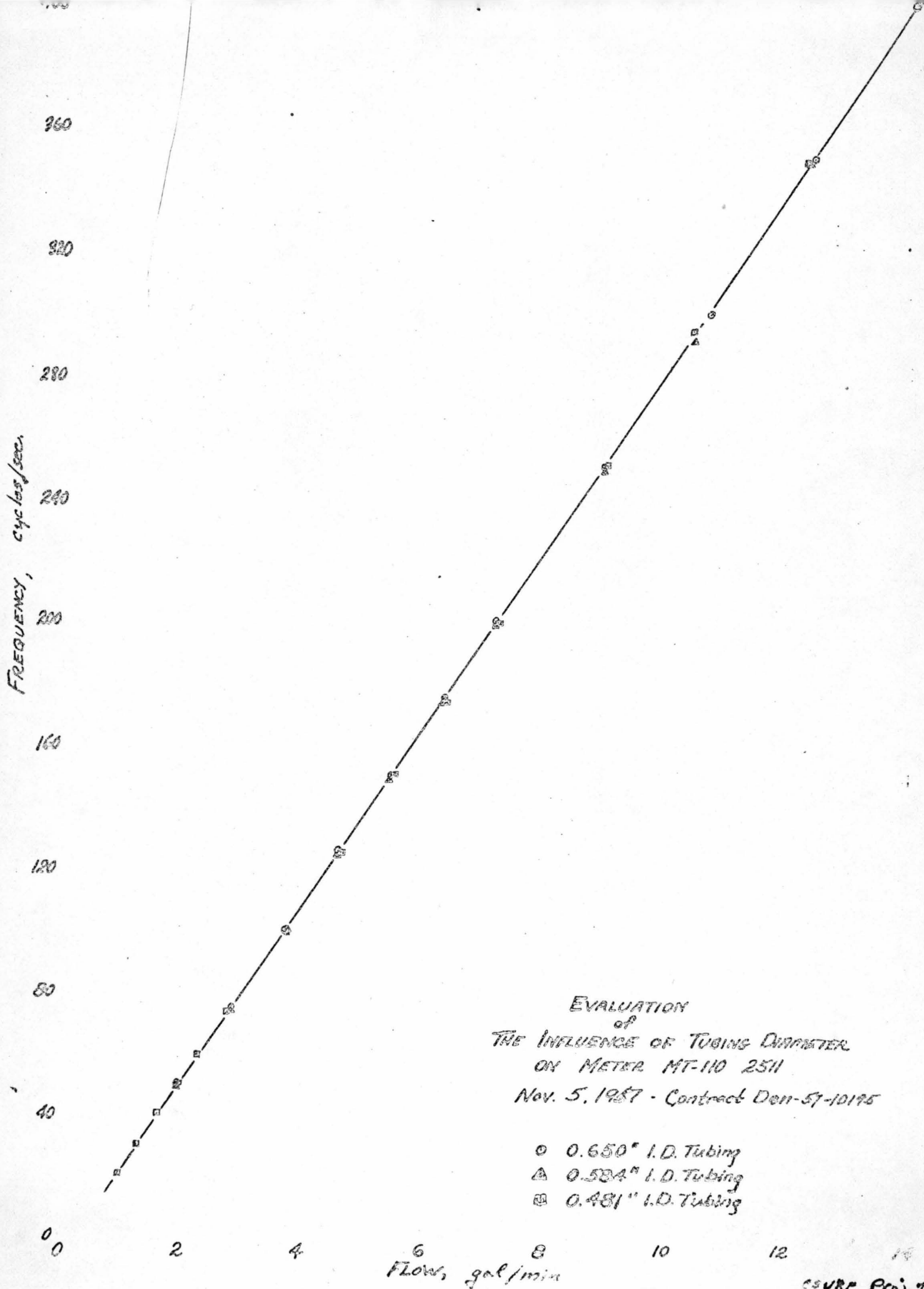
FLOW METER CALIBRATION
 COLORADO STATE UNIVERSITY
 DATA

METER NO. 3/4"-80 GMD-1 NO. OF PULSES/REV. _____ MANUFACTURED BY: Potter
 TYPE OF FLUID: MIL-O-5606 TUBE O.D. 0.750 TUBE I.D. 0.481
 CALIBRATED BY: Huckeby DATE: 10-31-57 TIME: 1:30 PM

REMARKS: _____

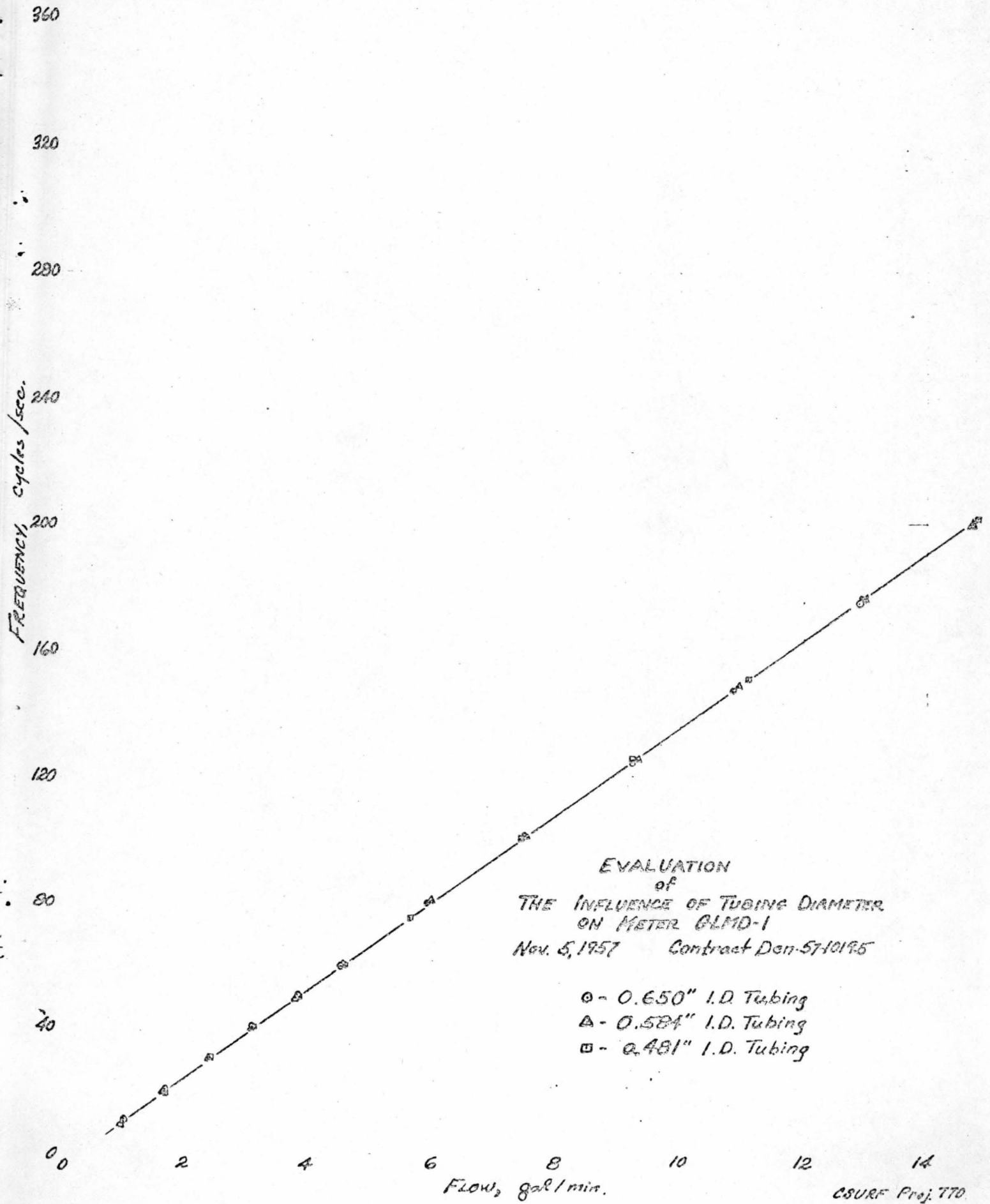
RUN NO.	T ₀ SEC.	T _F SEC.	TIME SEC.	CYCLES	CPS	OSC. SCALE	READING	MULTIPLIER	W ₀ LBS.	W _F LBS.	ΔW LBS.	TEMP °F	SPECIFIC WEIGHT	VOLUME GAL.	CPG	GPM	60 C TIME
1	6451	6501	50	12613	252.26	B	25.1	10	1.80	112.65	110.85	72.5	7.1501	15.503	813.52	18.604	11
2	6501	6561	60	12164	202.73	B	20.1	10	2.20	109.70	106.50	72.0	7.1517	14.891	810.00	14.891	
3	6561	6661	100	17578	175.78	A	17.5	10	2.00	155.70	153.70	71.0	7.1548	21.482	818.27	12.889	
4	6661	6761	100	15086	150.86	A	15.0	10	1.55	133.95	132.40	70.5	7.1564	18.500	815.45	11.100	
5	6761	6861	100	12560	125.60	A	12.5	10	1.90	111.35	109.45	70.0	7.1581	15.290	821.45	9.1739	
6	6861	6961	100	10034	100.34	A	10.0	10	2.10	90.60	88.50	69.5	7.1598	12.36	811.8	7.416	
7	6961	7061	100	7540	75.40	A	7.5	10	2.15	69.45	67.30	69.0	7.1616	9.397	802.4	5.633	
8	7061	7161	100	6033	60.33	B	60.0	1	1.90	55.15	53.25	69.0	7.1616	7.435	812.1	4.461	
9	7161	7261	100	5020	50.20	B	50.0	1	2.30	47.05	44.75	68.5	7.1632	6.247	803.5	3.748	
10	7261	7361	100	4022	40.22	B	40.0	1	1.95	39.00	37.05	68.0	7.1649	5.171	777.7	3.103	
11	7361	7561	200	6044	30.22	B	30.0	1	2.00	59.20	57.20	68.0	7.1649	7.983	757.1	2.395	
12	7561	7761	200	4040	20.20	B	20.2	1	1.95	42.35	40.40	68.0	7.1649	5.638	716.6	1.691	
				112,739													

TOTAL CYCLES: _____
 TOTAL VOLUME: 139.9
 MEAN CYCLES PER GALLON: 805.8



EVALUATION
of
THE INFLUENCE OF TUBING DIAMETER
ON METER MT-110 2511
Nov. 5, 1957 - Contract Don-57-10195

- 0.650" I.D. Tubing
- △ 0.584" I.D. Tubing
- 0.481" I.D. Tubing



EVALUATION
of
THE INFLUENCE OF TUBING DIAMETER
ON METER GLMD-1
Nov. 5, 1957 Contract Den-57-10195

- - 0.650" I.D. Tubing
- △ - 0.584" I.D. Tubing
- - 0.481" I.D. Tubing