FLOWDYNE FLOW ELEMENT INFORMATION

FOR

D-ZERO UPGRADE

D-ZERO ENGINEERING NOTE #3823.115-EN-433

October 3, 1995

Andy Kuwazaki
RD/D0 Mech.

Approved: 10/17/95

Summary

This engineering note provides the information used for purchasing two venturi flowmeters and one orifice flowmeter. One venturi and one orifice performance curve is provided along with the purchasing information. Performance data is also given to supplement the performance curves.

REQUESTED BY STEVE SAKLA	EMPLOYEE NO. 10496	EXT. 8453	ORGANIZATION UNIT RD/DØ/MECH. SUPP.	MAIL STATION 357	REQUESTER'S IDENTIFIER	REQ. DATE 7-31-95
SUGGESTED VENDOR LOW-DINE ENGINEERING	PHONE NO. (817) 281-6448	PROJECT DESCRIPTION DØ UPGRADE (WBS #3.1.1.3.6.1)			APPROVALS	EMPLOYEE NO.
FORT WORTH, TX 76117	TYSON SCHMIDT	DELIVER TO (INCLUDE NAME & BLDG. NO.) STEVE SAKLA DAS			BUS. OFFICE	

SHORT DESCRIPTION (30 CHARACTERS OR LESS) ORIFICE FLOWMETERS	PREVIOUS P.O.	DIR. OFFICE
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REC. AREA CODE	QUANTITY	ITEM DESCRIPTION	ESTIMATED UNIT PRICE	DO NOT USE		
				UNIT PRICE	DISCOUNT	DEL. DATE
	1	ORIFICE PLATE ASS'Y, INCLUDES ORIFICE PLATE AND TWO RAISED FACE SLIP ON FLANGES FOR A 2" SCHEDULE 10 PIPE. ALL MAT'L'S ARE 304 SS. GAS TO BE MEASURED IS HELIUM FLOWING AT 289K ± 275 PSIG. FULL RANGE FLOWRATE IS APPROX. 0.176 lbm/s. ORIFICE PLATE TO HAVE A MAXIMUM OF 5 PSI DIFFERENTIAL PRESSURE @ FULL RANGE FLOW. PROOF PRESSURE RATING TO BE A MINIMUM OF 350 PSIG. PROVIDE ALL NECESSARY FLOW EQUATIONS AND FLOW DATA FOR THE FLOW RANGE.	\$650			
		(QUOTE # Q 0695233, ITEM # 2)				

CHECK BOX IF CONFERENCE REQ.	CHECK BOX TO RECEIVE P. O. COPY VIA E-MAIL	☒	TOTAL AMOUNT OF THIS REQUISITION \$ \$2300⁰⁰
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BUDGET CODE	PERCENTAGE	NEPA APPROVAL	DIVISION OFFICE APPROVAL	BUDGET OFFICE APPROVAL	PURCHASING/CONTRACTS DEPT. STAMP
EEG	100				

PO. NUMBER	VENDOR CODE	BUYER	AT RIGHT, INDICATE SPECIAL ORDER TYPE (SPARES/ISS/GSA/CAFE/FAB/T&M)	GSA/FSS CONTRACT NO.
END P.O. TO ATTENTION OF	SHIP VIA	F.O.B. & POINT OF SHIPMENT FOR FB/FC/FD	TERMS	REPORTING CODE
COST ELEMENT	CONFIRMED TO & DATE	CHECK IF P.O. FOR INTERNAL USE ONLY	CHECK IF REQUESTER TO APPROVE PAYMENT	BEGINNING STD. TEXT CODES
ENDING STD. TEXT CODES	REQUISITION NUMBER

PURCHASE REQUISITION
(SEE INSTRUCTIONS ON REVERSE SIDE - DO NOT WRITE IN SHADED AREAS)

REQUESTED BY STEVE SAKLA	EMPLOYEE NO. 10496	EXT. 8453	ORGANIZATION UNIT RO/DØ/MECH SUPP.	MAIL STATION 357	REQUESTER'S IDENTIFIER	REQ. DATE 7-31-95
SUGGESTED VENDOR FLOW-DYNE ENGINEERING FORT WORTH, TX 76117	PHONE NO. (817) 281-6448	PROJECT DESCRIPTION DØ UPGRADE (WBS# 3.1.1.3-6.1)		APPROVALS		EMPLOYEE NO.
TYSON SCHMIDT		DELIVER TO (INCLUDE NAME & BLDG. NO.) STEVE SAKLA DAB		BUS. OFFICE		
SHORT DESCRIPTION (30 CHARACTERS OR LESS) VENTURI FLOW METERS				PREVIOUS P.O.	DIR. OFFICE	

REC. AREA CODE	QUANTITY	ITEM DESCRIPTION	ESTIMATED UNIT PRICE	DO NOT USE		
				UNIT PRICE	DISCOUNT	DEL. DATE
	2	VENTURI FLOWMETER, MATERIAL: 304 S.S., SOCKET WELD CONNECTION FOR 5/8" O.D. x 0.049" WALL 304 S.S. TUBE. GAS TO BE MEASURED IS HELIUM FLOWING @ 6.7K @ 2PSIG. FULL RANGE FLOWRATE IS APPROX. 0.0198 lbm/s. VENTURI TO HAVE APPROX. 50" H ₂ O DIFFERENTIAL PRESSURE @ FULL RANGE FLOW. PROOF PRESSURE RATING FOR VENTURI TO BE A MINIMUM OF 100 PSIG. PROVIDE ALL NECESSARY FLOW EQUATIONS AND ROW DATA FOR THE FLOW RANGE. (QUOTE # Q069523B, ITEM #1)	\$825 ⁰⁰			
* (CONTINUED ON NEXT PAGE)						

CHECK BOX IF CONFERENCE REQ.	CHECK BOX TO RECEIVE P.O. COPY VIA E-MAIL	☒ TOTAL AMOUNT OF THIS REQUISITION \$				
BUDGET CODE	PERCENTAGE	NEPA APPROVAL	DIVISION OFFICE APPROVAL	BUDGET OFFICE APPROVAL	PURCHASING/CONTRACTS DEPT. STAMP	
EEG	100					
P.O. NUMBER		VENDOR CODE	BUYER	AT RIGHT, INDICATE SPECIAL ORDER TYPE (SPARES/ISS/GSA/CAFE/FAB/T&M)	GSA/FSS CONTRACT NO.	
SEND P.O. TO ATTENTION OF		SHIP VIA	F.O.B. & POINT OF SHIPMENT FOR FB/FC/FD		TERMS	REPORTING CODE
CHECK IF P.O. FOR INTERNAL USE ONLY		CHECK IF REQUESTER TO APPROVE PAYMENT	BEGINNING STD. TEXT CODES	ENDING STD. TEXT CODES	REQUISITION NUMBER	

FLOW-DYNE Engineering, Inc.FLOWMETERS—~~Liquid~~—~~Gaseous~~—Cryogenic

P. O. BOX 9034

FORT WORTH, TEXAS 76107

(817) 732-2859

S/N: 35821; 35822

THROAT DIA: 0.195"

LINE SIZE: 5/8" OD x 0.049" wall

LENGTH: 4.94"

VENTURI PERFORMANCE CURVE
FOR Helium

TS 25 SEPT 95

CURVE BASED ON PROPERTIES
FOR Helium**AT** 6.7 K° AND 16.7 PSIA.SPECIFIC HEAT RATIO, $K = 1.9325$ GAS CONSTANT, $R = 386.08$ COMPRESS. FACTOR, $Z = 0.8608$ VISCOSITY, $\mu = 0.00174$ Cp**CURVE PARAMETERS:** W = MASS FLOW RATE—LB/ SEC T_1 = INLET TEMP.—°R P_1 = INLET PRESSURE—PSIA ΔP = DIFFERENTIAL PRESS.—PSI

$$\frac{W/T_1}{P_1}$$

- CRITICAL FLOW VENTURIS
- VENTURI TUBES
- FLOW NOZZLES
- ORIFICE PLATES AND FLANGES
- METER RUNS
- TEST STANDS AND SYSTEMS

FLOW-DYNE Engineering, Inc.

MAIL - P.O. Box 161655 • Fort Worth, Texas 76161-1655

PLANT - 4108 Garland Drive • Fort Worth, Texas 76117

TEL. 817-281-6448 FAX: 817-581-0936

- Consulting
- Design & Testing
- Development
- Manufacturing
- Calibration
- Software

Date 09-22-1995

Time 15:22:14

PRIMARY ELEMENTS

**** Performance Data ****

Based Upon;

Primary Element Type	Subsonic Venturi
Flowing Gas	Helium
Molecular Weight	4.0026
Inlet Density	0.599860 lbm/ft ³
Compressibility Factor	0.8608
Specific Heat Ratio	1.9325
Absolute Viscosity	1.7397E-03 cp

Inlet Static Pressure	16.6960 psia
Inlet Temperature	6.7000 K

Throat Diameter	0.1950 in
Inlet Diameter	0.536 in
Beta Ratio	0.3638

Coef. of Thermal Expansion	7.40E-06 in/in*F
Thermal Expansion Factor	0.9924

Discharge Coefficient	Theoretical
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DP/P: Diff. Press./Inlet Press. (PSID/PSIA)	Rd: Throat Reynolds No.
P: Inlet Static Pressure (PSIA)	Cd: Discharge Coefficient
T: Inlet Temperature (RANKINE)	Y: Gas Expansion Factor
W: Flowrate (IN UNITS AS SPECIFIED)	

DP (in H2O)	DP/P	W/T/P (lbm/s)	W (lbm/s)	Rd	Cd	Y
92.594	.20000	5.337E-03	2.566E-02	1,719,636	0.9916	0.9146
69.445	.15000	4.735E-03	2.276E-02	1,525,752	0.9915	0.9372
46.297	.10000	3.955E-03	1.901E-02	1,274,327	0.9913	0.9589
23.148	.05000	2.856E-03	1.373E-02	920,196	0.9907	0.9798
13.889	.03000	2.228E-03	1.071E-02	718,067	0.9898	0.9880
4.630	.01000	1.294E-03	6.221E-03	416,939	0.9874	0.9960
2.315	.00500	9.150E-04	4.399E-03	294,839	0.9855	0.9980
1.389	.00300	7.081E-04	3.404E-03	228,183	0.9838	0.9988
0.463	.00100	4.074E-04	1.958E-03	131,263	0.9795	0.9996

FLOW-DYNE Engineering, Inc.

FLOWMETERS—Liquid—Gaseous—Cryogenic

P. O. BOX 9034

FORT WORTH, TEXAS 76107

(817) 732-2859

ORIFICE P/N: OPP020947-S

S/N: 35823

THROAT DIA: 0.947"

LINE SIZE: 2" SCH 10S PIPE

LENGTH:

ORIFICE PERFORMANCE CURVE FOR HELIUM

TS 25 SEPT 95

CURVE BASED ON PROPERTIES

FOR Helium

AT 60 °F. AND 289.7 PSIA.

SPECIFIC HEAT RATIO, $K = 1.664$

GAS CONSTANT, $R = 386.08$

COMPRESS. FACTOR, $Z = 1.0136$

VISCOSITY, $\mu = 0.01951$ Cp

CURVE PARAMETERS:

W = MASS FLOW RATE—LB/ SEC

T_1 = INLET TEMP.—°R

P_1 = INLET PRESSURE—PSIA

ΔP = DIFFERENTIAL PRESS.—PSI

$$\frac{W}{T_1 P_1}$$

- CRITICAL FLOW VENTURIS
- VENTURI TUBES
- FLOW NOZZLES
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- Consulting
- Design & Testing
- Development
- Manufacturing
- Calibration
- Software

Date 09-22-1995

Time 15:31:09

PRIMARY ELEMENTS

**** Performance Data ****

Based Upon;

Primary Element Type	Orifice Plate w/ Flange Taps
Flowing Gas	Helium
Molecular Weight	4.0026
Inlet Density	0.205136 lbm/ft ³
Compressibility Factor	1.0136
Specific Heat Ratio	1.6640
Absolute Viscosity	1.9510E-02 cp

Inlet Static Pressure	289.7000	psia
Inlet Temperature	60.0000	F

Throat Diameter	0.9470	in
Inlet Diameter	2.157	in
Beta Ratio	0.4390	

Coef. of Thermal Expansion	9.50E-06	in/in*F
Thermal Expansion Factor	0.9998	

Discharge Coefficient	Theoretical
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DP/P: Diff. Press./Inlet Press. (PSID/PSIA)	Rd: Throat Reynolds No.
P: Inlet Static Pressure (PSIA)	Cd: Discharge Coefficient
T: Inlet Temperature (RANKINE)	Y: Gas Expansion Factor
W: Flowrate (IN UNITS AS SPECIFIED)	

DP (in H2O)	DP/P	W/T/P (lbm/s)	W (lbm/s)	Rd	Cd	Y
803.316	.10000	5.401E-02	6.864E-01	844,657	0.6021	0.9746
401.658	.05000	3.870E-02	4.918E-01	605,275	0.6024	0.9873
240.995	.03000	3.014E-02	3.831E-01	471,420	0.6026	0.9924
80.332	.01000	1.751E-02	2.225E-01	273,844	0.6032	0.9975
40.166	.00500	1.241E-02	1.577E-01	194,056	0.6037	0.9987
24.099	.00300	9.624E-03	1.223E-01	150,514	0.6042	0.9992
8.033	.00100	5.573E-03	7.082E-02	87,151	0.6056	0.9997
5.623	.00070	4.667E-03	5.931E-02	72,994	0.6063	0.9998
4.017	.00050	3.949E-03	5.019E-02	61,761	0.6069	0.9999

NOTE: SERVICE FOR HELIUM GAS AT 16.7 PSIA
AND 6.7 K TO FLOW 0.0198 LBM/SEC @
A DIFFERENTIAL PRESSURE OF 50.6 INWC.

2 V100195-SSW		304-SS	
QTY	PART NO.	DESCRIPTION	MATERIAL
LIST OF MATERIALS			
UNLESS OTHERWISE SPECIFIED: TOLERANCES 2 PLACE DECIMAL $\pm .010$ 3 PLACE DECIMAL $\pm .005$ FRACTION $\pm 1/64$ ANGULAR $\pm 30^\circ$ REMOVE BURRS AND BREAK ALL CORNERS .005 MAXIMUM. ALL DIMENSIONS ARE IN INCHES DO NOT SCALE		DWN. BY TS 25 SEPT 95 CHECKED ENGRG.	FLOW-DYNE Engineering, Inc. P.O. BOX 161655 FORT WORTH TEXAS 76161 TEL: 817 281-6448 FAX: 817 581-0936
NOTICE PROPRIETARY RIGHTS INVOLVED THIS DOCUMENT AND ALL ACCOMPANYING INFORMATION ARE DATA ARE AND REMAIN THE PROPERTY OF FLOW-DYNE ENGINEERING, INC. AND ARE NOT TO BE COPIED, REPRODUCED, RE-PRODUCED, NOR TRANSMITTED OR DISCLOSED TO OTHERS WITHOUT EXPRESS PERMISSION, AND ARE TO BE RETURNED UPON REQUEST THEREFORE. ALL RIGHTS IN PROPRIETARY AND NOVEL FEATURES FOR THE SUBJECT MATTER ARE EXPRESSLY RESERVED BY FLOW-DYNE ENGINEERING, INC. RECEIPT OF THIS DOCUMENT IS INDICATED BY ACCEPTANCE OF THIS DOCUMENT.		TITLE VENTURI FLOWMETER INSTALLATION FOR 5/8" O.D. x 0.049" WALL TBG. SOCKET WELD TYPE END CONN.	
SCALE NONE		SIZE B	DWG. NO. FDE 3582 SHEET OF