



PROCESS SYSTEMS INTERNATIONAL, INC. LIGO-E960114-00-V

FEDERAL EXPRESS

**TO :** LIGO PROJECT M/S 51-33  
CAL. INSTITUTE OF TECH.  
391 S. HOLLISTON AVENUE  
PASADENA, CA 91125

**DATE :** 09/06/96  
**TRANS. NO. :** CT060  
**PROJECT NO.:** V59049

**ATTN :** MS. LINDA TURNER

**SENT BY :** STU MOTEW

THE FOLLOWING  DRAWINGS  
 DOCUMENTS  
 SPECIFICATIONS

ARE ATTACHED  
 SENT SEPARATELY

Document No.	Rev.	Title	Dwg. Size	Sheets
V049-8-400	-	MAIN TURBO AIR SPEED TEST	A	11

**CC :**

**ISSUED FOR:**  APPROVAL  PRELIMINARY  
 REVIEW  CONSTRUCTION  
 INFORMATION  DISTRIBUTION

ENCL:  1 PRINTS  REPRODUCIBLES

PAGE 1 OF 1

Pumping speed results STPH2000C speed test

**PROCESS SYSTEMS INTERNATIONAL  
DOCUMENT REVIEW CHECKLIST**

PROJECT NAME: \_\_\_\_\_  
PSI DOC. NO. \_\_\_\_\_

(2151) 

CHK		BY / DATE
<input checked="" type="checkbox"/>	SM PROJECT ENG	SM 8/21/90
<input type="checkbox"/>	MECHANICAL	_____
<input type="checkbox"/>	STRESS	_____
<input type="checkbox"/>	ELECTRICAL	_____
<input checked="" type="checkbox"/>	RT PROCESS	RT/CM 8/20
<input type="checkbox"/>	MFG. ENG.	_____
<input type="checkbox"/>	MANUF	_____
<input type="checkbox"/>	Q.A.	_____
<input checked="" type="checkbox"/>	DMW DRAFTING	DMW

**PROCESS SYSTEMS INTERNATIONAL  
DOCUMENT APPROVAL CHECKLIST**

PROJECT NAME: LIG-0  
PSI DOC. NO. V049-8-400

NOTE: THIS REVIEW DOES NOT RELIEVE THE SELLER OR CONTRACTOR OF ANY OBLIGATIONS UNDER THE P.O. OR CONTRACT.

- FA = FINAL APPROVAL
- AS = APPRO AS NOTED - REVISE & RESUBMIT
- AF = APPROVED FOR FABRICATION
- NA = NOT APPROVED
- RP = RELEASED FOR PROCUREMENT OF MATERIALS ONLY
- RR = REVISE & RESUBMIT

BY \_\_\_\_\_ DATE 8/22

*A Bay*

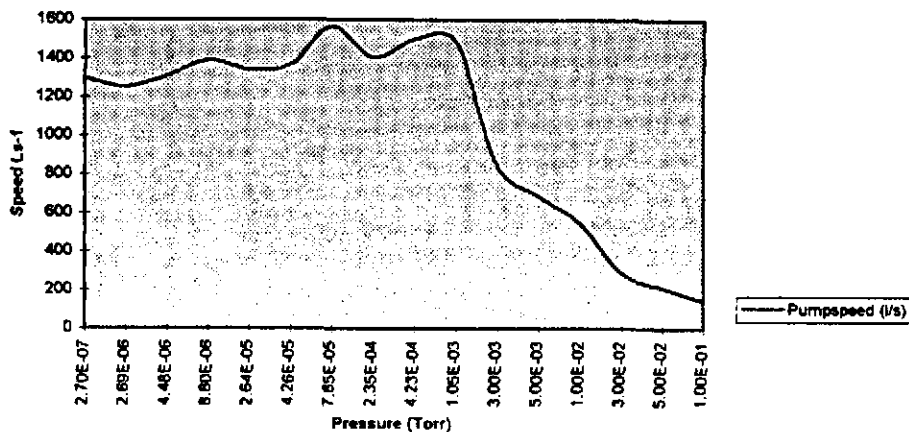
VENDOR NAME:	<u>Edwards HI-VAC</u>
REVISION NO:	<u>-</u>
SUBMITTAL NO.:	<u>1</u>
STATUS:	<u>review/approval</u>

PSI DWG # V049-8-400

STPH2000C SN0725 speed test

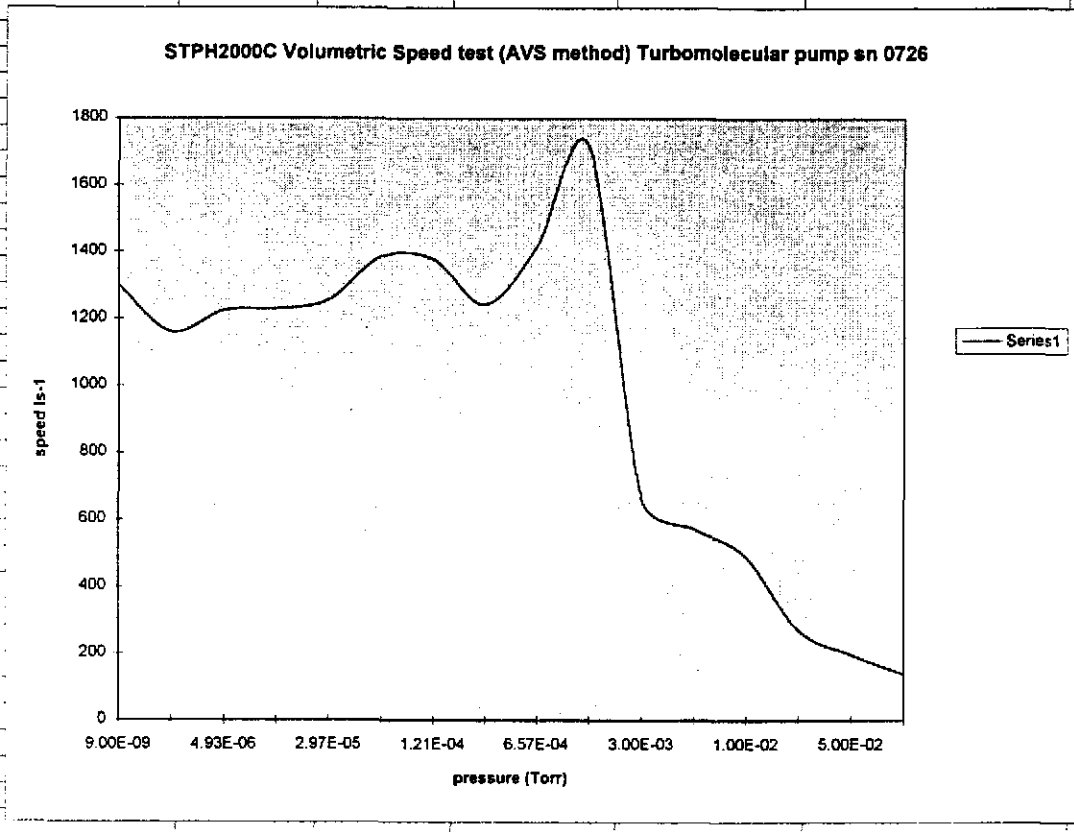
Reading #	Target Pressure (T)	Gauge type	Foreline (Torr)	Massflow (sccm)	Actual Pressure (T)	Corrected Pressure (T)	Pumpspeed (l/s)
1	Base Pressure	Cold Cathode	6.70E-03	0	2.70E-07	2.70E-07	1300
2	3.00E-06	Cold Cathode	7.20E-03	0.22	3.00E-06	2.69E-06	1252
3	5.00E-06	Cold Cathode	7.60E-03	0.4	5.00E-06	4.48E-06	1308
4	1.00E-05	Cold Cathode	8.70E-03	0.86	1.00E-05	8.80E-06	1390
5	3.00E-05	Cold Cathode	1.30E-02	2.54	3.00E-05	2.64E-05	1340
6	5.00E-05	Cold Cathode	1.70E-02	4.2	5.00E-05	4.26E-05	1366
7	1.00E-04	Cold Cathode	2.50E-02	8.9	1.00E-04	7.85E-05	1568
8	3.00E-04	Cold Cathode	4.90E-02	24	3.00E-04	2.35E-04	1406
9	5.00E-04	Cold Cathode	7.20E-02	46	5.00E-04	4.23E-04	1499
10	1.00E-03	Cold Cathode	1.20E-01	113	1.00E-03	1.05E-03	1487
11	3.00E-03	Pirani	1.70E-01	185	3.00E-03	3.00E-03	850
12	5.00E-03	Pirani	2.30E-01	250	5.00E-03	5.00E-03	689
13	1.00E-02	Pirani	3.20E-01	400	1.00E-02	1.00E-02	551
14	3.00E-02	Pirani	4.60E-01	640	3.00E-02	3.00E-02	294
15	5.00E-02	Pirani	5.40E-01	780	5.00E-02	5.00E-02	215
16	1.00E-01	Pirani	7.00E-01	1080	1.00E-01	1.00E-01	149

STPH2000C Volumetric Speed test (AVS method) Turbomolecular pump SN 0725



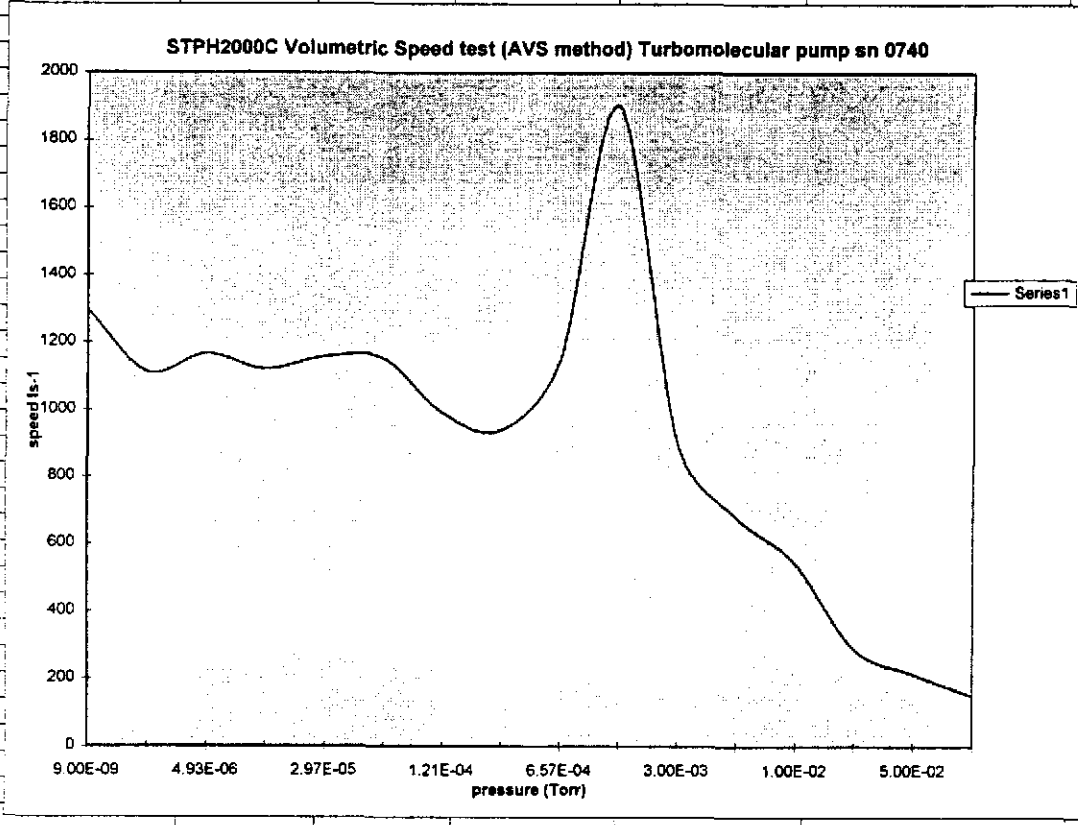
STPH2000C SN0726 speed test

Reading #	Target Pressure (T)	Gauge type	Foreline (Torr)	Massflow (sccm)	Actual Pressure (T)	Corrected Pressure(T)	Pumpspeed (l/s)
1	Base Pressure	Cold Cathode	5.00E-03	0	9.00E-09	9.00E-09	1300
2	3.00E-06	Cold Cathode	6.40E-03	0.25	3.00E-06	2.96E-06	1161
3	5.00E-06	Cold Cathode	7.10E-03	0.44	5.00E-06	4.93E-06	1225
4	1.00E-05	Cold Cathode	8.25E-03	0.93	1.00E-05	1.04E-05	1229
5	3.00E-05	Cold Cathode	1.30E-02	2.72	3.00E-05	2.97E-05	1256
6	5.00E-05	Cold Cathode	1.70E-02	5	5.00E-05	4.95E-05	1385
7	1.00E-04	Cold Cathode	2.80E+00	12.2	1.00E-04	1.21E-04	1379
8	3.00E-04	Cold Cathode	5.50E-02	33	3.00E-04	3.64E-04	1243
9	5.00E-04	Cold Cathode	8.30E-02	68	5.00E-04	6.57E-04	1418
10	1.00E-03	Cold Cathode	1.30E-01	125	1.00E-03	1.00E-03	1712
11	3.00E-03	Pirani	1.40E-01	146	3.00E-03	3.00E-03	667
12	5.00E-03	Pirani	1.90E-01	210	5.00E-03	5.00E-03	575
13	1.00E-02	Pirani	2.80E-01	360	1.00E-02	1.00E-02	493
14	3.00E-02	Pirani	4.20E-01	600	3.00E-02	3.00E-02	274
15	5.00E-02	Pirani	5.00E-01	730	5.00E-02	5.00E-02	200
16	1.00E-01	Pirani	6.50E-01	1030	1.00E-01	1.00E-01	141



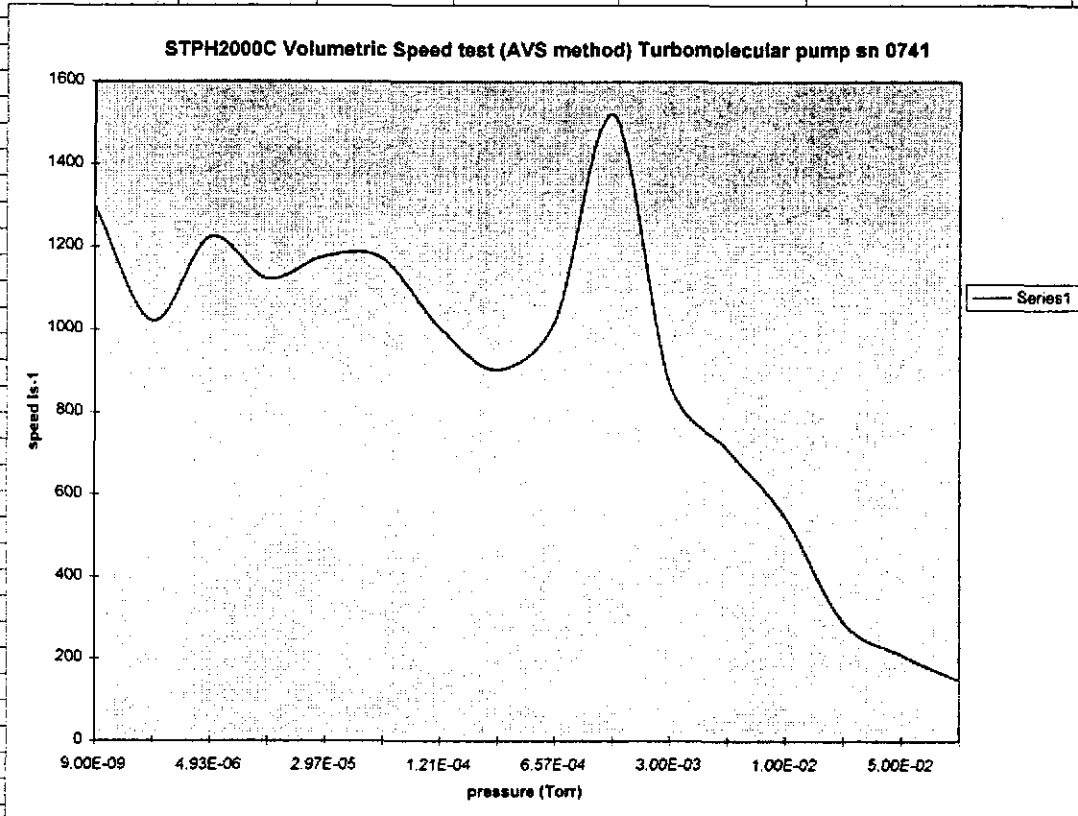
STPH2000C SN0740 speed test

Tested by: JT	Date:	8/2/96					
temp	72.9	Gage#	9610000383	Base pressure	4.5x10-8		
Reading #	Target Pressure (T)	Gauge type	Foreline (Torr)	Massflow (sccm)	Actual Pressure (T)	Corrected Pressure(T)	Pumpspeed (l/s)
1	Base Pressure	Cold Cathode	5.10E-03	0	9.00E-09	9.00E-09	1300
2	3.00E-06	Cold Cathode	6.20E-03	0.24	3.00E-06	2.96E-06	1115
3	5.00E-06	Cold Cathode	6.80E-03	0.42	5.00E-06	4.93E-06	1169
4	1.00E-05	Cold Cathode	7.90E-03	0.85	1.00E-05	1.04E-05	1123
5	3.00E-05	Cold Cathode	1.20E-02	2.51	3.00E-05	2.97E-05	1159
6	5.00E-05	Cold Cathode	1.60E-02	4.17	5.00E-05	4.95E-05	1155
7	1.00E-04	Cold Cathode	2.40E-02	8.8	1.00E-04	1.21E-04	995
8	3.00E-04	Cold Cathode	4.80E-02	25	3.00E-04	3.64E-04	942
9	5.00E-04	Cold Cathode	7.60E-02	55	5.00E-04	6.57E-04	1147
10	1.00E-03	Cold Cathode	1.30E-01	139	1.00E-03	1.00E-03	1904
11	3.00E-03	Pirani	1.70E-01	198	3.00E-03	3.00E-03	904
12	5.00E-03	Pirani	2.20E-01	250	5.00E-03	5.00E-03	685
13	1.00E-02	Pirani	3.10E-01	400	1.00E-02	1.00E-02	548
14	3.00E-02	Pirani	4.50E-01	640	3.00E-02	3.00E-02	292
15	5.00E-02	Pirani	5.20E-01	790	5.00E-02	5.00E-02	216
16	1.00E-01	Pirani	7.00E-01	1110	1.00E-01	1.00E-01	152



STPH2000C SN0741 speed test

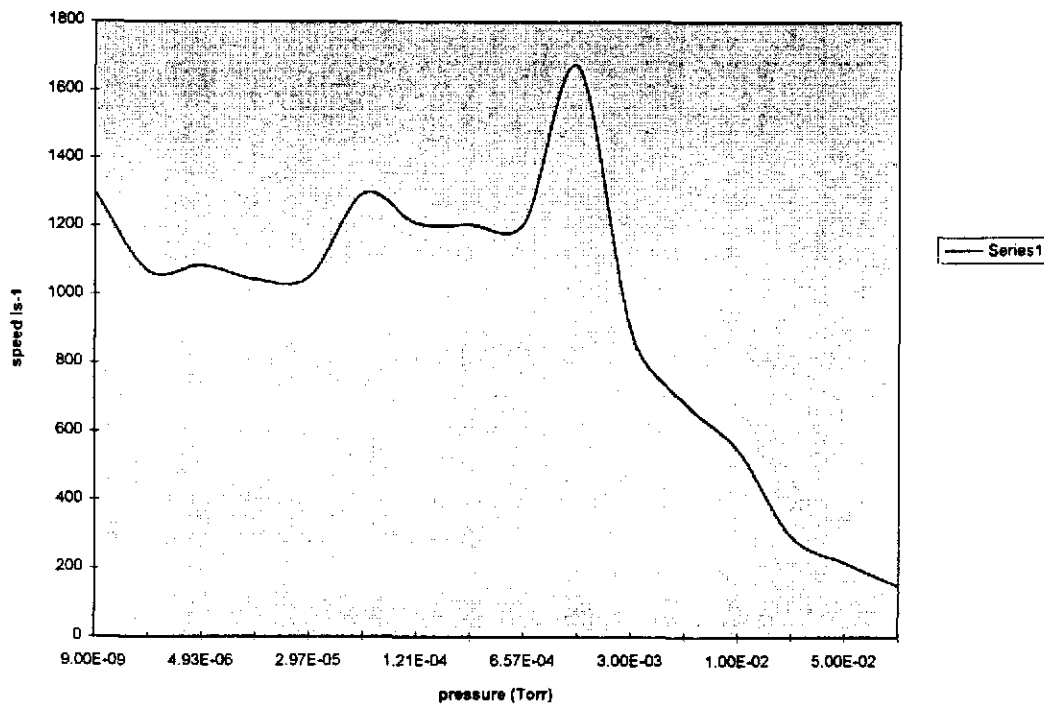
Tested by: JT	Date: 8/1/96						
temp 70.7	Gage# 9610000383	Base pressure 5x10-7					
Reading #	Target Pressure (T)	Gauge type	Foreline (Torr)	Massflow (sccm)	Actual Pressure (T)	Corrected Pressure(T)	Pumpspeed (l/s)
1	Base Pressure	Cold Cathode	7.30E-03	0	9.00E-09	9.00E-09	1300
2	3.00E-06	Cold Cathode	7.30E-03	0.22	3.00E-06	2.96E-06	1022
3	5.00E-06	Cold Cathode	7.70E-03	0.44	5.00E-06	4.93E-06	1225
4	1.00E-05	Cold Cathode	8.70E-03	0.85	1.00E-05	1.04E-05	1123
5	3.00E-05	Cold Cathode	1.30E-02	2.55	3.00E-05	2.97E-05	1178
6	5.00E-05	Cold Cathode	1.60E-02	4.23	5.00E-05	4.95E-05	1172
7	1.00E-04	Cold Cathode	2.50E-02	8.9	1.00E-04	1.21E-04	1006
8	3.00E-04	Cold Cathode	4.60E-02	24	3.00E-04	3.64E-04	904
9	5.00E-04	Cold Cathode	7.20E-02	49	5.00E-04	6.57E-04	1022
10	1.00E-03	Cold Cathode	1.10E-01	111	1.00E-03	1.00E-03	1521
11	3.00E-03	Pirani	1.80E-01	190	3.00E-03	3.00E-03	868
12	5.00E-03	Pirani	2.30E-01	260	5.00E-03	5.00E-03	712
13	1.00E-02	Pirani	3.10E-01	400	1.00E-02	1.00E-02	548
14	3.00E-02	Pirani	4.50E-01	640	3.00E-02	3.00E-02	292
15	5.00E-02	Pirani	5.20E-01	770	5.00E-02	5.00E-02	211
16	1.00E-01	Pirani	6.60E-01	1080	1.00E-01	1.00E-01	148



STPH2000C SN0764 speed test

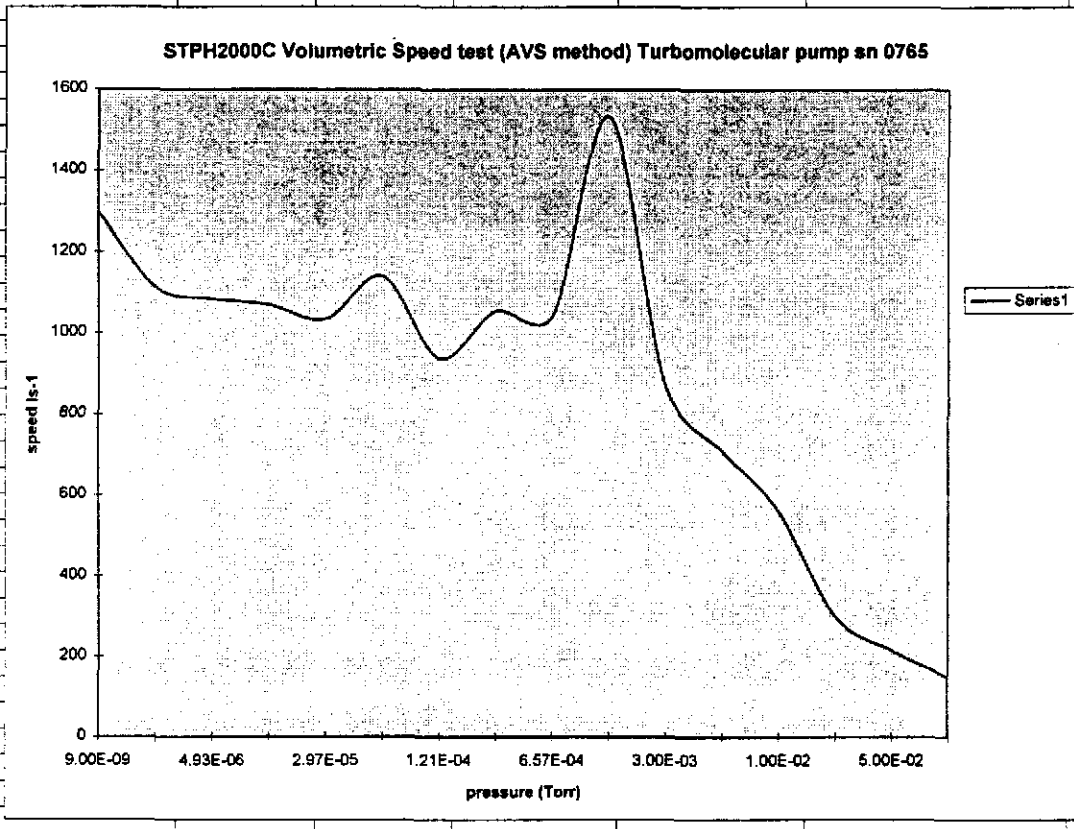
Reading #	Target Pressure (T)	Gauge type	Foreline (Torr)	Massflow (sccm)	Actual Pressure (T)	Corrected Pressure(T)	Pumpspeed (l/s)
1	Base Pressure	Cold Cathode	6.70E-03	0	9.00E-09	9.00E-09	1300
2	3.00E-06	Cold Cathode	7.20E-03	0.23	3.00E-06	2.96E-06	1068
3	5.00E-06	Cold Cathode	7.60E-03	0.39	5.00E-06	4.93E-06	1085
4	1.00E-05	Cold Cathode	8.50E-03	0.79	1.00E-05	1.04E-05	1044
5	3.00E-05	Cold Cathode	1.20E-02	2.28	3.00E-05	2.97E-05	1053
6	5.00E-05	Cold Cathode	1.70E-02	4.68	5.00E-05	4.95E-05	1297
7	1.00E-04	Cold Cathode	2.70E-02	10.7	1.00E-04	1.21E-04	1209
8	3.00E-04	Cold Cathode	5.50E-02	32	3.00E-04	3.64E-04	1206
9	5.00E-04	Cold Cathode	7.80E-02	58	5.00E-04	6.57E-04	1209
10	1.00E-03	Cold Cathode	1.20E-01	122	1.00E-03	1.00E-03	1671
11	3.00E-03	Pirani	1.70E-01	195	3.00E-03	3.00E-03	890
12	5.00E-03	Pirani	2.20E-01	250	5.00E-03	5.00E-03	685
13	1.00E-02	Pirani	2.80E-01	400	1.00E-02	1.00E-02	548
14	3.00E-02	Pirani	4.50E-01	650	3.00E-02	3.00E-02	297
15	5.00E-02	Pirani	5.30E-01	800	5.00E-02	5.00E-02	219
16	1.00E-01	Pirani	6.90E-01	1090	1.00E-01	1.00E-01	149

STPH2000C Volumetric Speed test (AVS method) Turbomolecular pump sn 0764



STPH2000C SN0765 speed test

Temp	71F	Gage#	104230002	Base pressure	1.4x10 <sup>-7</sup>		
Reading #	Target Pressure (T)	Gauge type	Foreline (Torr)	Massflow (sccm)	Actual Pressure (T)	Corrected Pressure(T)	Pumpspeed (l/s)
1	Base Pressure	Cold Cathode	5.30E-03	0	9.00E-09	9.00E-09	1300
2	3.00E-06	Cold Cathode	6.30E-03	0.24	3.00E-06	2.96E-06	1115
3	5.00E-06	Cold Cathode	6.90E-03	0.39	5.00E-06	4.93E-06	1085
4	1.00E-05	Cold Cathode	8.00E-03	0.81	1.00E-05	1.04E-05	1071
5	3.00E-05	Cold Cathode	3.00E-02	2.24	3.00E-05	2.97E-05	1034
6	5.00E-05	Cold Cathode	1.60E-02	4.12	5.00E-05	4.95E-05	1141
7	1.00E-04	Cold Cathode	2.40E-02	8.3	1.00E-04	1.21E-04	938
8	3.00E-04	Cold Cathode	6.60E-03	28	3.00E-04	3.64E-04	1055
9	5.00E-04	Cold Cathode	6.60E-02	50	5.00E-04	6.57E-04	1042
10	1.00E-03	Cold Cathode	1.10E-01	112	1.00E-03	1.00E-03	1534
11	3.00E-03	Pirani	1.80E-01	190	3.00E-03	3.00E-03	868
12	5.00E-03	Pirani	2.30E-01	260	5.00E-03	5.00E-03	712
13	1.00E-02	Pirani	3.20E-01	410	1.00E-02	1.00E-02	562
14	3.00E-02	Pirani	4.60E-01	660	3.00E-02	3.00E-02	301
15	5.00E-02	Pirani	6.30E-01	790	5.00E-02	5.00E-02	216
16	1.00E-01	Pirani	7.00E-01	1090	1.00E-01	1.00E-01	149





EHVI, TURBO PUMP TEST RAW DATA SHEET	
CUSTOMER:	LIGO
TURBO PUMP SERIAL NUMBER:	741
BACKING PUMP SERIAL NUMBER:	19286
CALIBRATED GAUGE SERIAL NO.	9610000383
PUMPCART GAUGE SERIAL NO.	N/A
GAS:	N <sub>2</sub>
DATE:	8/1/96
TEST ENGINEER:	[Signature]
QUALITY CONTROL ENGINEER:	[Signature]

± BASE 0

	Gauge Type	Mass Flowrate SCCM	Calibrated Gauge Pressure Torr	Pump Cart Gauge Pressure Torr	Foreline Pressure Torr	Ambient Temp °C	Test Dome Temp °C
1.15	0 CC	.22	$3 \times 10^{-6}$	$2.9 \times 10^{-6}$	$7.3 \times 10^{-3}$	69.5	70.7
1.25	1 CC	.44	$5 \times 10^{-6}$	$5.0 \times 10^{-6}$	$7.7 \times 10^{-3}$		
1.35	2 CC	.85	$1 \times 10^{-5}$	$1.0 \times 10^{-5}$	$8.7 \times 10^{-3}$		
1.45	3 CC	2.55	$3 \times 10^{-5}$	$3.0 \times 10^{-5}$	$1.3 \times 10^{-2}$		
1.55	4 CC	4.23	$5 \times 10^{-5}$	$5.0 \times 10^{-5}$	$1.6 \times 10^{-2}$		
2.05	5 CC	8.90	$1 \times 10^{-4}$	$1.0 \times 10^{-4}$	$2.5 \times 10^{-2}$		
2.15	6 CC	24.00	$3 \times 10^{-4}$	$3.0 \times 10^{-4}$	$4.6 \times 10^{-2}$		
2.25	7 CC	49.00	$5 \times 10^{-4}$	$5.6 \times 10^{-4}$	$7.2 \times 10^{-2}$		
2.35	8 CC	111.00	$1 \times 10^{-3}$	$1 \times 10^{-3}$	$1.1 \times 10^{-1}$		
2.45	9 PIR	190.00	$3 \times 10^{-3}$	$3 \times 10^{-3}$	$1.8 \times 10^{-1}$		
2.55	10 PIR	260.00	$5 \times 10^{-3}$	$5 \times 10^{-3}$	$2.3 \times 10^{-1}$		
3.05	11 PIR	400.00	$1 \times 10^{-2}$	$1 \times 10^{-2}$	$3.1 \times 10^{-1}$		
3.15	12 PIR	640.00	$3 \times 10^{-2}$	$3 \times 10^{-2}$	$4.5 \times 10^{-1}$		
3.25	13 PIR	710.00	$5 \times 10^{-2}$	$5.0 \times 10^{-2}$	$5.2 \times 10^{-1}$		
3.35	14 PIR	1080.00	$1 \times 10^{-1}$	$1.0 \times 10^{-1}$	$6.8 \times 10^{-1}$		
3.45	15 PIR	1780.00	$3 \times 10^{-1}$	$3.0 \times 10^{-1}$	$1.1 \times 10^0$		
3.55	16 PIR		$5 \times 10^{-1}$				

EHVI, TURBO PUMP TEST RAW DATA SHEET	
CUSTOMER:	PSI L196
TURBO PUMP SERIAL NUMBER:	740
BACKING PUMP SERIAL NUMBER:	19372
CALIBRATED GAUGE SERIAL NO.	9610007383
PUMPCART GAUGE SERIAL NO.	
GAS:	NITROGEN
DATE:	8/2/96
TEST ENGINEER:	<i>[Signature]</i>
QUALITY CONTROL ENGINEER:	<i>[Signature]</i>

t	Gauge Type	Mass Flowrate SCCM	Calibrated Gauge Pressure Torr	Pump Cart Gauge Pressure Torr	Foreline Pressure Torr	Ambient Temp °C	Test Dome Temp °C
0 8:30	CC		$4.5 \times 10^{-8}$	$2.3 \times 10^{-8}$	$5.1 \times 10^{-3}$	67.8	72.9
1 8:40	CC	.24	$3 \times 10^{-6}$	$2.3 \times 10^{-6}$	$6.2 \times 10^{-3}$		
2 8:50	CC	.42	$5 \times 10^{-6}$	$3.8 \times 10^{-6}$	$6.8 \times 10^{-3}$		
3 9:00	CC	.85	$1 \times 10^{-5}$	$7.5 \times 10^{-6}$	$7.9 \times 10^{-3}$		
4 9:10	CC	2.51	$3 \times 10^{-5}$	$2.1 \times 10^{-5}$	$1.2 \times 10^{-2}$		
5 9:20	CC	4.17	$5 \times 10^{-5}$	$3.4 \times 10^{-5}$	$1.6 \times 10^{-2}$		
6 9:30	CC	8.8	$1 \times 10^{-4}$	$5.6 \times 10^{-5}$	$2.4 \times 10^{-2}$		
7 9:40	CC	25.00	$3 \times 10^{-4}$	$1.7 \times 10^{-4}$	$4.8 \times 10^{-2}$		
8 9:50	CC	55.00	$5 \times 10^{-4}$	$3.1 \times 10^{-4}$	$7.6 \times 10^{-2}$		
9 10:00	CC	139.00	$1 \times 10^{-3}$	$6.4 \times 10^{-4}$	$1.3 \times 10^{-1}$		
10 10:10	PIR	198.00	$3 \times 10^{-3}$	$8.9 \times 10^{-4}$	$1.7 \times 10^{-1}$		
11 10:20	PIR	250.-	$5 \times 10^{-3}$	$4.9 \times 10^{-3}$	$2.2 \times 10^{-1}$		
12 10:30	PIR	400.-	$1 \times 10^{-2}$	$1.0 \times 10^{-2}$	$3.1 \times 10^{-1}$		
13 10:40	PIR	640.-	$3 \times 10^{-2}$	$3.1 \times 10^{-2}$	$4.5 \times 10^{-1}$		
14 10:50	PIR	790.-	$5 \times 10^{-2}$	$5.1 \times 10^{-2}$	$5.2 \times 10^{-1}$		
15 11:00	PIR	1110.-	$1 \times 10^{-1}$	$1.0 \times 10^{-1}$	$7.0 \times 10^{-1}$		

## CERTIFICATE of TEST

Product Description : EDP200/EH2600 System.

Certificate No : B301

Product Code No : NCB301000

Customer Order No : PA4005

Serial No : CSM 1165

EHVI Order No : MCB3010

We hereby certify that the above mentioned product has been fully tested and inspected and conforms in all aspects to our drawing N105356000, the test specification shown below, and to the conditions of the contract.

Test Specification:

ENST 0008 pt. 3

DP250 Chemical Drypump ; General Running Specification.

The following results being achieved

ENST 0008 pt. 3    Date of Test....30th . May 1996    Unit Serial No. CSM 1165.

Ultimate Vacuum    4.8 x10<sup>-3</sup> mbar.

Pumping Speeds	at 0.5 mbar	2430 M3 / hr.
	1.0 mbar	2399 M3 / hr.
	2.0 mbar	2278 M3 / hr.
	5.0 mbar	1944 M3 / hr.
	10.0 mbar	1671 M3 / hr.

All functions of System checked and working correctly.



Name : R. Creasey

Signed : *[Signature]*

Position : Quality Engineer

Stamp :



EDWARDS

NGB050100

Edwards High Vacuum International  
Manor Royal, Crawley  
West Sussex  
England, RH10 2LW  
Telephone : (01293) 528844  
Facsimil : (01293) 533453

### CERTIFICATE of TEST

Product Description : EDP200 / EH2600 System.	Certificate No : B302
Product Code No : NCB302000	Customer Order No : PA4006
Serial No : CSM 1166	EHVI Order No : MCB3020

We hereby certify that the above mentioned product has been fully tested and inspected and conforms in all aspects to our drawing N105356000, the test specification shown below, and to the conditions of the contract.

Test Specification:

ENST 0008 pt. 3

DP250 Chemical Drypump ; General Running Specification.

The following results being achieved

ENST 0008 pt. 3	Date of Test.....29th. May 1996.	Unit Serial No. CSM 1166
Ultimate Vacuum	5.0 x 10 <sup>-3</sup> mbar.	
Pumping Speeds	at 0.5 mbar	2400 M3 / hr.
	1.0 mbar	2340 M3 / hr.
	2.0 mbar	2204 M3 / hr.
	5.0 mbar	1830 M3 / hr.
	10.0 mbar	1680 M3 / hr.

All functions of System checked and working correctly.



Name : R. Creasey

Signed : *[Signature]*

Position : Quality Engineer

Stamp :

Quality Systems Certificate Numbers (ISO 9001)  
FS23443 FM21010 FM1011 FM1309 FM5069

For and on behalf of EDWARDS HIGH VACUUM INTERNATIONAL