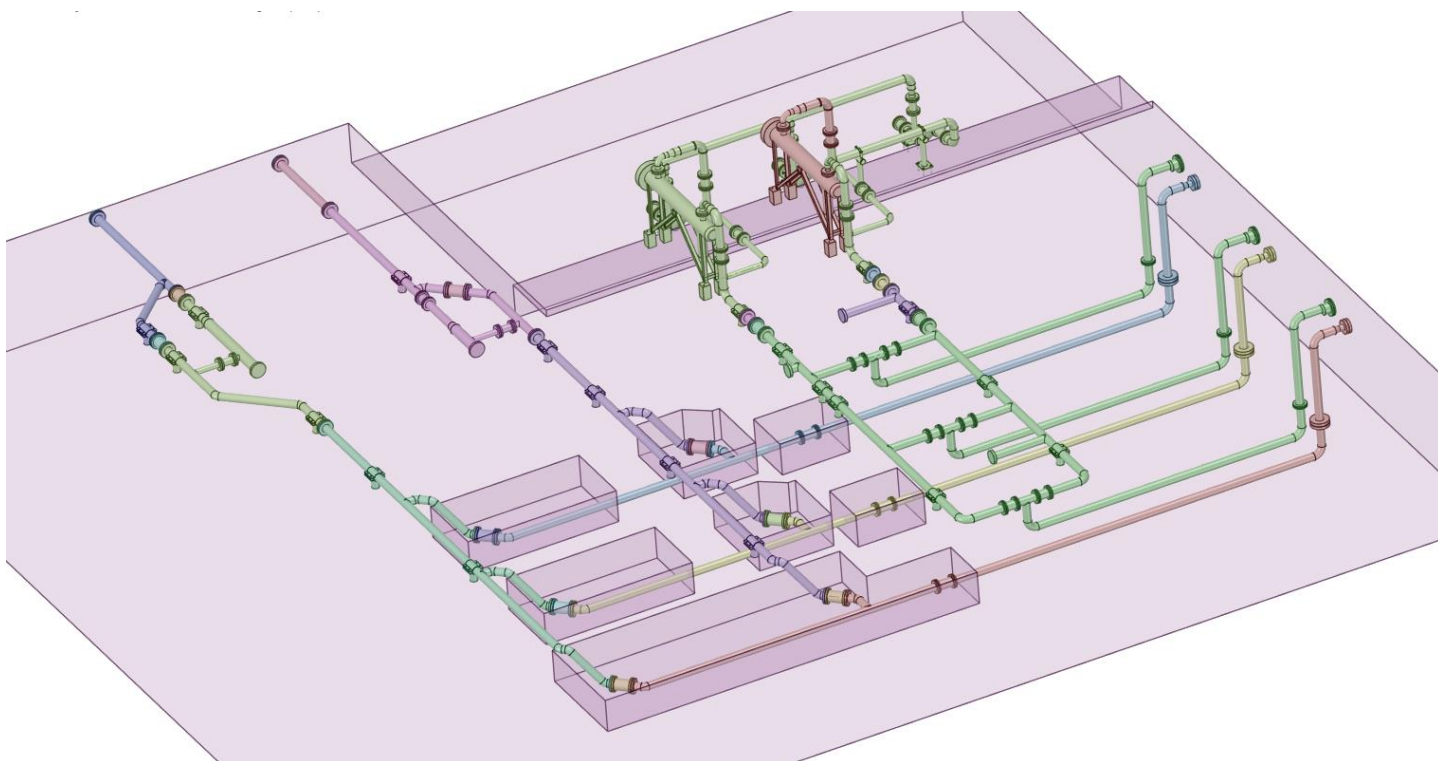


Vibration Measurement Report for OCOLP Piping



Report prepared by: Daniel Solares

Vibration Analyst Certified: Category II

1. Introduction

At the request of the Engineering Management, vibration measurements were carried out on the suction and discharge piping of reciprocating units 1 and 2, which belong to OCOLP 1 and OCOLP 2.

The scope of these measurements includes the following:

- A)** Determine the combination of units, transported product, and speed where the highest vibration values occur in the suction and discharge piping.
- B)** Vibration measurement at 77 points orthogonal to the piping.

2. Data Collection Equipment Configuration

Analysis Mode: Spectral

Maximum Frequency: 1000 Hz

Minimum Frequency: 0.5 Hz

Averaging Type: Normal

Measurement Units: IPS Pk

Number of Averages: 3

Window Type: Hanning

3. Determination of Ideal Conditions for Vibration Recording

After analyzing the combination of units, transported products, and pump speeds, the following conditions were determined:

Pumping Unit 1

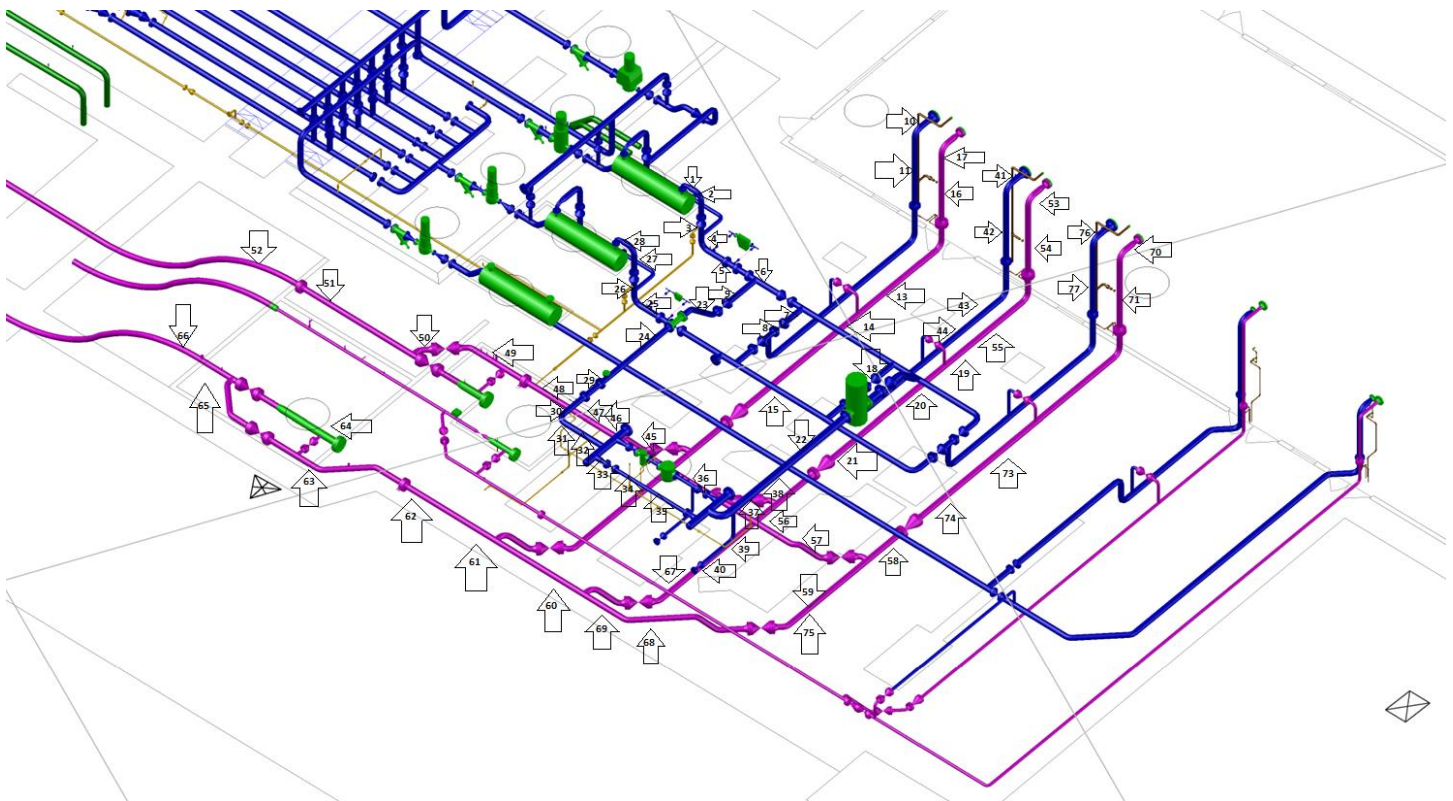
- Product: Gasoline (0.7211 gr/cc)
- Flow: 53.85 sm³/hr
- Suction pressure: 133.8 PSI
- Discharge pressure: 1407 PSI
- Stroke: 27%
- Pump RPM: 182 RPM
- Stroke Length: 7"
- Bore Size: 11/16"
- Plunger/Piston Range: 5.75"
- Pump Type: Vertical Triplex Reciprocating Pump (VTE-H).
- Suction temperature: 25 °C
- Discharge temperatura: 55 °C

Pumping Unit 2

- Product: Gasoline (0.7211 gr/cc)
- Flow: 52.69 sm³/hr
- Suction pressure: 133.9 PSI
- Discharge pressure: 1309 PSI
- Stroke: 38%
- Pump RPM: 247 RPM
- Stroke Length: 7"
- Bore Size: 11/16"
- Plunger/Piston Range: 5.75"
- Pump Type: Vertical Triplex Reciprocating Pump (VTE-H).
- Suction temperature: 23 °C
- Discharge temperatura: 56 °C

4. Detailed Map of Collected Points

Figure 2 details the location of the points collected in the suction and discharge piping. The 77 points were taken in horizontal (H) and vertical (V) directions, orthogonal to the direction of flow.



5. Detail of Analyzed Points

Point	Direction	Max Velocity [IPS Pk]	RMS Velocity [IPS]	Max Frequency [CPM]	Max Frequency [Hz]
1	H	0,210	0,308	1035,68	17,26
1	V	0,175	0,272	3621,17	60,35
2	H	0,273	0,439	3633,19	60,55
2	V	0,107	0,188	5188,44	86,47
3	H	0,420	0,546	2595,50	43,26
3	V	0,356	0,475	3629,94	60,50
4	H	0,175	0,286	3616,49	60,27
4	V	0,271	0,380	3620,13	60,34
5	H	0,127	0,213	5176,59	86,28
5	V	0,154	0,205	3617,38	60,29
6	H	0,049	0,088	2578,84	42,98
6	V	0,154	0,219	5169,84	86,16
7	H	0,094	0,149	2587,47	43,12
7	V	0,062	0,115	2587,00	43,12
8	H	0,050	0,144	3625,09	60,42
8	V	0,069	0,152	5172,11	86,20
9	H	0,108	0,146	3617,06	60,28
9	V	0,013	0,046	9800,55	163,34
10	H	0,296	0,455	3610,15	60,17
10	V	0,100	0,349	9270,47	154,51
11	H	0,450	0,585	3617,02	60,28
11	V	0,176	0,360	6189,67	103,16
12	H	0,178	0,306	3615,80	60,26
12	V	0,110	0,178	2579,59	42,99
13	H	0,154	0,323	20169,70	336,16
13	V	0,063	0,203	8155,35	135,92
14	H	0,010	0,178	3619,28	60,32
14	V	0,114	0,241	4078,28	67,97
15	H	0,056	0,116	3613,95	60,23
15	V	0,076	0,133	4077,21	67,95
16	H	0,781	0,895	4079,58	67,99
16	V	0,212	0,497	6345,19	105,75
17	H	0,511	0,682	4076,14	67,94

Point	Direction	Max Velocity [IPS Pk]	RMS Velocity [IPS]	Max Frequency [CPM]	Max Frequency [Hz]
17	V	0,098	0,309	13135,40	218,92
18	H	0,212	0,243	3614,42	60,24
18	V	0,146	0,216	4079,15	67,99
19	H	0,092	0,209	4076,89	67,95
19	V	0,081	0,183	2724,44	45,41
20	H	0,072	0,185	2718,44	45,31
20	V	0,488	0,530	4075,15	67,92
21	H	0,054	0,145	2579,12	42,99
21	V	0,391	0,450	4073,08	67,88
22	H	0,122	0,199	4079,28	67,99
22	V	0,339	0,413	4077,21	67,95
23	H	0,103	0,216	4079,31	67,99
23	V	0,399	0,448	4082,85	68,05
24	H	0,106	0,152	8182,64	136,38
24	V	0,075	0,127	12236,40	203,94
25	H	0,350	0,395	4080,70	68,01
25	V	0,201	0,283	2042,02	34,03
26	H	0,676	0,725	4082,49	68,04
26	V	0,539	0,592	4077,41	67,96
27	H	0,596	0,658	4090,34	68,17
27	V	0,161	0,243	2043,26	34,05
28	H	0,173	0,204	2596,02	43,27
28	V	0,024	0,048	3627,17	60,45
29	H	0,084	0,123	5171,05	86,18
29	V	0,013	0,035	5181,54	86,36
30	H	0,039	0,059	2588,42	43,14
30	V	0,047	0,053	4089,69	68,16
31	H	0,046	0,071	2598,63	43,31
31	V	0,079	0,084	4083,73	68,06
32	H	0,066	0,082	1039,23	17,32
32	V	0,022	0,040	4082,80	68,05
33	H	0,159	0,189	1036,13	17,27
33	V	0,025	0,043	1552,38	25,87
34	H	0,090	0,131	1038,33	17,31
34	V	0,029	0,049	7782,31	129,71
35	H	0,067	0,101	4083,32	68,06
35	V	0,040	0,061	4759,79	79,33
36	H	0,075	0,108	4080,71	68,01
36	V	0,053	0,076	4081,28	68,02

Point	Direction	Max Velocity [IPS Pk]	RMS Velocity [IPS]	Max Frequency [CPM]	Max Frequency [Hz]
37	H	0,075	0,109	1037,04	17,28
37	V	0,055	0,093	3625,14	60,42
38	H	0,098	0,174	1037,52	17,29
38	V	0,049	0,080	4082,04	68,03
39	H	0,129	0,165	3630,59	60,51
39	V	0,024	0,043	7773,56	129,56
40	H	0,223	0,257	3629,86	60,50
40	V	0,031	0,052	4077,27	67,95
41	H	0,235	0,404	3630,07	60,50
41	V	0,091	0,309	519,14	8,65
42	H	0,471	0,556	3624,67	60,41
42	V	0,276	0,452	5186,93	86,45
43	H	0,006	0,024	21729,40	362,16
43	V	0,014	0,054	21757,10	362,62
44	H	0,007	0,019	44755,50	745,93
44	V	0,014	0,044	6731,47	112,19
45	H	0,041	0,100	10892,40	181,54
45	V	0,053	0,120	10854,60	180,91
46	H	0,166	0,268	5182,99	86,38
46	V	0,187	0,293	2073,80	34,56
47	H	0,262	0,280	5186,20	86,44
47	V	0,059	0,100	6754,85	112,58
48	H	0,151	0,199	2077,95	34,63
48	V	0,070	0,134	3629,79	60,50
49	H	0,115	0,194	1038,36	17,31
49	V	0,085	0,131	1035,54	17,26
50	H	0,067	0,155	1035,77	17,26
50	V	0,042	0,081	4654,42	77,57
51	H	0,098	0,193	6726,14	112,10
51	V	0,111	0,148	5169,35	86,16
52	H	0,102	0,126	6717,92	111,97
52	V	0,154	0,299	5173,52	86,23
53	H	0,248	0,382	7458,85	124,31
53	V	0,103	0,250	4749,73	79,16
54	H	0,118	0,263	3626,24	60,44
54	V	0,248	0,382	7458,85	124,31
55	H	0,103	0,250	4749,73	79,16
55	V	0,098	0,193	6726,14	112,10

Point	Direction	Max Velocity [IPS Pk]	RMS Velocity [IPS]	Max Frequency [CPM]	Max Frequency [Hz]
56	H	0,118	0,263	3623,24	60,39
56	V	0,248	0,382	7458,58	124,31
57	H	0,103	0,250	4749,73	79,16
57	V	0,098	0,193	6726,14	112,10
58	H	0,042	0,081	4654,42	77,57
58	V	0,102	0,126	6717,92	111,97
59	H	0,154	0,299	5173,52	86,23
59	V	0,118	0,263	3623,24	60,39
60	H	0,239	0,448	5417,26	90,29
60	V	0,004	0,014	2049,97	34,17
61	H	0,009	0,027	7461,41	124,36
61	V	0,005	0,013	2057,03	34,28
62	H	0,009	0,029	46788,80	779,81
62	V	0,023	0,071	25470,90	424,52
63	H	0,024	0,063	10851,40	180,86
63	V	0,063	0,173	4088,78	68,15
64	H	0,126	0,173	2061,38	34,36
64	V	0,076	0,180	2034,12	33,90
65	H	0,038	0,097	2039,88	34,00
65	V	0,358	0,674	4742,48	79,04
66	H	0,416	0,621	2036,85	33,95
66	V	0,222	0,465	5424,23	90,40
67	H	0,260	0,322	2038,20	33,97
67	V	0,470	0,721	5425,18	90,42
68	H	0,164	0,273	4073,28	67,89
68	V	0,077	0,180	4071,71	67,86
69	H	0,244	0,331	4065,21	67,75
69	V	0,175	0,325	4745,75	79,10
70	H	0,267	0,314	5429,14	90,49
70	V	0,282	0,384	2032,81	33,88
71	H	0,328	0,393	2035,77	33,93
71	V	0,422	0,594	5421,50	90,36
73	H	0,148	0,282	4746,19	79,10
73	V	0,074	0,149	4070,55	67,84
74	H	0,069	0,176	7461,76	124,36
74	V	0,302	0,488	5422,11	90,37
75	H	0,233	0,458	7458,62	124,31
75	V	0,546	0,897	8135,35	135,59

Point	Direction	Max Velocity [IPS Pk]	RMS Velocity [IPS]	Max Frequency [CPM]	Max Frequency [Hz]
76	H	0,308	0,581	5423,60	90,39
76	V	0,024	0,030	2032,48	33,87
77	H	0,006	0,012	4741,76	79,03
77	V	0,017	0,027	2031,99	33,87

6. Pressure rate of change data

As we discussed in the emails, we do not have the instruments to measure pressure variations at that rate.