

J H Corvell
Sterling

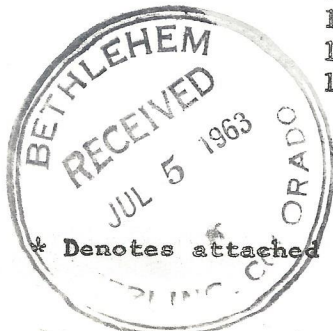
BETHLEHEM STEEL COMPANY
Supply Division
Tulsa, Oklahoma

#20

BETHLEHEM API PUMPING UNITS - ENGINEERING DATA
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Beam Balanced Pumping Unit

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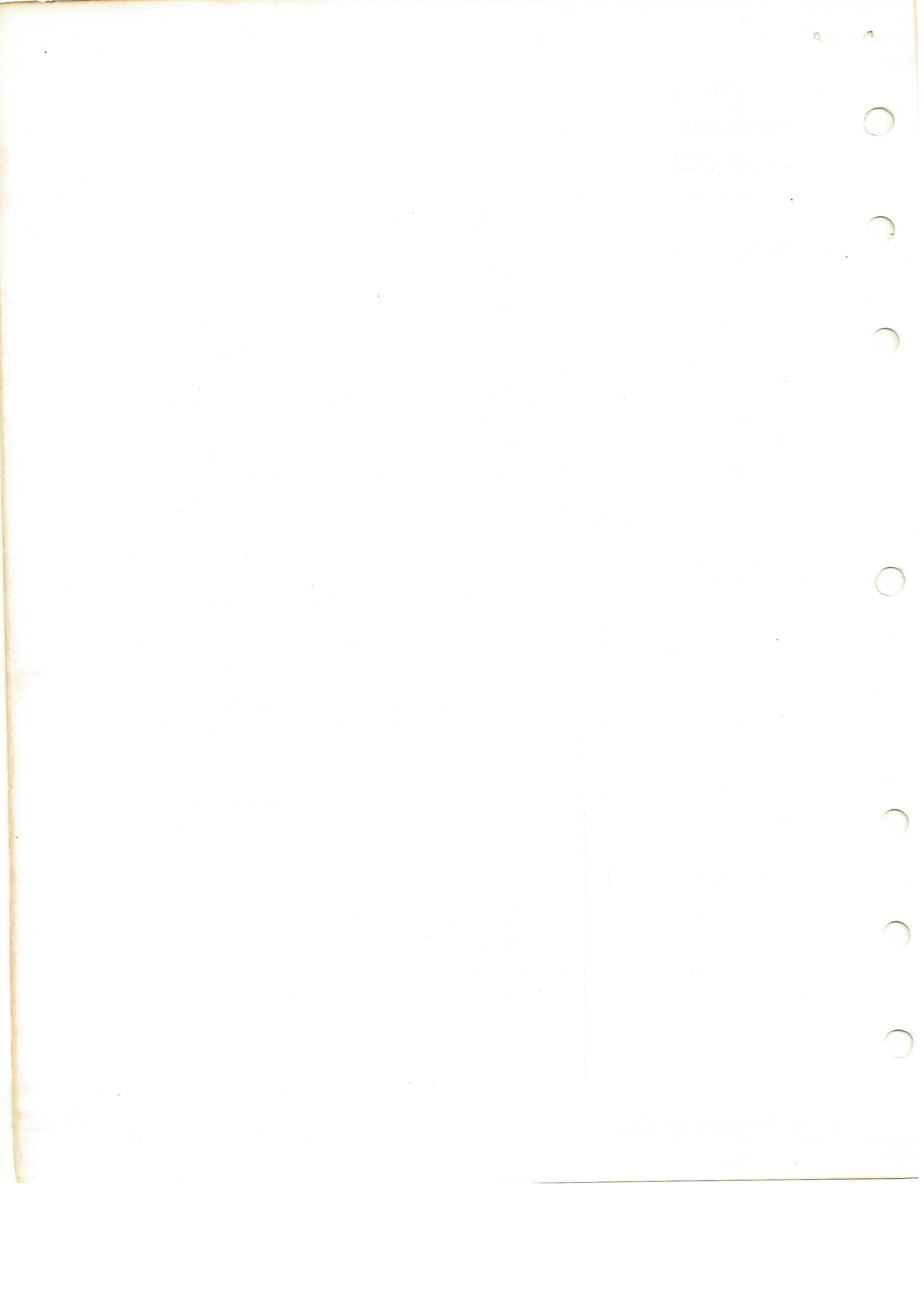
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*Denotes Attached Sheets

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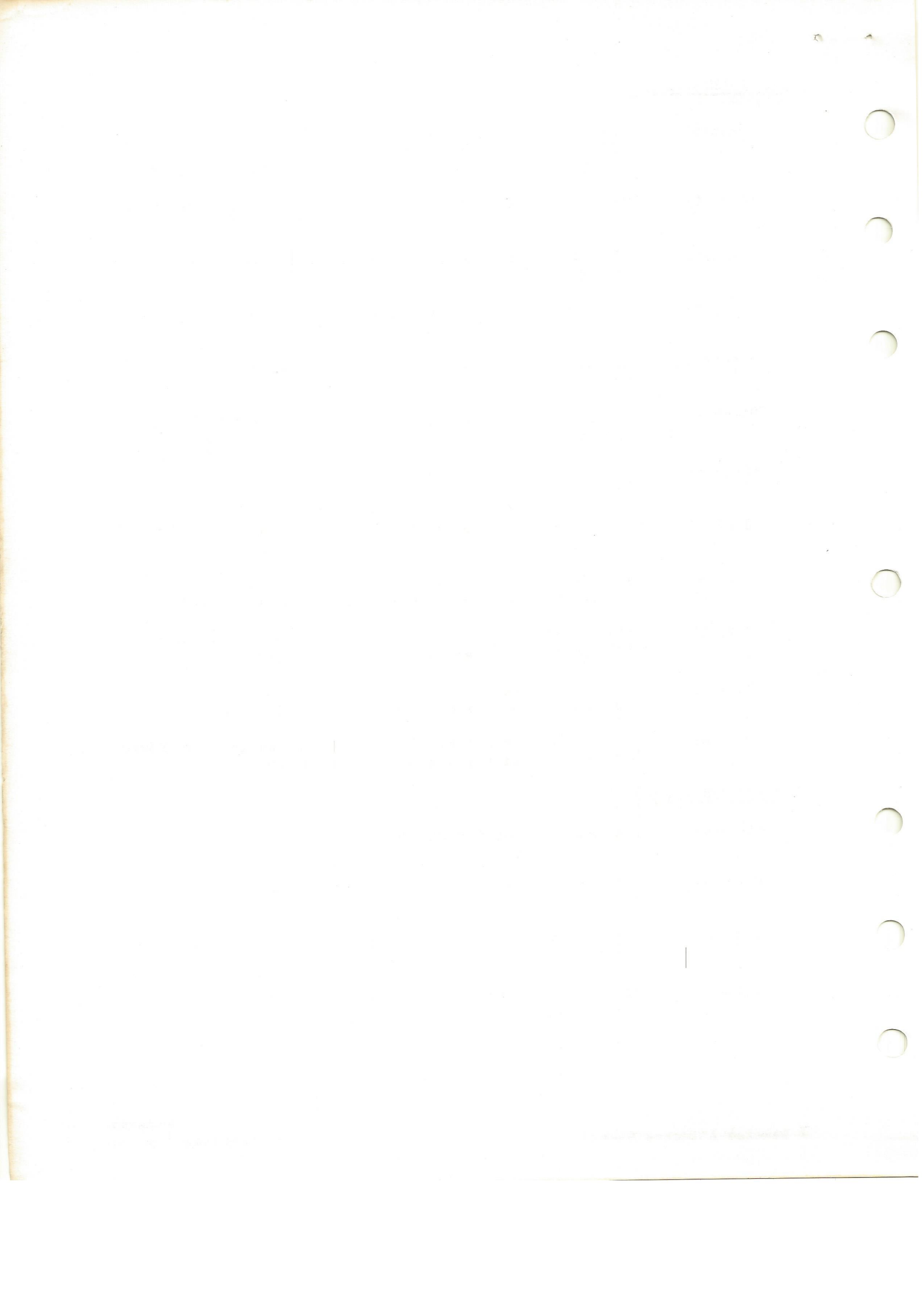
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*Denotes Attached Sheets

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1. The purpose of this document is to provide a comprehensive overview of the current state of the project and to identify the key areas that require attention. This document is intended for the use of the project manager and the steering committee.

2. The project has made significant progress since the last meeting. The initial phase of data collection is complete, and the analysis of the results is well advanced. However, there are several areas that require further investigation and clarification.

3. The first area that requires attention is the definition of the project objectives. It is essential that the objectives are clearly defined and measurable. This will enable us to track progress and ensure that the project is on track to meet the required goals.

4. The second area that requires attention is the allocation of resources. It is important that the resources are allocated efficiently and effectively. This will ensure that the project is completed on time and within budget.

5. The third area that requires attention is the communication plan. It is essential that there is a clear and effective communication plan in place. This will ensure that all stakeholders are kept informed of the progress of the project and that any issues are identified and resolved in a timely manner.

6. The fourth area that requires attention is the risk management plan. It is important that the risks are identified and managed effectively. This will ensure that the project is completed on time and within budget, and that any issues are identified and resolved in a timely manner.

7. The fifth area that requires attention is the quality management plan. It is essential that the quality of the project is maintained throughout. This will ensure that the project meets the required standards and that any issues are identified and resolved in a timely manner.

8. The sixth area that requires attention is the stakeholder management plan. It is important that the stakeholders are identified and managed effectively. This will ensure that the project meets the requirements of all stakeholders and that any issues are identified and resolved in a timely manner.

9. The seventh area that requires attention is the change management plan. It is essential that the changes are managed effectively. This will ensure that the project is completed on time and within budget, and that any issues are identified and resolved in a timely manner.

10. The eighth area that requires attention is the monitoring and reporting plan. It is important that the progress of the project is monitored and reported effectively. This will ensure that the project is completed on time and within budget, and that any issues are identified and resolved in a timely manner.

11. The ninth area that requires attention is the final review and evaluation. It is essential that the project is reviewed and evaluated effectively. This will ensure that the project meets the required standards and that any issues are identified and resolved in a timely manner.

12. The tenth area that requires attention is the lessons learned. It is important that the lessons learned are identified and shared. This will ensure that the project is completed on time and within budget, and that any issues are identified and resolved in a timely manner.

13. The eleventh area that requires attention is the final report. It is essential that the final report is prepared and submitted effectively. This will ensure that the project is completed on time and within budget, and that any issues are identified and resolved in a timely manner.

14. The twelfth area that requires attention is the final review and evaluation. It is essential that the project is reviewed and evaluated effectively. This will ensure that the project meets the required standards and that any issues are identified and resolved in a timely manner.

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Bethlehem PUMPING UNITS

ENGINEERING DATA

25-53-24

API PUMPING UNIT STROKE AND TORQUE FACTORS

1 POSITION OF CRANK DEGREES (1)	2 POSITION OF RODS (2) LENGTH OF STROKE - INCHES			5 TORQUE FACTOR (3) (4) LENGTH OF STROKE - INCHES		
	24"	16"		24"	16"	
	0	0.000	0.000		0.17	0.00
15	0.019	0.020		3.81	2.41	
30	0.080	0.077		7.43	4.60	
45	0.174	0.166		10.16	6.33	
60	0.291	0.278		11.71	7.46	
75	0.418	0.404		12.12	7.94	
90	0.545	0.532		11.63	7.85	
105	0.663	0.655		10.55	7.29	
120	0.767	0.766		9.13	6.37	
135	0.856	0.860		7.48	5.17	
150	0.925	0.932		5.61	3.74	
165	0.974	0.980		3.48	2.11	
180	0.998	1.000		1.01	0.32	
195	0.994	0.989		- 1.81	- 1.58	
210	0.959	0.948		- 4.84	- 3.48	
225	0.892	0.878		- 7.75	- 5.24	
240	0.796	0.780		-10.16	- 6.70	
255	0.679	0.663		-11.80	- 7.71	
270	0.549	0.534		-12.57	- 8.20	
285	0.415	0.401		-12.47	- 8.11	
300	0.287	0.275		-11.54	- 7.45	
315	0.173	0.163		- 9.79	- 6.23	
330	0.082	0.076		- 7.24	- 4.51	
345	0.022	0.019		- 3.97	- 2.38	

- (1) Position of crank is the angular displacement measured clockwise from the 12 o'clock position, viewed with the well head to the right.
- (2) Position is expressed as a fraction (percentage) of stroke above lowermost position.
- (3) Torque factor = $\frac{T}{W}$ where T = torque on pumping-unit reducer due to polished rod load W.
- (4) Negative signs on torque factor indicate a clockwise torque on crankshaft.

$$\text{NET REDUCER TORQUE} = \overline{TF} (W-B) - M \sin \theta$$

Where θ = Position of Crank Degrees (See Col. 1 above)

M = Maximum Moment of Counterbalance (See Page 4)

W = Measured Polish Rod Load (Lbs.) At Position Of Rods Corresponding to θ .

B = Structural Unbalance = 200#

\overline{TF} = Torque Factor Corresponding to θ .

MEMORANDUM FOR THE RECORD

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Bethlehem PUMPING UNITS

ENGINEERING DATA

40-67-30
25-67-30

25-53-30
25-43-30

API PUMPING UNIT STROKE AND TORQUE FACTORS

1	2	3	4	5	6	7
POSITION OF CRANK DEGREES (1)	POSITION OF RODS (2)			TORQUE FACTOR (3) (4)		
	LENGTH OF STROKE - INCHES			LENGTH OF STROKE - INCHES		
	30"	20"		30"	20"	
0	0.000	0.000		0.21	0.00	
15	0.019	0.020		4.76	3.01	
30	0.080	0.077		9.28	5.75	
45	0.174	0.166		12.70	7.91	
60	0.291	0.278		14.64	9.32	
75	0.418	0.404		15.14	9.93	
90	0.545	0.532		14.53	9.81	
105	0.663	0.655		13.19	9.11	
120	0.767	0.766		11.41	7.96	
135	0.856	0.860		9.35	6.46	
150	0.925	0.932		7.01	4.68	
165	0.974	0.980		4.35	2.64	
180	0.998	1.000		1.26	0.40	
195	0.994	0.989		- 2.26	- 1.98	
210	0.959	0.948		- 6.05	- 4.36	
225	0.892	0.878		- 9.69	- 6.55	
240	0.796	0.780		-12.70	- 8.37	
255	0.679	0.663		-14.75	- 9.64	
270	0.549	0.534		-15.71	-10.25	
285	0.415	0.401		-15.59	-10.14	
300	0.287	0.275		-14.42	- 9.31	
315	0.173	0.163		-12.23	- 7.79	
330	0.082	0.076		- 9.05	- 5.64	
345	0.022	0.019		- 4.97	- 2.80	

- (1) Position of crank is the angular displacement measured clockwise from the 12 o'clock position, viewed with the well head to the right.
- (2) Position is expressed as a fraction (percentage) of stroke above lowermost position.
- (3) Torque factor = $\frac{T}{W}$ where T = torque on pumping-unit reducer due to polished rod load W.
- (4) Negative signs on torque factor indicate a clockwise torque on crankshaft.

$$\text{NET REDUCER TORQUE} = \overline{TF} (W-B) - M \sin \theta$$

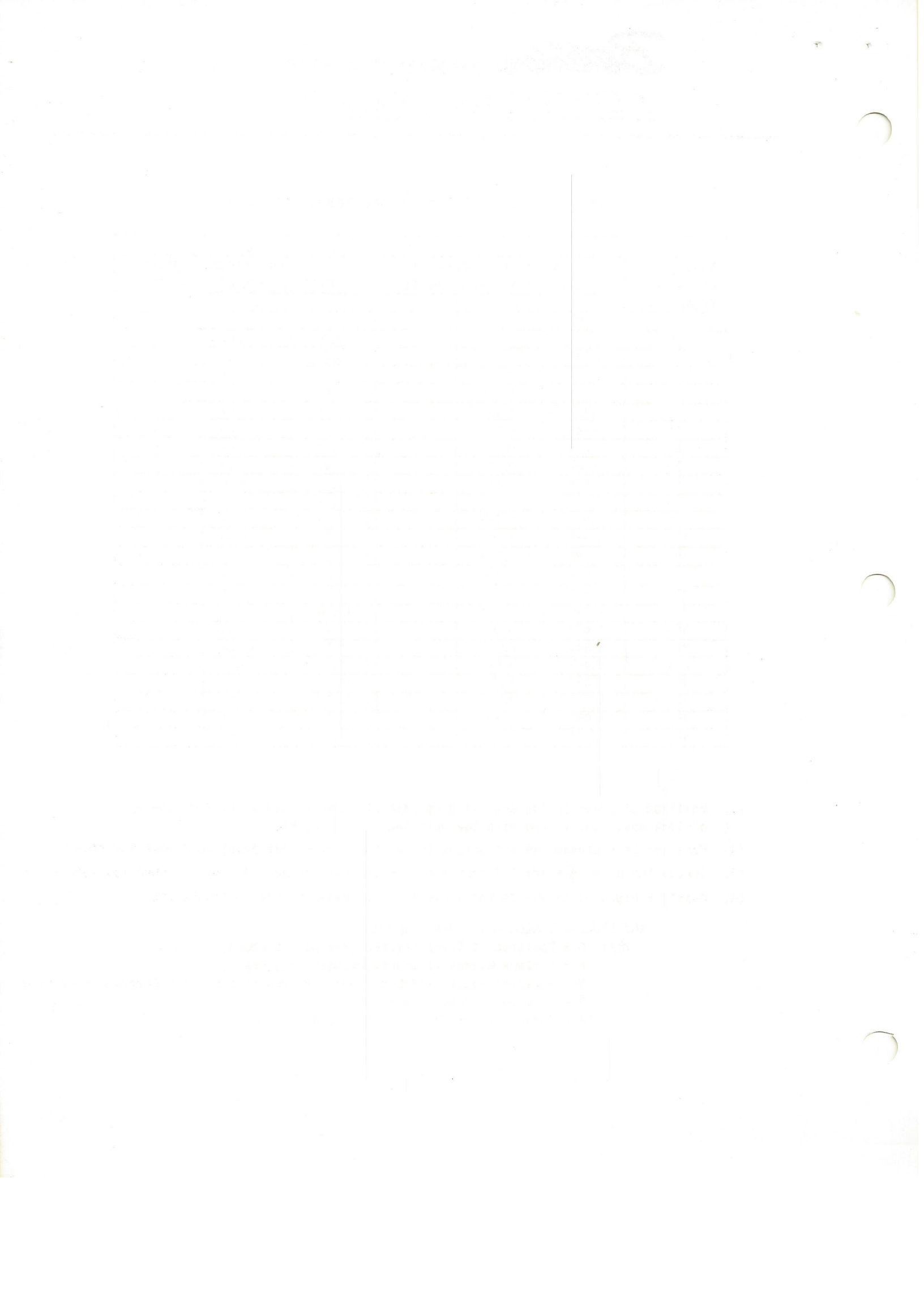
Where θ = Position of Crank Degrees (See Col. 1 above)

M = Maximum Moment of Counterbalance (See Page 4)

W = Measured Polish Rod Load (Lbs.) At Position Of Rods Corresponding to θ .

B = Structural Unbalance = 150#

\overline{TF} = Torque Factor Corresponding to θ .



Bethlehem PUMPING UNITS

ENGINEERING DATA

57-89-36
40-89-36

40-67-36
25-67-36

40-56-36
25-56-36

API PUMPING UNIT STROKE AND TORQUE FACTORS

1 POSITION OF CRANK DEGREES (1)	2 POSITION OF RODS (2) LENGTH OF STROKE - INCHES			5 TORQUE FACTOR (3) (4) LENGTH OF STROKE - INCHES		
	36"	28"	20"	36"	28"	20"
	0	0.000	0.000	0.000	- 0.73	- 0.28
15	0.018	0.019	0.019	5.79	4.39	3.01
30	0.081	0.080	0.077	11.85	8.65	5.81
45	0.181	0.175	0.168	16.33	11.92	8.03
60	0.306	0.294	0.282	18.57	13.80	9.45
75	0.438	0.425	0.410	18.69	14.30	10.03
90	0.566	0.554	0.540	17.37	13.68	9.86
105	0.681	0.674	0.663	15.30	12.32	9.07
120	0.781	0.779	0.774	12.92	10.52	7.85
135	0.863	0.866	0.866	10.44	8.44	6.29
150	0.927	0.934	0.936	7.85	6.14	4.49
165	0.973	0.979	0.982	5.01	3.61	2.48
180	0.997	0.999	1.000	1.74	0.79	0.30
195	0.996	0.992	0.989	- 2.12	- 2.30	- 1.99
210	0.966	0.956	0.948	- 6.50	- 5.55	- 4.27
225	0.904	0.891	0.879	-10.96	- 8.69	- 6.40
240	0.813	0.798	0.783	-14.81	-11.40	- 8.19
255	0.698	0.683	0.668	-17.51	-13.35	- 9.48
270	0.569	0.555	0.540	-18.88	-14.39	-10.14
285	0.435	0.422	0.407	-18.93	-14.42	-10.11
300	0.305	0.293	0.280	-17.74	-13.45	- 9.35
315	0.188	0.178	0.167	-15.32	-11.48	- 7.87
330	0.092	0.085	0.078	-11.64	- 8.54	- 5.74
345	0.027	0.023	0.021	- 6.72	- 4.73	- 3.07

- (1) Position of crank is the angular displacement measured clockwise from the 12 o'clock position, viewed with the well head to the right.
- (2) Position is expressed as a fraction (percentage) of stroke above lowermost position.
- (3) Torque factor = $\frac{T}{W}$ where T = torque on pumping-unit reducer due to polished rod load W.
- (4) Negative signs on torque factor indicate a clockwise torque on crankshaft.

$$\text{NET REDUCER TORQUE} = \overline{TF} (W-B) - M \sin \theta$$

Where θ = Position of Crank Degrees (See Col. 1 above)

M = Maximum Moment of Counterbalance (See Page 4)

W = Measured Polish Rod Load (Lbs.) At Position Of Rods Corresponding to θ .

B = Structural Unbalance = 275#

\overline{TF} = Torque Factor Corresponding to θ .

FINANCIAL STATEMENTS
FOR THE YEAR ENDED 31st DECEMBER 1983

The following table shows the financial results of the Company for the year ended 31st December 1983. The figures are in thousands of pounds sterling.

Particulars	1983	1982
Revenue	1,200	1,100
Cost of sales	(800)	(750)
Gross profit	400	350
Operating expenses	(250)	(220)
Operating profit	150	130
Finance income	20	10
Finance charges	(10)	(5)
Profit before tax	160	135
Income tax	(40)	(35)
Profit after tax	120	100
Dividends paid	(80)	(70)
Retained profit	40	30

Particulars	1983	1982
Fixed assets	500	450
Current assets	200	180
Current liabilities	(100)	(90)
Net assets	600	540

The above figures are based on the accounts of the Company for the year ended 31st December 1983, which have been audited by Messrs. [Name of Auditor] and found to be correct.

Signed: _____
Director

Signed: _____
Secretary

Bethlehem PUMPING UNITS

ENGINEERING DATA

57-89-42

57-76-42

40-89-42

40-76-42

API PUMPING UNIT STROKE AND TORQUE FACTORS

1 POSITION OF CRANK DEGREES (1)	2 POSITION OF RODS (2) LENGTH OF STROKE - INCHES			5 TORQUE FACTOR (3) (4) LENGTH OF STROKE - INCHES		
	42"	33"	23"	42"	33"	23"
	0	0.000	0.000	0.000	- 0.85	- 0.32
15	0.018	0.019	0.019	6.76	5.12	3.52
30	0.081	0.080	0.077	13.82	10.10	6.78
45	0.181	0.175	0.168	19.05	13.91	9.37
60	0.306	0.294	0.282	21.66	16.10	11.03
75	0.438	0.425	0.410	21.81	16.68	11.71
90	0.566	0.554	0.540	20.27	15.96	11.50
105	0.681	0.674	0.663	17.85	14.37	10.59
120	0.781	0.779	0.774	15.08	12.27	9.15
135	0.863	0.866	0.866	12.18	9.85	7.34
150	0.927	0.934	0.936	9.16	7.17	5.23
165	0.973	0.979	0.982	5.85	4.21	2.89
180	0.997	0.999	1.000	2.03	0.92	0.35
195	0.996	0.992	0.989	- 2.47	- 2.68	- 2.32
210	0.966	0.956	0.948	- 7.59	- 6.47	- 4.98
225	0.904	0.891	0.879	- 12.79	- 10.14	- 7.46
240	0.813	0.798	0.783	- 17.28	- 13.30	- 9.56
255	0.698	0.683	0.668	- 20.43	- 15.58	- 11.06
270	0.569	0.555	0.540	- 22.02	- 16.78	- 11.84
285	0.435	0.422	0.407	- 22.08	- 16.82	- 11.79
300	0.305	0.293	0.280	- 20.70	- 15.69	- 10.91
315	0.188	0.178	0.167	- 17.87	- 13.39	- 9.19
330	0.092	0.085	0.078	- 13.58	- 9.96	- 6.70
345	0.027	0.023	0.021	- 7.84	- 5.51	- 3.59

- (1) Position of crank is the angular displacement measured clockwise from the 12 o'clock position, viewed with the well head to the right.
- (2) Position is expressed as a fraction (percentage) of stroke above lowermost position.
- (3) Torque factor = $\frac{T}{W}$ where T = torque on pumping-unit reducer due to polished rod load W.
- (4) Negative signs on torque factor indicate a clockwise torque on crankshaft.

$$\text{NET REDUCER TORQUE} = \overline{TF} (W-B) - M \sin \theta$$

Where θ = Position of Crank Degrees (See Col. 1 above)

M = Maximum Moment of Counterbalance (See Page 4)

W = Measured Polish Rod Load (Lbs.) At Position Of Rods Corresponding to θ .

B = Structural Unbalance = 150#

\overline{TF} = Torque Factor Corresponding to θ .

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Bethlehem PUMPING UNITS

ENGINEERING DATA

80-109-42

57-109-42

API PUMPING UNIT STROKE AND TORQUE FACTORS

1	2			3			4	5			6	7
POSITION OF CRANK DEGREES (1)	POSITION OF RODS (2)						TORQUE FACTOR (3) (4)					
	LENGTH OF STROKE - INCHES						LENGTH OF STROKE - INCHES					
	42"	32"	22"	42"	32"	22"	42"	32"	22"	42"	32"	22"
0	0.000	0.000	0.000	- 1.04	- 0.41	- 0.10						
15	0.017	0.018	0.019	6.65	4.95	3.27						
30	0.080	0.079	0.076	13.86	9.87	6.35						
45	0.181	0.174	0.166	19.22	13.66	8.80						
60	0.307	0.294	0.281	21.89	15.85	10.40						
75	0.440	0.425	0.408	22.01	16.44	11.07						
90	0.569	0.555	0.539	20.39	15.73	10.90						
105	0.685	0.676	0.663	17.87	14.15	10.05						
120	0.784	0.781	0.774	15.02	12.04	8.68						
135	0.866	0.869	0.867	12.06	9.61	6.94						
150	0.930	0.935	0.937	8.99	6.95	4.93						
165	0.974	0.980	0.982	5.68	4.02	2.68						
180	0.997	0.999	1.000	1.89	0.81	0.27						
195	0.996	0.992	0.988	- 2.54	- 2.69	- 2.24						
210	0.966	0.956	0.947	- 7.53	- 6.34	- 4.73						
225	0.905	0.890	0.877	- 12.62	- 9.87	- 7.04						
240	0.814	0.798	0.782	- 17.06	- 12.92	- 8.98						
255	0.701	0.684	0.667	- 20.24	- 15.15	- 10.39						
270	0.573	0.557	0.540	- 21.90	- 16.36	- 11.12						
285	0.440	0.424	0.408	- 22.04	- 16.45	- 11.09						
300	0.310	0.295	0.281	- 20.74	- 15.38	- 10.27						
315	0.192	0.180	0.168	- 18.00	- 13.17	- 8.66						
330	0.095	0.087	0.079	- 13.77	- 9.83	- 6.33						
345	0.028	0.024	0.021	- 8.05	- 5.49	- 3.41						

- (1) Position of crank is the angular displacement measured clockwise from the 12 o'clock position, viewed with the well head to the right.
- (2) Position is expressed as a fraction (percentage) of stroke above lowermost position.
- (3) Torque factor = $\frac{T}{W}$ where T = torque on pumping-unit reducer due to polished rod load W.
- (4) Negative signs on torque factor indicate a clockwise torque on crankshaft.

$$\text{NET REDUCER TORQUE} = \overline{TF} (W-B) - M \sin \theta$$

Where θ = Position of Crank Degrees (See Col. 1 above)

M = Maximum Moment of Counterbalance (See Page 4)

W = Measured Polish Rod Load (Lbs.) At Position Of Rods Corresponding to θ .

B = Structural Unbalance = 500#

\overline{TF} = Torque Factor Corresponding to θ .

1952

Dear Mr. [Name],

I have received your letter of the 15th and am sorry that I cannot give you a more definite answer at this time. The matter is being reviewed and I will be in touch with you again as soon as a final decision has been reached.

Very truly yours,

[Signature]

Yours faithfully,

[Signature]

Bethlehem PUMPING UNITS

ENGINEERING DATA

80-109-48

80-95-48

57-109-48

57-95-48

API PUMPING UNIT STROKE AND TORQUE FACTORS

1 POSITION OF CRANK DEGREES (1)	2 POSITION OF RODS (2) LENGTH OF STROKE - INCHES			5 TORQUE FACTOR (3) (4) LENGTH OF STROKE - INCHES		
	3			6		
	48"	37"	25"	48"	37"	25"
0	0.000	0.000	0.000	- 1.19	- 0.46	- 0.12
15	0.017	0.018	0.019	7.60	5.65	3.74
30	0.080	0.079	0.076	15.84	11.28	7.26
45	0.181	0.174	0.166	21.96	15.61	10.06
60	0.307	0.294	0.281	25.02	18.12	11.89
75	0.440	0.425	0.408	25.16	18.79	12.65
90	0.569	0.555	0.539	23.30	17.98	12.46
105	0.685	0.676	0.663	20.43	16.17	11.48
120	0.784	0.781	0.774	17.16	13.76	9.92
135	0.866	0.869	0.867	13.78	10.99	7.94
150	0.930	0.935	0.937	10.28	7.94	5.63
165	0.974	0.980	0.982	6.49	4.60	3.07
180	0.997	0.999	1.000	2.16	0.92	0.31
195	0.996	0.992	0.988	- 2.90	- 3.07	- 2.55
210	0.966	0.956	0.947	- 8.61	- 7.25	- 5.40
225	0.905	0.890	0.877	- 14.42	- 11.28	- 8.04
240	0.814	0.798	0.782	- 19.50	- 14.77	- 10.27
255	0.701	0.684	0.667	- 23.13	- 17.32	- 11.87
270	0.573	0.557	0.540	- 25.02	- 18.70	- 12.71
285	0.440	0.424	0.408	- 25.19	- 18.79	- 12.68
300	0.310	0.295	0.281	- 23.70	- 17.58	- 11.74
315	0.192	0.180	0.168	- 20.57	- 15.04	- 9.90
330	0.095	0.087	0.079	- 15.74	- 11.24	- 7.23
345	0.028	0.024	0.021	- 9.20	- 6.28	- 3.89

- (1) Position of crank is the angular displacement measured clockwise from the 12 o'clock position, viewed with the well head to the right.
- (2) Position is expressed as a fraction (percentage) of stroke above lowermost position.
- (3) Torque factor = $\frac{T}{W}$ where T = torque on pumping-unit reducer due to polished rod load W.
- (4) Negative signs on torque factor indicate a clockwise torque on crankshaft.

$$\text{NET REDUCER TORQUE} = \overline{TF} (W-B) - M \sin \theta$$

Where θ = Position of Crank Degrees (See Col. 1 above)

M = Maximum Moment of Counterbalance (See Page 4)

W = Measured Polish Rod Load (Lbs.) At Position Of Rods Corresponding to θ .

B = Structural Unbalance = 400#

\overline{TF} = Torque Factor Corresponding to θ .

OFFICE OF THE ATTORNEY GENERAL

IN SENATE, January 15, 1914.

REPORT OF THE ATTORNEY GENERAL

ON THE SUBJECT OF THE

PROPOSED CHANGES IN THE

CONSTITUTION OF THE STATE

AS REFERRED TO THE SENATE

BY RESOLUTION PASSED

BY THE SENATE ON JANUARY 15, 1914.

ALBANY: JAMES BROWN PUBLISHING CO., 1914.

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RECEIVED JAN 15 1914

STATE OF NEW YORK

OFFICE OF THE ATTORNEY GENERAL

ALBANY, N. Y.

1914

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OFFICE OF THE ATTORNEY GENERAL

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1914

STATE OF NEW YORK

OFFICE OF THE ATTORNEY GENERAL

ALBANY, N. Y.

1914

Bethlehem PUMPING UNITS

ENGINEERING DATA

320-212-86

228-212-86

API PUMPING UNIT STROKE AND TORQUE FACTORS

1 POSITION OF CRANK DEGREES (1)	2 POSITION OF RODS (2) LENGTH OF STROKE - INCHES				3 (4) TORQUE FACTOR (3) (4) LENGTH OF STROKE - INCHES			
	86	74	62	51	86	74	62	51
	0	.000	.000	.000	.000	- 2.28	- 1.39	- 0.78
15	.017	.018	.018	.019	13.52	11.56	9.60	7.66
30	.080	.079	.078	.077	28.37	23.59	19.15	15.02
45	.181	.177	.173	.169	39.40	32.69	26.51	20.81
60	.307	.300	.293	.285	44.82	37.62	30.84	24.44
75	.441	.433	.424	.414	44.96	38.44	32.05	25.80
90	.570	.562	.554	.545	41.53	36.20	30.74	25.16
105	.686	.681	.675	.668	36.33	32.14	27.69	23.00
120	.785	.784	.781	.777	30.49	27.16	23.59	19.77
135	.866	.868	.869	.868	24.49	21.72	18.83	15.79
150	.929	.933	.936	.937	18.31	15.91	13.57	11.24
165	.974	.978	.980	.982	11.62	9.57	7.80	6.23
180	.997	.999	.999	1.000	3.97	2.48	1.47	0.81
195	.996	.994	.991	.989	- 5.04	- 5.47	- 5.38	- 4.90
210	.966	.960	.955	.950	- 15.26	- 14.04	- 12.48	- 10.66
225	.905	.897	.889	.881	- 25.76	- 22.52	- 19.33	- 16.06
240	.815	.806	.796	.787	- 34.81	- 29.88	- 25.21	- 20.66
255	.702	.693	.683	.673	- 41.27	- 35.23	- 29.53	- 24.00
270	.574	.565	.555	.546	- 44.62	- 38.11	- 31.85	- 25.78
285	.441	.432	.423	.413	- 44.92	- 38.37	- 32.01	- 25.80
300	.311	.303	.294	.286	- 42.30	- 36.03	- 29.92	- 23.98
315	.193	.186	.179	.172	- 36.77	- 31.08	- 25.60	- 20.34
330	.096	.091	.086	.082	- 28.22	- 23.52	- 19.11	- 14.98
345	.029	.026	.024	.022	- 16.61	- 13.46	- 10.66	- 8.17
MAXIMUM TORQUE FACTORS								
64.9	.377				45.46			
276.1	.496				-45.16			

- (1) Position of crank is the angular displacement measured clockwise from the 12 o'clock position, viewed with the well head to the right.
- (2) Position is expressed as a fraction (percentage) of stroke above lowermost position.
- (3) Torque factor = $\frac{T}{W}$ where T = torque on pumping-unit reducer due to polished rod load W.
- (4) Negative signs on torque factor indicate a clockwise torque on crankshaft.

$$\text{NET REDUCER TORQUE} = TP (W-B) - M \sin \theta$$

Where θ = Position of Crank Degrees (See Col. 1 above)

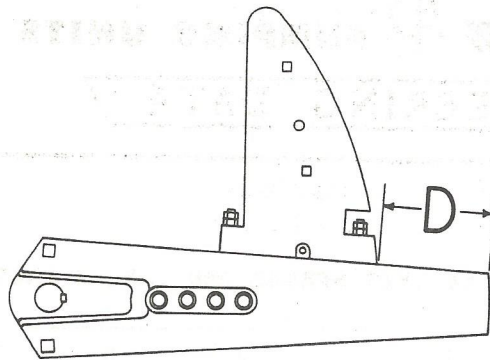
M = Maximum Moment of Counterbalance (See Page 4)

W = Measured Polished Rod Load (Lbs.) At Position Of Rods Corresponding to θ .

B = Structural Rebalance = 500#

TP = Torque Factor Corresponding to θ .

API RATING FORM
FOR
CRANK COUNTERBALANCE



TWO #7478-B CRANKS - TOTAL WEIGHT - 4650# MOMENT - 183,117"#

ABOVE TOTAL WEIGHT AND MOMENT OF TWO #7478-B CRANKS
IS INCLUDED IN FIGURES SHOWN BELOW

Distance "D" Counterweights From End Of Crank	4 Main Weights #78		One Filler Weight #78		4 Main Weights and 12 Filler Weights #78	
	Total Weight	Total Moment	Total Weight	Total Moment	Total Weight	Total Moment
	0"	7,830	378,687	5,055	207,781	12,690
6"	"	359,607	"	205,351	"	626,421
12"	"	340,527	"	202,921	"	578,181
18"	"	321,447	"	200,491	"	529,941
24"	"	302,367	"	198,061	"	481,701
30"	"	283,287	"	195,631	"	433,461
36"	"	264,207	"	193,201	"	385,221
42"	"	245,127	"	190,771	"	336,981
46" (Max.)	"	232,407	"	189,151	"	304,821

Distance "D" Counterweights From End Of Crank	4 Main Weights #68		One Filler Weight #68		4 Main Weights and 12 Filler Weights #68	
	Total Weight	Total Moment	Total Weight	Total Moment	Total Weight	Total Moment
	0"	7,590	366,867	4,948	201,369	11,166
6"	"	349,227	"	199,581	"	546,801
12"	"	331,587	"	197,793	"	507,705
18"	"	313,947	"	196,005	"	468,609
24"	"	296,307	"	194,217	"	429,513
30"	"	278,667	"	192,429	"	389,417
36"	"	261,027	"	190,641	"	351,321
42"	"	243,387	"	188,853	"	312,225
48"	"	225,747	"	187,065	"	273,129

NOTE: To obtain moment of one filler weight deduct moment of cranks (118,117"#) from total moment of one filler weight.

Bethlehem PUMPING UNITS

ENGINEERING DATA

640-365-100

456-365-100

API PUMPING UNIT STROKE AND TORQUE FACTORS

1 POSITION OF CRANK DEGREES (1)	2 POSITION OF RODS (2) LENGTH OF STROKE - INCHES				3 (4) TORQUE FACTOR (3) (4) LENGTH OF STROKE - INCHES			
	100	85	70	56	100	85	70	56
	0	0.000	0.000	0.000	0.000	- 2.25	- 1.30	- 0.67
15	0.018	0.018	0.019	0.019	15.60	13.18	10.77	8.40
30	0.080	0.080	0.079	0.077	32.26	26.54	21.24	16.33
45	0.181	0.177	0.173	0.168	44.61	36.65	29.33	22.58
60	0.306	0.299	0.291	0.283	50.73	42.18	34.14	26.56
75	0.439	0.431	0.421	0.411	50.98	43.20	35.58	28.13
90	0.567	0.560	0.551	0.542	47.24	40.83	34.26	27.55
105	0.683	0.678	0.672	0.665	41.46	36.39	30.99	25.29
120	0.782	0.781	0.779	0.775	34.93	30.87	26.50	21.81
135	0.864	0.866	0.867	0.866	28.17	24.77	21.21	17.47
150	0.928	0.932	0.935	0.936	21.16	18.19	15.32	12.46
165	0.973	0.977	0.980	0.981	13.53	10.99	8.82	6.91
180	0.997	0.999	0.999	1.000	4.76	2.91	1.68	0.89
195	0.996	0.994	0.991	0.989	- 5.61	- 6.16	- 6.04	- 5.44
210	0.967	0.960	0.954	0.949	-17.43	-15.95	-14.04	-11.79
225	0.906	0.896	0.888	0.880	-29.52	-25.61	-21.72	-17.74
240	0.815	0.805	0.795	0.786	-40.00	-33.98	-28.31	-22.77
255	0.701	0.691	0.681	0.671	-47.41	-40.05	-33.11	-26.42
270	0.572	0.563	0.553	0.543	-51.19	-43.26	-35.68	-28.32
285	0.438	0.429	0.420	0.410	-51.43	-43.48	-35.78	-28.28
300	0.308	0.300	0.291	0.283	-48.28	-40.71	-33.35	-26.21
315	0.191	0.184	0.177	0.170	-41.81	-34.98	-28.42	-22.14
330	0.094	0.089	0.084	0.080	-31.91	-26.32	-21.09	-16.22
345	0.028	0.025	0.023	0.021	-18.57	-14.90	-11.64	- 8.75
MAXIMUM TORQUE FACTORS								
65.2	0.378				51.49			
275.6	0.496				-51.75			

- (1) Position of crank is the angular displacement measured clockwise from the 12 o'clock position, viewed with the well head to the right.
- (2) Position is expressed as a fraction (percentage) of stroke above lowermost position.
- (3) Torque factor = $\frac{T}{W}$ where T = torque on pumping-unit reducer due to polished rod load W.
- (4) Negative signs on torque factor indicate a clockwise torque on crankshaft.

$$\text{NET REDUCER TORQUE} = \overline{TF} (W-B) - M \sin \theta$$

Where θ = Position of Crank Degrees (See Col. 1 above)

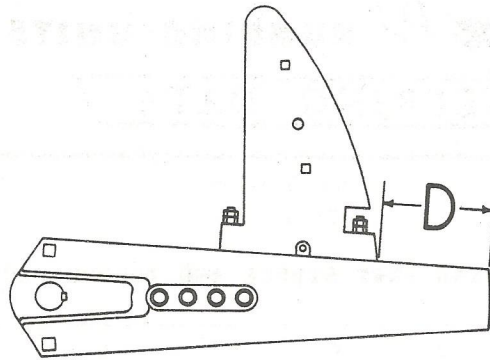
M = Maximum Moment of Counterbalance (See Page 4)

W = Measured Polish Rod Load (Lbs.) At Position Of Rods Corresponding to θ .

B = Structural Unbalance = 700#

\overline{TF} = Torque Factor Corresponding to θ .

API RATING FORM
FOR
CRANK COUNTERBALANCE



TWO #8495-B CRANKS - TOTAL WEIGHT - 7020# - MOMENT - 324,675#

ABOVE TOTAL WEIGHT AND MOMENT OF TWO #8495-B CRANKS
IS INCLUDED IN FIGURES SHOWN BELOW.

Distance "D" Counterweights From End Of Crank	4 Main Weights #95		One Filler Weight #95		4 Main Weights and 12 Filler Weights #95	
	Total Weight	Total Moment	Total Weight	Total Moment	Total Weight	Total Moment
	0"	11,700	687,843	7,515	362,641	17,640
12"	"	631,683	"	356,701	"	1,016,001
18"	"	603,603	"	353,731	"	952,281
24"	"	575,523	"	350,761	"	888,561
30"	"	547,443	"	347,791	"	824,841
36"	"	519,363	"	344,821	"	761,121
42"	"	491,283	"	341,851	"	697,401
48"	"	463,203	"	338,881	"	633,681
54"	"	435,123	"	335,911	"	569,961
60" (Max.)	"	407,043	"	332,941	"	506,241

Distance "D" Counterweights From End Of Crank	4 Main Weights #78		One Filler Weight #78		4 Main Weights and 12 Filler Weights #78	
	Total Weight	Total Moment	Total Weight	Total Moment	Total Weight	Total Moment
	1-1/4"	10,200	571,443	7,425	355,860	15,060
6"	"	556,338	"	353,936	"	907,473
12"	"	537,258	"	351,506	"	859,233
18"	"	518,178	"	349,076	"	810,993
24"	"	499,098	"	346,646	"	762,753
30"	"	480,018	"	344,216	"	714,513
36"	"	460,938	"	341,786	"	666,273
42"	"	441,858	"	339,356	"	618,033
48"	"	422,778	"	336,926	"	569,793
54"	"	403,698	"	334,496	"	521,553
60"	"	384,618	"	332,066	"	473,313
62" (Max.)	"	374,283	"	330,750	"	447,183

NOTE: To obtain moment of one filler weight deduct moment of cranks (324,675"#) from total moment of one filler weight.

Bethlehem PUMPING UNITS

ENGINEERING DATA

640-304-120

456-304-120

API PUMPING UNIT STROKE AND TORQUE FACTORS

1 POSITION OF CRANK DEGREES (1)	2 POSITION OF RODS (2) LENGTH OF STROKE - INCHES				3 (4) TORQUE FACTOR (3) (4) LENGTH OF STROKE - INCHES			
	120	102	85	67	120	102	85	67
	0	0.000	0.000	0.000	0.000	- 2.70	- 1.56	- 0.80
15	0.018	0.018	0.019	0.019	18.74	15.83	12.94	10.09
30	0.080	0.080	0.079	0.077	38.77	31.89	25.52	19.62
45	0.181	0.177	0.173	0.168	53.60	44.03	35.24	27.13
60	0.306	0.299	0.291	0.283	60.95	50.68	41.02	31.92
75	0.439	0.431	0.421	0.411	61.25	51.91	42.75	33.80
90	0.567	0.560	0.551	0.542	56.76	49.06	41.16	33.10
105	0.683	0.678	0.672	0.665	49.82	43.73	37.24	30.38
120	0.782	0.781	0.779	0.775	41.97	37.09	31.84	26.21
135	0.864	0.866	0.867	0.866	33.85	29.76	25.49	20.99
150	0.928	0.932	0.935	0.936	25.42	21.86	18.41	14.97
165	0.973	0.977	0.980	0.981	16.26	13.21	10.60	8.30
180	0.997	0.999	0.999	1.000	5.72	3.50	2.02	1.07
195	0.996	0.994	0.991	0.989	- 6.74	- 7.40	- 7.25	- 6.53
210	0.967	0.960	0.954	0.949	-20.94	-19.16	-16.87	-14.17
225	0.906	0.896	0.888	0.880	-35.47	-30.78	-26.09	-21.31
240	0.815	0.805	0.795	0.786	-48.07	-40.83	-34.01	-27.36
255	0.701	0.691	0.681	0.671	-56.96	-48.12	-39.79	-31.74
270	0.572	0.563	0.553	0.543	-61.51	-51.98	-42.87	-34.03
285	0.438	0.429	0.420	0.410	-61.79	-52.24	-42.99	-33.98
300	0.308	0.300	0.291	0.283	-58.02	-48.92	-40.08	-31.50
315	0.191	0.184	0.177	0.170	-50.24	-42.04	-34.15	-26.61
330	0.094	0.089	0.084	0.080	-38.35	-31.63	-25.34	-19.49
345	0.028	0.025	0.023	0.201	-22.32	-17.90	-13.98	-10.52
MAXIMUM TORQUE FACTORS								
65.2	0.378				61.87			
275.6	0.496				-62.18			

- (1) Position of crank is the angular displacement measured clockwise from the 12 o'clock position, viewed with the well head to the right.
- (2) Position is expressed as a fraction (percentage) of stroke above lowermost position.
- (3) Torque factor = $\frac{T}{W}$ where T = torque on pumping-unit reducer due to polished rod load W.
- (4) Negative signs on torque factor indicate a clockwise torque on crankshaft.

$$\text{NET REDUCER TORQUE} = \overline{TF} (W-B) - M \sin \theta$$

Where θ = Position of Crank Degrees (See Col. 1 above)

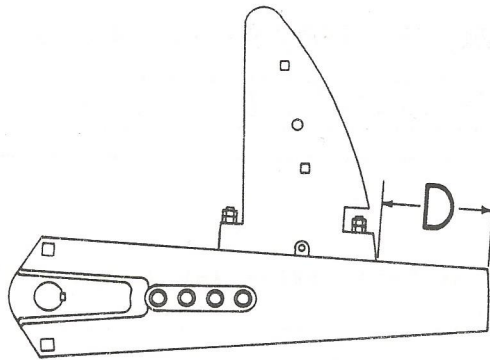
M = Maximum Moment of Counterbalance (See Page 4)

W = Measured Polish Rod Load (Lbs.) At Position Of Rods Corresponding to θ .

B = Structural Unbalance = 200#

\overline{TF} = Torque Factor Corresponding to θ .

API RATING FORM
FOR
CRANK COUNTERBALANCE



TWO #8495-B CRANKS - TOTAL WEIGHT - 7020# - MOMENT - 324,675"#

ABOVE TOTAL WEIGHT AND MOMENT OF TWO #8495-B CRANKS
IS INCLUDED IN FIGURES SHOWN BELOW

Distance "D" Counterweights From End Of Crank	4 Main Weights #95		One Filler Weight #95		4 Main Weights and 12 Filler Weights #95	
	Total Weight	Total Moment	Total Weight	Total Moment	Total Weight	Total Moment
	0"	11,700	687,843	7,515	362,641	17,640
6"	"	659,763	"	359,671	"	1,079,721
12"	"	631,683	"	356,701	"	1,016,001
18"	"	603,603	"	353,731	"	952,281
24"	"	575,523	"	350,761	"	888,561
30"	"	547,443	"	347,791	"	824,841
36"	"	519,363	"	344,821	"	761,121
42"	"	491,283	"	341,851	"	697,401
48"	"	463,203	"	338,881	"	633,681
54"	"	435,123	"	335,911	"	569,961
60" (Max.)	"	407,043	"	332,941	"	506,241

Distance "D" Counterweights From End Of Crank	4 Main Weights #78		One Filler Weight #78		4 Main Weights and 12 Filler Weights #78	
	Total Weight	Total Moment	Total Weight	Total Moment	Total Weight	Total Moment
	1-1/4"	10,200	571,443	7,425	355,860	15,060
6"	"	556,338	"	353,936	"	907,473
12"	"	537,258	"	351,506	"	859,233
18"	"	518,178	"	349,076	"	810,993
24"	"	499,098	"	346,646	"	762,753
30"	"	480,018	"	344,216	"	714,513
36"	"	460,938	"	341,786	"	666,273
42"	"	441,858	"	339,356	"	618,033
48"	"	422,778	"	336,926	"	569,793
54"	"	403,698	"	334,496	"	521,553
60"	"	384,618	"	332,066	"	473,313
62" (Max.)	"	374,283	"	330,750	"	447,183

NOTE: To obtain moment of one filler weight, deduct moment of cranks (324,675"#) from total moment of one filler weight.

Bethlehem PUMPING UNITS

ENGINEERING DATA

640-356-144
640-304-144

API PUMPING UNIT STROKE AND TORQUE FACTORS

1 POSITION OF CRANK DEGREES (1)	2 POSITION OF RODS (2) LENGTH OF STROKE - INCHES				6 TORQUE FACTOR (3) (4) LENGTH OF STROKE - INCHES			
	3 LENGTH OF STROKE - INCHES				7 LENGTH OF STROKE - INCHES			
	144	124	106	88	144	124	106	88
0	0.000	0.000	0.000	0.000	- 3.69	- 2.31	- 1.34	- 0.69
15	0.017	0.018	0.018	0.019	22.22	19.18	16.13	13.11
30	0.079	0.079	0.078	0.077	46.54	39.13	32.21	25.75
45	0.180	0.177	0.173	0.169	64.60	54.21	44.60	35.68
60	0.306	0.299	0.292	0.285	73.54	62.39	51.85	41.87
75	0.439	0.431	0.423	0.414	73.91	63.80	53.87	44.14
90	0.567	0.561	0.553	0.545	68.47	60.16	51.66	43.00
105	0.683	0.679	0.674	0.668	60.09	53.52	46.58	39.28
120	0.782	0.782	0.780	0.777	50.60	45.34	39.73	33.77
135	0.864	0.867	0.868	0.867	40.77	36.36	31.79	27.01
150	0.929	0.932	0.935	0.936	30.56	26.71	22.98	19.30
165	0.974	0.977	0.980	0.981	19.42	16.12	13.29	10.76
180	0.997	0.999	0.999	1.000	6.59	4.23	2.60	1.49
195	0.996	0.994	0.992	0.990	- 8.51	- 9.15	- 9.02	- 8.32
210	0.965	0.960	0.955	0.950	-25.60	-23.57	-21.08	-18.22
225	0.904	0.896	0.889	0.882	-42.90	-37.76	-32.67	-27.53
240	0.813	0.804	0.796	0.788	-57.76	-49.96	-42.59	-35.41
255	0.699	0.691	0.682	0.673	-68.19	-58.74	-49.79	-41.13
270	0.571	0.563	0.555	0.546	-73.52	-63.37	-53.62	-44.14
285	0.438	0.431	0.422	0.414	-73.86	-63.70	-53.81	-44.14
300	0.309	0.302	0.294	0.286	-69.46	-59.75	-50.27	-41.03
315	0.192	0.185	0.179	0.173	-60.33	-51.52	-43.02	-34.82
330	0.095	0.091	0.086	0.082	-46.28	-38.99	-32.13	-25.68
345	0.029	0.026	0.024	0.022	-27.21	-22.33	-17.95	-14.04
MAXIMUM TORQUE FACTORS								
65.2	0.378				74.65			
275.7	0.495				-74.30			

- (1) Position of crank is the angular displacement measured clockwise from the 12 o'clock position, viewed with the well head to the right.
- (2) Position is expressed as a fraction (percentage) of stroke above lowermost position.
- (3) Torque factor = $\frac{T}{W}$ where T = torque on pumping-unit reducer due to polished rod load W.
- (4) Negative signs on torque factor indicate a clockwise torque on crankshaft.

$$\text{NET REDUCER TORQUE} = \overline{TF} (W-B) - M \sin \theta$$

Where θ = Position of Crank Degrees (See Col. 1 above)

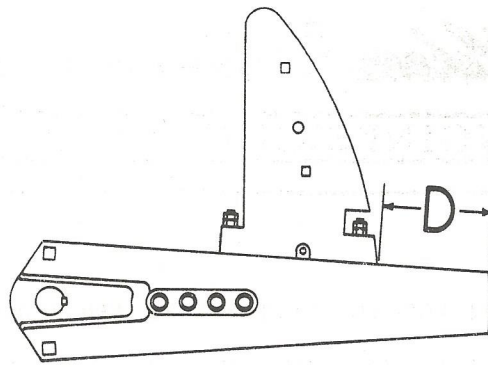
M = Maximum Moment of Counterbalance (See Page 4)

W = Measured Polish Rod Load (Lbs.) At Position Of Rods Corresponding to θ .

B = Structural Unbalance = 500#

\overline{TF} = Torque Factor Corresponding to θ .

API RATING FORM
FOR
CRANK COUNTERBALANCE



TWO #94110-B CRANKS - TOTAL WEIGHT - 8700# MOMENT - 463,275"#"

ABOVE TOTAL WEIGHT AND MOMENT OF TWO #94110-B CRANKS
IS INCLUDED IN FIGURES SHOWN BELOW

Distance "D" Counterweights From End Of Crank	4 Main Weights #95		One Filler Weight #95		4 Main Weights and 16 Filler Weights #95	
	Total Weight	Total Moment	Total Weight	Total Moment	Total Weight	Total Moment
0"	13,380	896,643	9,195	508,666	21,300	1,622,907
12"	"	840,483	"	502,726	"	1,471,707
24"	"	784,323	"	496,786	"	1,320,507
36"	"	728,163	"	490,846	"	1,169,307
48"	"	672,003	"	484,906	"	1,018,107
60"	"	615,843	"	478,966	"	866,907
72"	"	559,683	"	473,026	"	715,707
75" (Max.)	"	545,643	"	471,541	"	677,907

Distance "D" Counterweights From End Of Crank	4 - OARO Weights		4 - OARO Plus 4 - OAS		4 - OARO Plus 4 - OAD	
	Total Weight	Total Moment	Total Weight	Total Moment	Total Weight	Total Moment
0"	19,500	1,373,715	22,844	1,655,447	26,188	1,937,179
12"	"	1,244,115	"	1,485,719	"	1,727,323
24"	"	1,144,515	"	1,315,991	"	1,517,467
36"	"	984,915	"	1,146,263	"	1,307,611
48"	"	855,315	"	976,535	"	1,097,755
60"	"	725,715	"	806,807	"	887,899
72"	"	596,115	"	637,079	"	678,043
80" (Max.)	"	509,715	"	523,927	"	538,139

NOTE: To obtain moment of one filler weight, deduct moment of cranks (463,275"#") from total moment of one filler weight.