EVIDENCE OF THE CAUSE OF SUCKER ROD FAILURES

JAMES M. McGEE
Mobil Oil Corporation

INTRODUCTION

In 1973 and 1974, the petroleum industry experienced shortages of many items which formerly had been available at a reasonable cost. Not the least of these items are sucker rods. Prior to 1972, manufacturers were producing several types of rods in rather large quantities. From time to time, these rods were sold at "bargain basement" prices to reduce their inventories. During this same time, prior to 1972, pulling units were available usually on a day's notice, to do well work at competitive rates. Sucker rod failures and replacement of sucker rods were more of a nuisance to operators than a large expense.

This pre-1972 atmosphere of plenty no longer prevails. Not only has the price of sucker rods increased 60%, but at times the size and type of rod needed is not available. It is also sometimes days or weeks before pulling units are available to fish, pull or repair sucker rod failures in a well. It has become imperative that a concentrated effort be made to eliminate as many sucker rod failures as possible, not only to reduce the direct expense of repair but also downtime and loss of current income. This paper presents one approach to the problem of trying to minimize sucker rod failures.

SUCKER ROD FAILURE REPORTS

Operators have devised different methods for pursuing the cause of sucker rod breaks. Most production foremen keep good records on pumping wells showing when and why they were pulled. These records include information on pump changes, tubing repairs and the fishing of sucker rod parts. The information will generally include the depth of the rod part, the failing member, and the cost of the work to repair it. However, there is usually no notation as to the specific cause of the failure other than sucker rods parted either in the body, coupling or pin. Unless someone personally inspects the break, there is no information with which remedial programs can be designed to prevent future failures.

Some companies have reports in which equipment failures are cataloged by computers in an effort to pinpoint problem areas. Most of the equipment failure reports are only of historic value to determine the success of remedial programs. Specific details as to the reason for the failure, or a description of the failure, are usually not in the report. Therefore, remedial programs for the prevention of failures are not tailored to fit the actual problem. As a result, sucker rod boxes, or whole strings of sucker rods were changed on the basis of past failure history. While this method of maintenance was acceptable when sucker rods were plentiful, it cannot be justified at the present cost and availability of sucker rods and pulling units.

OPERATING PERSONNEL THE KEY

It becomes obvious when studying sucker rod failures that the operating people are the key to the solution of the problem. The key personnel must have the tools, information and desire to attack the problem before it can be solved.

In the last five to ten years, several articles have been published on the causes of sucker rod failures and what can be done to reduce the number of failures. However, dissemination of the contents of these articles has largely been limited to the participants of conventions and short courses. The operating personnel directly responsible for the repair work on wells, as a whole, do not attend these meetings. A concerted effort must be made to present this information to the field personnel in such a manner that they can begin to solve their problems.

THE EVIDENCE

Too many times, people accept the prevailing conditions as incidental to oilfield operations. In reality there are practical and economical solutions to problems if the proper evidence of cause is available. Sucker rod failures were, and in some instances still are, considered a necessary evil to pumping crude oil. However, the evidence gathered indicates that most of the failures can possibly be eliminated.

Not being satisfied with the information in field records and equipment failure reports, a six-county area in West Texas and Southeast New Mexico was selected in which to gather evidence as to the cause of sucker rod failures. The evidence was to be the failing member itself. In the six counties there are 259 active sucker rod pumping wells. In 1973 there were 228 rod parts recorded in the field records. Out of these 228 failures, 190 were closely inspected and the cause of the failure determined. Table 1 is a summary of the 228 failures. It shows that 47% of the failures are the result of handling, running and operating conditions, 48% the result of corrosion and 5% due to wear in crooked holes. Table 2 shows the varying operating conditions of the wells.

In order to have a presentation that would be meaningful, factual and of practical use, it was decided to retain the evidence gathered. The first 104 samples of the sucker rod breaks were cleaned, coated and mounted for future reference.

TABLE 1—CAUSES OF SUCKER ROD FAILURES

259	Active Sucker Rod Pumping Wells
228	Sucker Rod Failures in 1973
96	Wells with One Sucker Rod Failure
48	Wells with More Than One Failure
111	Sucker Rod Coupling Failures - 48.7%
	56 Due to Corrosion
	40 Due to Looseness
	10 Due to Wear
	5 Due to Damage
92	Sucker Rod Body Failures - 46.4%
	54 Due to Corrosion
	37 Due to Bending
	1 Due to Damage
25	Sucker Rod Pin Failures 10.9%
	24 Due to Looseness
	1 Due to Damage

CLASSIFICATION OF THE CAUSE OF FAILURE

The causes of the sucker rod failures in Table 2 were classified as either corrosion, looseness, bending, damage or wear. Tensile stress was not used as a category because no tensile failures were found. A simplified definition follows:

Corrosion

Corrosion reactions taking place at metal-electrolyte interfaces are electrochemical. They produce corrosion products which usually slough-off and leave a pit in the metal. In steel sucker rods, this produces stress concentrations opposite the pit, or the pit acts as a stress raiser. Corrosion failures are most effectively controlled by a comprehensive application of corrosion inhibitor chemicals. Each well, according to its production, has to have a treatment designed especially for it. Many times, this treatment is determined through trial and error; that is, different chemicals in different time periods until a combination is found that minimizes the problem. Samples 14, 20, 22, 24, 29, 31, 32, 34, 35, 42, 44, 51, 58, 61, 62, 67, 68, 69, 70, 71, 72, 75, 76, 78, 79, 80, 93, 94, 100 and 104 are examples of the results of corrosion on sucker rod bodies. Samples 9, 19, 36, 37, 38, 39, 40, 65, 66, 98, 100 and 103 are examples of the results of corrosion on sucker rod couplings.

Looseness

The number one cause of coupling and pin failures is looseness under load. Sucker rod couplings and pins should be made up tight enough so that the pin neck tensile load is greater than any load encountered during operation of the well. This insures that the pin remains straight in the coupling and that the pressure-face friction between the pin shoulder and the coupling shoulder will keep the pin from backing out. Eccentric loading, due to looseness under load, allows the pin to rock back and forth in the coupling. This acts as a stress raiser in either the last full thread root of the pin, or opposite this last full thread in the thread root of the coupling. Looseness can be caused by insufficient make-up of the joint while running the rods, by damage to the pin shoulder face or coupling shoulder face, or by the operating conditions of the well itself. The greater the range of load on the sucker rods from minimum to maximum, the more the rods will stretch or elongate on each stroke. If, through pounding fluid, abnormal load ranges are placed on sucker rods, pin shoulders can separate from coupling shoulders. This allows the pin to back out of the coupling because the pressure-face friction is lost. Samples 1, 4, 25, 41, 45, 46, 48, 54, 55, 59 and 83 are examples of pin failures due to looseness. Samples 5, 6, 7, 8, 13, 16, 17, 18, 28, 33, 47, 50, 64, 81, 89, 95 and 96 are examples of coupling failures due to looseness.

Bending

When a sucker rod is bent, it increases the stress on the concave side of the rod in the area of the bend. This acts as a stress raiser and, eventually, a fatigue crack will appear in the surface of the rod. Bends are caused mostly by handling procedures and by defective or worn rod elevators. Samples 2, 3, 10, 11, 21, 23, 26, 30, 43, 49, 52, 53, 56, 57, 60, 73, 74, 77, 85, 86, 88, 90, 91, 92 and 102 are examples of sucker rod failures due to bending.

Damage

Nicks, dents, and hammer marks can be points where corrosion begins its attack on sucker rods, or they can be stress raisers where fatigue cracks start. Damage to the pressure-face of the pin or coupling can cause the joint to become loose and back out. Samples 12, 15, 84 and 87 are examples of sucker rod failures caused by damage.

Wear

The physical removal of metal from the sucker rod reduces its cross-sectional area, and, thereby, its ability to carry load. Many coupling failures are experienced in crooked holes where the coupling is pulled against the tubing with excessive force. Samples 27, 82 and 99 are examples of sucker rod coupling failures caused by wear.

PROGRAM FOR PREVENTION

The above data, as well as the 104 samples, will be presented in several sessions to field operating personnel. It is the intention of the sessions to provide these people with first-hand experience in examination of the breaks and enough supplementary material already published for them to make field analyses of their problems and instigate solutions. As a result there should be a marked decrease in sucker rod failures.

BIBLIOGRAPHY

1. Steward, W.B.: Sucker-Rod Failures, *Oil & Gas Jour.*, Apr. 9, 1973, p. 53.
2. Moore, Keith H.: Learn to Identify and Remedy Sucker-Rod Failures, *Oil & Gas Jour.*, Apr. 9, 1973, p. 73.
3. Bucaram, S.M.; Byars, H.G.; and Kaplan, M.: Selection, Handling and Protection of Downhole Materials: A Practical Approach, *Materials Protection and Performance,* vol. 12, no. 9, Sept. 1973.
4. Dvoracek, L.M.: Corrosion Fatigue Testing of Oil Well Sucker-Rods, *Materials Protection and Performance,* vol. 12, no. 9, Sept. 1973.
5. API Recommended Practice for Care and Handling of Sucker-Rods, *API RP11BR,* 5th edition, Mar. 1969.

ACKNOWLEDGMENT

Many thanks are in order to Mr. W.B. (Bud) Steward for his help in analyzing the sucker rod failures.

TABLE 2—SUCKER-ROD FAILURE ANALYSIS DATA SHEET

NO.	DATE	DEPTH	LOCATION	SIZE	CAUSE	S. N. DEPTH	PLNG. SIZE	STROKES NO.-LENGTH	API GRADE	REMARKS
1	1-17-73	650	Pin	7/8	Looseness	5595	1.5	12-54	K	
2	1-24-73	5376	Body	3/4	Bent	5550	1.5	18-54	K	
3	2-07-73	5374	Body	3/4	Bent	5550	1.5	18-54	K	
4	1-18-73	325	Pin	3/4	Looseness	2850	1.5	13-34		
5	1-20-73	1600	Box	7/8	Looseness	7443	1.25	8-100		
6	1-31-73	400	Box	3/4	Looseness	3114	1.5	16-64		
7	1-12-73	175	Box	3/4	Looseness	3114	1.5	16-64		
8	2-02-73	1537	Box	3/4	Looseness	3256	1.5	15-54		
9	2-11-73	2150	Box	3/4	Corrosion	2900	1.5	13-64		
10	2-10-73	2	Body	3/4	Bent	3237	1.5	16-34		
11	2-12-73	2	Body	5/8	Bent	3200	1.5	16-44	K	
12	1-23-73	1950	Box	7/8	Damage	8109	1.5	7-120		
13	1-11-73	2600	Box	5/8	Looseness	3200	1.5	16-44		
14	2-21-73	2700	Body	3/4	Corrosion	3298	1.5	15-74	D	
15	1-12-73	925	Box	7/8	Damage	3125	2.0	12-64		
16	2-20-73	2600	Box	7/8	Looseness	4937	1.5	14-54		
17	2-18-73	364	Box	7/8	Looseness	3135	2.0	16-74	K	
18	2-21-73	60	Box	7/8	Looseness	3310	1.5	12-120	K	
19	1-12-73	225	Box	3/4	Corrosion	2900	1.5	14-64		
20	2-13-73	1775	Body	3/4	Corrosion	3100	2.25	12-74	K	
21	2-21-73	2850	Body	3/4	Bent	4800	1.5	14-64	K	
22	2-20-73	875	Body	3/4	Corrosion	4805	1.5	14-64		
23	1-22-73	3375	Body	3/4	Bent	8297	1.25	8-120	D	
24	1-11-73	2425	Body	3/4	Corrosion	2800	1.5	17-54	C	

TABLE 2—SUCKER-ROD FAILURE ANALYSIS DATA SHEET
Continued

NO.	DATE	DEPTH	LOCATION	SIZE	CAUSE	S. N. DEPTH	PLNG. SIZE	STROKES NO.-LENGTH	API GRADE	REMARKS
25	1-08-73	1500	Pin	7/8	Looseness	7860	1.5	10-84	C	
26	1-15-73	7725	Body	3/4	Bent	10450	1.25	8-86		
27	2-11-73	1225	Box	3/4	Wear	3470	1.5	17-54		
28	3-17-73	1175	Box	7/8	Looseness	7533	1.5	11-100		
29	2-27-73	3150	Bocy	3/4	Corrosion	7900	1.5	11-74	D	
30	1-11-73	4	Body	3/4	Bent	2815	1.5	16-54		
31	2-21-73	2000	Body	5/8	Corrosion	3143	1.5	12-44		
32	2-25-73	3400	Body	3/4	Corrosion	4982	1.25	12-64	K	
33	3-26-73	175	Box	7/8	Looseness	7597	1.5	12-84		
34	3-21-73	2775	Body	5/8	Corrosion	3400	1.5	19-44	C	Remainder of Rod looked good
35	3-21-73	2600	Body	3/4	Corrosion	4805	2.0	15-64	K	
36	3-22-73	1525	Box	7/8	Corrosion	3135	2.0	16-74		
37	3-26-73	500	Box	7/8	Corrosion	3135	2.0	16-74		
38	3-29-73	2950	Box	3/4	Corrosion	3341	2.0	18-86		
39	3-03-73	2950	Box	3/4	Corrosion	3341	2.25	11-86		
40	3-26-73	1525	Box	3/4	Corrosion	3100	1.5	12-74	K	
41	3-09-73	25	Pin	3/4	Looseness	2815	1.5	16-54		
42	3-12-73	125	Body	3/4	Corrosion	2800	1.5	16-54	C	
43	3-18-73	300	Body	3/4	Bent	2800	1.5	18-44	C	Well Pounds Badly
44	3-26-73	1350	Body	5/8	Corrosion	3295	1.5	12-34		
45	3-16-73	750	Pin	3/4	Looseness	4820	1.5	12-86	K	
46	4-18-73	0	Pin	7/8	Looseness	5584	1.5	18-54	D	
47	5-11-73	6	Box	7/8	Looseness	7798	1.5	11-72		
48	5-11-73	8450	Pin	3/4	Looseness	10081	1.25	8-86	K	
49	4-05-73	5775	Body	3/4	Bent	8109	1.5	7-120	C	
50	5-22-73	550	Box	3/4	Looseness	3221	1.5	16-54		
51	5-22-73	2766	Body	5/8	Corrosion	2990	1.5	15-42	K	
52	4-05-73	325	Body	3/4	Bent	2850	1.5	13-34	K	
53	3-31-73	2950	Body	5/8	Bent	3295	1.5	12-34	K	
54	5-01-73	400	Pin	7/8	Looseness	6500	1.5	12-120	K	
55	5-05-73	27	Pin	7/8	Looseness	6500	1.5	12-120	K	
56	4-16-73	775	Body	3/4	Bent	4820	1.5	12-86	K	Polish Rod Now Parted
57	5-07-73	2450	Body	3/4	Bent	4937	1.5	14-54	K	
58	4-07-73	2150	Body	3/4	Corrosion	3298	1.5	15-74		Plastic Coated
59	4-30-73	1425	Pin	3/4	Looseness	4820	1.5	12-86	K	
60	5-02-73	1425	Body	3/4	Bent	2800	1.5	16-54	K	Rods Changed Out
61	4-16-73	2337	Body	3/4	Corrosion	2800	1.5	16-54	K	
62	3-06-73	1300	Body	3/4	Corrosion	4805	1.5	15-64		
63	5-04-73	50	Box	7/8	Looseness	3272	1.5	12-64		
64	4-12-73	2400	Box	5/8	Looseness	3200	1.5	16-44		
65	4-30-73	3200	Box	3/4	Corrosion	3341	2.0	11-86		
66	4-12-73	2325	Box	3/4	Corrosion	3100	2.25	12-74		
67	5-09-73	1560	Body	3/4	Corrosion	3333	1.5	12-34	C	
68	4-30-73	1000	Body	3/4	Corrosion	3333	1.5	12-34	C	
69	4-24-73	850	Body	3/4	Corrosion	3333	1.5	12-34	C	
70	4-16-73	2100	Body	3/4	Corrosion	3333	1.5	12-34	C	
71	4-06-73	2000	Body	3/4	Corrosion	3333	1.5	12-34	C	
72	4-04-73	1800	Body	3/4	Corrosion	3333	1.5	12-34	C	
73	4-02-73	625	Body	3/4	Bent	3329	1.5	14-54	C	
74	3-22-73	2875	Body	3/4	Bent	3307	1.5	14-48	K	
75	3-21-73	2775	Body	5/8	Corrosion	3400	1.5	19-44	C	
76	4-06-73	1625	Body	3/4	Corrosion	3329	1.5	14-54	C	
77	4-30-73	1325	Body	3/4	Bent	3400	1.5	15-64	C	
78	4-24-73	2050	Body	3/4	Corrosion	3316	1.5	14-44		
79	5-21-73	2925	Body	3/4	Corrosion	3310	1.5	14-44		
80	5-08-73	3374	Body	5/8	Corrosion	3300	1.5	15-44		
81	7-05-73	2850	Box	3/4	Looseness	7957	1.5	12-84		
82	6-07-73	22	Box	7/8	Wear	9399	1.25	10-86		
83	6-18-73	1500	Pin	7/8	Looseness	7407	1.5	11-74		
84	6-10-73	5300	Body	3/4	Damage	5600	2.0	12-100	C	
85	7-04-73	3275	Body	3/4	Bent	4800	1.5	12-86	K	Body Bent Near Upset
86	5-18-73	1950	Body	7/8	Bent	4800	1.5	7-120	K	
87	7-17-73	450	Pin	7/8	Damage	4800	1.5	12-74	K	
88	6-18-73	650	Body	3/4	Bent	4805	1.5	14-64	K	
89	7-17-73	1300	Box	3/4	Looseness	4805	1.5	14-64		
90	6-13-73	1625	Body	5/8	Bent	2800	1.25	18-44	Spec.	
91	7-27-73	2775	Body	5/8	Bent	2800	1.25	18-44	K	
92	5-26-73	1000	Body	3/4	Bent	2800	1.5	16-54	C	
93	6-12-73	1525	Body	3/4	Corrosion	2924	1.75	17-54	C	
94	7-27-73	1975	Body	3/4	Corrosion	2924	1.75	17-54	C	
95	6-13-73	2100	Box	7/8	Looseness	2856	1.5	15-48		
96	5-18-73		Box	3/4	Looseness	4937	1.5	11-120		
97	7-07-73	2950	Body	3/4	Corrosion	3315	1.5	14-64	C	
98	7-13-73	1000	Box	3/4	Corrosion	3470	1.5	17-54		
99	6-01-73	1100	Box	3/4	Wear	3551	1.5	14-64		
100	5-30-73	1600	Body	3/4	Corrosion	3329	1.5	14-54	C	
101	7-05-73	1375	Box	7/8	Corrosion	3260	1.5	16-64		
102	7-26-73	1431	Body	7/8	Bent	3198	1.5	13-54	K	
103	7-26-73	2000	Box	3/4	Corrosion	2908	1.5	12-54		
104	7-06-73	1525	Body	3/4	Corrosion	2918	1.5	15-54	K	
105	7-14-73	1500	Body	5/8	Corrosion	3205	1.5	13-44		
106	7-11-73	1525	Body	3/4	Bent			10-120	C	Elevator Damage
107	6-02-73	1387	Body	3/4	Corrosion	3321	1.5	16-54		
108	6-20-73	2250	Box	3/4	Wear	3032	1.5	14-64		
109	6-20-73	3000	Body	3/4	Bent	8109	1.5	7-120	D	Elevator Damage
110	8-27-73	825	Box	7/8	Looseness	10386	1.07	8-74	K	
111	10-07-73	2400	Box	7/8	Looseness	7553	1.25	11-100		
112	4-20-73	2800	Pin	3/4	Looseness	7523	1.25	10-100		
113	8-28-73	2515	Box	3/4	Looseness	7540	1.25	10-100		

TABLE 2—SUCKER-ROD FAILURE ANALYSIS DATA SHEET
Continued

NO.	DATE	DEPTH	LOCATION	SIZE	CAUSE	S. N. DEPTH	PLNG. SIZE	STROKES NO.-LENGTH	API GRADE	REMARKS
114	7-24-73	45	Box	7/8	Looseness	7498	1.25	9-100		
115	4-30-73	2100	Pin	3/4	Looseness	7471	1.25	10-74		
116	7-24-73	675	Box	7/8	Looseness	7776	1.25	9-86		
117	8-20-73	425	Box	7/8	Looseness	7443	1.25	8-100		
118	4-05-73	1175	Box	7/8	Looseness	10000	1.5	12-86		
119	7-11-73	2175	Box	7/8	Damage	7594	1.25	10-100		
120	4-08-73	175	Pin	7/8	Looseness	7682	1.25	12-100	D	Undercut Pin. Parted at first thread
121	4-06-73	8	Box	7/8	Looseness	7526	1.25	10-85		
122	8-13-73	1300	Box	7/8	Looseness	6000	1.5	12-86		
123	7-22-73	2000	Box	7/8	Looseness	7660	1.25	11-84		
124	8-06-73	1000	Box	7/8	Looseness	7660	1.25	11-84		
125	5-14-73	1950	Pin	3/4	Looseness	6825	1.25	11-84		
126	9-28-73	1225	Pin	7/8	Looseness	5436	1.5	12-54		
127	12-13-73	750	Box	7/8	Looseness	5595	1.5	12-54		
128	12-15-73	1750	Box	7/8	Looseness	7520	1.25	11-86		
129	10-01-73	5025	Body	3/4	Bent	7588	1.25	9-100	D	
130	11-19-73	575	Pin	7/8	Looseness	7443	1.25	8-100	K	
131	10-18-73	40	Body	7/8	Corrosion	7587	1.25	11-86	D	
132	9-12-73	250	Pin	7/8	Looseness	7587	1.25	11-86	D	Undercut Pin. Parted at First Thread.
133	10-01-73	1850	Body	5/8	Bent	2800	1.5	18-44	Spec	
134	9-19-73	1875	Body	3/4	Corrosion	3316	1.5	14-44	K	
135	7-13-73	1000	Box	3/4	Wear	3470	1.5	14-54		
136	12-27-73	1400	Box	3/4	Wear	3289	1.5	18-34		
137	10-24-73		Box	3/4	Wear	3024	1.5	15-64		
138	10-07-73	2225	Box	5/8	Corrosion	2990	1.5	15-34		
139	10-12-73	1875	Body	5/8	Bent	2990	1.5	15-34		
140	12-29-73	1775	Body	5/8	Corrosion	2990	1.5	15-34		
141	9-28-73	2500	Body	3/4	Corrosion	2821	1.5	15-34		
142	9-21-73	2025	Box	3/4	Damage	2815	2.25	12-64		
143	10-04-73	2000	Body	3/4	Bent	2815	2.25	12-64		
144	10-20-73	3250	Box	5/8	Corrosion	3295	1.5	12-34		
145	9-17-73	10	Body	3/4	Bent	2915	1.5	12-54		
146	10-12-73	1100	Box	3/4	Corrosion	2915	1.5	12-54		
147	11-14-73	2300	Box	3/4	Corrosion	2915	1.5	12-54		
148	12-28-73	15	Body	3/4	Corrosion	2915	1.5	12-54		
149	9-07-73	2350	Box	5/8	Wear	2862	1.5	13-44		
150	9-18-73	3000	Body	3/4	Corrosion	3198	1.5	12-64		
151	10-25-73	3100	Box	3/4	Corrosion	3198	1.5	12-64		
152	8-29-73	300	Box	7/8	Corrosion	3272	1.5	12-64		
153	8-20-73	10	Box	7/8	Corrosion	3272	1.5	12-64		
154	10-14-73	1025	Body	7/8	Bent	3272	1.5	12-64		
155	10-10-73	750	Box	7/8	Corrosion	3272	1.5	12-64		
156	9-05-73	2500	Box	5/8	Corrosion	3200	1.5	16-44		
157	10-05-73	2275	Body	5/8	Corrosion	3200	1.5	16-44		
158	9-23-73	1700	Body	3/4	Corrosion	3341	2.0	11-86	D	Plastic Coated
159	11-22-73	75	Body	7/8	Corrosion	3341	2.0	11-86	D	Plastic Coated
160	11-30-73	1375	Box	7/8	Corrosion	3341	2.0	11-86	D	Plastic Coated
161	12-10-73	50	Box	7/8	Corrosion	3341	2.0	11-86	D	Plastic Coated
162	8-15-73	575	Box	3/4	Corrosion	3341	2.0	11-86	D	Plastic Coated
163	12-17-73	2200	Box	3/4	Corrosion	3130	2.0	10-64		
164	12-27-73	1875	Box	3/4	Corrosion	3130	2.0	10-64		
165	9-12-73	2775	Box	3/4	Corrosion	3130	2.0	10-64		
166	9-19-73	1875	Box	3/4	Corrosion	3130	2.0	10-64		
167	12-13-73	3000	Box	3/4	Corrosion	3143	2.0	14-44		
168	9-28-73	500	Body	7/8	Corrosion	3250	1.5	12-86		
169	9-07-73	825	Box	7/8	Corrosion	3250	1.5	12-86		
170	9-21-73	225	Box	7/8	Corrosion	3250	1.5	12-86		
171	10-14-73	1225	Box	7/8	Corrosion	3250	1.5	12-86		
172	12-08-73	250	Box	7/8	Corrosion	3250	1.5	12-86		
173	12-12-73	300	Box	7/8	Corrosion	3250	1.5	12-86		
174	12-26-73	1225	Box	7/8	Corrosion	3250	1.5	12-86		
175	11-14-73	875	Box	7/8	Corrosion	3250	1.5	12-86		
176	11-21-73	950	Box	7/8	Corrosion	3250	1.5	12-86		
177	10-31-73	2400	Box	3/4	Corrosion	3260	1.5	14-64		
178	8-07-73	2600	Box	3/4	Corrosion	3260	1.5	14-64		
179	9-04-73	750	Box	7/8	Corrosion	3260	1.5	14-64		
180	11-19-73	1050	Box	7/8	Corrosion	3260	1.5	14-64		
181	11-06-73	2700	Box	3/4	Corrosion	3260	1.5	14-64		
182	12-19-73	2025	Box	3/4	Corrosion	3298	1.5	14-74		
183	10-31-73	1425	Box	3/4	Corrosion	3298	1.5	14-74		
184	9-01-73	1575	Box	3/4	Corrosion	3298	1.5	14-74		
185	10-06-73	2125	Body	3/4	Corrosion	3298	1.5	14-74		Plastic Coated
186	10-28-73	2025	Box	3/4	Corrosion	3114	1.5	13-64		
187	11-01-73	1950	Pin	3/4	Looseness	3114	1.5	13-64		
188	9-21-73	1550	Body	3/4	Corrosion	3114	1.5	13-64		
189	11-02-73	500	Box	3/4	Corrosion	3221	1.5	14-54		
190	11-29-73	2150	Body	3/4	Corrosion	3221	1.5	14-54		