ROD PUMP SHOP AUDITS and PERFORMANCE REQUIREMENTS

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Abstract

As part of the effort to select an alliance company for handling domestic, downhole, rod pump manufacture, and repair, an audit program was developed. This program was conducted to evaluate six different pump companies that were available at the time. Audits were conducted on over 150 pump shops. The results were used as part of the selection criteria for Conoco's domestic rod pump alliance.

This paper will provide the list of quality, performance, and technical requirements that were originally used to perform these audits. A summary of the findings from the companies in one producing region will be provided. These findings showed a wide variation in skills, training, and quality of the pump shop personnel. Additionally, the original requirements will be updated based on the latest technical requirements in the industry and so that the audit criteria can be used for more producing regions in the world.

Introduction

Selection of an alliance company for supply of any service or equipment usually needs to be based on a variety of requirements in order to determine the best company for the longest term. During the selection of the Alliance Company for Conoco's domestic, downhole, rod pump business, the evaluation criteria included a variety of concerns. These included the quality and manufacture of the original parts, the technical capabilities of the manufacturer, the cost for the original purchase of specified pump types, and the cost for repair of this equipment. These are normal topics typically evaluated for any type of supply. However, we had to develop a checklist approach to evaluate the rod pump shops since these shops usually assembled or repaired the pump at a different location than where the components are made. This checklist contained technical, training program, quality, and performance requirements based on the American Petroleum Institute's standardization requirements found in Spec. 11AX and RP 11AR (ref. 1, 2) coupled with specific quality requirements from API Spec. Q1 (ref. *3)* and specific Conoco Inc.'s technical requirements.

The checklist approach allowed for consistent evaluation of all the necessary requirements and the pump shops. This allowed auditing pump shops that were either controlled/associated with the original equipment manufacturer or independent shops (distributors) that could use parts from various manufacturers. In many instances, the distributor may have more than one shop in a region. When this occurred, audits were performed on the shops that the production fields were using or could potentially use if that company would be selected for the alliance.

The local field Production Technician normally conducted these evaluations. This allowed over 150 shops to be audited in a variety of locations and in a short period (less than two weeks). Additionally,

once this checklist was developed, it was used to do spot audits of originally approved shops and allowed new shops to be audited that were seeking approval.

Checklist Requirements

Table I shows the original checklist. The form starts with information on Conoco's auditor, date, name of shop, and location. The form then provides questions and, in some cases, the appropriate answer so that simple "yes or no" answers or short history information could be recorded. Although the form only lists 12 questions, a number of these have multiple parts associated with the question's topic. These topics cover:

- Experience,
- Shop cleanliness,
- Quality requirements,
- Standard Operating Procedures,
- Training,
- Calibration,
- Pump assembly and teardown equipment, and
- Witness of an actual pump teardown with appropriate questions on the procedures.

Audit Results

Once the checklist was developed and approved for use by the alliance team, audits were performed on the various pump shops. The results of these audits were very informative. Approximately 150 pump shops were audited in less than two weeks. The results showed various manufacturers' and distributors' pump shops could be easily compared. Easy comparisons were due to the consistent questions all auditors asked and providing the appropriate answers. Not only did this provide an easy selection of the pump shop/repair company for the alliance, summarizing the responses from various locations from the same company showed where there were inconsistencies. Our selected downhole rod pump alliance contractor had these inconsistencies brought to their attention and the problems were rectified.

Table II shows an example of summary results from six different distributors in the Permian Basin. All of these shops were authorized facilities for a pump component manufacturer. One distributor had four different shops audited. Another distributor had two shops audited. Four distributors only had one of their shops audited. The responses under a distributing company from the different locations are separated with a slash (/) in the table.

It was expected that the responses would have been similar, especially related to training, quality, technical requirements, and procedures used. However, comparing the different distributors showed that not all were the same. Additionally, comparing different locations for the same distributor showed that all of these shops did not follow the same requirements nor had the latest procedures, quality manuals, or training programs.

New Form

Once we selected our alliance pump shop provider, we were able to work with the Alliance Company to update the form reflecting some additional procedural and new standardization requirements. These

changes were in questions 11, 12cc, and 12ee. Table III presents the final, readily usable form. Changes in font and page margins were included to make this a two-page form, in hopes that others could reproduce and use it inside their organizations.

Conclusions and Recommendations

1. A checklist was developed to easily audit downhole rod pump assembly and teardown facilities.

2. This form allowed many different company personnel to perform consistent audits on over 150 pump shops in domestic North America oil field regions.

3. Other oil companies or even the various distributors could use the final checklist to assure proper procedures, quality, and handling of the major items associated with sucker rod pumps.

4. The API Subcommittee on Field Operating Equipment should consider the final form for potential modification and inclusion in the next issue of RP11AR.

References

1. "Spec. 11AX, Subsurface Sucker Rod Pumps and Fittings," Ninth Edition, American Petroleum Institute, Washington, D. C.
2. "RP 11**AR,** Care and Use of Subsurface Pumps," Third Edition, American Petroleum Institute, Washington, D. C.
3. Spec. Q1, "Quality Programs," Fourth Edition, American Petroleum Institute, Washington, D.C.

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Table 1 - Conoco Inc. Original Pump Shop Checklist

Conoco Auditor: _____ Date: _____

Pump Company *or* Distributor and Location: _____

1. Name of repair technician: _____

2. Years of experience repairing pumps: _____

3. How many years has the repair technician been in that position at the company? _____

4. Is the shop clean? Yes No

5. Is there adequate room to work on all pump sizes? Yes No

6. How often is the shop audited by the parts supplier/ manufacturer? _____

7. Do they have a written quality manual that covers pump shop assembly, teardown, and repair? Yes No

   Ask to see the manual. What is the latest revision date? _____

8. Do they have written standard operating procedures (SOPs) and specifications covering the actual procedures involved in shop assembly, teardown, and repair? Yes No

   Ask to see them. What is the latest revision date? _____

9. Do they have a specific training session for their pump shop employees? Yes No

   How long is the program? _____

   What does it cover?

Visual inspection	Yes	No
Teardown procedures	Yes	No
Selection of materials	Yes	No
Failure analysis	Yes	No
Assembly procedures	Yes	No

10. As part of the quality program, do they have calibration procedures for measuring and testing equipment? Yes No

    How often is the equipment calibrated? _____

    Ask to see the calibration for both the air micrometer used to check barrel wear and a regular micrometer for measuring thickness. Are the dates current? Yes No

    Do the dates reflect the calibration time period said? Yes No

11. Are proper bench vises (which don't mark/indent the part they are holding) used to hold pumps when fittings are being unscrewed? Yes No

    Are proper wrenches (friction not pipe) used? Yes No

12. During the witness of an actual pump teardown and assembly, check if:

aa. Is a log/form used to record the parts and materials the parts are made from that is being placed in a pump? Yes No

bb. Is a log/form used to record the condition of the parts and possible reason for failure when parts are removed from a used pump? Yes No

cc. Ask the pump repair technician; "If not specifically told by the oil company, what is the amount of internal barrel wear that will require the barrel to be replaced?" (0.005 inches is correct.) Did they have the right answer? Yes No

dd. Ask the technician; "If not specifically told by the oil company, what is the amount of plunger outside diameter wear that will require the plunger to be replaced?" (0.002 to 0.003 inches is correct.) Did they have the right answer? Yes No

ee. Ask to witness a ball and seat vacuum test.

How often is the tester calibrated? _____

Is the calibration sticker (or support document) present on the vacuum/pressure gauge? Yes No

Does the calibration date reflect the required schedule? Yes No

What is the amount of vacuum required to make the ball and seat acceptable? _____

ff. Ask the technician; "If not specifically told by the oil company, what is the amount of valve rod/pull tube wear that will require the rod/tube to be replaced?" (Wear more than 20% is correct.) Did they have the right answer? Yes No

Also, ask the technician; "What is the proper spacing between the standing and travelling valves for a collapsed pump?" (1/2 inch is correct.) Did they have the right answer? Yes No

Also, ask the technician and record; "**How** do you determine this spacing?" _____

_____

gg. During re-assembly, are new seating cups put on the pump? Yes No

hh. Are steel brushes used during cleaning of any of the pump parts? Yes No

If yes, on what parts are the brushes used? (Note: they shouldn't be used on the threads.) _____

_____

ii. Are all pump openings wrapped **or** protected against foreign material entry after the pump is assembled? Yes No

jj. Are pumps longer than **16** ft. picked up by at least two locations? Yes No

Are pumps supported by at least three locations during transportation? Yes No

Table 2 - Audit Results From Different Distributors for the Same Manufacturing Company

Question No.	Distributor 1	Distributor 2	Distributor 3	Distributor 4	Distributor 5	Distributor 6
2. yrs. exp.	8/9/2/10	12/38	16	8	11	3
3. yrs. pos.	5/2/2/10	-/38	1.5	3	11	1
4. clean	y/n/y/y	y/y	y	y	n	y
5. adeq room	y/n/y/y	y/y	y	y	y	y
6. audited	n/n/n/n	Yrly/n	Weekly	monthly	n	weekly
7. QA manl.	89/92/90/93	n/n	85	93	n	92
8.SOP manl.	89/89/no/92	n/n	no date	93	n	In QA man.
9. train prog.	y/y/y/y	y/y	y	y	y	y
9. duration	2d/2yr/3d/3d	3mo/1wk	4 wk	4 mo	Not attend	1 yr
10. cal proc.	y/n/y/y	n/n	y	y	n	n
11. vises	y/y/y/y	n/y	y	y	y	y
12.aa.log	y/y/y/y	y/y	y	y	y	y
12.bb.condit	y/y/y/y	y/y	y	y	y	y
12.cc.barrel	n/n/n/y	y/y	y	y	n	y
12.dd.plunger	y/y/y/y	y/y	y	y	y	y
12.ee.calibrat	n/n/n/1yr	New/n	n	n	n	n
12.ee.sticker	n/n/n/n	n/n	n	n	n	n
12.ff.wear	n/n/n/y	n/y	y	y	y	y
12.ff.spacing	y/y/y/n	y/y	y	y	y	n
12.gg.cups	y/y/y/y	y/y	y	y	y	y
12.hh.brushes	y/y/y/y	y/y	y	y	y	y
12.ii.wrapped	y/y/y/y	y/y	y	y	y	y
12.jj.lifted	y/y/y/y	y/y	y	y	y	y
12.jj.support	y/y/y/y	y/y	y	y	y	y

Table 3 - Final, Modified

Pump Shop Checklist

Conoco Auditor: _____ Date: _____

Pump Company or Distributor and Location: _____

1. Name of repair technician: _____

2. Years of experience repairing pumps: _____

3. How many years does the repair technician have in that position at the company? _____

4. Is the shop clean? Yes No

5. Is there adequate room to work on all pump sizes? Yes No

6. How often does the parts supplier/ manufacturer audit the shop? _____

7a. is there a written quality manual that covers pump shop assembly, teardown, and repair? Yes No

7b. Ask to see the manual. What is the latest revision date? _____

8a. Do they have written standard operating procedures (SOPs) and specifications covering the actual procedures involved in shop assembly, teardown, and repair? Yes No

8b. Ask to see them. What is the latest revision date? _____

9a. Do they have a specific training session for their pump shop employees? Yes No

9b. How long is the program? _____

9c. What does it cover?

Visual inspection	Yes	No
Teardown procedures	Yes	No
Selection of materials	Yes	No
Failure analysis	Yes	No
Assembly procedures	Yes	No

10a. As part of the quality program, do they have calibration procedures for their measuring and testing equipment? Yes No

10b. How often is the equipment calibrated? _____

10c. Ask to see the calibration for both the air micrometer used to check barrel wear and a regular micrometer for measuring thickness. Are the dates current? Yes No

10d. Do the dates reflect the calibration time period said? Yes No

11a. Are proper bench vises (which don't mark/indent the part they are holding) used to hold pumps when fittings are being unscrewed? Yes No

11b. Are vise blocks new/not worn and/or is emery cloth not used to shim the blocks which might damage nickel carbide pump barrels? Yes No

11c. Are proper wrenches (friction not pipe) used? Yes No

12. During the witness of an actual, pump tear down and assembly, check if:

aa. Is a log/form used to record the parts and materials the parts are made from that is being placed in a pump? Yes No

bb. Is a log/form used to record the condition of the parts and possible reason for failure when parts are removed from a used pump? Yes No

cc. Ask the pump repair technician; "If not specifically told by the oil company, what is the amount of internal barrel wear that will require the barrel to be replaced?" (0.005 inches is correct for chrome and heat-treated barrels; 0.001 inches is correct for nickel carbide barrels.) Did they have the right answer? Yes No

dd. Ask the technician; "If not specifically told by the oil company, what *is* the amount of plunger outside diameter wear that will require the plunger to be replaced?" (0.002 to 0.003 inches is correct.) Did they have the right answer? Yes No

eel. Ask to witness a ball and seat vacuum test.

ee2. How often is the tester calibrated? _____

ee3. Is the calibration sticker (or support document) present on the vacuum/pressure gauge? Yes No

ee4. Does the calibration date reflect the required schedule? Yes No

ee5. Ask the technician "What is the amount of vacuum required to make the ball and seat acceptable?" (It should be tested dry, without any oil, and in the Permian Basin, hold 18 to 20 inches of water vacuum for 15 to 20 sec. Higher or lower altitudes require decreased or increased pressure, respectively.) Did they have the right answer? Yes No

ffl. Ask the technician; "If not specifically told by the oil company, what is the amount of valve rod/pull tube wear that will require the rod/tube to be replaced?" (Wear more than 20% is correct.) Did they have the right answer? Yes No

ff2. Also, ask the technician; "What is the proper spacing between the standing and travelling valves for a collapsed pump?" (1/2 inch is correct.) Did they have the right answer? Yes No

ff3. Also, ask the technician and record; "How do you determine this spacing?"

_____

_____

gg. During re-assembly, are new seating cups put on the pump? Yes No

hhl. Are steel brushes used during cleaning of any of the pump parts? Yes No

hh2. If yes, on what parts are the brushes used? (Note: they shouldn't be used on the threads.)

_____

ii. Are all pump openings wrapped or protected against foreign material entry after the pump is assembled? Yes No

jjl. Are pumps longer than 16 ft. picked up by at least two locations? Yes No

jj2. Are pumps supported by at least three locations during transportation? Yes No