SUCKER ROD PUMP SHOP RECOMMENDED PRACTICES

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ABSTRACT

Pumps are the heart of a rod pump system, but as operators, how much do you know about the pumps that are being run into your wells and how they are being repaired. This paper will briefly describe pump repair procedures, best practices that the shop should be following, and a pump shop inspection report that helps identify if those procedures are being followed. It will cover what pump failure data should be captured, why it is important, and what type of information may be available in report form. Many operators do not realize that you can gain valuable well and operational data from a pump report besides what is needed to optimize the pump alone. It will also explain how the operator should get involved in the decisions that affect the pump design and repair which can affect costs and run life.

INTRODUCTION

A rod pump is simple in design yet contains multiple components that if not properly selected can result in operational issues, a short pump life, and/or an uphole failure. Therefore, an operator should be closely involved in not only the initial design of a pump but also the repair of that pump.

There are API Recommended Practices that cover the design, repair, and handling of pumps, and can be used to better understand the procedures that pump shops should be following. Many operators often rely on a local pump shop for their expertise, but sometimes that can be lacking so it is imperative that the operator gain and utilize some expertise themselves to better determine if they are getting the best bang for their buck.

In this paper, we will cover some aspects that should be considered when designing a new pump, repairing one, pump shop visits, and reporting. We will not get into a metallurgy or specific pump part discussion or recommendation other than their use to make a point.

API Documents

API Specification 11AX Specification for Subsurface Sucker Rod Pumps and Fittings effective December 2006 provides dimensional requirements for all component parts manufactured under the API monogram program. It provides a description of the standard API pumps along with the letter designation that is used by most pump shops, but it does not delve in metallurgies.

API Recommended Practice 11AR Recommended Practice for Care and Use of Subsurface Pumps reaffirmed April 2008 gives information on the selection, operation, and maintenance of pumps. It describes the standard API pumps and lists the advantages as well as the limitations of each. It discusses common operational problems and their solutions along with some troubleshooting flow charts. It covers pump teardown, inspection, repair, assembly, and record keeping procedures. Pump shops should have a copy of this document or an internal document with references from it on how to conduct pump tear downs. Some auditors will find a pump shop out of compliance if they do not have a copy and that the repair staff does not have access and knowledge of the contents.

PUMP SHOPS

Pump shops include manufacturer's selling their own products, companies that sell their and others parts, and small independent shops that may focus on one or multiple manufacturers. In the Permian Basin, there are typically multiple shops available, but in many of the shale areas the choices are limited. The choice should be based upon performance and costs, but it may be the only choice. However, do not assume that a "brand name" shop will give you exactly what you need for a specific well.

Pump shops will sell the customer what they want whether they agree with the choices or not as the customer is always right. They will recommend choices based upon local experience and knowledge, and if an operator does not provide input, they will build it their way. That is not to say their way is wrong or bad, but it may not be the way the operator wants it as there are almost as many opinions as there are shops. For instance, how much wear do you allow on the plunger and/or barrel before junking it, do you replace any parts based upon run life, do you use "chum" parts, and/or at what point do you build a new pump rather than repair one.

The pump shop should repair pumps according to API procedures, but not all pump shops are equal and some may not follow recommended procedures. Figure 1 is a pump shop inspection form that can be adapted, modified, and used to determine if a shop is following those procedures.

An operator with pump shop input should design a base pump for their wells with guidelines related to when the parts should be replaced. This will be the basis to develop changes related to specific pump pulls, overall part changes based upon performance, and pricing. Figure 2 is an example where an operator specified all new pump components and repair actions. It should be noted that typically the cost of a whole new pump is less than if you build that same pump part by part.

Data should be the number one goal in having the pump brought in to a pump shop and this is where the operator needs to work closely with the shop manager and repair technicians. It is important to make sure you have a clear idea of what you expect them to capture and make sure they are capable and willing to do so. For example will they capture any sand from the pump? Do they have plastic bags or containers for that? Do you need to provide them? Do they personnel know how to read a micrometer? Is it properly stored? Do they have a way to calibrate it regularly? Remember you are asking them to measure the plunger and barrel within thousands of an inch! Is there equipment up to this and can they really do the measurement? So it is important to get to know the repair shop and have them audited by someone who can check that they are qualified and then make sure you make sure they have a clear understanding of what you want. And remember if you ask them to do more make sure you pay them appropriately so they can do the job!

Repair is also important but collecting data is the first step because it will guide you as to the best way to repair the pump if it is going back in the same well or a similar application.

REPORTS

Each new and repaired pump should have a report log similar to the API recommended form shown in Figure 3. While it does not have to be a duplicate of the report, it should at least contain the information shown in the report. The information greatly helps to evaluate part life, damage severity, and serve as a reminder months down the road when that pump is pulled. Associated pictures and failed parts from a pump teardown greatly assist during failure meetings and pump discussions. Digital cameras are everywhere today and adding a few key photographs can be very helpful. It is important to keep the resolution at a medium level to give good detail in a small picture but not so high a resolution so that 3-4 pictures makes the report too large to email.

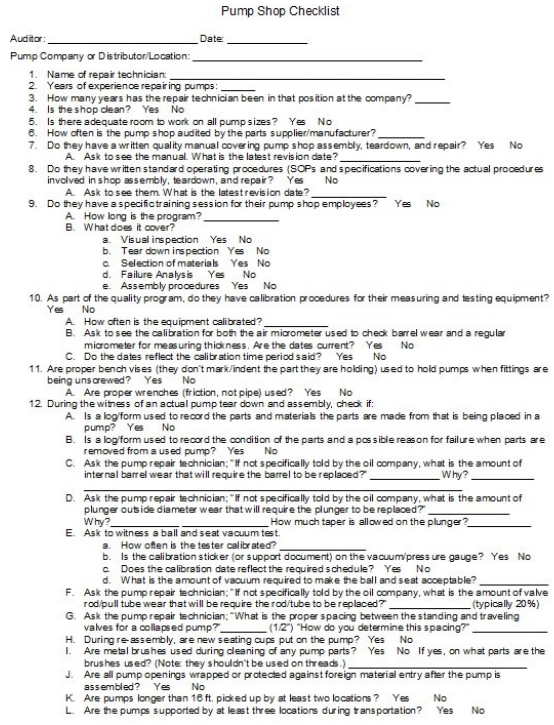
A pump card (Figure 4) should be attached to each pump when delivered. This is critical in knowing that the correct pump is delivered to location as too often miscommunication results in this occurring. This card should contain the proper API description and details of the pump metallurgy, valve configuration, sucker rod connection etc.

Most manufacturers and/or pump shops have reporting systems (pump tracking systems) where the information contained in the pump reports are inputted. These reports should have two sets of data, one a based on the pump number to track every part replaced on the pump. This is important in the life of a pump that may well have every part on it replaced over a span of years with perhaps the exception of the valve rod that might suddenly cause the pump to fail because of cycle fatigue from years and years of use. Without proper tracking this information would be lost. The second set of data is by well, pump number, and date installed/removed. This way you can see what the well itself may be doing to each pump installed either by well conditions or well operation. The reports can vary greatly, but generally they allow an operator to evaluate their pumps by providing the information electronically. This can be critical in determining whether the operator needs to change the metallurgy of any component to optimize the pump. If the reporting system tracks individual parts as shown in the expectant life of that specific part can be assessed resulting in changing that part if it nears or passes its life expectancy to reduce failures.

CONCLUSION

Pumps should be managed in partnership with the pump shop. This requires ownership by both parties and continued communication. Continual improvement requires tracking failures, conducting RCFA, reviewing the data, and making the appropriate changes.

Operators should conduct some type of regular failure analysis/reduction team meeting on a regular basis to analyze/ review well failures. It should include anyone in the process including the pump shop and data collected from tear down-hole pump tear downs and tracking data.



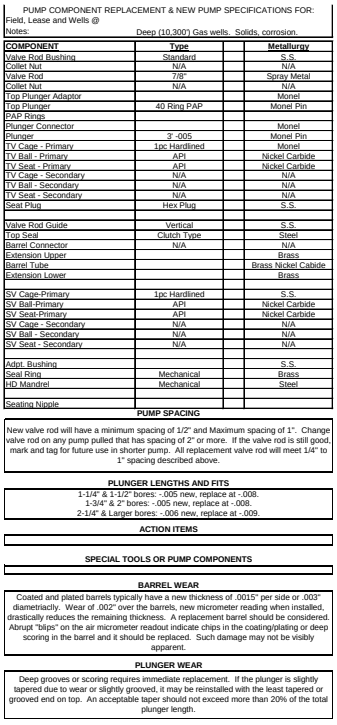
Pump Shop Checklist

Auditor: _____ Date: _____

Pump Company or Distributor/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 pump shop audited by the parts supplier/manufacturer? _____
7. Do they have a written quality manual covering pump shop assembly, teardown, and repair? Yes No
   A. 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
   A. 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
   A. How long is the program? _____
   B. What does it cover?
      a. Visual inspection Yes No
      b. Tear down inspection Yes No
      c. Selection of materials Yes No
      d. Failure Analysis Yes No
      e. Assembly procedures Yes No
10. As part of the quality program, do they have calibration procedures for their measuring and testing equipment? Yes No
    A. How often is the equipment calibrated? _____
    B. 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
    C. Do the dates reflect the calibration time period said? Yes No
11. Are proper bench vises (they don't mark/indent the part they are holding) used to hold pumps when fittings are being unscrewed? Yes No
    A. Are proper wrenches (friction, not pipe) used? Yes No
12. During the witness of an actual pump tear down and assembly, check if:
    A. 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
    B. Is a log/form used to record the condition of the parts and a possible reason for failure when parts are removed from a used pump? Yes No
    C. 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?" _____ Why? _____
    D. Ask the pump repair 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?" _____ Why? _____ How much taper is allowed on the plunger? _____
    E. Ask to witness a ball and seat vacuum test.
       a. How often is the tester calibrated? _____
       b. Is the calibration sticker (or support document) on the vacuum/pressure gauge? Yes No
       c. Does the calibration date reflect the required schedule? Yes No
       d. What is the amount of vacuum required to make the ball and seat acceptable? _____
    F. Ask the pump repair technician; "If not specifically told by the oil company, what is the amount of valve rod/pull tube wear that will be require the rod/tube to be replaced?" _____ (typically 20%)
    G. Ask the pump repair technician; "What is the proper spacing between the standing and traveling valves for a collapsed pump?" _____ (1/2") "How do you determine this spacing?" _____
    H. During re-assembly, are new seating cups put on the pump? Yes No
    I. Are metal brushes used during cleaning of any pump parts? Yes No If yes, on what parts are the brushes used? (Note: they shouldn't be used on threads.) _____
    J. Are all pump openings wrapped or protected against foreign material entry after the pump is assembled? Yes No
    K. Are pumps longer than 16 ft. picked up by at least two locations? Yes No
    L. Are the pumps supported by at least three locations during transportation? Yes No

Figure1



PUMP COMPONENT REPLACEMENT & NEW PUMP SPECIFICATIONS FOR:
Field, Lease and Wells @
Notes: Deep (10,300') Gas wells. Solids, corrosion.

COMPONENT	Type		Metallurgy
Valve Rod Bushing	Standard		S.S.
Collet Nut	N/A		N/A
Valve Rod	7/8"		Spray Metal
Collet Nut	N/A		N/A
Top Plunger Adaptor			Monel
Top Plunger	40 Ring PAP		Monel Pin
PAP Rings			
Plunger Connector			Monel
Plunger	3' -005		Monel Pin
TV Cage - Primary	1pc Hardlined		Monel
TV Ball - Primary	API		Nickel Carbide
TV Seat - Primary	API		Nickel Carbide
TV Cage - Secondary	N/A		N/A
TV Ball - Secondary	N/A		N/A
TV Seat - Secondary	N/A		N/A
Seat Plug	Hex Plug		S.S.
Valve Rod Guide	Vertical		S.S.
Top Seal	Clutch Type		Steel
Barrel Connector	N/A		N/A
Extension Upper			Brass
Barrel Tube			Brass Nickel Cabide
Extension Lower			Brass
SV Cage-Primary	1pc Hardlined		S.S.
SV Ball-Primary	API		Nickel Carbide
SV Seat-Primary	API		Nickel Carbide
SV Cage - Secondary	N/A		N/A
SV Ball - Secondary	N/A		N/A
SV Seat - Secondary	N/A		N/A
Adpt. Bushing			S.S.
Seal Ring	Mechanical		Brass
HD Mandrel	Mechanical		Steel
Seating Nipple			

PUMP SPACING

New valve rod will have a minimum spacing of 1/2" and Maximum spacing of 1". Change valve rod on any pump pulled that has spacing of 2" or more. If the valve rod is still good, mark and tag for future use in shorter pump. All replacement valve rod will meet 1/4" to 1" spacing described above.

PLUNGER LENGTHS AND FITS

1-1/4" & 1-1/2" bores: -.005 new, replace at -.008.
1-3/4" & 2" bores: -.005 new, replace at -.008.
2-1/4" & Larger bores: -.006 new, replace at -.009.

ACTION ITEMS

SPECIAL TOOLS OR PUMP COMPONENTS

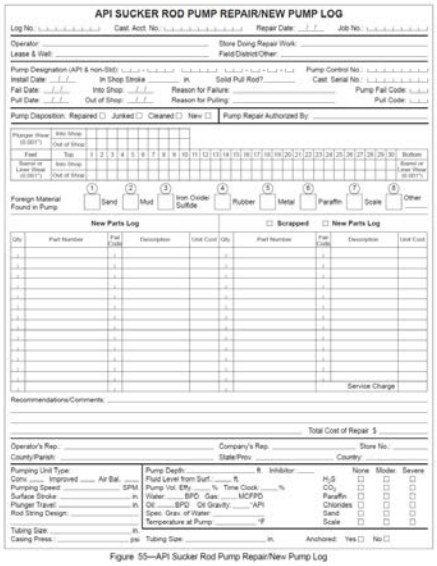
BARREL WEAR

Coated and plated barrels typically have a new thickness of .0015" per side or .003" diametriacly. Wear of .002" over the barrels, new micrometer reading when installed, drastically reduces the remaining thickness. A replacement barrel should be considered. Abrupt "blips" on the air micrometer readout indicate chips in the coating/plating or deep scoring in the barrel and it should be replaced. Such damage may not be visibly apparent.

PLUNGER WEAR

Deep grooves or scoring requires immediate replacement. If the plunger is slightly tapered due to wear or slightly grooved, it may be reinstalled with the least tapered or grooved end on top. An acceptable taper should not exceed more than 20% of the total plunger length.

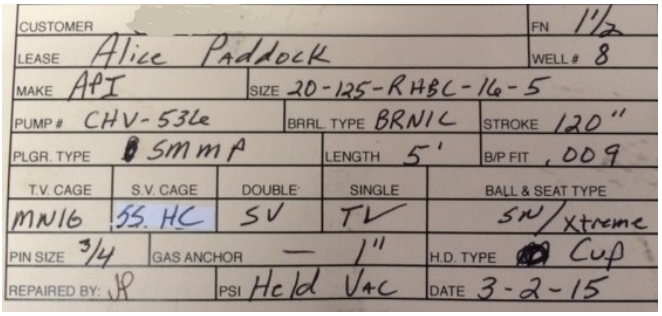
Figure 2



API SUCKER ROD PUMP REPAIR/NEW PUMP LOG

Figure 55—API Sucker Rod Pump Repair/New Pump Log

Figure 3



CUSTOMER FN 1½
LEASE Alice Paddock WELL # 8
MAKE API SIZE 20-125-RHBC-16-5
PUMP # CHV-536 BRRL. TYPE BRNIC STROKE 120"
PLGR. TYPE 8 SMMP LENGTH 5' B/P FIT .009

T.V. CAGE	S.V. CAGE	DOUBLE	SINGLE	BALL & SEAT TYPE
MN16	SS. HC	SV	TV	SV/Xtreme

PIN SIZE 3/4 GAS ANCHOR — 1" H.D. TYPE Cup
REPAIRED BY: JR PSI Hold Vac DATE 3-2-15

Figure 4