Recommended Practice for Electrical Submersible Pump Teardown Report

API RECOMMENDED PRACTICE 11S1
THIRD EDITION, SEPTEMBER 1997

EFFECTIVE DATE: DECEMBER 15, 1997

American
Petroleum
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CONTENTS

Recommended Practice for Electrical Submersible Pump Teardown Report

1 Scope

This recommended practice covers a recommended electrical submersible pump teardown report form. It also includes equipment schematic drawings which may provide assistance in identifying equipment components. It should be noted that these schematics are for generic equipment components, and there may be differences between manufacturers on the exact description or configuration of the assemblies.

2 Additional Information

In order to properly interpret the information gathered using this API recommended practice, the following data also should be provided:

a. Equipment amp charts.
b. Production data prior to failure.
c. Information on any unusual conditions such as sand or scale production, power interruptions, bad weather or storms, changes in chemical treatments, etc.
d. Equipment pull and run reports, service reports, and equipment test records.

Form 1—Motor Inspection Report

Operator: ____________________ E.S.P. Manufacturer: ____________________
Lease: ____________________ Well: ____________________
S/N: ____________________ HP: __________ Voltage: __________ AMPS: __________ Model: __________
Date Installed: ____________________ Date Pulled: ____________________ Run Time: ____________________

1. HEAD:
Terminal cavity: OK _____ Burned _____
Cavity corroded: Yes _____ No _____
Evidence of water track: Yes _____ No _____
Head corroded: Yes _____ No _____

2. BASE:
Corroded: Yes _____ No _____
Base blushing: OK _____ Worn _____
Filter (if applicable): OK _____ Plugged _____ Dirty _____

3. HOUSING CONDITION:
OK: _____ Corroded: Yes _____ No _____
Pressure test: Passed: _____ Failed _____
Scaled on OD: Yes _____ No _____
Thickness:____________________
Acid soluble: Yes _____ No _____
Coating: OK _____ Bad _____ (REM)

4. SHAFT CONDITION:
Turns OK: Yes _____ No _____
Broken: Yes _____ No _____
Shaft high strength: Yes _____ No _____
Spline Condition:
Twisted: Yes _____ No _____
Corroded: Yes _____ No _____
Extension: OK _____ Out of Spec. _____
Burned: Yes _____ No _____

5. COUPLING:
OK _____ Worn _____ Broken _____ Missing _____

6. THRUST BEARING ASSEMBLY:
Thrust bearing: OK _____
Down thrust: Negligible _____
Moderate _____ Severe _____
Hi-load bearing: Yes _____ No _____
Bearing collapsed: Yes _____ No _____
Thrust Runner:
Thrust runner: OK _____
Down thrust: Negligible _____
Moderate _____ Severe _____

7. ROTOR BEARING ASSEMBLY:
OK _____ Heat noted: Yes _____ No _____
Spun: Yes _____ No _____
Thrust Washers: OK _____
Brittle _____ Cut _____ Impressioned _____
Rotor bearing sleeve: OK _____ Worn _____
Discolored: Yes _____ No _____

8. STATOR:

Electrical:	(A - B)	(A - C)	(B - C)
Phase to phase	_____	_____	_____
Phase to ground	_____	_____	_____

Megohm reading:____________________
Hypot test: OK _____ Failed _____
Burned top end turn: ____________________
Burned bottom end turn: ____________________
Burned leads: ____________________
Laminations:
Burned: Yes _____ No _____ Location: ____________________
____
ID: OK _____ Worn _____

9. POTHEAD CONNECTOR ASSEMBLY:
Plug IN: _____ Tape IN: _____
OK _____ Burned _____ Damaged _____
Pothead:
OK _____ Damaged _____ Heat noted _____
"O" Ring: OK _____ Hard _____ Seized _____
Cut _____ Melted _____
Terminal block: OK _____ Stained _____
Burned _____ Damaged _____

10. ROTORS:
Corroded: Yes _____ No _____
Worn on OD: Yes _____ No _____
Location of wear:____________________
Burned on OD: Yes _____ No _____
Location of burn: ____________________
____
____

11. OIL CONDITION:
Clear: _____ Free water: _____ Dark: _____
Emulsion _____ Solids: _____

Notes: 1. For any item not covered, use comment section or back of this page, if necessary, to document condition.
2. REM means remanufacture.

Comments & Summary: ____________________
____
____
____
____

Inspected by: ____________________ Date: __________ Location:____________________

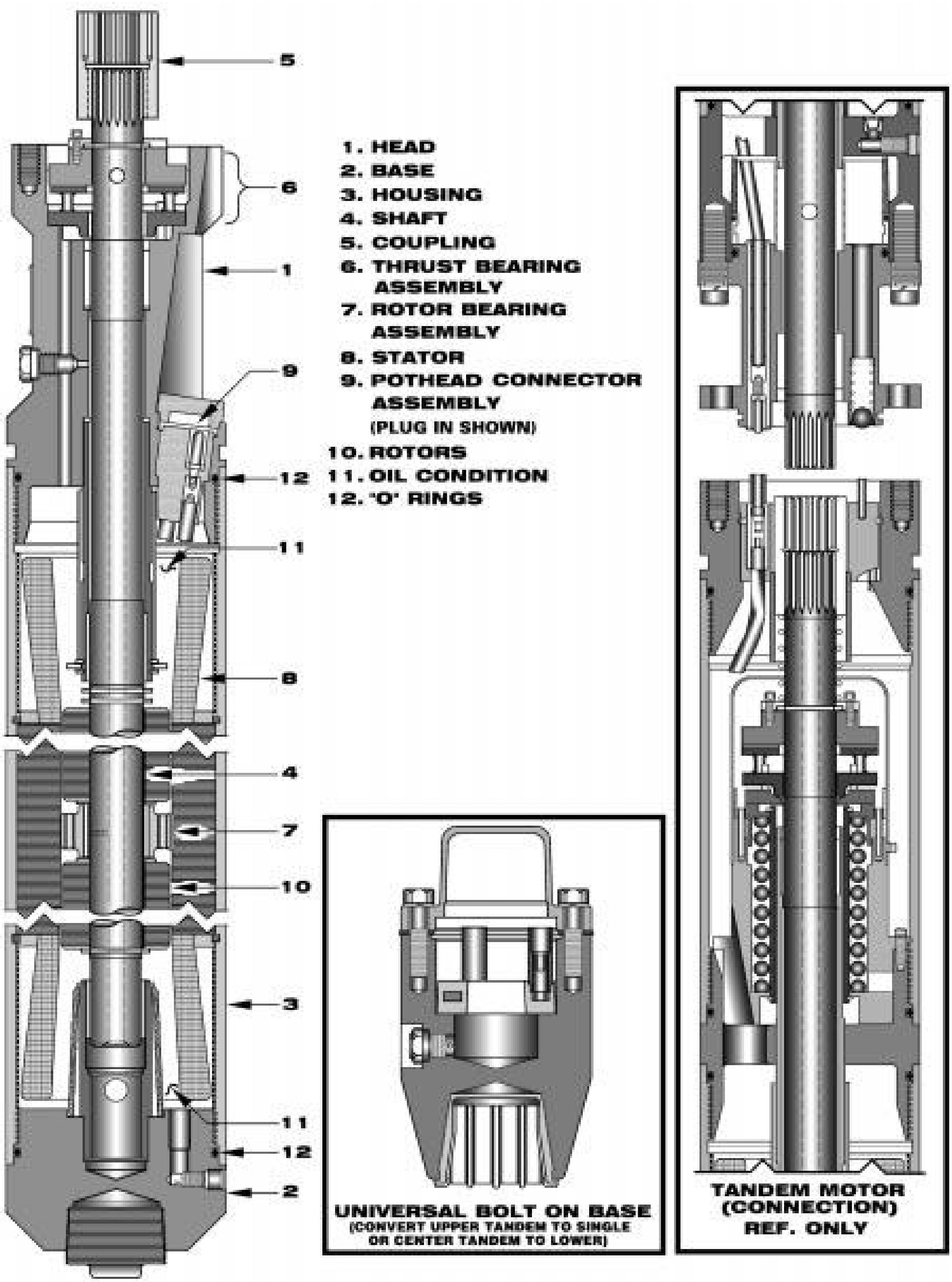


Figure 1—Typical Motor Section

Form 2—Seal Chamber Inspection Report

Operator: ______________________ E.S.P. Manufacturer: ______________________

Lease: ______________ Well: ______________________

S/N: ______________ Model: ______________________

Date Installed: ______________ Date Pulled: ______________ Run Time: ______________

1. HEAD:

Check valves: OK _____ Stuck open _____

Communication ports open: Yes _____ No _____

Plugged: Yes _____ No _____

Plugged with: ______________________

Acid soluble: Yes _____ No _____

Corrosion: Yes _____ No _____

2. BASE:

OK: _____ Corroded: Yes _____ No _____

Anti-rotation pins: OK _____

Bushing: OK _____ Worn _____

Filter: OK _____ Plugged _____

3. HOUSING CONDITION:

OK: _____ Corroded: Yes _____ No _____

Scaled on OD: Yes _____ No _____

Thickness: ______________________

Acid soluble: Yes _____ No _____

Vibration marks: Yes _____ No _____

Pressure test: Pass _____ Fail _____

4. SHAFT CONDITION:

Turns OK: Yes _____ No _____

Broken: Yes _____ (REM) No _____

Shaft high strength: Yes _____ No _____

Spline Condition:

Twisted: Yes _____ No _____

Corroded: Yes _____ No _____

Extension: OK _____ Out of Spec. _____

5. COUPLING:

OK _____ Worn _____ Broken _____ Missing _____

6. THRUST BEARING ASSEMBLY:

Thrust bearing: OK _____

Up thrust: Negligible wear _____ Moderate _____ Severe _____

Down thrust: Negligible wear _____ Moderate _____ Severe _____

Hi-Load bearing: Yes _____ No _____

Bearing collapsed: Yes _____ No _____

Thrust Runner:

Thrust runner: OK _____

Up thrust: Negligible wear _____ Moderate _____ Severe _____

Down thrust: Negligible wear _____ Moderate _____ Severe _____

7. BAG CHAMBER ASSEMBLY:

Pressure test: OK _____ Failed _____

Bag collapsed: Yes _____ No _____

Punctured: Yes _____ No _____

Blown/ruptured: Yes _____ No _____

Deposition on OD: None _____ Type ______________

Fasteners: OK _____ No _____

8. MECHANICAL SEALS:

Condition:

Specify Type—Circle One:

Rotating element: Carbon Silicone Tungsten

Stationary element: Ceramic Silicone Tungsten

	Top	Middle	Bottom
OK	_____	_____	_____
Displaced	_____	_____	_____
Ran displaced	_____	_____	_____
Shaft grooved	_____	_____	_____
Spring broken	_____	_____	_____
Seal bellows OK	_____	_____	_____
Rotating element OK	_____	_____	_____
Rotating element worn	_____	_____	_____
Rotating element broken	_____	_____	_____
Stationary element OK	_____	_____	_____
Pressure test: pass/fail	_____	_____	_____

9. RELIEF VALVES:

OK _____ Failed _____

10. LABYRINTH CHAMBER ASSEMBLY:

Breather tube: OK _____ Broken _____ Corroded _____

Communicator ports: OK _____ Plugged _____

11. CONDITION OF ALL "O" RINGS:

	Top	Middle	Bottom
Set/pliable	_____	_____	_____
Hard	_____	_____	_____
Seized	_____	_____	_____
Melted	_____	_____	_____
Cut/damaged	_____	_____	_____

12. OIL CONDITION:

	Clear	Water	Dark	Emulsion	Solids
Top bag	_____	_____	_____	_____	_____
Bottom bag	_____	_____	_____	_____	_____
Chamber	_____	_____	_____	_____	_____
Base	_____	_____	_____	_____	_____

Notes: 1. For any item not covered, use comment section or back of this page, if necessary, to document condition.
2. For piggy-back equalizers use a second form. When seal types are mixed, use comments to identify.
3. REM means remanufacture.

Comments & Summary: ____

____

____

____

Inspected by: ______________________ Date: ______________________

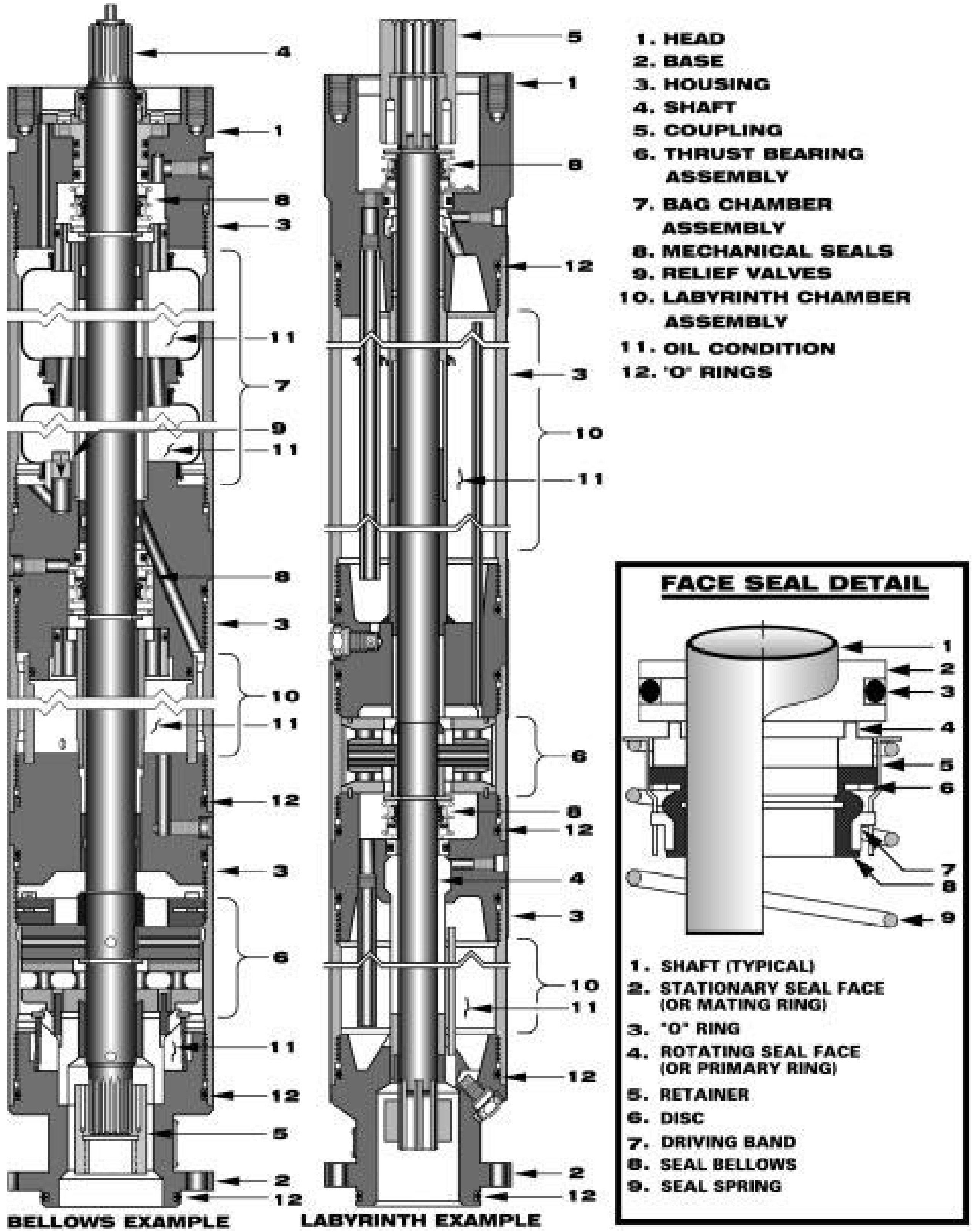


Figure 2—Typical Seal Chamber Section Types

Form 3—Pump Inspection Report

Operator: ______________________ E.S.P. Manufacturer: ______________________
Lease: ______________________ Well: ______________________
S/N: ______________ Stage Type: __________ No. Stages: __________ Model: ______________
Date Installed: ______________ Date Pulled: ______________ Run Time: ______________

1. HEAD:

OK: _____	Yes _____	No _____	
Bolt on: _____	Screw in: _____		
Bolts:	OK _____	Corroded _____	
Head corroded:	Yes _____	No _____	
Plugged:	Yes _____	No _____	% ______

Plugged with: ______________________________

2. BASE:

OK: _____	Yes _____	No _____	
Bolt on: _____	Screw in: _____		
Bolts:	OK _____	Corroded _____	
Base corroded:	Yes _____	No _____	
Plugged:	Yes _____	No _____	% ______

Plugged with: ______________________________

3. HOUSING CONDITION:

Scaled on OD: Yes _____ No _____
Thickness: ______________________________
Acid soluble: Yes _____ No _____
Scarred axially: Yes _____ No _____
Depth: ______________________________
Vibration marks: Yes _____ No _____
Coating: OK _____ Bad _____ (REM)

4. SHAFT CONDITION:

(If broken, describe below in detail)

Turns OK:	Yes _____	No _____
Broken:	Yes _____	No _____
Shaft high strength:	Yes _____	No _____
Spline Condition:		
Twisted:	Yes _____	No _____
Corroded:	Yes _____	No _____
Extension:	OK _____	Out of Spec. _____
Radial wear:	Yes _____	No _____

5. COUPLING:

OK _____	Broken _____	
Scale:	Yes _____	No _____
Acid soluble:	Yes _____	No _____

6. SCREEN CONDITION:

Plugged: Yes _____ No _____
Plugged with: ______________________________
Collapsed: Yes _____ No _____
Corroded: Yes _____ No _____
Scale: Yes _____ No _____
Acid soluble: Yes _____ No _____

7. SHAFT SUPPORT BEARING:

Upper:	OK _____	Worn _____	Worn out of spec. _____
	Bushing:	OK _____	Worn _____
Lower:	OK _____	Worn _____	Worn out of spec. _____
	Bushing:	OK _____	Worn _____

8. "O" RING CONDITION:

	Diffuser			Housing
	Top	Middle	Bottom	
OK	_____	_____	_____	_____
Hard	_____	_____	_____	_____
Seized	_____	_____	_____	_____
Swollen	_____	_____	_____	_____
Melted	_____	_____	_____	_____

9. CONDITION OF ALL THRUST WASHERS:

	Down Thrust Washers	Up Thrust Washers
OK	_____	_____
Slight wear	_____	_____
Moderate wear	_____	_____
Severe wear	_____	_____
Brittle	_____	_____
Missing	_____	_____

10. DIFFUSERS:

OK _____ Percentage Plugged _____ %
Plugged with: ______________________________
Thrust wear: Slight _____ Moderate _____ Severe _____
Radial wear: Slight _____ Moderate _____ Severe _____
Spinning diffuser: Yes _____ No _____
Location: ______________________________
Eccentric wear: Yes _____ No _____

11. IMPELLERS:

OK _____ Percentage Plugged _____ %
Plugged with: ______________________________
Thrust wear: Slight _____ Moderate _____ Severe _____
Radial wear: Slight _____ Moderate _____ Severe _____

12. SNAP RINGS:

OK _____ Corroded _____ Missing _____

Notes: 1. For any item not covered, use comment section or back of this page, if necessary, to document condition.
2. REM means remanufacture.

Comments & Summary: ______________________________
____
____
____

Inspected by: ______________________ Date: ______________________

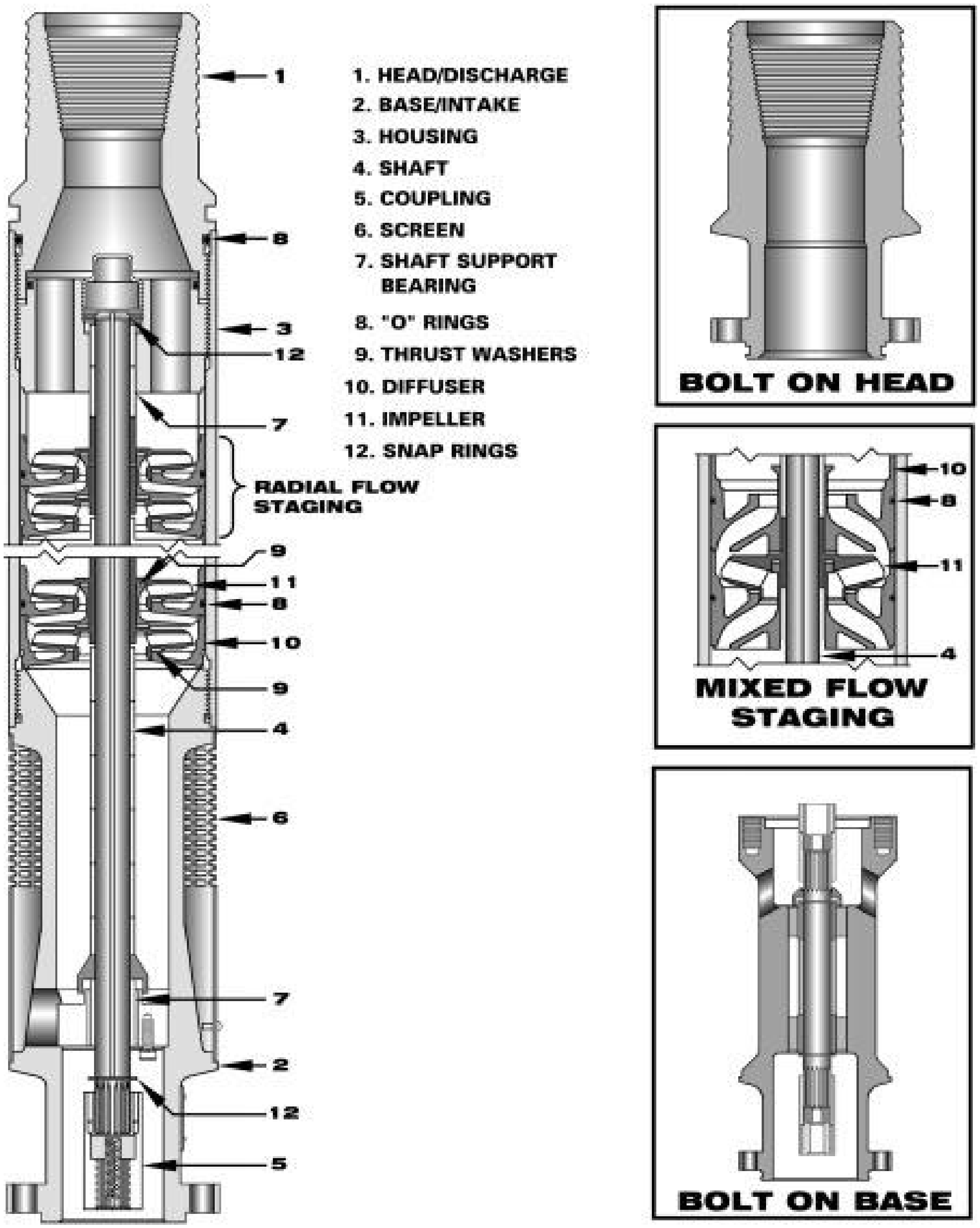


Figure 3—Typical Pump Section

Form 4—Gas Separator Inspection Report

Operator: ______________________ E.S.P. Manufacturer: ______________________
Lease: ______________ Well: ______________________
S/N: ______________ Model: ______________________
Date Installed: ______________ Date Pulled: ______________ Run Time: ______________

1. HEAD:
OK: _____
Ports plugged: Yes _____ No _____
Plugged with: ______________________
Corroded: Yes _____ No _____

2. BASE/INLET:
Intake clear: Yes _____ No _____
Plugged: Yes _____ No _____ % ______
Plugged with: ______________________
Intake screen: Yes _____ No _____
Screen OK: Yes _____ No _____
Screen plugged: Yes _____ No _____
Plugged with: ______________________
Base corroded: Yes _____ No _____
Scaled on OD: Yes _____ No _____
Scale acid soluble: Yes _____ No _____
Erosion: Yes _____ No _____

3. HOUSING:
OK: _____ Scaled: Yes _____ No _____
Thickness: ______________________
Acid soluble: Yes _____ No _____
Corroded: Yes _____ No _____
Scarred axially: Yes _____ No _____
Coating: Yes _____ No _____
Coating damaged: Yes _____ No _____

4. SHAFT:
(If broken, describe in detail below)
Turns OK: Yes _____ No _____
Broken: Yes _____ No _____
Shaft high strength: Yes _____ No _____
Spline Condition:
Twisted: Yes _____ No _____
Corroded: Yes _____ No _____
Extension: OK _____ Out of Spec. _____
Radial wear: Yes _____ No _____

5. COUPLING:
OK _____ Worn _____ Broken _____ Missing _____
Scale: Yes _____ No _____
Acid soluble: Yes _____ No _____

6. RADIAL BEARINGS:

	Top	Middle	Bottom
OK:	_____	_____	_____
Worn out of Spec:	_____	_____	_____

7. INDUCER SECTION:
OK: _____
Plugged: Yes _____ No _____
Plugged with: ______________________
Percentage plugged: ______ %
Erosion: Yes _____ No _____
Down thrust washer:
OK _____ Worn _____ Brittle _____ Missing _____

8. SEPARATION SECTION/ROTOR:
OK: _____
Plugged: Yes _____ No _____
Plugged with: ______________________
Acid soluble: Yes _____ No _____
Percentage plugged: ______ %
Erosion: Yes _____ No _____

9. SNAP RINGS:
OK _____ Worn _____ Broken _____ Missing _____

Notes: For any item not covered, use comment section or back of this page, if necessary, to document condition.

Comments & Summary: ____
____
____
____
____

Inspected by: ______________________ Date: ______________________

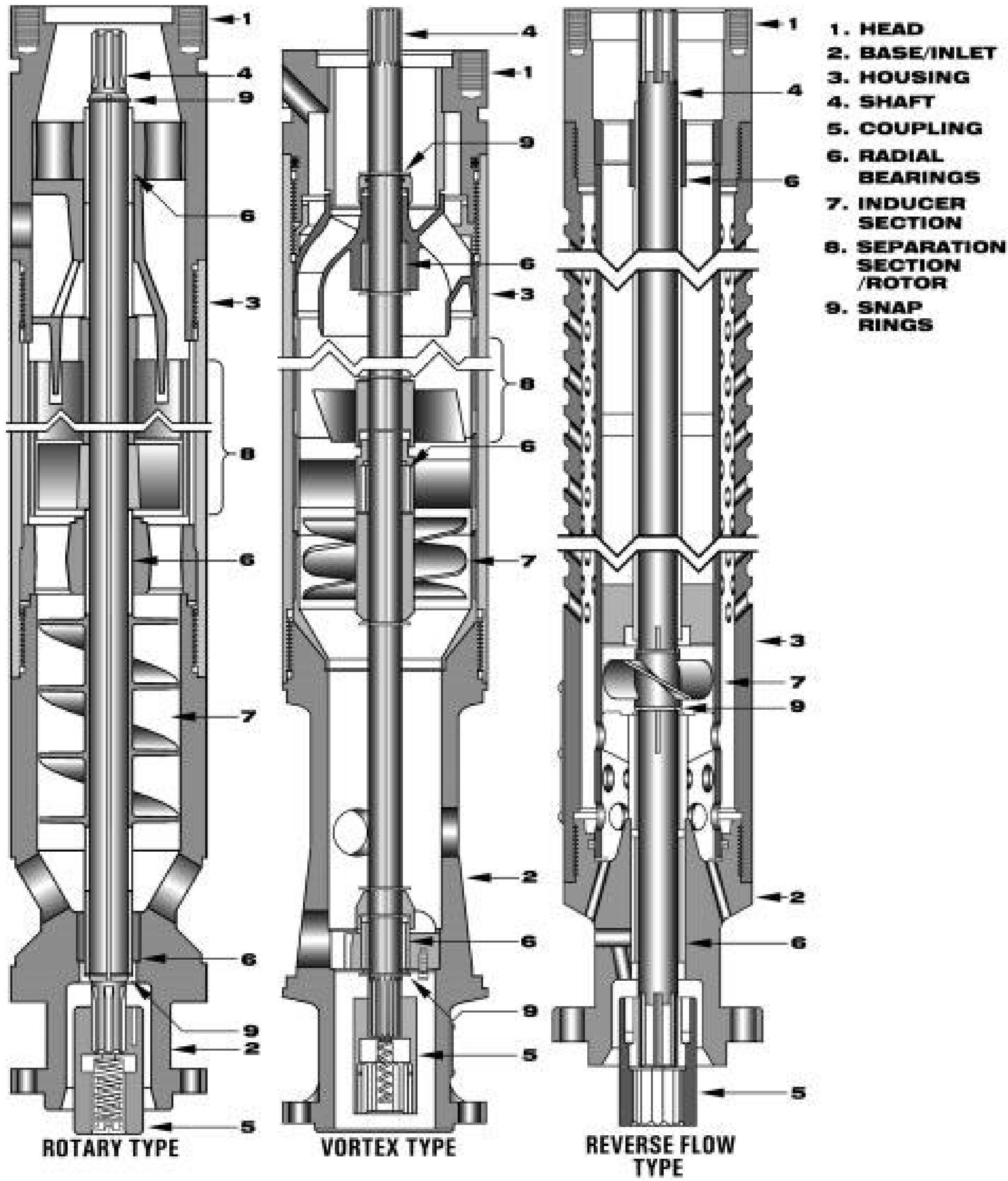


Figure 4—Typical Gas Separator Section Types

APPENDIX A—RECOMMENDED PRACTICE FOR API RP 11S1 TEARDOWN REPORTING DATABASES

A.1 Scope

This appendix provides recommended teardown observation codes to facilitate the transfer and storage of electrical submersible pump teardown reporting in relational databases. The main purpose of this section is to provide a common foundation for electronic teardown reporting.

Alternative methods may exist for storage that could be superior to those shown in this recommended practice. Provisions to read and write to files in a common format, as shown in this appendix, are recommended to permit ease in transferring teardown data between software systems. Recommended table structures and data relationships are also provided, but these are not as critical to data transfer as the observation codes.

Appendix B shows examples of the many potential reports that could be generated using a teardown report database by manufacturers and producers to: 1) improve ESP run lives, 2) identify operational problems, and 3) compare equipment performance.

A.2 Database Tables

Database tables refers to all tables where data is stored within a database. A table contains a set of related data. The headings in the table are defined as the fields. The information under each heading is called a record. One of the fields should always contain a unique record. This field is defined as the PRIMARY KEY. In some cases a pair of fields form this unique record in a table. One of the fields is then defined as the SECONDARY KEY. The tables are related to each other through these keys. Descriptions of the recommended teardown reporting for databases are split into three sections:

A.3 Pertinent Data—General information related to the well and ESP.

A.4 Teardown Observations—Observations by each component.

A.5 Cause of the Failure—Conclusion of the primary and contributing factors resulting in the ESP failure.

In Section A.3, the data not specific to the teardown observations themselves have been called *Pertinent Data.*

A.3 Pertinent Data

The pertinent data have two purposes. The first is to uniquely link the equipment teardown report to a well. This same unique (primary) key can relate the teardown data to data in other databases. A unique well identifier (UWI) and a pull date can uniquely define a teardown as an event. This pair uniquely identifies two teardowns from the same well or two ESP teardowns pulled on the same date at different locations. When used with a serial number, the ESP equipment is also uniquely identified.

Secondly, pertinent data should provide information that is useful in the teardown analysis, but not normally contained or easily accessible from other databases. Much of this pertinent data regarding the well completion, production rate, and the ESP equipment are valuable to both the oil company and ESP manufacturers in determining the cause of a failure. Unfortunately, these external databases are not usually shared.

Following a recognized standard database format allows compatibility between different database systems. This allows downloading data into a teardown database or uploading teardown data into larger database platforms.

This standard can be either PPDM or POSC. It is left up to the program developer to decide which standard to use, since a teardown database will probably be coupled with an existing database. The suggested data for proper teardown reporting are summarized in Figures A-3 through A-5, while the relationships between the tables are shown in Figure A-1.

A.3.1 WELL NAME TABLE (WELLTAB)

The *unique well identifier* (UWI) is the primary key that ties all of the important parameters to a well. The WELLTAB Table (see Figure A-3) uses the UWI to uniquely identify the well. Items in this table should be those that do not change often, such as the physical well location. The UWI is used in other external tables such as ownership, production workover history, and/or completion databases.

A.3.2 EVENT TABLE (EVENTTAB)

The pull date and the UWI pair should uniquely identify a teardown as an event in the EVENTTAB Table (see figure A-3). The primary key, however, is the EVENTID field. The EVENTID could be a random alphanumeric, a work order, or the service contract alphanumeric. The values kept in the EVENTTAB table relate to the information that is unique to the event. This can include the reason for the pump pull (see Figure A-8 for recommended code listing), pump landing depth, failure dates, and production rate data prior to failure and after initial startup.

Note: Production data could be kept on a separate table, but linked by the EVENTID.

Field service reports can be linked to the EVENTTAB table using the alphanumeric serial number from the field service report.

A.3.3 EQUIPMENT TABLE (EQUIPTAB)

The ESP can be broken up into its main components of: pump, gas separator, seal, and motor, and each component can also have multiple housing units. Combining the EVEN-

TID with the serial number identifies the ESP component being torn down with the well and pull date. This combination of EVENTID and the serial number is given a unique ID defined as the EQUIPID and is stored in the EQUIPTAB Table (see Figure A-3).

The EQUIPID could be a random alphanumeric or the teardown report alphanumeric serial number. This EQUIPID code should be linked to a table that describes the equipment in a minimum amount of detail (see A.3.4 and Figure A-5 for the recommended format for the equipment detail reporting).

Multiple manufacturers use different serial number conventions, which makes defining the type of equipment being described from a serial number difficult. A field defined as SECTID that universally defines the ESP components as pump, gas separator, seal, or motor eliminates this problem. The letters P, G, S, and M are used, followed by a single-digit number. The purpose of the SECTID single-digit suffix is discussed in A.4.5.

A.3.4 EQUIPMENT DETAIL TABLES

Details of the equipment are maintained in equipment detail tables (see Figure A-5). The four tables in Figure A-5 show the recommended minimum data to define each ESP component. Existing manufacturers' databases will dictate the structure of this information. Manufacturers' databases can use serial numbers to link the ESP details within their own databases, but these data are lost unless standard tables are created for transferring data to non-manufacturers' databases. To facilitate data exchange, the field sizes shown in Figure A-5 should be followed.

A.3.4.1 ESP Construction

With the large number of materials available, the details of reporting the materials used within an ESP are left up to the manufacturer; however, the suggested field sizes should be maintained.

A.3.5 OBSERVATIONS

The forms in the main body show the observations recommended by this recommended practice in a form format. Figure A-2 shows these same observations listed with a corresponding unique code for use in a database. The structure and relationship of fields in the Observation Table (OBSTAB) are discussed below.

A.4 Teardown Observations

All of the observations from a teardown are reported on the same table (OBSTAB—see Figure A-4). Failure observation codes can be stored in separate lookup tables based on components of the ESP. Only the observations made are kept on the database. It is assumed that if no observations were made the sub-component was in good condition. Observations can be made on a large number of sub-components that exist within an ESP.

The fields in the OBSTAB table consist of three main components:

a. EQUIPID (Equipment Identification).
b. SUBID (Sub-component Identification).
c. OBS# (Observation Number).

A.4.1 EQUIPID

To uniquely identify any observation, a unique observation code must be linked to the EQUIPID as defined above in A.3.3. The EQUIPID is the primary key in the OBSTAB table.

A.4.2 SUBID

The SUBID is a two character TEXT field that identifies the subcomponents being described by the observation. When used in combination with the OBS#, the observations recorded become unique. Figure A-2 shows how the SUBID is broken into two groups, where each item is either:

a. common to more than one piece of ESP equipment (SUBID defined as "XY"), or
b. unique to an individual device (SUBID defined as "WZ").

The variable pairs "XY" and "WZ" are all defined using letters from the words that describe the sub-component. The Y component of the XY pair is defined for common sub-components like *B* for *Base*, *H* for *H*ead or *G* for Housin*G*, while "X" is defined by the section of the ESP that is being described (pump, motor, etc.). For example: "X" = *P* for *P*ump; *G* for *G*as separator; *S* for *S*eal, and *M* for *M*otor. Hence, the *P*ump *H*ead and the *M*otor Housin*G* are described as *PH* and *MG*, respectively.

For sub-components that are unique to a device, the character pair, WZ, is defined uniquely by letters in the sub-component name. There is no direct reference between the component and the sub-component. For example, SE describes the Stator Electrical condition, while BC describes the Bag Chamber assembly condition.

A.4.3 OBS#

OBS# describes the observation code, where "#" can be a single-digit number 1 through 9. Figure A-2 shows the recommended four-digit integer codes that correspond with the teardown reporting forms presented in the main text of this recommended practice. Note that in each sub-component table there is no duplication of observation codes; however, the same code can exist once in each of many sub-component tables.

To facilitate unique needs of individual users, the codes chosen are set in a recognizable pattern which is summarized in Figures A-6 and A-7. For example, all corrosion observations have the code 3700, but corrosion of one sub-component is distinguished from corrosion in another by the SUBID.

Additional component observations can be handled using this nomenclature, allowing flexibility in the system yet minimizing the effort to make queries and transfer data between software.

Concatenating the SUBID and the OBS# is an alternative method of reporting observation codes uniquely, but it is not recommended.

A.4.3.1 Physical Measurements

Physical measurements taken are stored in the physical measurement table, PHYTAB (see Figure A-5). The EQUIPID is the primary key linking physical measurements such as the phase-to-phase and phase-to-ground readings from a motor to the equipment and the event.

A.4.3.2 Added Flexibility in Observation Codes

To add flexibility to the observations, follow a recognizable pattern as noted above. Figure A-6 describes the standard observations that are shown in Figure A-2 in increments of 100 in the "y" vertical axis and incrementally by 10 in the horizontal axis. Significant space is provided to allow additional categories to be added. The units digit can be also be used to provide more details on several existing parameters without adding remarks. Common terms that can be used are shown in Figure A-7. These are referenced back to the relative categories where they apply using footnotes in Figure A-6.

It should be noted that for the seal condition, only the top, middle, and bottom seal are described in Figure A-6 by the 4900, 5400, and 5900 series. For additional seals, increments of 100 can be used between 4900 and 5900, where the middle seal remains the 5400 series. Note that some of this data can be lost if provisions are not made for this increase in detail.

A.4.4 REMARKS

Remarks are important in any teardown report to allow further description of the observations, but remarks are often ignored in databases. The use of Figure A-7 to fine tune the observations can help but may not be adequate for all observations. Ideally, remarks can be made about each observation; however, in practice this is unlikely. Comments regarding each sub-component are more practical. Remarks should be kept in a separate table (TDREM) and linked to the Observation Table (TDOBS) using the EQUIPID and SUBID pair.

A.4.5 STRUCTURE OF OBSERVATION TABLE

The recommended table structure of the Observation Table (TDOBS) is shown in Figure A-4. The EQUIPID and SUBID form a unique pair. This pair is followed by a list of the observation codes that pertain to the sub-components. To minimize the number of fields, the number of observations with each EQUIPID and SUBID pair is limited to 9. Thus, if the equipment is in good shape, only the observations made will be recorded. In cases where there is no damage, the EQUIPID and SUBID combination does not exist and no record is made.

In a few cases, the number of observations may exceed 9. Exceeding 9 observations can be handled by ignoring the least significant observations. Alternatively, incrementing the section ID in the EQUIPID table allows a second EQUIPID for the same EVENTID and serial number pair to be used and allows the reporting of all observations.

A.5 Cause of ESP Failure

The causes of ESP failures are important parameters to maintain in a database, because the database takes all of the observations made and puts them together to create a single conclusion or a set of conclusions. At this point, it is more useful to identify the cause of the systems failure rather than the cause of failure in the individual components. The reason for an ESP failure can be very complex, but it is valuable to draw some conclusion based on field and teardown data and report it in a database.

The failure may be related to findings within the teardown report or could be external to it. For example, if a splice failure occurs, but a teardown was still performed, there would be no cause for the failure reported. The recommended structure for the Teardown Conclusions Table (CONCLTAB) is shown in Figure A-4.

A.5.1 EVENTID

To uniquely identify the cause of an ESP failure, the unique failure observation code must be linked to the EVENTID. It is not critical that the piece of equipment be identified since the teardown observations should already contain this information.

A.5.2 SUBIDX#

The *sub-component* field (SUBIDx#) is a two-character text field that identifies the failing sub-component where the downhole ESP fails (see the description in A.4.2).

The "x" in the SUBIDx# name is P, C, or S, which represent the primary, contributing, and secondary failures, respectively. The "#" value is set at 1. See A.5.6.1 for more detail.

When the cause of the failure is not related to the downhole ESP (such as is the case with a cable or tubing failure), the SUBIDx# is given the value "XF". The "X" denotes the location of the failure as upper, middle, or lower, using the numbers X = 1, 2, or 3 respectively. The number 4 is used for "X" where the location is unknown or not relative to the answer. This recommended practice contains no further guidelines for detailing ESP failures external to the teardown results.

A.5.3 PFAIL

The primary cause of failure field (PFAIL) uses the four-digit observation codes shown in Figure A-2 and discussed in A.4.3. Figure A-9 shows some additional failure/observation codes to account for failures not related to the downhole equipment involved in the teardown. These codes are also shown in Breakdown of Observation Codes, Figure A-6.

A.5.4 CFAIL#

The contributing factors field (CFAIL# for # = 1) uses the four-digit observation codes shown in Figure A-2 (see A.4.3 for discussion). The field provides an important observation that contributed to the ESP's primary mode of failure. Knowing the contributing factors aids in determining the cause of the problem. Additional contributing factors could be included by adding fields to the table as discussed in A.5.6.1.

A.5.5 SFAIL1

The secondary failure field (SFAIL#, where # = 1) is another significant failure mechanism or observation that appears unrelated to the primary and contributing causes of failure reported in the fields PFAIL1 and CFAIL#. If the primary failure mechanism was corrected, SFAIL# failure may become the most significant. For example, significant corrosion in the pump body can be a secondary causes of failure if the primary failure is a motor shorted out due to the contributing factor of a failed seal.

A.5.6 CONCLUSION REMARKS

Remarks can be made to provide more insight into the failure conclusions made. The primary, contributing, and secondary failure analyses (PREM1; CREM# and SREM#, respectively) each have 240 character spaces for a brief explanation to support the conclusions made.

A.5.6.1 Additional Failure Conclusions

Although not recommended in this recommended practice, provisions for additional contributing factors or secondary failures can be included. Note that there cannot be two primary causes of failure. Additional contributing or secondary failure fields can be included as denoted by the field name pairs of SUBID2# and CFAIL#, or SUBID3# and SFAIL# (where # is 2 for the second, 3 for the third, etc.), respectively. This recommended practice recommends only keeping track of the first set of conclusions since comments provide better insight for more detailed failure conclusions.

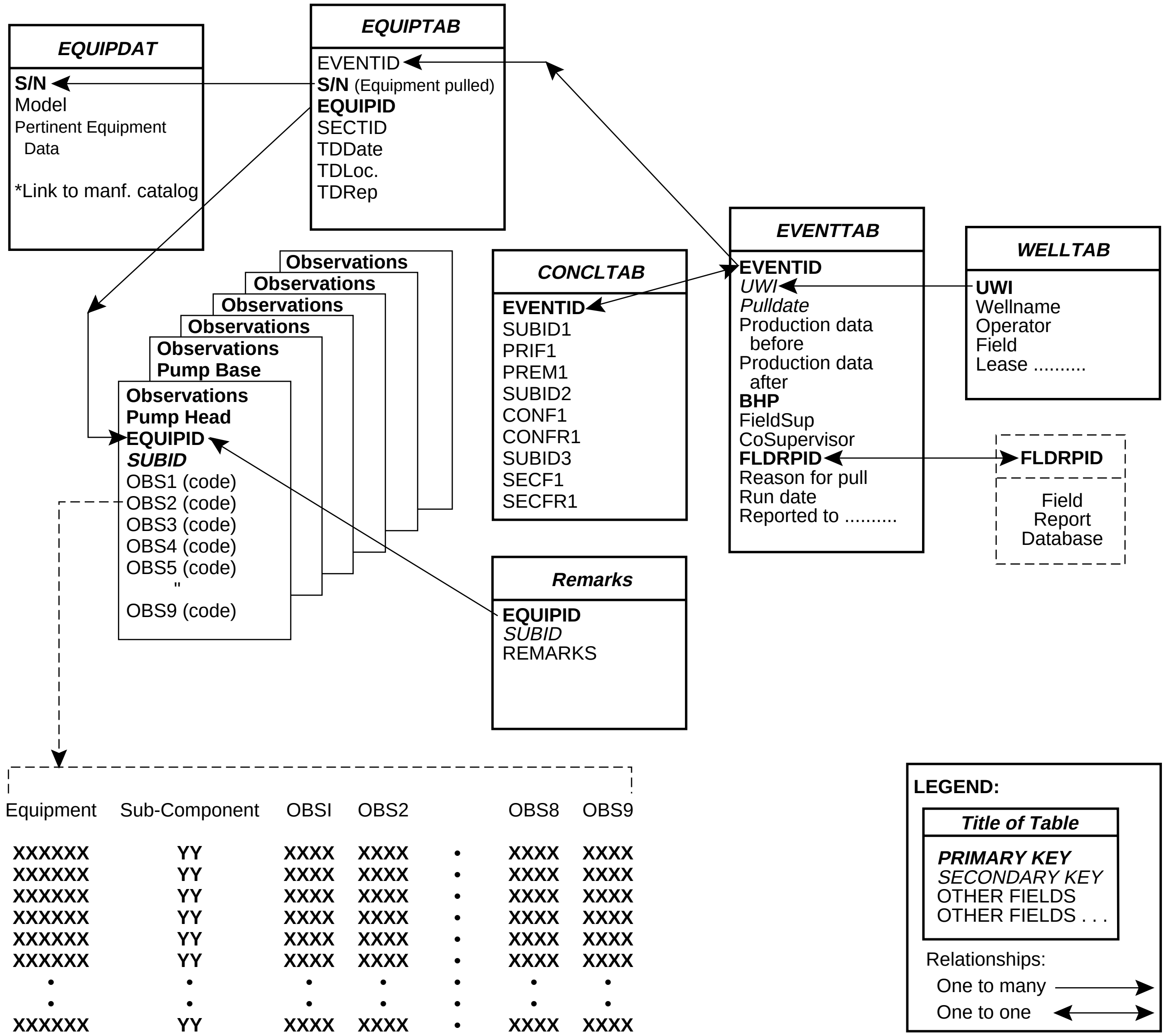


Figure A-1—Relationship Diagram for Teardown Reporting

EQUIPMENT COMPONENT

Common	Specialty	Description	P (PUMP)	G (Gas Separator)	S (Seal Section)	M (Motor)	Observation Code
XH		**H**ead					
		Bolt on Head used	X				2810
		Terminal Cavity Burnt				X	3060
		Check Valve open			X		3420
		Evidence of Water Track				X	3460
		Plugged	X	X	X		3610
		Communication Ports open			X		3620
		Percent Plugged	X	X			3630
		Plugged w/	X	X	X		3660
		Corroded	X	X	X	X	3700
		Cavity Corroded				X	3710
		Bolts Corroded	X			X	3720
		Acid Soluble			X		3820
XB		**B**ase					
		Erosion Evident		X			1000
		Anti Rotation Pins Damaged			X		2000
		Bolt on Base used	X				2810
		Filter Dirty				X	3600
		Plugged	X	X			3610
		Filter Plugged			X	X	3610
		Percent Plugged	X	X			3650
		Plugged w/	X	X			3660
		Corroded	X	X	X	X	3700
		Corroded Bolts	X				3720
		Scaled on OD		X			3810
		Scale is Acid Soluble		X			3820
		Bushing Worn			X	X	3900
XG		Housin**G**					
		Coating Present	X	X	X	X	2820
		Coating Damaged	X	X	X	X	2830
		Leaked at					3400
		Pressure test Failed			X	X	3410
		Corroded	X	X	X	X	3700
		Scaled on OD	X	X	X	X	3810
		Acid Soluble Scale	X	X	X	X	3820
		Thickness of scale	X	X	X	X	3830
		Vibration Marks observed	X		X		4420
		Scarred Axially	X	X			4440
		Depth/Thickness:	X	X			4450
XS		**S**haft					
		Shaft Broken	X	X	X	X	2000
		High Strength Shaft Used	X	X	X	X	2840
		Shaft Burnt				X	3030
		Spline Corroded	X	X	X	X	3720
		Radial Wear Evident	X	X			3900
		Shaft extension out of Spec.	X	X	X	X	4220
		Shaft Twisted	X	X	X	X	4300
		Shaft Doesn't Rotate OK	X	X	X	X	4400
		Spline Twisted	X	X	X	X	4430
XP		Cou**P**ling					
		Coupling Broken	X	X	X	X	2000
		Coupling Missing		X	X	X	2700
		Coupling Scaled	X	X			3810
		Scale is Acid Soluble	X	X			3820
		Coupling Worn	X	X	X	X	4210
X-B		Bea**R**ings					
		Highload bearing Used			X	X	2850
		Bearing Collapsed			X	X	3550
		Lower Bearing Worn	X				3910
		Lower\Bottom Bearing Worn out of Spec	X	X			3920
		Middle Bearing Worn out of Spec		X			3940
		Upper Bearing Worn	X				3950
		Upper\Top Bearing Worn out of Spec	X	X			3960
		Upper Bushing Worn	X				3970
		Lower Bushing Worn	X				3980
		Thrust Bearing Wear - Down Thrust - negligible			X	X	4022
		Thrust Bearing Wear - Down Thrust - moderate			X	X	4025
		Thrust Bearing Wear - Down Thrust - severe			X	X	4028
		Thrust Runner - Down Thrust - negligible			X	X	4032
		Thrust Runner - Down Thrust - moderate			X	X	4035
		Thrust Runner - Down Thrust - severe			X	X	4038
		Thrust Bearing Wear - Upthrust negligible			X		4122
		Thrust Bearing Wear - Upthrust moderate			X		4125
		Thrust Bearing Wear - Upthrust severe			X		4128

EQUIPMENT COMPONENT

Common	Specialty	Description	P (PUMP)	G (Gas Separator)	S (Seal Section)	M (Motor)	Observation Code
X-B		Bea**R**ings					
		Thrust Runner - Upthrust - negligible			X		4132
		Thrust Runner - Upthrust - moderate			X		4135
		Thrust Runner - Upthrust - severe			X		4138
		Thrust Bearing Damaged			X	X	4320
		Thrust Runner - Damaged			X	X	4330
X-O		**O**-Rings					
		Top - - Set/Pliable			X		1310
		Middle - - Set/Pliable			X		1330
		Bottom - - Set/Pliable			X		1350
		Pothead O Ring - - Seized				X	1400
		Top - - Seized	X		X		1410
		Middle - - Seized	X		X		1430
		Housing - Seized	X				1440
		Bottom - - Seized	X		X		1450
		Pothead O Ring - - Cut				X	1500
		Top - -Cut/Damaged			X		1510
		Middle - -Cut/Damaged			X		1530
		Bottom - -Cut/Damaged			X		1550
		Pothead O Ring - - Melted				X	1600
		Top - - Melted	X		X		1610
		Middle - - Melted	X		X		1630
		Housing - Melted	X				1640
		Bottom - - Melted	X		X		1650
		Pothead O Ring - - Swollen				X	1700
		Top - - Swollen	X				1710
		Middle - - Swollen	X				1730
		Housing - Swollen	X				1740
		Bottom - - Swollen	X				1750
		Pothead O Ring - - Hard				X	1800
		Top - - Hard	X		X		1810
		Middle - - Hard	X		X		1830
		Housing - Hard	X				1840
		Bottom - - Hard	X		X		1850
	RB	**R**otor **B**earings					
		Heating Noted				X	2900
		Bearing Spun				X	4410
		Thrust Washer Cut				X	4070
		Thrust Washer Brittle				X	4080
		Thrust Washer Impressioned				X	4090
		Rotor Bearing Sleeve Worn				X	4240
		Rotor Bearing Discolored				X	2910
	SE	**S**tator: **E**lectrical					
		Hypot Test Failed				X	3480
		Burned Top End Turn				X	3010
		Burned Bottom End Turm				X	3020
		Burned Leads				X	3030
		Burned Laminations				X	3040
		Laminations Worn (Worn ID)				X	4210
		Location of Lamination Wear				X	4200
	PC	**P**othead **C**ondition					
		Pothead is plugin type (default Tap)				X	2870
		Burnt pothead connector				X	3050
		Damaged Pothead Connector				X	3220
		Pothead Damaged				X	3200
		Pothead Heat noted				X	2900
		Terminal Block damage				X	3240
		Terminal Block Burnt				X	3060
		Terminal Block Stained				X	3570
	RO	**RO**tors					
		Corroded				X	3700
		Worn on OD				X	3900
		Location of Wear on Rotor				X	4200
		Burned on OD				X	3070
		Location of Burn				X	3000
	BC	**B**ag **C**hamber Assembly					
		Failed Pressure Test			X		3410
		Bag Collapsed			X		3550
		Bag Punctured			X		2010
		Bag Blown/Ruptured			X		2020
		Bag in Bad Condition			X		3500
		Fastner unsatisfactory			X		3430
		Deposit on OD of bag			X		3850
		Type of Deposit			X		3840

Figure A-2—Recommended Observation Codes for ESP Teardown

EQUIPMENT COMPONENT

Common	Specialty	Description	P (PUMP)	G (Gas Separator)	S (Seal Section)	M (Motor)	Observation Code
	ME	**ME**chanical Seals					
		Top Displaced			X		4900
		Top Ran Displaced			X		4910
		Top Shaft Grooved			X		4920
		Top Spring Broken			X		4930
		Top Seal Bellows Damaged			X		4940
		Top Rotating Element damaged			X		4950
		Top Rotating Element Worn			X		4960
		Top Rotating Element Broken			X		4970
		Top Stationary Element Damaged			X		4980
		Top Seal Failed Pressure Test			X		4990
		Middle Displaced			X		5400
		Middle Ran Displaced			X		5410
		Middle Shaft Grooved			X		5420
		Middle Spring Broken			X		5430
		Middle Seal Bellows Damaged			X		5440
		Middle Rotating Element damaged			X		5450
		Middle Rotating Element Worn			X		5460
		Middle Rotating Element Broken			X		5470
		Middle Stationary Element Damaged			X		5480
		Middle Seal Failed Pressure Test			X		5490
		Bottom Displaced			X		5900
		Bottom Ran Displaced			X		5910
		Bottom Shaft Grooved			X		5920
		Bottom Spring Broken			X		5930
		Bottom Seal Bellows Damaged			X		5940
		Bottom Rotating Element damaged			X		5950
		Bottom Rotating Element Worn			X		5960
		Bottom Rotating Element Broken			X		5970
		Bottom Stationary Element Damaged			X		5980
		Bottom Seal Failed Pressure Test			X		5990
		Rotating Element Carbon			X		6000
		Rotating Element Silicone			X		6010
		Rotating Element Tungston			X		6020
		Stationary Element Ceramic			X		6050
		Stationary Element Silicone			X		6060
		Stationary Element Tungston			X		6070
	RV	**R**elief **V**alves					
		Relief Valve Failed			X		3440
	CA	**C**hamber **A**ssembly					
		Breathing Tube Broken			X		2050
		Communication Ports Plugged			X		3620
		Breathing Tube Corroded			X		3700
	IN	**IN**ducer Section					
		Eroded		X			1000
		Down Thrust Washers Missing		X			2770
		Plugged		X			3610
		Percent Plugged		X			3630
		Plugged w/		X			3650
		Down Thrust Washers Worn		X			4012
		Down Thrust Washers Brittle		X			4080
	SS	**S**eparator **S**ection					
		Eroded		X			1000
		Plugged		X			3610
		Percent Plugged		X			3630
		Plugged w/		X			3660
		Scale is Acid Soluble		X			3820
	TW	**T**hrust **W**ashers Condition					
		Up Thrust Washers Missing	X				2760
		Down Thrust Washers Missing	X				2770
		Down Thrust Washers Slight Wear	X				4012
		Down Thrust Washers Moderate Wear	X				4015
		Down Thrust Washers Severe Wear	X				4018
		Down Thrust Washers Brittle	X				4080
		Up Thrust Washers Slight Wear	X				4112
		Up Thrust Washers Moderate Wear	X				4115
		Up Thrust Washers Severe Wear	X				4118
		Up Thrust Washers Brittle	X				4180

EQUIPMENT COMPONENT

Common	Specialty	Description	P (PUMP)	G (Gas Separator)	S (Seal Section)	M (Motor)	Observation Code
	DU	Diff**U**sers					
		Percent Plugged	X				3630
		Plugged w/	X				3640
		Radial Wear - Slight	X				3902
		Radial Wear - Moderate	X				3905
		Radial Wear - Severe	X				3908
		Thrust Wear - Slight	X				4072
		Thrust Wear - Moderate	X				4075
		Thrust Wear - Severe	X				4078
		Eccentric Wear (diffuser)	X				4260
		Diffuser Spinning	X				4410
		Location of Spinning Diffuser	X				4460
	IM	**IM**pellers					
		Percent Plugged	X				3630
		Plugged w/	X				3640
		Radial Wear - Slight	X				3902
		Radial Wear - Moderate	X				3905
		Radial Wear - Severe	X				3908
		Thrust Wear - Slight	X				4072
		Thrust Wear - Moderate	X				4075
		Thrust Wear - Severe	X				4078
X-N		S**N**ap Rings					
		Broken		X			2050
		Missing	X	X			2700
		Corroded	X	X			3700
		Worn		X			4210
X-L		Oi**L** Condition					
		Top Bag - Oil -Color			X		2200
		Top Bag - Water -Color			X		2210
		Top Bag - Emulsion - Color			X		2220
		Top Bag - Solids Present			X		2280
		Bottom Bag - Oil -Color			X		2300
		Bottom Bag - Water -Color			X		2310
		Bottom Bag - Emulsion - Color			X		2320
		Bottom Bag - Solids Present			X		2380
		Chamber - Oil -Color			X		2400
		Chamber - Water -Color			X		2410
		Chamber - Emulsion - Color			X		2420
		Chamber - Solids Present			X		2480
		Base - Oil -Color			X	X	2500
		Base - Water -Color			X		2510
		Base - Emulsion - Color			X	X	2520
		Base - Solids Present			X	X	2580
		Free Water				X	2600

Nomenclature for X

X	DESCRIPTION
P	**P**UMP
G	**G**AS SEPARATOR OR INTAKE
S	**S**EAL SECTION
M	**M**OTOR

Figure A-2—Recommended Observation Codes for ESP Teardown (Continued)

Table	Attribute Name	Format	Size	Dec Point Pos.	Optional	Description
WELLTAB *(WELL_INDENTIFICATION TABLE)*						
	UWI	TEXT	20		N	Unique Well Identifier
	LeaseName	TEXT	20		Y	Lease name
	Altname	TEXT	20		Y	Alternate Well ID (for internal identification only)
	Field	TEXT	12		Y	Designated Field Name
	County	TEXT	12		Y	County parish or small designation
	District	TEXT	12		Y	District Identification
	State	TEXT	12		Y	State or Province
	Country	TEXT	12		Y	Country
EVENTTAB (EVENT_IDENTIFICATION TABLE)						
	EVENTID	TEXT	12		N	Counter to uniquely Identify the time and well the equipment was pulled from.
	UWI	TEXT	20		N	Unique Well Identifier
	PullDate	DATE	YY/MM/DD		N	Date equipment was run in the hole
	FailDate	DATE	YY/MM/DD		Y	Date Equipment was reported to fail
	InDate	DATE	YY/MM/DD		N	Date Equipment was pulled
	Operator	TEXT	20		N	Operator of the well
	PullRepID	TEXT	20		Y	Pull Report ID (Could be used as EVENTID)
	SerOID	TEXT	20		Y	Service Order ID (Could be used as EVENTID)
	Reason4Pull	TEXT	4		Y	Code Describing Reason for Pull (See Figure 8)
	Deviation_Indicator	INTEGER	1		Y	Indicates if well is deviated (0=(default) straight hole;1=deviated hole depths in MD;2= deviated hole depths in TVD)
	UnitsID	INTEGER	1		N	0=Imperial;1=Metric
	MotorBOT	NUMBER	10	5	Y	Depth of the bottom of the motor
	OilRate	NUMBER	12	2	Y	Oil rate from last test prorated to a 24hr day
	WaterRate	NUMBER	12	2	Y	Water rate from last test prorated to a 24hr day
	GasRate	NUMBER	12	2	Y	Gas rate from last test prorated to a 24hr day
	Testdate	DATE	YY/MM/DD		Y	Date of Production test
	BHT	NUMBER	5	2	Y	Estimated Bottom hole temperature
	APIOil	NUMBER	5	2	Y	API Gravity of the oil
	ViscOil	NUMBER	12	2	Y	Viscosity (cp) of oil at in situ conditions (BHT,PIP)
	WaterGr	NUMBER	12	2	Y	Gravity of the Water
EQUIPTAB *(EQUIPMENT_IDENTIFICATION TABLE)*						
	EQUIPID	TEXT	12		N	Counter to Uniquely Identify Equipment being Reported
	SerialNumber	TEXT	20		N	Serial Number of component torn down
	EVENTID	TEXT	12		N	Counter to uniquely event (Link to EVENTTAB)
	SectionID	TEXT	2		Y	X# where X=**P**ump,**G**S,**S**eal,**M**otor and **#** =0,1,2...
	MfgESP	TEXT	20		Y	Manufacturer of ESP Component
	TDCo	TEXT	20		Y	Company tearing down ESP
	TDLoc	TEXT	20		N	Location of teardown
	TDRepID	TEXT	20		Y	Teardown Report ID (Could be used as EQUIPID)
	TDDate	DATE	YY/MM/DD		Y	Date of teardown
	MfgRep	TEXT	20		N	Name of Teardown Company representative reviewing teardown
	OpRep	TEXT	20		N	Name of operator reviewing teardown

Notes: 1. Liquid Rates: Metric/Imperial m^3PD/BPD.
2. Gas Rates: 10^3m^3PD/MMSCFPD.
3. Temperature ∞C/∞F.

Figure A-3—Pertinent Data

Table	Attribute Name	Format	Size	Dec Point Pos.	Optional	Description
OBSTAB *(TEARDOWN OBSERVATIONS)*						
	EQUIPID	TEXT	12		Y	Counter to Uniquely Identify Equipment Component (i.e. Pump, Seal) being Reported
	(SUBID)	TEXT	2		Y	Identifies sub-component for observations
	Obs1	NUMBER	4		Y	Observations # 1 for Component
	Obs2	NUMBER	4		Y	Observations # 2 for Component
	Obs3	NUMBER	4		Y	Observations # 3 for Component
	Obs4	NUMBER	4		Y	Observations # 4 for Component
	Obs5	NUMBER	4		Y	Observations # 5 for Component
	Obs6	NUMBER	4		Y	Observations # 6 for Component
	Obs7	NUMBER	4		Y	Observations #7 for Component
	Obs8	NUMBER	4		Y	Observations #8 for Component
	Obs9	NUMBER	4		Y	Observations # 9 for Component
MEASTAB *(TEARDOWN MEASURMENT OBSERVATION TABLE)*						
	EQUIPID	TEXT	12		Y	Counter to Uniquely Identify Equipment Component (i.e. Pump, Seal) being Reported
	P2PA-B	NUMBER	5	0	N	Phase to Phase (A-B)
	P2PA-C	NUMBER	5	0	N	Phase to Phase (A-C)
	P2PB-C	NUMBER	5	0	N	Phase to Phase (B-C)
	P2GA	NUMBER	5	0	N	Phase to Ground (A)
	P2GB	NUMBER	5	0	N	Phase to Ground (B)
	P2GC	NUMBER	5	0	N	Phase to Ground (C)
TREMTAB *(TEARDOWN REMARKS TABLE)*						
	EQUIPID	TEXT	12		Y	Counter to Uniquely Identify Equipment Component (i.e. Pump, Seal) being Reported
	(SUBID)	TEXT	2		Y	Identifies sub-component for observation remark
	Remark1	TEXT	80		Y	Comments explaining Observation #7
CONCLTAB *(TEARDOWN CONCLUSION TABLE)*						
	EVENTID	TEXT	12		Y	Counter to Uniquely Identify Event being Reported
	SUBID1	TEXT	2		Y	Identifies Sub-Component for Primary Cause of Failure
	PRIM1	NUMBER	4	0	Y	Primary Cause of Failure
	PREM1	TEXT	120		Y	Explaining Reasoning for Primary Failure
	SUBID2#	TEXT	2		Y	Sub-Component ID for Contributing Factor
	CONF#	NUMBER	4	0	Y	Explanation of Contributing to Primary Failure
	CONFR#	TEXT	120		Y	Explanation for Contributing Factor
	SUBID3#	TEXT	2		Y	Sub-Component ID for Notable Problems
	SECF#	NUMBER	4	0	Y	Notable Problem (Item near Failure not related to Primary Failure)
	SECFR#	TEXT	120		Y	Comments explaining Notable Problem

Note: **BOLD** text = primary key: **(BRACKETED BOLD)** text = secondary key.

Figure A-4—Teardown Observation Data

Table	Attribute Name	Format	Size	Dec Point Pos.	Optional	Description
EQUIPID						
PUMDT (Pump_Details)						
	Serial#	TEXT	20		N	Serial Number for Pump
	Order#	TEXT	20		Y	Order Number for Pump
	Model#	TEXT	20		N	Pump Model
	Type	TEXT	20		N	Description of Pump
	Hsg	NUMBER	5	0	N	Housing Size
	Stages	NUMBER	5	0	N	Number of Stages
	MatMfgCode1	NUMBER	4	0	Y	Material Descriptors (user defined)
	MatMfgCode2	NUMBER	4	0	Y	Material Descriptors (user defined)
	MatMfgCode3	NUMBER	4	0	Y	Material Descriptors (user defined)
	MatMfgCode4	NUMBER	4	0	Y	Material Descriptors (user defined)
IGSDT *(Intake/Gas_Separator Details)*						
	Serial#	TEXT	20		N	Serial Number for Gas Separator
	GOrder#	TEXT	20		Y	Order Number for Gas Separator
	GModel#	TEXT	20		N	Gas Separator Model
	GType	TEXT	20		N	Description of Gas Separator
	MatMfgCode1	NUMBER	4	0	Y	Material Descriptors (user defined)
	MatMfgCode2	NUMBER	4	0	Y	Material Descriptors (user defined)
	MatMfgCode3	NUMBER	4	0	Y	Material Descriptors (user defined)
	MatMfgCode4	NUMBER	4	0	Y	Material Descriptors (user defined)
SEALDT *(Seal_Chamber Details)*						
	Serial#	TEXT	20		N	Serial Number for Seal Chamber
	SOrder#	TEXT	20		Y	Order Number for Seal Chamber
	SModel#	TEXT	20		N	Seal Chamber Model
	SType	TEXT	20		N	Description of Seal Chamber
	MatMfgCode1	NUMBER	4	0	Y	Material Descriptors (user defined)
	MatMfgCode2	NUMBER	4	0	Y	Material Descriptors (user defined)
	MatMfgCode3	NUMBER	4	0	Y	Material Descriptors (user defined)
	MatMfgCode4	NUMBER	4	0	Y	Material Descriptors (user defined)
MOTDT *(Motor Details)*						
	Serial#	TEXT	20		N	Serial Number for Motor
	MOrder#	TEXT	20		Y	Order Number for Motor
	MModel#	TEXT	20		N	Motor Model
	MType	TEXT	20		N	Description of Motor
	HP	NUMBER	5	0	N	Horsepower Rating at 60 Hz
	VLTS	NUMBER	5	0	N	Name plate Voltage @ 60 Hz (Volts)
	Amps	NUMBER	5	0	N	Name plate Current @ 60 Hz (Amps)
	MatMfgCode1	NUMBER	4	0	Y	Material Descriptors (user defined)
	MatMfgCode2	NUMBER	4	0	Y	Material Descriptors (user defined)
	MatMfgCode3	NUMBER	4	0	Y	Material Descriptors (user defined)
	MatMfgCode4	NUMBER	4	0	Y	Material Descriptors (user defined)

Note: **BOLD** text = primary key: **(BRACKETED BOLD)** text = secondary key.

Figure A-5—Pertinent Data (Equipment Identification)

		0	10	20	30	40	50	60	70	80	90
Eroded	1000	Evident [1]	-	-	-	-	-	-	-	-	-
Set/Pliable	1300	-	Top	-	Middle	-	Bottom	-	-	-	-
Seized	1400	Pothead	Top	-	Middle	Hsg Bottom	Bottom	-	-	-	-
Cut/Damaged	1500	Pothead	Top	-	Middle	Hsg Bottom	Bottom	-	-	-	-
Melted	1600	Pothead	Top	-	Middle	Hsg Bottom	Bottom	-	-	-	-
Swollen	1700	Pothead	Top	-	Middle	Hsg Bottom	Bottom	-	-	-	-
Hard	1800	Pothead	Top	-	Middle	Hsg Bottom	Bottom	-	-	-	-
Broken/ Damaged	2000	Damaged	Punctured	Ruptured	Damaged Runner	Broken	-	-	-	-	-
Fluid Top Bag	2200	Oil Color	Water Color	Emulsion Color	-	-	-	-	-	Solids	-
Fluid Btm Bag	2300	Oil Color	Water Color	Emulsion Color	-	-	-	-	-	Solids	-
Fluid Chamber	2400	Oil Color	Water Color	Emulsion Color	-	-	-	-	-	Solids	-
Fluid Base	2500	Oil Color	Water Color	Emulsion Color	-	-	-	-	-	Solids	-
Free Water	2600	Present	-	-	-	-	-				-
Missing	2700	Missing	N/A	-	-	-	-	Upthrust Washer	Down Thrust Washer		-
Equipment Used	2800	-	Bolt on	Coating	Coating Damaged[2]	High Strength Shaft	High Load Bearing	-	-	Plug-in Pothead	-
Heating	2900	Heat Noted	Rotor Bearing Discolored	-	-	-	-	-	-	-	-
Burnt	3000	Location of Rotor Burn [7]	Top End Burn	Btm End Burn	Leads	Laminations	Burnt Pothead Connector	Terminal Cavity Block	on OD	-	-
Damaged/ Failed	3200	Damaged	-	Pothead Connector	-	Terminal Block	-	-	-	-	-
Failed Tests	3400	Leaked at	Pressure Test	Valve open	Fastener	Relief Valve	-	Evidence of Water Track	Stained Terminal Block	Hypot Test	-
MISC	3500	Bag Cond.(poor)	-	-	-	-	Collapsed	-	-	-	-
Plugging	3600	Filter Dirty [4]	Plugged	Screen/ Com'n Ports	% Plugged [3]	Plugged w/ [4]	-	-	-	-	-
Corrosion	3700	Corroded[6]	Corroded Cavity	Corroded [6] (Spline/Screen)	-	-	-	-	-	-	-
Scaling	3800	Scale/ Deposits [4,5]	Scale Present	Acid Soluble	Scale Thickness[1]	Deposit Present	Deposit Type [5]	-	-	-	-
Eccentric Wear	3900	Evident[9]	Lower Bearing Worn	Lower Bearing Worn Out of Spec	Location of Wear[7]	Middle Bearing Worn Out of Spec	Upper Bearing Worn	Upper \Top Bearing Worn Out of Spec	Upper Bushing Worn	Lower Bushing Worn	-
Down Thrust	4000	-	Thrust Washer	Thrust Bearing	Thrust Runner	-	-	Washer Cut	Thrust Wear	Washers Brittle	Washer Impression
Up Thrust	4100	-	Thrust Washer	Thrust Bearing	Thrust Runner	-	-	-	-	-	-
Wear	4200	Location[7]	Evident	Extension out of Spec.	-	RB Sleeve	-	Eccentric	-	-	-
Twisted	4300	Shaft Twisted	Spline Twisted	-	-	-	-	-	-	-	-
Rotating	4400	Shaft Not Rotating	Spinning	Vibration Marks[1]	Scarred axial	Depth of Scarring[1]			-	-	-
Btm Seal	4900[9]	Displaced	Ran Displaced	Shaft Grooved	Spring Broken	Seal Bellows Damaged	Rotating Element Damaged	Rotating Element Worn	Rotating Element Broken	Stationary Element Damaged	Seal Failed Pressure Test
Middle Seal	5400[9]	Displaced	Ran Displaced	Shaft Grooved	Spring Broken	Seal Bellows Damaged	Rotating Element Damaged	Rotating Element Worn	Rotating Element Broken	Stationary Element Damaged	Seal Failed Pressure Test
Top Seal	5900[9]	Displaced	Ran Displaced	Shaft Grooved	Spring Broken	Seal Bellows Damaged	Rotating Element Damaged	Rotating Element Worn	Rotating Element Broken	Stationary Element Damaged	Seal Failed Pressure Test
Materials Mechn. Seals	6000	Rotating Element Carbon	Rotating Element Silicone	Rotating Element Tungsten	-	-	Stationary Element Ceramic	Stationary Element Silicone	Stationary Element Tungsten	-	-
Other (For Failure Table only)	7000	Splice Failure	Cable Failure	Motor Flat Failure	Pigtail Failure	Tubing Failure	-	-	Equipment Changed out (No failure evident)	Unknown	Other
		0	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**

Note: For explanation of footnote, ref. 4.3.2 and Figure A-7.

Figure A-6—Common Terms for Remarks Teardown Observation Code Breakdown Table

Final Digit	Thickness	Coating Description	Plugged With	Deposits of	Colors	Corrosion Descriptors	Location Descriptors	Rotating Description	Wear Descriptors
For Codes #	**1000, 3640,**	**2830**	**3600, 3640**	**3650**	**2300, 2310, 2320**	**3700, 3720**	**4200**	**3000, 3900, 4400**	**4900 to 5900**
Footnote #	1	2	4	5		6	7	8	9
0	.05 mm	Minor	Asphaltine	Asphaltine	Clear	Minor	-	Locked	Other (1)
1	1.0 mm	Blistering	Iron Sulfide	Iron Sulfide	White	General	Inner Radius	Other (1)	Negligible Evenly
2	2.0 mm	Flaking	Mud	Other (1)	Yellow	Other (1)	Outer Radius	Overly loose	Negligible
3	3.0 mm	Worn	Paraffin	Paraffin	Green	Pitting	Top	Other (2)	Negligible One Sided
4	4.0 mm	Dented/Chipped	Rubber	Other (2)	Light Brown	Other (2)	Middle	Other (3)	Moderate Evenly
5	5.0 mm	Cracked	Sand	Other (3)	Other (1)	Cracking	Bottom	Other (4)	Moderate
6	7.0 mm	Other (1)	Scale	Scale	Dark Brown	Other (3)	Other (1)	Tight Spots	Moderate One Sided
7	10.0 mm	Other (2)	Formation	Other (4)	Other (2)	Other (4)	Other (2)	Other (6)	Severe Evenly
8	15.0 mm	Other (3)	Other (1)	Other (5)	Other (3)	Other (5)	Other (3)	Hard to Rotate	Severe
9	>25 mm	Severe	Other (2)	Other (6)	Black	Severe	Other (4)	Other (7)	Severe One Sided

Note: Other (_) available for user to define.

Figure A-7—Common Terms for Remarks Teardown Observation Code Breakdown

Code	Description	Code	Description
LPRO	Low Production	STIM	Stimulation Required
POFF	Production Off	LOGG	Logging Well Required
RSIH	Resize (Increase Production)	COVT	Converting Well
RSDH	Resize (Decrease Production)	TEST	Testing Well
DHSH	Downhole Short	TSPN	Temporary Suspending Well
LPUM	Locked Pump	ABAN	Abandoning Well
LOAM	Drawing Low Amps	OTH1	Other (1)
HIAM	Drawing High Amps	OTH2	Other (2)
HITB	Hole in Tubing	OTH3	Other (3)
CSRP	Casing Repair Required	OTH4	Other (4)
WKOV	Workover	OTH5	Other (5)

Note: OTH# can be user-defined.

Figure A-8—Reason for Pump Pull

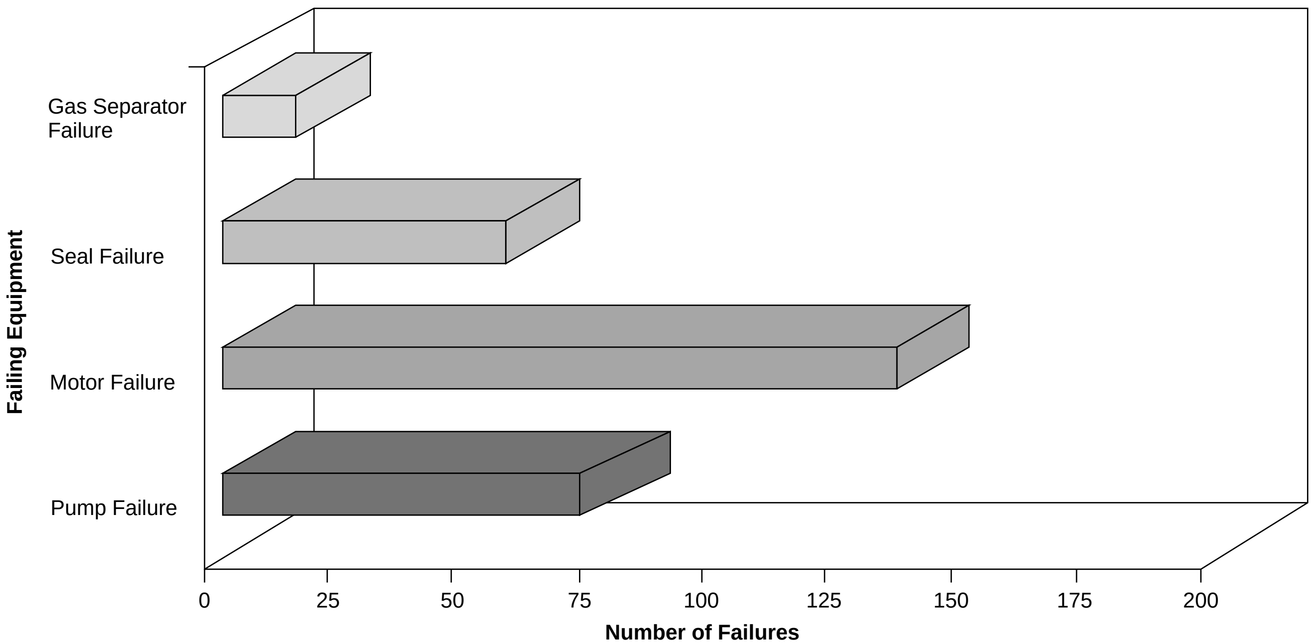
PFAIL1/CFAIL1/SFAIL1 Indices		1	2	3	4	
Common	**Description**	**Upper**	**Middle**	**Lower**	**Other**	**Observation Code**
X-F	Cause of Failure					
	Splice Failure	X	X	X		7000
	Cable Failure	X	X	X	X	7010
	Motor Flat Failure	X	X	X		7020
	Pigtail Failure	X	X	X		7030
	Tubing Failure	X	X	X	X	7040
	No Failure, Equipment Changed Out				X	7070
	Unknown				X	7080
	Other Failures				X	7090

Figure A-9—Failure Codes

APPENDIX B—TEARDOWN REPORT QUERIES

Description: Plot 1 shows the distribution of failures within Field X along with the average run lives by failure. From **Plot 1** we see that PUMP failures represent a significant portion of the failures (27%) and also the shortest run lives. Attention to this problem will have the largest immediate impact on improving this fields run lives and potentially its operating cost. **Plot 2** shows the primary causes of PUMP failure further broken down into 4 major categories, mainly: thrust washers, diffusers, impellers, and screen type failures. It shows that the screen condition and the condition of the thrust washer represent most of the failures.

PLOT 1: ESP FAILURES



PLOT 2: PRIMARY CAUSE OF PUMP FAILURES

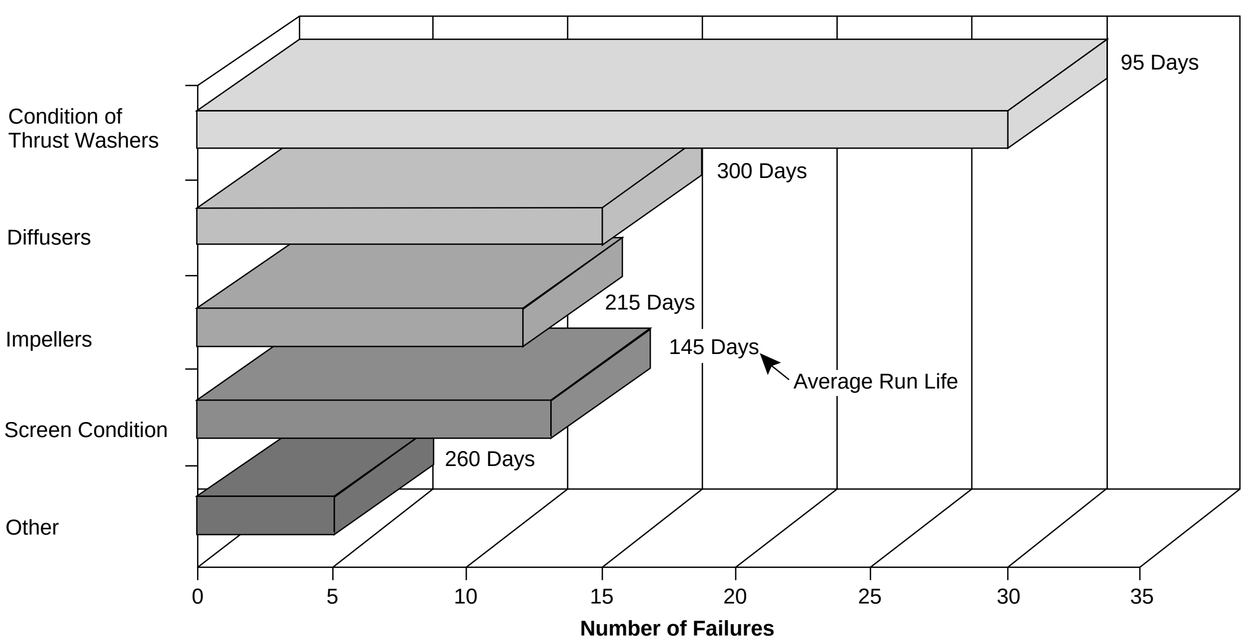
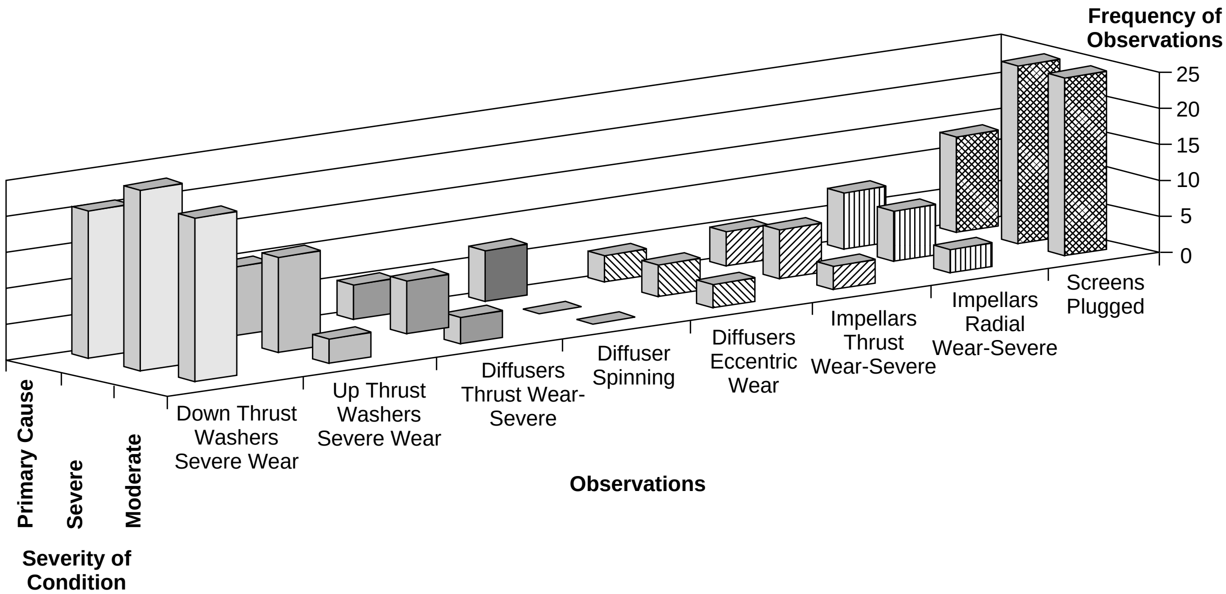


Figure B-1— Example 1: Teardown Report Queries

Description: Plot 3 breaks the PUMP failures down even further, showing that plugging and down thrust are the major components of the failures in this field PUMP failures. In addition to being one of the primary causes of failures, the trend is observed in all teardowns within the field, as **Plot 3** shows. Attention can then be put on operating and design practices within the field.

In a similar fashion to **Plots 2** and **3**, we can progress into increasing levels of detail to determine that pothead failures are one of the main concerns in MOTOR failures. **Plot 4** shows the distribution of the MOTOR failures by manufactures as related to the pothead failures only. It shows that Manufacture B has fewer pothead failures than the other two manufactures; and, if queries also showed the pothead failure problem is limited to certain wells of operating conditions, Manufacture B pumps should be the first choice in those wells. Alternatively, Manufactures A and C would have the data available to determine if design changes are warranted to address this problem.

PLOT 3: BREAKDOWN OF FAILURES



PLOT 4: DESCRIPTION OF POTHEAD BY MANUFACTURES

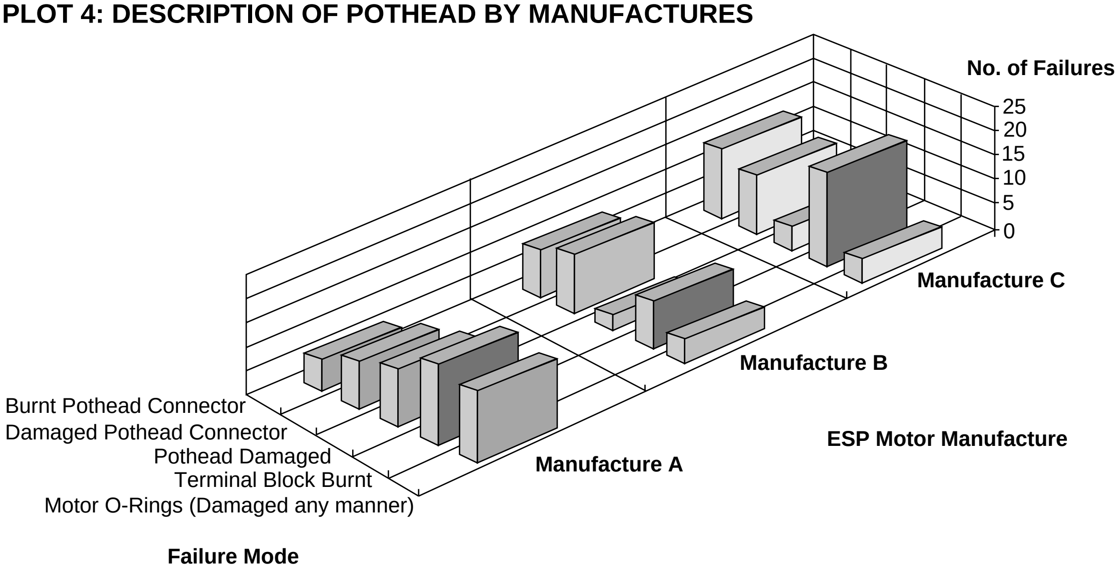
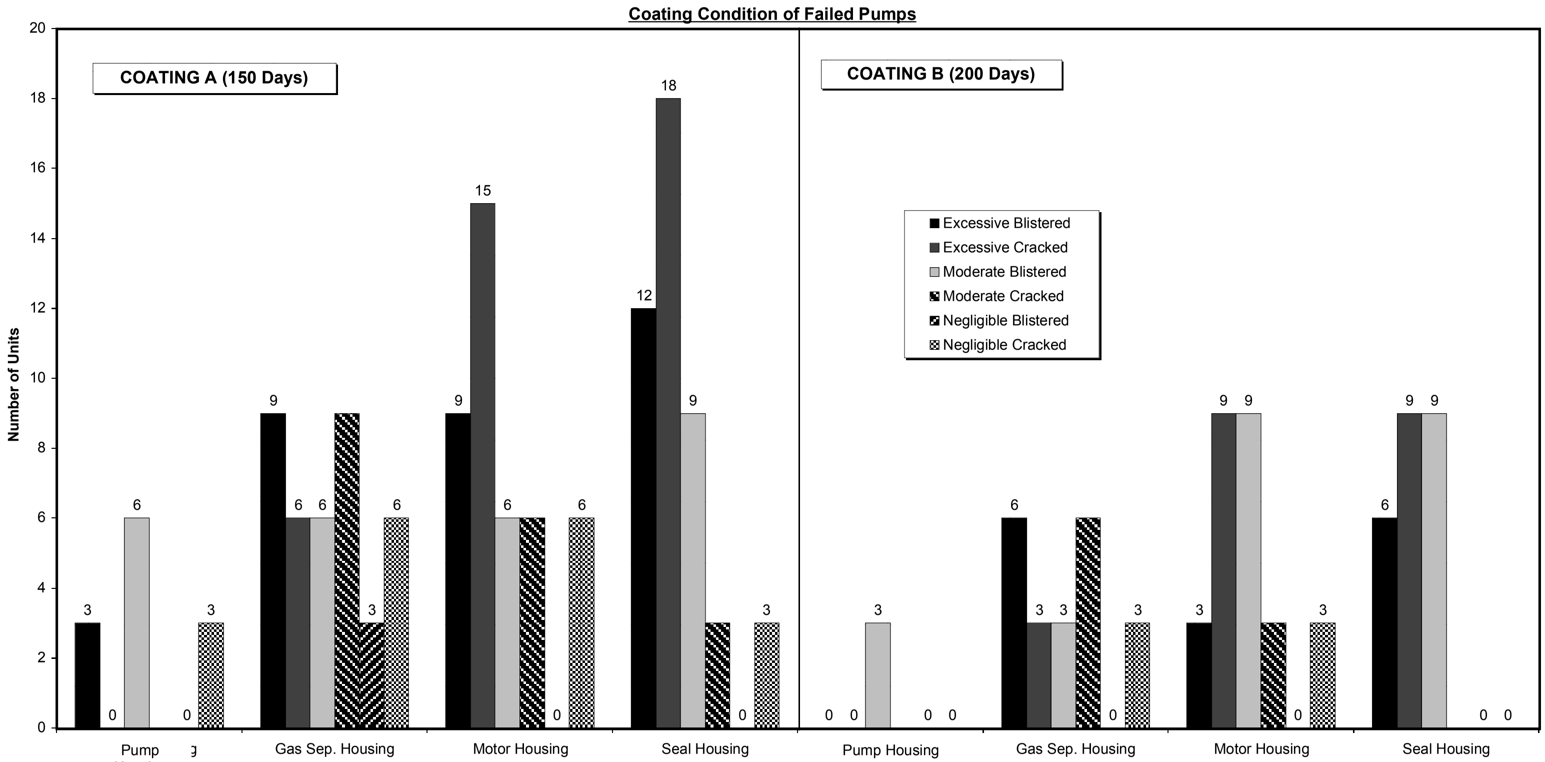


Figure B-1— Example 1: Teardown Report Queries (Continued)



Coating Conditions		Coating A Average Run Time 150 days				Coating B Avg Run Time 200 days			
		Pump Housing	Gas Sep. Housing	Motor Housing	Seal Housing	Pump Housing	Gas Sep. Housing	Motor Housing	Seal Housing
Excessive	**Blistered**	3	9	9	12	0	6	3	6
	Cracked	0	6	15	18	0	3	9	9
Moderate	**Blistered**	6	6	6	9	3	3	9	9
	Cracked	0	9	6	3	0	6	3	0
Negligible	**Blistered**	0	3	0	0	0	0	0	0
	Cracked	3	6	6	3	0	3	3	0

Based on tracking the condition of coatings on the pump torn down, it can be concluded that Coating B is superior to Coating A. A comparison of the run time and the bottom hole conditions would have to be made to confirm this

Figure B-2—Example 2: Teardown Report Queries

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