GAS LIFT TEAR DOWN DATA ANALYZATION & UTILIZATION OF DATA TO IMPROVE PRODUCTION

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ABSTRACT

With the data collected over many years, we can show how we have improved the gas lift valve tear down process, and how that data collected from this process has increased longevity of wells in each, individual area. While following the API Standards of gas lift valve expectancies, both in initial installs as well as reporting once valves are pulled, data is paramount. The ability to provide extensive data, that tracks trends across formations, mandrel types, valve types, and a myriad of other parameters better enables the operator to make the best choices going forward in their wells. This has shown better production from wells that were utilizing the "status quo". In this presentation, the aim is to show how more data can be prudent in making better choices for the lifetime of the well.

INTRODUCTION

Summary and Overview of Paper

Weatherford began gathering and logging micro data for each gas lift component failure beginning in 2021 and have used that date to build a database of those failure types by equipment and customer. Weatherford has been able to improve the quality of the tear down reports, improve the processes, and help our customers troubleshoot and problem solve any issues that they see in their wells. In order to improve any process, one must understand the process itself first. The process of how tear downs are performed, like all processes, can always be improved and refined as new technology, practices, and standards are developed.

Through the implementation and understanding of the tear down process several improvements have already been made. Documentation has been improved upon or added based on customer feedback and internal discussions. These changes where needed to help organize notes, thoughts, and processes allowing the tear down process to be more efficient and increase quality of the tear down data. The determination of what data should be gathered and reported has made teardown output data a valuable resource to identify trends and adjust based on those trends.

Consistent accurate data gathering, and processing is paramount to recognizing trends. Several factors that were generally understood to be the more common causes of leaks and failures became an area of interest when the data was compiled. We began tracking all data from the most common occurrence to the unique or rare cases that occurred only once or twice every few months. This gave a numerical value to the tear downs that can be used beyond one tear down or one well. Using the data collected over the span of two years has opened discussions to further improve practices in quality of injection gas, chemicals, drill outs, coating types, gas lift equipment improvement, material selection, etc. As more data is collected and more patterns form and change even more improvements can be made to drive longevity and development.

CONDUCTING A TEAR DOWN

Tear Down Procedure

In order to fully understand the data, it is important to understand what tests are conducted and what procedures are followed during a tear down: Once a set of equipment has ran its course, is pulled from a well, and returned to the shop the equipment is immediately tagged and scheduled to be torn down. The customers are notified Upon the equipment arrival and the tear down has been scheduled, and in most cases are conducted while the customer is present. The first step in a tear down is to visually inspect and mark the equipment, noting any damage or abnormalities in the equipment. The mandrels are then marked, and hydro tested up to the testing pressure allowed per the mandrel specification. The purpose of the hydrotest is to check the integrity of the mandrel wall, welds, threads, and the integrity of the check valve. Next the check valves are removed and marked. the gas lift valves are removed and marked either prior to the hydro test or along with the check valves depending on the type of mandrel and valve. A closer visual inspection is conducted to check each individual piece of equipment. Documentation of mandrel failures and types are recorded, and check valves not passing the hydrotest are disassembled, inspected, documented with pictures and comments of findings. The gas lift valves are cooled to 60ºF, and the TRO (Test Rack Opening Pressure) is checked and documented. While verifying the TRO, notes are taken on the opening pressure, closing pressure, and leak details if any. The gas lift valves exhibiting leaks and/or have a TRO outside of the set parameters are disassembled and each part inspected for debris or damage. Pictures and notes of test results, damage, debris, etc. are taken and documented throughout the tear down process to ensure accuracy for the report. By understanding this process, we can implement changes to improve and maintain the accuracy of the tear down data.

IMPROVEMENTS WE MADE

Changes to Increase Efficiency and Accuracy

Documentation was added for when the equipment that is returned from the field so that the technicians can document what equipment has been removed and any observations about the equipment that seems noteworthy. The report, itself, has been improved to highlight and focus on the issues of the system and the cause of those issues. Long ago, we started tracking extensive data alongside the report. This data can and has provided useful information when making decisions and guiding improvements for us and our customers.

Weatherford has recently digitized the hydro testing in our facility making it easier to read and share the results of the testing. As the demand for annulare flowing mandrel grows so must our techniques for testing annulare mandrels. We have the “Rocket” for testing annulare flow, but we have implemented internal testing and snorkel testing for side pocket mandrels. These test the integrity of the mandrels and the check valve/packing individually to better pinpoint issues or leaks that may occur.

The data from the tear down is recorded in a spread sheet for Weatherford use and our customers. Using this data, we can track trends and see patterns that improve equipment and well performance. Several trends and discussions have already come from this data. We have used this data to address certain issues faced in very specific formations that allow us to make improvements and provide guidance to our customers for further installations.

<u>Collected Data</u>
Our Results

2021 data was the starting point for this endeavor. This is where we began tracking more than pass/fail rates for tear downs. In late 2021 information like run life, manufacturer, leaks per type of equipment, notation on single or double checked, unique causes of equipment leaks or failure, and TRO status. In 2022 the data collection was expanded to include type of equipment pass rate, short-term and long-term patterns, and expanded details on individual customer information.

Data from 2022 has shown the biggest contributors to valve malfunctions are sand, sediment, stem erosion, and scale (Figure 1). Scale, sand, sediment, and debris (Figure 2) are the largest contributors to check valve leaks. Holes in the mandrels, second only to mandrels being left on location (Figure 3), shows to be a large contributor to gas lift failure which has led to many Permian operators to increase the quality of mandrel coating and make metallurgy changes in mandrels themselves. Figures 4, 5, and 6 show the test results of the individual equipment that we started recording in 2022. The data from 2021 and 2022 have been compared to show trends in run life and equipment pass rate. This data should be considered new, but also important as trendlines can be established with as little as 2 years of data collection. Weatherford has already taken steps using this data to help reduce these issues by improving current procedures and equipment, developing new equipment, and conducting training classes to help educate the industry on why these issues occur.

COMING SOON

Future Updates and Plans

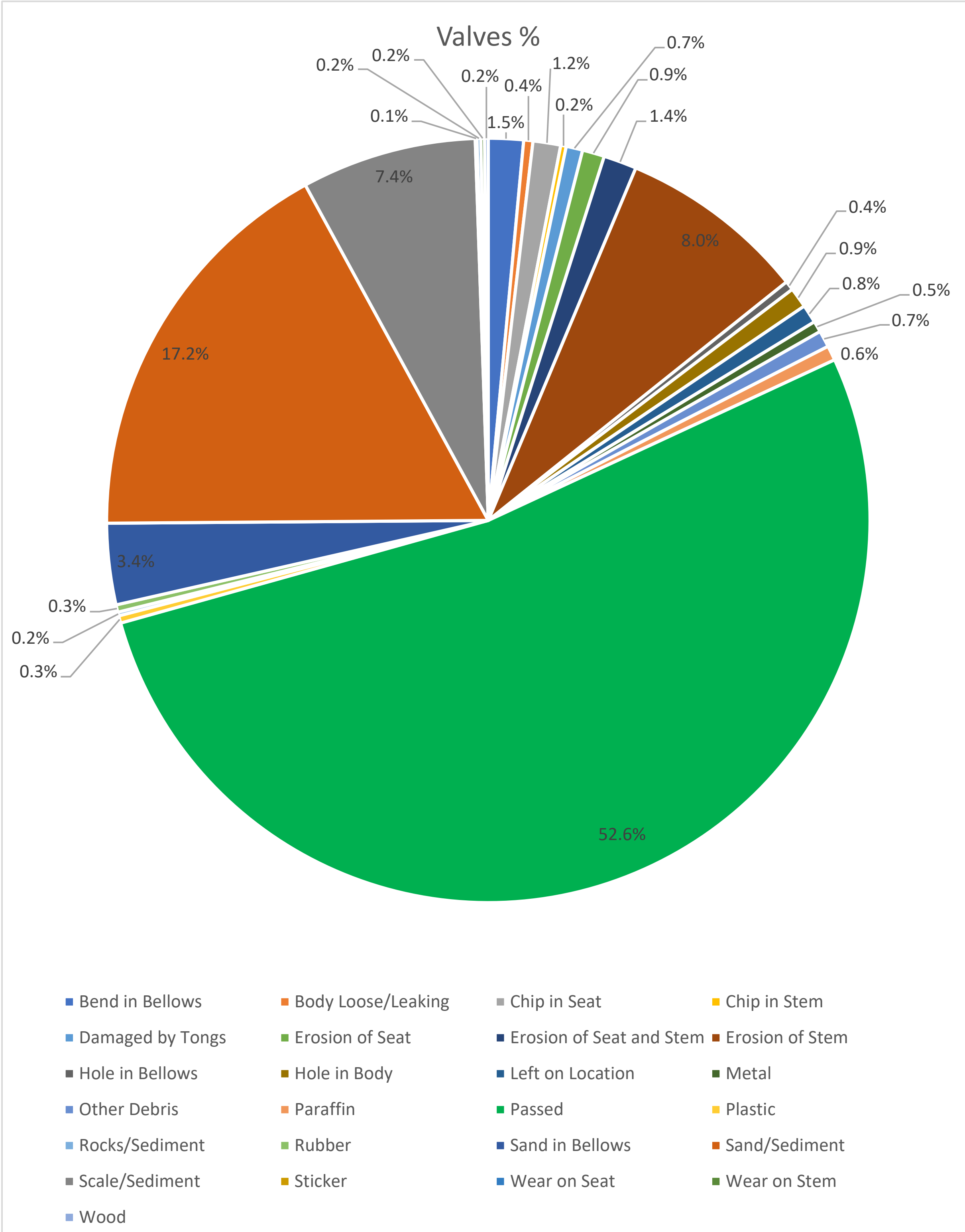
Looking forward to 2023 adding lifespan per equipment type, vendor statistics, pivot tables to better organize the data, quarterly break down data, run time vs pass rate comparisons, individual equipment type leak/fail vs run time comparison, and more to the tear down data collected in order to provide more cohesive picture of the data. With the continuation of further data gathering in gas lift tear down processes, the production should follow trend in gaining. Our goal in providing detailed failure data is and has been to provide customers with quantifiable information to assist in decision making and process improvements. As for the methods of gas lift, that data set is ever changing; however, we challenge that the more data ascertained, the better the well can produce.

CONCLUSION

Recap

The data gathered in recent years from tear downs has been instrumental in decision making, and in driving new developments and practices. As we continue to improve our tear down method and the data collection, the more improvements we can make to designs and equipment. From coating selection, to adjusting gas dehydration practices, chemical composition and delivery types, clean-out/drill out procedures, injection rates, kick-off procedures, and general operations, the data gathered from teardowns has helped operators across the Permian make better decisions for their wells. As time moves forward so shall we.

Figure 1:



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Chip in Stem
Damaged by Tongs
Erosion of Seat
Erosion of Seat and Stem
Erosion of Stem
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Hole in Body
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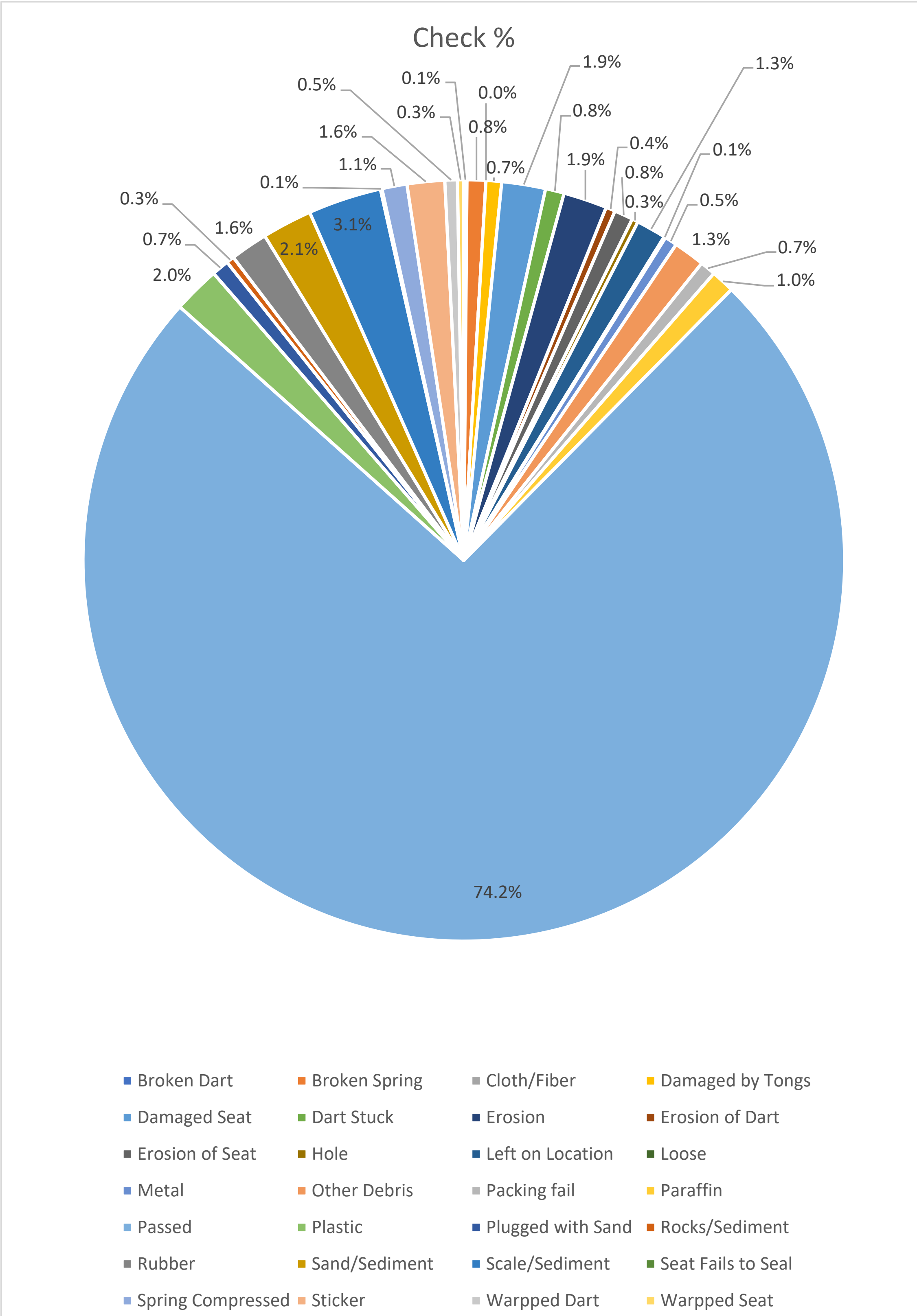
Metal
Other Debris
Paraffin
Passed
Plastic
Rocks/Sediment
Rubber
Sand in Bellows
Sand/Sediment
Scale/Sediment
Sticker
Wear on Seat
Wear on Stem
Wood

Figure 2: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Broken Spring
Cloth/Fiber
Damaged by Tongs
Damaged Seat
Dart Stuck
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Loose
Metal
Other Debris
Packing fail
Paraffin
Passed
Plastic
Plugged with Sand
Rocks/Sediment
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Scale/Sediment
Seat Fails to Seal
Spring Compressed
Sticker
Warpped Dart
Warpped Seat

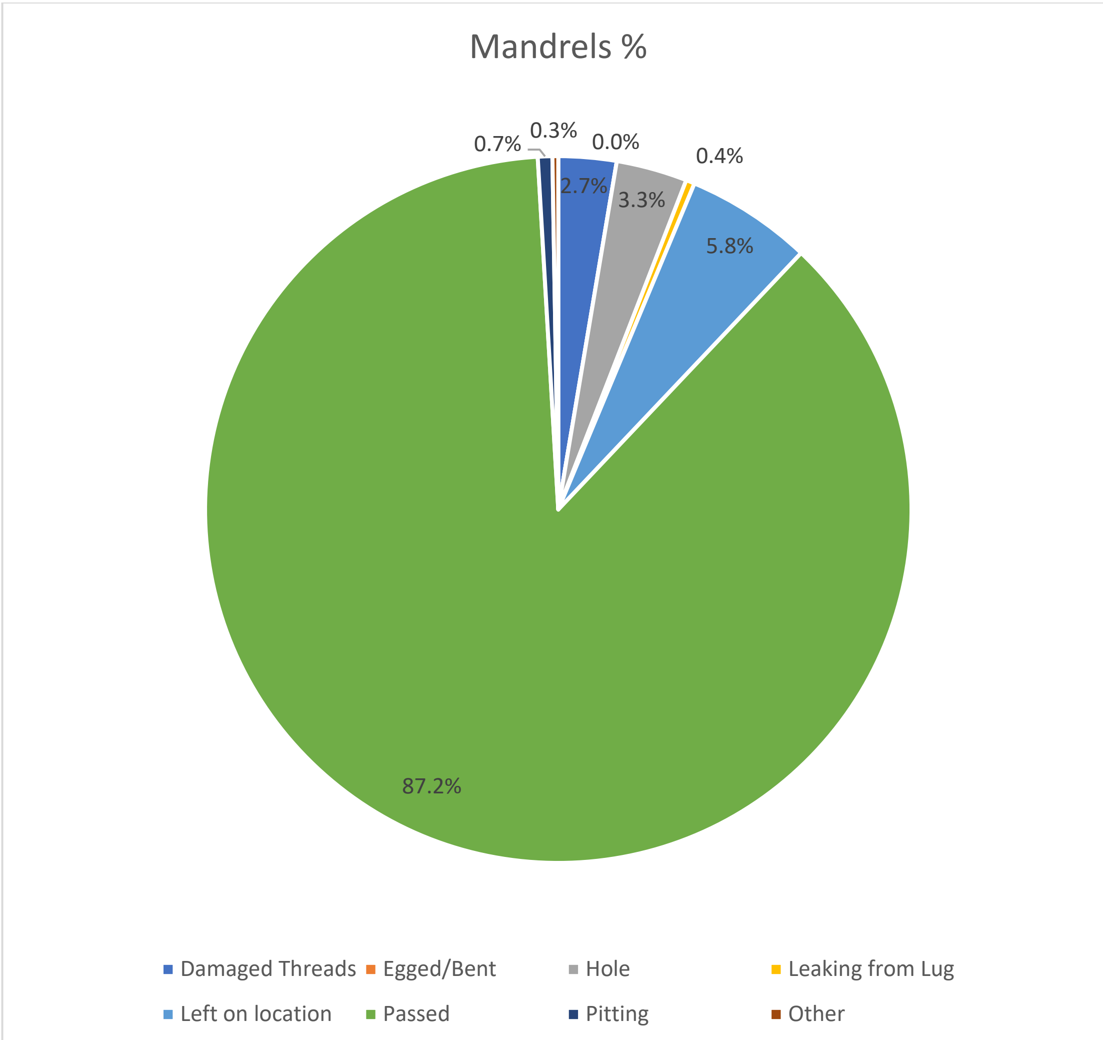
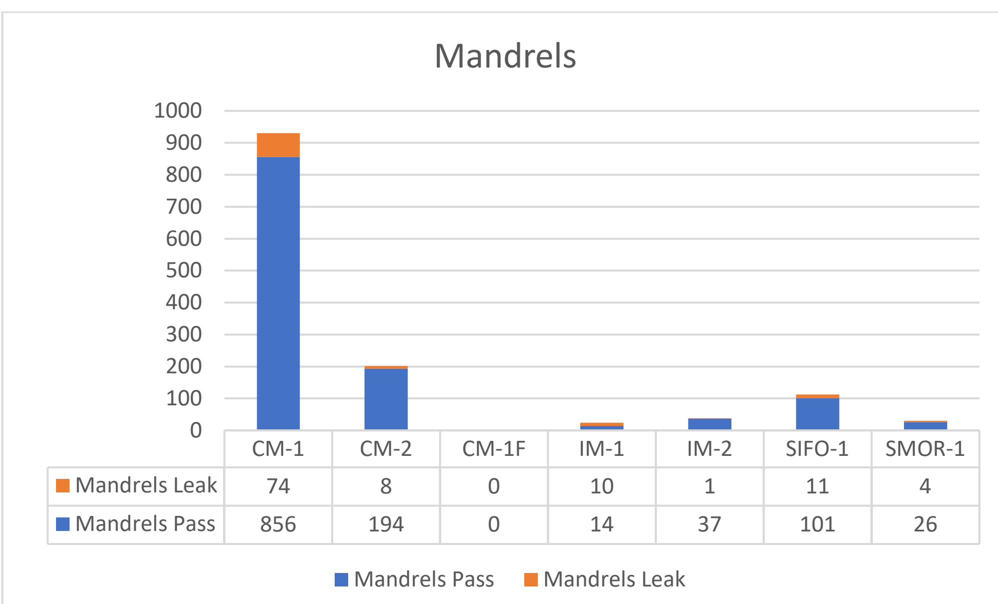


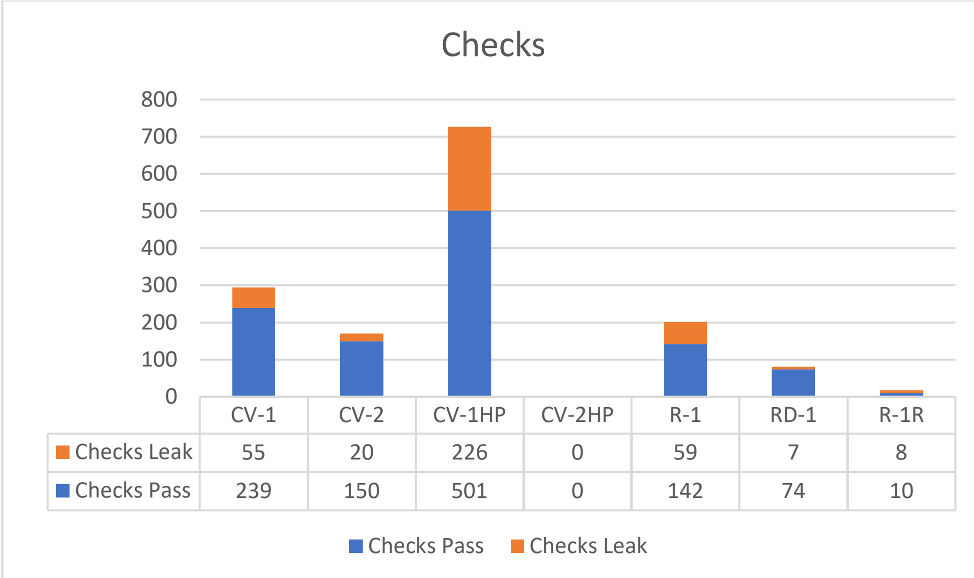
Figure 3:



	CM-1	CM-2	CM-1F	IM-1	IM-2	SIFO-1	SMOR-1
Mandrels Leak	74	8	0	10	1	11	4
Mandrels Pass	856	194	0	14	37	101	26

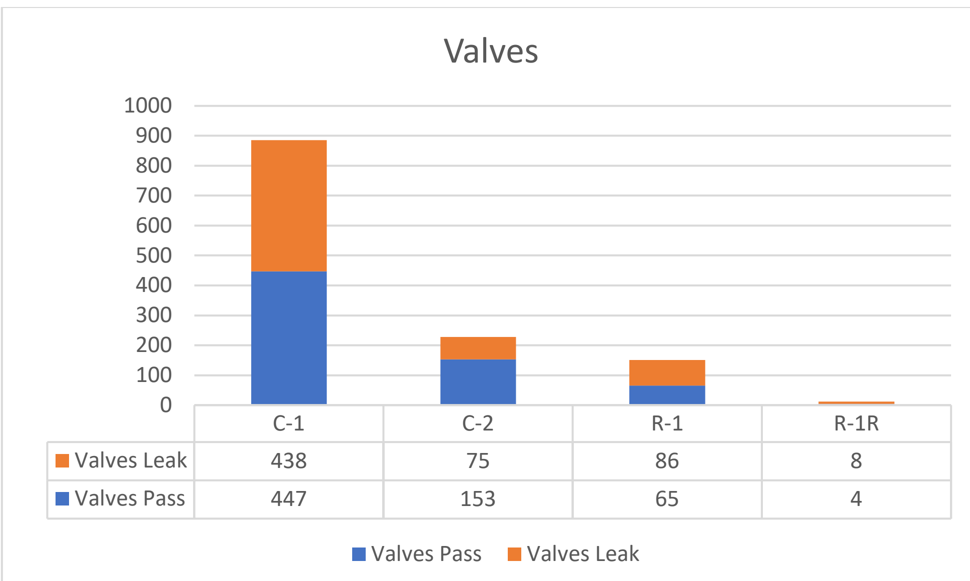
Figure 4:

Figure 5:



	CV-1	CV-2	CV-1HP	CV-2HP	R-1	RD-1	R-1R
Checks Leak	55	20	226	0	59	7	8
Checks Pass	239	150	501	0	142	74	10

Figure 6:



	C-1	C-2	R-1	R-1R
Valves Leak	438	75	86	8
Valves Pass	447	153	65	4