Towards a Universal Test Rig – a design challenge

The Weir Group PLC & University of Strathclyde

A Remanufacturing Case Study

Project Summary

Redesign of an essential piece of testing equipment used in the remanufacture of pumps has the potential to save Weir Group in excess of £22,000 and 233 hours per unit test cycle.

The redesign could generate an additional £500,000 per annum and create 4 new operator roles at the Weir Alloa facility through an increased throughput of remanufactured pumps.

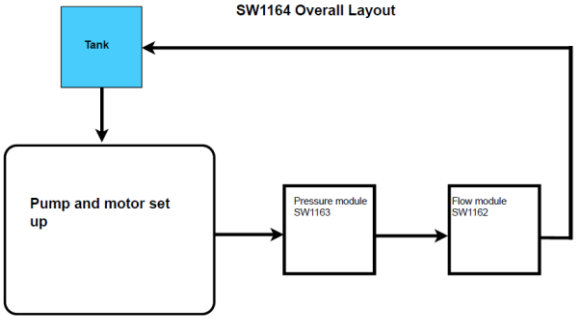
The Challenge

The Weir Group identified a potential opportunity to optimise the time and costs associated with testing and commissioning of remanufactured pumps.

The existing test rig set up often required the purchase of specific pipes to create a bespoke test rig for each pump generating additional costs and extending lead times.

The challenge was to develop a flexible test rig design with an operational range sufficient to meet the variety of pumps refurbished at their Alloa Service Centre with a minimum number of parts.

The ability to test a wider range of equipment more quickly and efficiently will increase responsiveness and help the company to secure future orders.



The basic required layout of the test rig is show above.

Academics from the Design, Manufacture and Engineering Management Department at the University of Strathclyde worked with Weir to research the challenge and potential solutions.

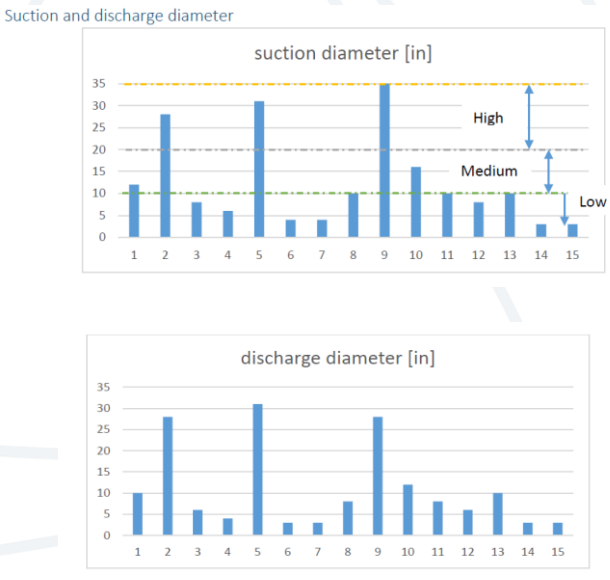
Differences in pump designs resulted in high variability in connecting parts as well as pipe sizes which drives the setup cost for each pump to be tested. In any new design, the fluid loop had to be not only functional and accurate but also compliant with API and BS industry standards for certification.

Research & Analysis

A review of the service centre's test history allowed the project team to determine the design requirements for a new test rig which must accommodate the largest variety of pump sizes, these included:

- Suction diameter
- Discharge diameter
- Discharge Pressure

Analysis of the test history allowed the researchers to categorise the previously tested pumps as large, medium and small and determine the range the test rig needed to service.

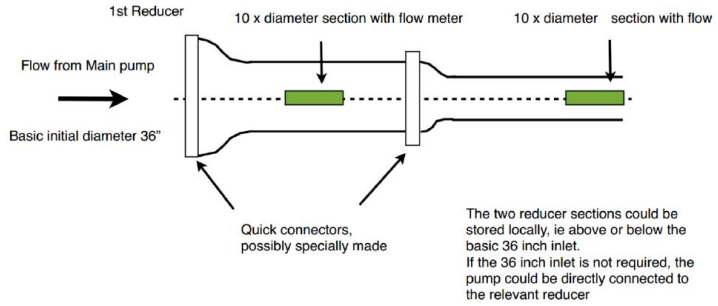


Designing a solution

It was identified that using standardised straight sections sizes will decrease set up time. The proposed design envisions the use of custom-made flange reducers of various sizes that will allow the connection of different equipment sizes. This will require flexible, quick change-over, adaptable connectors.

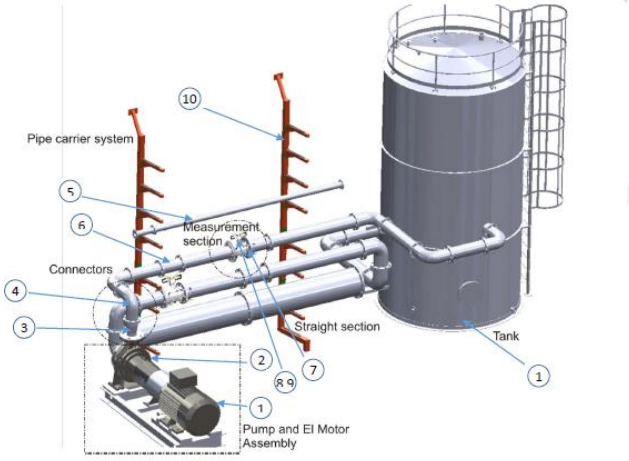
For example, in such a case where a 10” straight section is installed and the pump under test has 12” flange the solution proposes using 12” to 10” reducer flange to minimize the need for a complete reconfiguration of the test rig. Similarly, if the pump flange had a 14” flange, two flange reducers could be employed (e.g. a 10”-12” valve and a 12”-14”).

This principle of bridging the size difference between the pump flange and straight section would rely on the Weir Alloa facility manufacturing a sufficient number of custom flange fittings which would include a ‘quick-lock’ design instead of a traditional nut and bolt fastening system, in sections where this is acceptable, to reduce down time between tests.



The diagram to the left demonstrates the flow measurement arrangement covering 36” to 10” pipes.

The final proposed design is imaged below and demonstrates that with the introduction of two variable, custom made sections, the testing process would be configurable to most pump sizes.



Component	Item in Figure 11	Number of items	Comments
Pump	1	1	test unit
Motor	2	1	standard
Flange reducer	3	2	custom made
Elbow	4	8	standard
Straight section	5	10	standard
Flow straightener	6	4	standard
Measurement section	7	4	custom made
Flow meter	8	2	standard
Pressure sensor	9	4	standard
Pipe carrier system	10	1	standard
Tank	11	1	standard

This study has demonstrated that it is feasible to design a universal test rig that could accommodate a variety of pump sizes and operating regimes. The proposed solution considers using custom flanges to connect standardised straight sections to a test pump assembly.

There are plans for a follow on study to quantify the time and throughput improvements from the design before building a business case for the detailed design and construction of the test rig.