Performance Analysis of Gland for Development of Hydro Test SPM

Shrinath D. Joshi [#1]
Mechanical Department-SPPU
Jayawantrao Sawant College of Engineering. Pune, India.

Kaveri D. Hore [#1]
Mechanical Department-SPPU
Jayawantrao Sawant College of Engineering. Pune, India.

Guided by,
Prof. Mahesh C. Shinde[#2]
Jayawantrao Sawant College of Engineering. Pune, India.

([#1] Under Graduate, [#2] Project Guide)

***Abstract*—**

Mechanical seals were first introduced more than 60 years for sealing rotating shafts. They are engineered for most pumps, mixers and agitator applications in maintenance. It is a device that helps to join the mechanism together and allows the rotating shaft to enter the fluid without allowing it to escape or leak out. Burgmann-Germany developed mechanical seal in 1962. Nippon – Sealol Co. Ltd. a joint venture between Sealol USA and Nok Japan, started manufacturing mechanical face seal in1964. This company changed its name to Eagle industries Co. Ltd im1978. Burgmann And Eagle merged in 2004, to be known as Eagle-Burgmann.[1] After Studying and working there we got more information about sealing systems.

It is suitably used for pressurised fluid at certain temperature range. There ae lot of applications of mechanical seals all over the world like refining and petrochemical industries, chemical industries, power industries, municipal water supply, etc. because of its performance and efficiency of work. It made easy to avoid the wastage of fluid and further consequences of it and cautions to be taken for prevention of leakage as well. The aim is about to test the capacity or sustainability of the seal at the pressure for which it has to be manufactured

I. INTRODUCTION

Mechanical seal is as a machine part which has two flat surfaces with buffer action against the shaft performing seal ability by rotating portion. It is a part that helps join system or mechanism together by preventing leakage, containing pressure between the two surfaces vertically setting against the shaft. The fluid can be liquid, gas or slurry.

Mechanical seal is applied to sealing portion at the rotating equipment (pumps, compressors, etc.) and also for sealing the fluid flowing in between two mating parts. When a seal is mounted inside the product there are several advantages. There are some parts need to be tested before it gets assembled on the field. Hydro testing is the most common method employed for testing seal, pipes and pressure vessels. Using this test helps maintain safety standards and durability of a seal over time. Newly manufactured pieces are initially qualified using the hydrostatic test. Mechanical seal is a device that helps joining system together by preventing leakages, containing pressure or excluding contamination.

The main part in the seal which experience the maximum working pressure and temperature is 'Gland'. The gland is single component made from casting. As it experiences high working pressure and temperature it is necessary to test the strength and stability of the gland. Indirectly the life of the seal depends on how long gland sustains on field. The gland must satisfy the working conditions for efficiency, quality and safety. Hence to test this gland 'Hydro Test Seal Pressure Measurement'

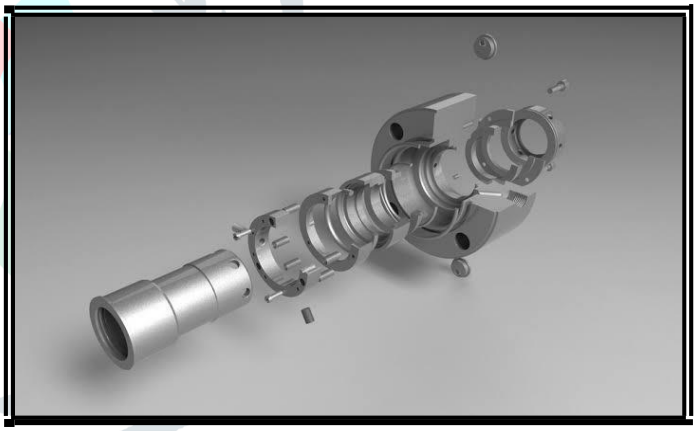


Fig no.1 Exploded view of the seal

1.Manual Hydro Test SPM

Previously the gland was tested on 'Manual Hydro Test SPM'. The word manual itself indicates that the manual efforts are more in this procedure.[2] The gland is mounted on a set up closing its all inlets and outlets, and a pressure is applied using hand pump manually. It gives large pressure range but manual efforts required is also high and time-consuming setup hence not suitable to workers for application.

2.Semi-Auto Hydro Test SPM

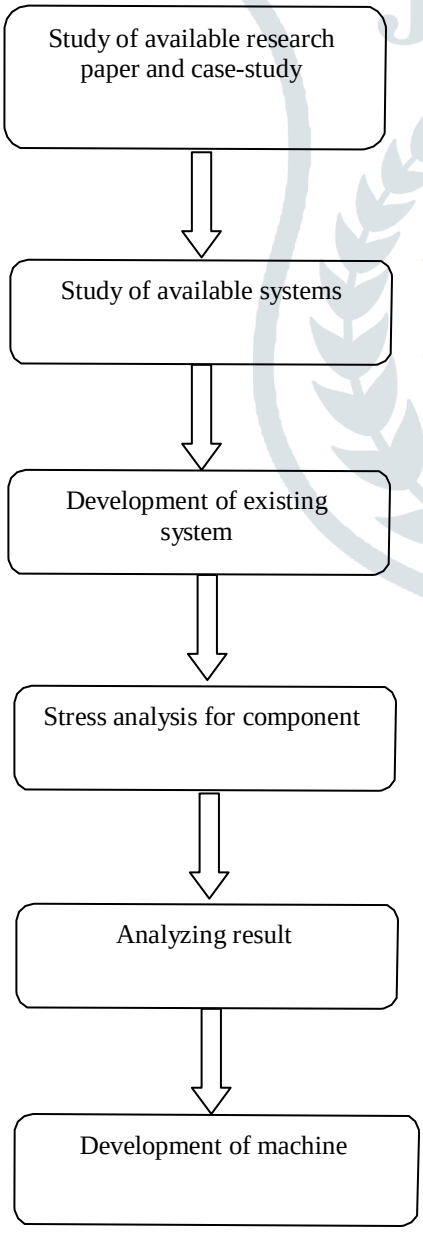
Every industry wants more work to be done in less time at high quality to increase production rate. Hence the semi-auto hydro test SPM is taken into consideration. In this way

of testing the mounting of gland is made simpler than manual hydro test SPM by two bolts clamping and the pressure applied is by hydraulic press after entering the operating conditions of temperature and pressure by PLC programming. The worker only has to mount the gland on the setup and enter the conditions that's it. It has made easy

3. Modified Semi-Auto Hydro Test SPM

The objective behind development of this machine is to increase the testing pressure range. The design of semi-auto hydro test SPM is taken as a reference for developing this modified hydro test SPM. Along with this there are some more changes done in the design. Likewise, the hydraulic mechanism for movement replaced with a ball screw mechanism and servo motors which reduced the maintenance of the machine. Gland holding is done by 8 bolts clamping for better sealing and safety reasons.

METHODOLOGY



but the pressure range given by this machine have very narrow range which is not sufficient. This is one of the main reasons to develop a machine having combination of advantage of 'Manual Hydro Test SPM and Semi-Auto Hydro Test SPM'.

WORKING

The machine is so designed that the operation on machine can be easily performed & understood by the operator. Operation of machine can be well explained by the "Water-Circuit" diagram of the machine. Following procedure gives us the detail information about the Gland installation & its testing in machine for the desired pressure.

1.The gland that has been tested needs to be cleaned which is done by the operator with help of air gun and should be properly installed onto the base plate.

2. The gland is mounted between the plates and manually clamped by the M20 blots with the help of air gun and also the gland is given a inlet and exit for water while other all exits are shut off to avoid pressure loss.

3. Once this setup gets completed, Operator gives the water pressure as per the requirement and the seal gets tested for 30 min. (standard) (or based on requirement) and check for the limiting pressure of 3 drops. If the pressure drop exceeds then the seal fails in test.

4.The water from the tank is pumped & discharged by the Single piston pump of 7 HP at 130 flow rate & discharge rate of 500. The pump is connected to actuators through the non-return valve and swaglok-T valve in order to avoid back flow of water.

5.The actuators actuate the flow of water and the water is given to the gland at high pressure. A pressure gauge with the help of T-valve is connected in line in order to check the pressure of water. The actuator first cleans the gland with high pressure air taken from atmosphere. After this water gets filled in gland.

6.The gland with all other outlets sealed gets the high-

pressured fluid or water as per the required conditions and gets tested for same. Once the gland is checked water is released back to the tank and seal is again cleaned with the help of air which is actuated with high speed by actuator to clean the inner surface.

7.The test involves filling the seal with a liquid, usually water, which may be dyed to aid in visual leak detection, and pressurization of the seal to the specified test pressure. Pressure tightness can be tested by shutting off the exit valve and observing whether there is a pressure loss.

8.The location of a leak can be visually identified more easily if the water contains a colorant.

STRESS ANALYSIS

The design made for gland is depend on the operating conditions. As in this machine h=the pressure range is very high i.e.400+ bar. At the time of testing if the gland fails to sustain the pressure applied it will cause hazardous to the setup as well as the worker. Hence to ensure the design is safe there are more techniques or application to get the stress analysis of the designed product. Hence by using Solid works and Ansys a gland is tested to know that weather it will sustain the pressure or not.

EXAMPLE: Problem 1,

Type of material: - Duplex stainless-steel ASTM A276 2205

Type of fluid: - water

Pressure: - 273kg/cm2

*1.5(401.92 bar)

Temperature -120°C

Results to be obtained:

1. Results of the total deformation
2. Stress and strain analysis
3. Frictional stress

First Saved	Sunday, December 16, 2018
Last Saved	Sunday, December 16, 2018
Product Version	16.0 Release
Save Project Before Solution	No
Save Project After Solution	No

Object Name	*Mesh*
State	Solved
Display	
Display Style	Body Color
Defaults	
Physics Preference	Mechanical
Relevance	0
Sizing	
Use Advanced Size Function	Off
Relevance Center	Coarse
Element Size	5.0 mm
Initial Size Seed	Active Assembly
Smoothing	Medium
Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	0.359210 mm
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5

MESH

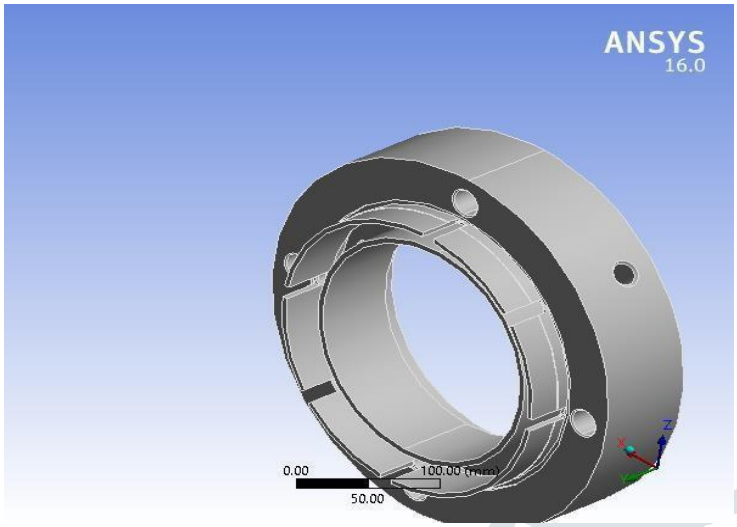


Table 1
Model (A4) Mesh Model (A4) Mesh

Object Name	*Face Sizing*
State	Fully Defined
Scope	
Scoping Method	Geometry Selection
Geometry	2 Faces
Definition	
Suppressed	No
Type	Element Size
Element Size	5. mm
Behavior	Soft

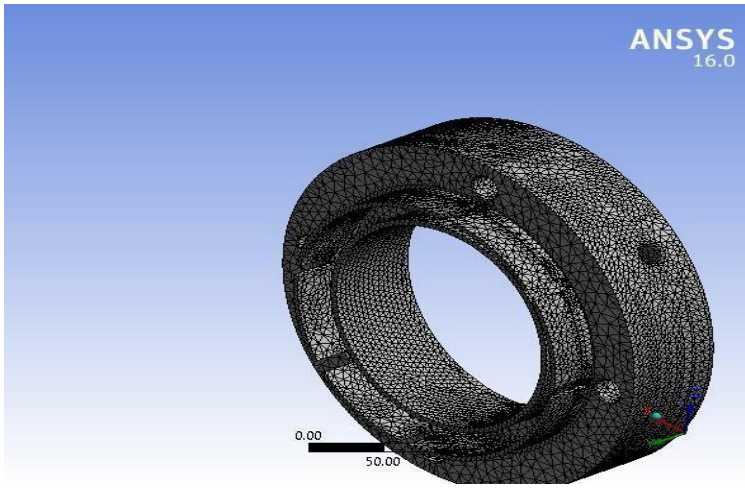


Fig.no.2 Meshing of the seal flange (Gland).

TABLE **2**

Model (A4) Mesh Mesh Controls

Pressure Determined : -

Time [s]	Minimum [MPa]	Maximum [MPa]
1.	1.7386e-002	990.99

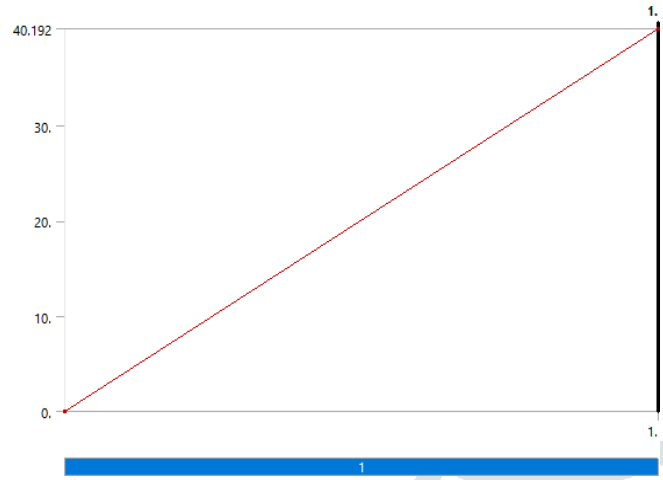


Fig.no.3 Model (A4) Static Structural (A5) Pressure Graph

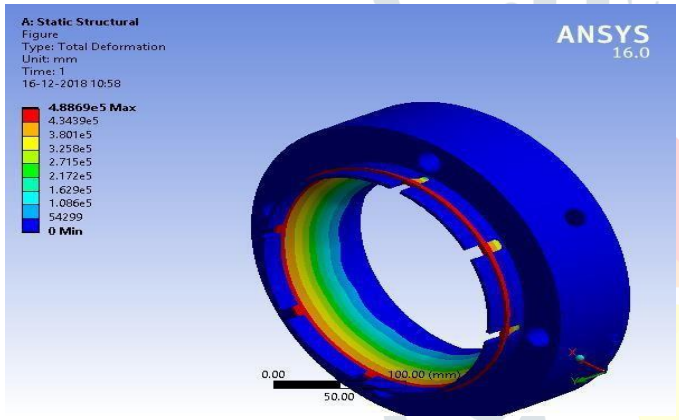


Fig.no.4 Model (A4) Static Structural (A5) Solution (A6) Total Deformation

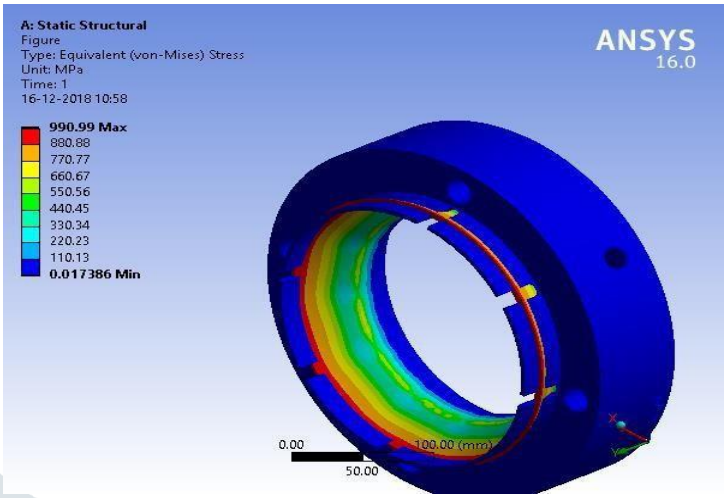


Fig.no.5 Model (A4) Static Structural (A5) Solution (A6) Equivalent Stress

CONCLUSION

1.According to the analysis it is clear that the seal designed for the required pressure has sustained and has the negligible amount of deformation.

2.As the machine is developed for higher pressure it becomes important for the safety and any loss for living surrounding.

3.Before testing the seal or installing any seal on site this analysis will give them the assurance for what pressure the seal may fail if further applied.

ADVANTAGES

The machine will facilitate us with the following advantages given below:

1.The Machine is capable of sustaining varying pressure upto 450 bar which makes it to test a seal gland of wide range.

2.Reduces the maintenance due to installation of the servo motors for the movement along with the combination of the guide ways.

3.Reducing Size and making Compact machine.

4.Achieving the Desired goal of Developing machine with optimum Cost and Standard Quality.

5.To Make it Easy and Safe for Operation to the Workers.

4.And also, the "Semi-automatic Hydro test SPM will be capable of testing the seal gland to such pressure.

REFERENCES

1.Test rig design for mechanical seal by EAGLE- BURGMANN PVT. LTD.

2.JSCOE Project diary.

LINKS [1] http://www.google.com/url?sa=t&source=web&rct=j&url =http://www.rolonseals.com/mechanical%2520seals%252 0history.html&ved=2ahUKEwiQmM ek2czfAhWJvl8KHXs3B7gQFjABegQIGRAE&usg=AO vVaw0YfB6u77PS1Tms8WRpzfOU.

[2] http://pressurejet.com/pages/600/High_pressure_hydro_te sting_pump.aspx?gclid=Cj0KCQiAvKzhBRC1ARIsANE XdgwFaskGmVXwunrPdn7rH7FNtFafcywte7myMLm3h XjtmYuU2ITwN4aAkebEALw_wcBS. Zhang, C. Zhu, J. K. O. Sin, and P. K. T. Mok, "A novel ultrathin elevated channel low-temperature poly-Si TFT," IEEE Electron Device Lett., vol. 20, pp. 569–571, Nov. 1999