HYD 127

FILE COPY
BUREAU OF RECLAMATION
HYDRAULIC LABORATORY
NOT TO BE REMOVED FROM FILES

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

- - -

HYDRAULIC LABORATORY REPORT NO. 127

- - -

HYDRAULIC MODEL TESTS OF FLANGE GASKETS FOR 72-INCH RING-FOLLOWER GATES IN OUTLET WORKS FOR BOISE STORAGE PROJECT ANDERSON RANCH DAM - BOISE PROJECT

- - -

By

E. S. GRAY, ASSISTANT ENGINEER

- - -

Denver, Colorado
June 5, 1943

UNITED STATES

DEPARTMENT OF THE INTERIOR

BUREAU OF RECLAMATION

- - -

MEMORANDUM TO CHIEF DESIGNING ENGINEER

SUBJECT: HYDRAULIC MODEL TESTS

FLANGE GASKETS FOR

BOISE STORAGE PROJECT

HYDRAULIC MODEL TESTS OF FLANGE GASKETS FOR 72-INCH RING-FOLLOWER GATES IN OUTLET WORKS ANDERSON RANCH DAM - BOISE PROJECT

- - -

By

E. S. GRAY, ASSISTANT ENGINEER

- - -

Under Direction of

J. E. WARNOCK, ENGINEER

and

R. F. BLANKS, SENIOR ENGINEER

- - -

Denver, Colorado

June 5, 1943

Denver, Colorado, June 5, 1943.

MEMORANDUM TO CHIEF DESIGNING ENGINEER
(E. S. Gray through J. E. Warnock)

Subject: Hydraulic model tests of flange gaskets for 72-inch ring-follower gates in outlet works - Anderson Ranch Dam, Boise project.

1. Introduction. Gaskets for large flanges and the shape of the groove for them have already been developed and applied satisfactorily in the field. The gaskets used have been round solid rubber of good grade tread stock.

The war has brought on a shortage of the critical material, rubber, so that other materials have been proposed as gaskets. The tests were instituted with this in mind.

2. Scope of the tests. It was desired to test several materials and shapes, in suitable grooves at 400 pounds per square inch water pressure. The grooves were subject to change and several designs were proposed.

3. The testing apparatus and procedure. The testing apparatus is shown in figure 1. The detail of the model in which the gaskets were installed for the tests is shown in figure 2.

The apparatus consisted of the model, a hand pump, an air reservoir, Bourdon gages, and suitable water supply piping with inlet and relief valves. The model was made of two flat plates representing two flanges. In one plate was cut the groove for holding the gaskets and the other plate was flat over the groove; the designed compression was produced when the plates were bolted together until the spacer stop was reached.

The procedure in testing was to form a circular gasket of the material, place it in the groove, clamp the plates together firmly, then apply water pressure in the annular space between the plates and inside of the gasket. The pressure was brought up slowly until a maximum of 550 pounds per square inch was reached. The sustained pressure tests were usually started at about 450 pounds and then allowed to remain for minutes, hours, or days. If for days, the pressure dropped to about 250 pounds overnight then in the morning it was pumped up to 420 pounds and held to an average pressure of about 400 pounds throughout the day. The gaskets were examined after being subjected to the hydraulic tests.

4. Description of the gaskets and tests.

(a) The first gasket tested was a "Garlock wrapped asbestos packing for water," 1/2-inch round. It appeared to be impregnated with a paraffin grease and was a woven cord. The splice for the 6-1/8-inch diameter ring was made by cutting the ends at an angle of about 45 degrees so that the flats overlapped when placed between the flanges clamped together.

Upon the application of water pressure there was a little leakage at one point. The unit was disassembled and the gasket inspected. A small piece of packing was found embedded in the outside sealing surface contacting the groove. The next assembly and test was watertight up to 500 pounds gage pressure. Under sustained pressure of 500 pounds for two minutes there was not a drop of leakage.

Inspection of the gasket showed that it was formed to the groove shape, was not resilient and had somewhat flowed to the outside of the groove. The splice was in place and lightly stuck together.

(b) The second gasket tested was a black plastic tube of 5/8-inch outside diameter and 1/8-inch wall. The material was a sample and its trade name is not known. It could not be permanently deformed easily and it was resilient and elastic. It behaved very much like good rubber of about 70 durometer.

The splice was cut on an angle of about 45 degrees to the plane of the ring and the flats were welded together by first heating them on a flat hot iron. The material melted with heat or would burn very much like rubber.

This gasket sealed droptight up to 550 pounds. It was subjected to an average pressure of 400 pounds for two days. On disassembly the gasket very nearly regained its original shape.

(c) The third gasket tested was a Saran plastic tube of 1/4-inch outside diameter by 1/32-inch wall. Saran is a trade name for a vinylidene chloride plastic manufactured by Dow Chemical Company that is yellow in color and translucent and does not chemically react with many substances including gasoline or oil. The tubing of any nominal size can be obtained at present. It is being used extensively for oil lines on engines. The tubing can be bent cold to quite a short radius, and with heating and proper precautions, can be bent to a very short radius. It will not permanently deform easily and has a high tensile strength so that it cannot be stretched out of shape, except with excessive strain.

The splice was cut at an angle of about 45 degrees to the plane of the ring and heat-welded. In welding the flat surfaces are held on

a hot plate until melting starts then the parts are brought together and clamped until cold. The joint thus made is about as strong as the original tube. The ring was made 7-1/2 inches in diameter to fit the additional groove cut in the plate. The splice was dressed with a knife and fine emery cloth.

The groove, shaped with flat sides and flat bottom, machined much easier than a rounded one and sealed just as well as the larger round bottom groove made for the half-inch size gaskets. The reason for the small size was that tubing of this size was on hand and a larger size was difficult to obtain.

The results of the tests on the Saran tube with the 1/32-inch wall were unsatisfactory. The tube collapsed at about 250 pounds pressure toward the outside 45-degree flat surface of the groove, and did not again regain its original shape. There was leakage of a fine spray at the splice due to imperfections in it. When pressure was relieved and again applied, there was leakage in several spots until further pressure pushed the gasket outwardly and tight in the slot between the two plates.

(d) The fourth gasket tested was a Saran plastic tube 1/4-inch outside diameter by 1/16-inch wall. The splice was a butt joint which was easier to make than the diagonal splice but it was not so smooth. A slip mould was used for its manufacture where the ends of the ring were pushed together in the hole of the mould and thus held until the plastic became hard. Afterward the joint was dressed with a knife and fine emery cloth.

The results of the tests were entirely satisfactory. A droptight seal was obtained up to 550 pounds pressure and for a sustained pressure of 400 pounds average for four days.

On dismantling, the tube was in good condition and had only a slight permanent deformation. A reassembly was again made and additional pressure tests produced no leakage. After the unit stood assembled for several weeks (but not under pressure) and again opened for inspection, the Saran gasket returned to nearly its original shape.

5. Conclusions and recommendations.

(a) There are innumerable materials that might produce a droptight seal when used similarly. Each different material should no doubt be tested before field installation is ordered.

(b) Tubing having a wall thickness at least equal to one-fourth the outside diameter should work well in most any suitable and elastic material. The Saran tube, 1/4-inch outside diameter by 1/16-inch wall

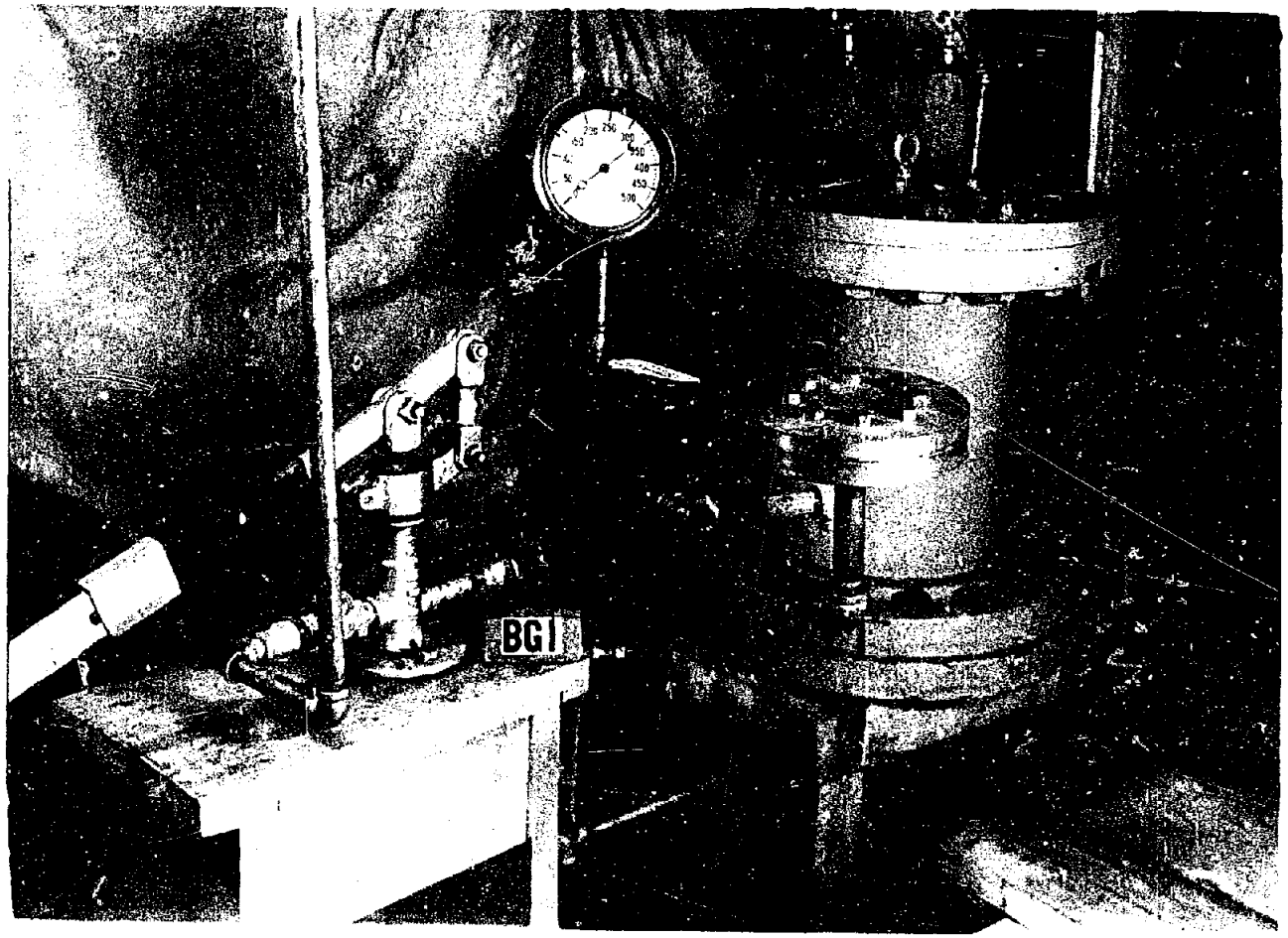
is satisfactory for maintained pressure of at least 400 pounds per square inch. For machining and handling purposes, the 3/8-inch outside diameter size with either a 1/8-inch or 3/16-inch hole should work well.

(c) It is possible that the directional tendency of a tube to collapse may be changed so as to assist in sealing by the addition of a groove chiseled in the upstream slope of the groove (figure 2D). This chiseled groove would admit water under the gasket on the upstream side. It is believed the resultant force on the gasket would thus be more in the direction to aid in pushing it toward the downstream crack. At present the resultant force pushes it away from the flat flange as demonstrated by the collapsed shape of the thin walled Saran gasket (figure 2B).

(d) The shape of the groove as shown for the smaller gaskets produced good results, therefore the flat bottom shape is recommended rather than the rounded bottom which is much more difficult to machine. Furthermore, the flat bottom would probably assist the sealing condition if the chiseled groove were used as in (c) above.

- - -

E. S. Gray.

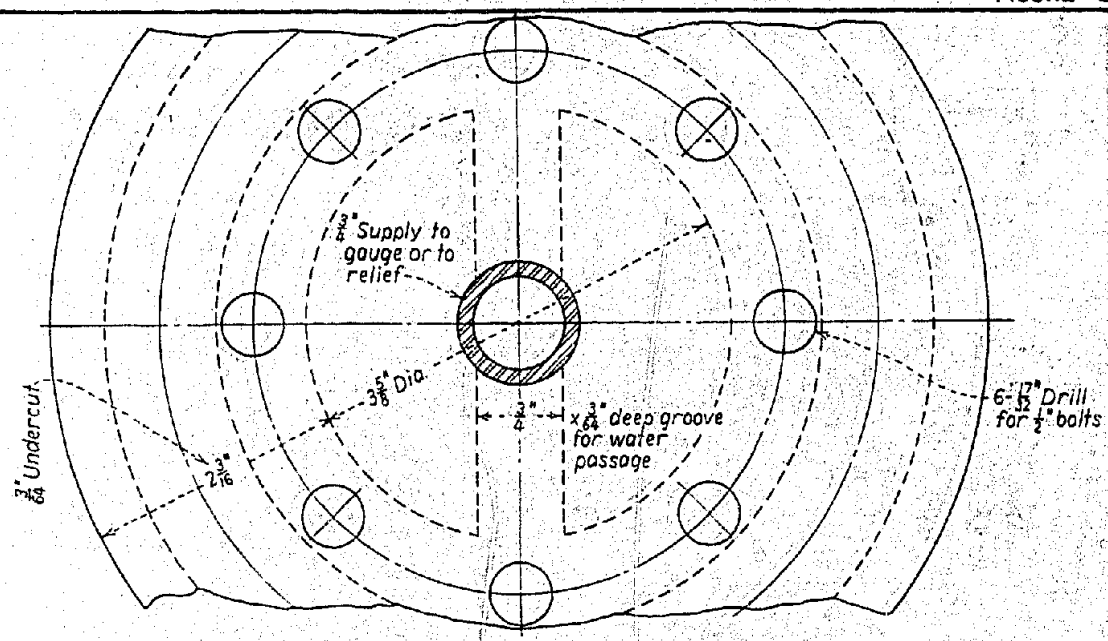


GASKET TESTING APPARATUS

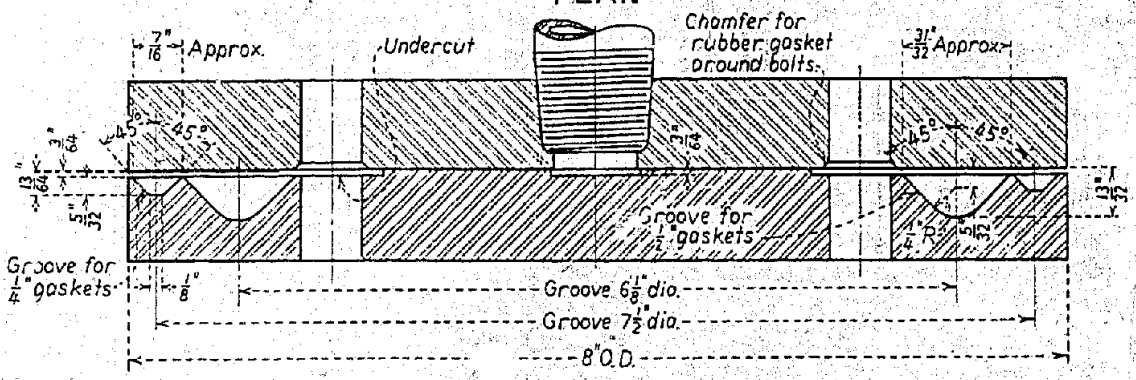
FLANGE MODEL FOR GASKETS, HAND PUMP, PRESSURE TANK,
PRESSURE GAGE, AND PIPING LAYOUT

FIGURE I

FIGURE 2

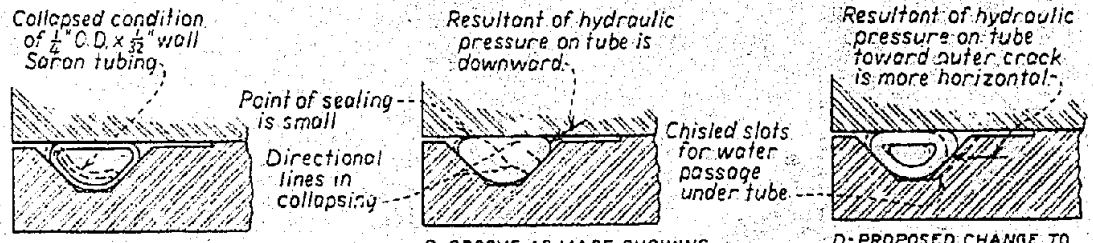


PLAN



SECTIONAL ELEVATION

A-FLANGE MODEL



B-ENLARGED DIAGRAM OF COLLAPSED CONDITION OF TUBE

C-GROOVE AS MADE SHOWING PROBABLE PROGRESSION OF COLLAPSE

D-PROPOSED CHANGE TO PREVENT COLLAPSE AND AID SEALING.

GASKETS TESTED

1. 1/2" Round wrapped asbestos for water. Withstood pressure of 500 lbs. for 2 minutes. Sealed drop-tight
2. 5/8" O.D. x 1/8" wall, black plastic tubing - rubbery and elastic in quality. Withstood pressure of 400 lbs. for 2 days. Sealed drop-tight.
3. 1/4" O.D. x 1/32" wall, Saron tubing. Collapsed immediately at about 250 lbs. Leaked in thin sheet several places at low pressures. Leaked at the joint.
4. 1/4" O.D. x 1/16" wall, Saron tubing. Sealed drop tight immediately. Withstood pressure of 250 lbs. to 450 lbs. for 4 days continuously.

ANDERSON RANCH DAM-BOISE PROJECT-IDAHO

GASKET TESTS

FLANGE MODEL AND GASKETS TESTED

E.S.G.-J.E.O.L.