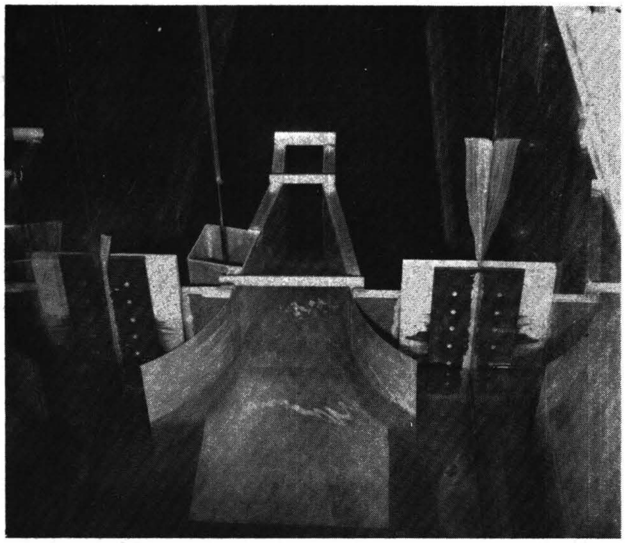


UNITED STATES

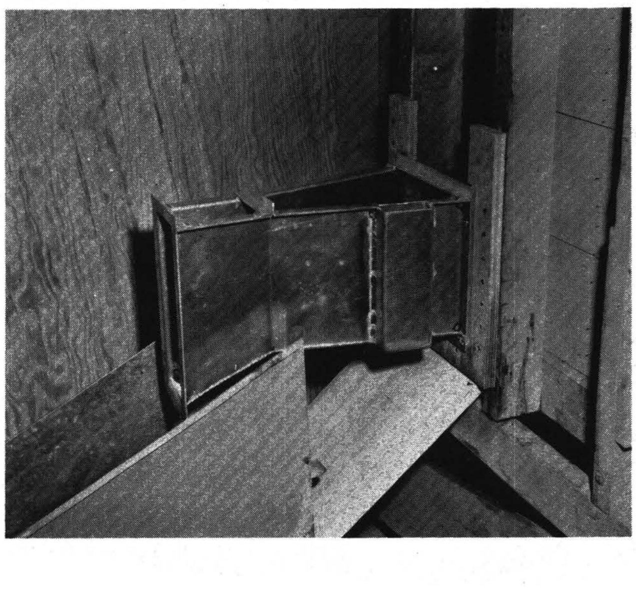
DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

MODIFIED PARSHALL FLUME

HYDROLOGIC LABORATORY

Denver, Colorado



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MODIFIED PARSHALL FLUME

By A. I. Johnson

U.S. Geological Survey Open-File Report

Hydrologic Laboratory
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INTRODUCTION

This flume is a modification of Parshall's original design, but is more portable and convenient to use as it consists only of the converging section and throat section; the diverging section of Parshall's original flume is discarded (fig. 1). This modified Parshall flume was designed in 1931 by H. C. Troxell (U.S. Geological Survey) and C. A. Taylor (U.S. Department of Agriculture) for use in southern California. It was originally described as "Venturi flume" in a March 10, 1932 memorandum from the office of the Ground Water Branch, USGS. The flume was again brought to the attention of potential users by a May 1954 unpublished paper entitled "Portable Venturi Flume for Measuring Small Flows," by George H. Taylor.

The original design specified a 6-inch height, but the height has been increased to 9 inches in the present flumes to give increased capacity and to allow some free-board (fig. 2). The original flume was rated at the Colorado State University Hydraulic Laboratory (then Colorado A and M Experiment Station), Fort Collins, Colo., July 16, 1931. That flume had a maximum capacity of approximately 0.5 second-foot (224 gpm), whereas the present flume has a maximum capacity of approximately 0.7 second-foot (314 gpm).

The dimensions of each of the recently redesigned flumes were checked at the Hydrologic Laboratory of the USGS, Denver, Colo., as they were received from the manufacturer. All flumes were very much alike so one flume was rated at the Bureau of Reclamation Hydraulic Laboratory, Denver, Colo. and one flume was rated at the Colorado State University Hydraulic Laboratory (cover photographs). Both ratings provided essentially the same data as the rating for the original flume.

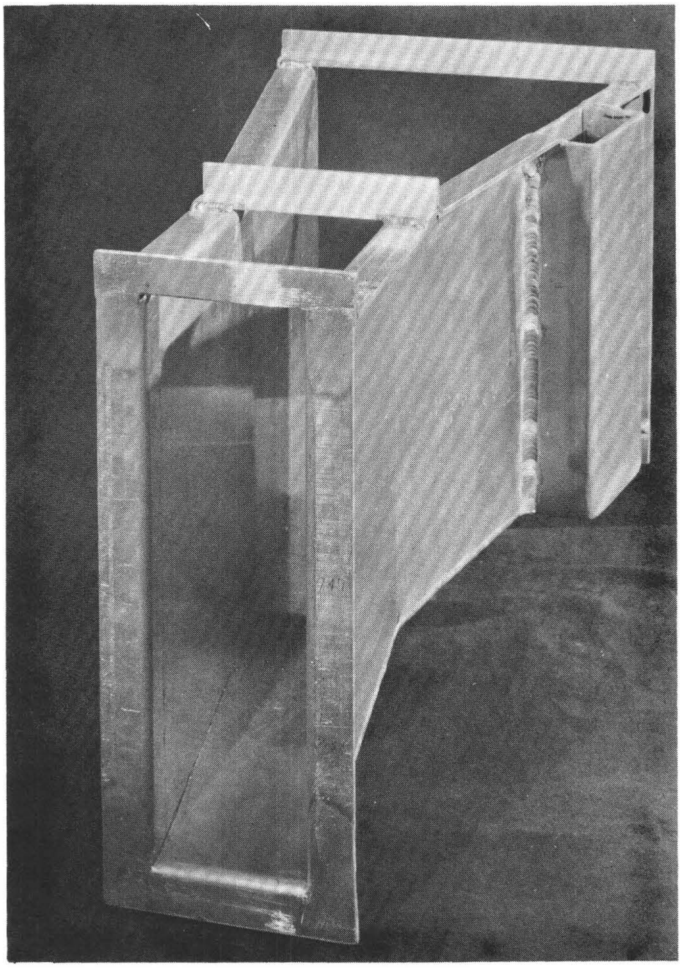


Figure 1.--Modified Parshall flume, throat view.

A log-log plot of the rating data is presented in figure 3. The equation for the curve by the Least-squares Method was determined to be

$$Q = 1.142\ H_a^{1.58}\ .$$

The individual discharges, in second-feet, are given in table 1 for each 0.01-foot increment of head, or gage height. The discharges in gallons per minute are given in table 2.

Setting the Flume

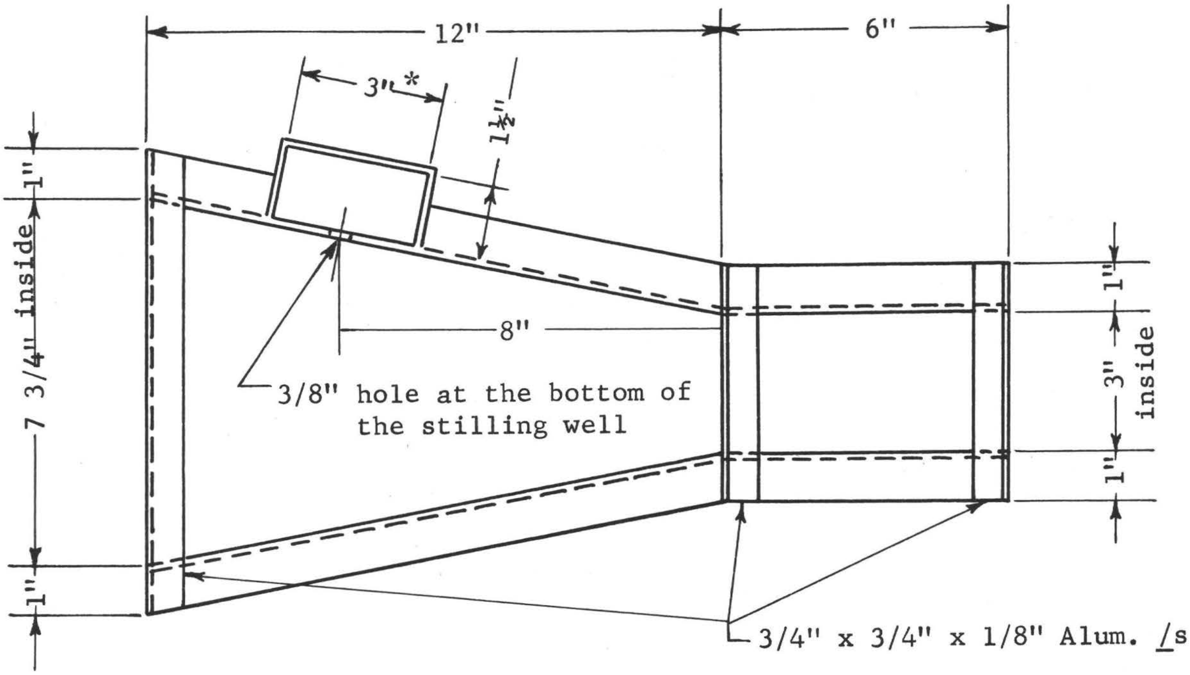
The rating table holds true only for free-flow conditions. Considerable error results when submergence is greater than 0.5 H_a.

The floor in the converging section of the flume should be set level in all directions. The utility of the flumes may be increased considerably by permanently attaching two small levels to the flume frame work at the top of the throat section--one on a lengthwise angle and the other on the middle-cross angle. Aluminum carpenter's "line" levels (cost about 75 cents each) may be secured to the angles by "Pliobond" cement and sheet-metal screws. These permanently attached levels prevent the lost time and poor measurements resulting when the user leaves his level back in the office.

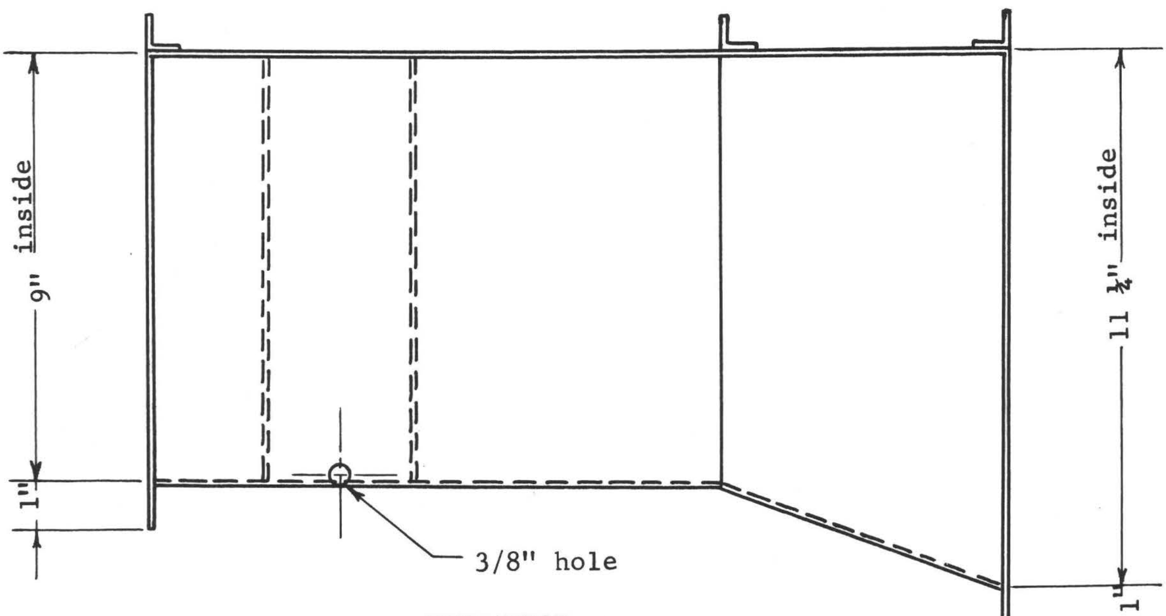
The flume should be placed in a straight section of the channel and not too near the point of discharge into the ditch. The turbulent water will cause surging and difficulty in the reading of the head in the stilling well. Also, the unbalanced flow will create an additional error.

If the ditch is wider than the flume, wing walls should be installed on the flume or a gradually converging wall of earth constructed. Also, a short sloping approach floor should be constructed in the ditch at the front end of the converging section.

The channel, immediately upstream from the flume, should be maintained free from sand and debris accumulation. The flume section and stilling well should be kept clean of sand and vegetation.



PLAN



ELEVATION

Material: 1/8" aluminum
Welded construction
* Note: Stilling well may be increased to 4 inches square so recorder can be installed.

Scale: 1/4" = 1"

A. I. Johnson
October, 1955

Figure 2.--Construction plans for modified Parshall flume.

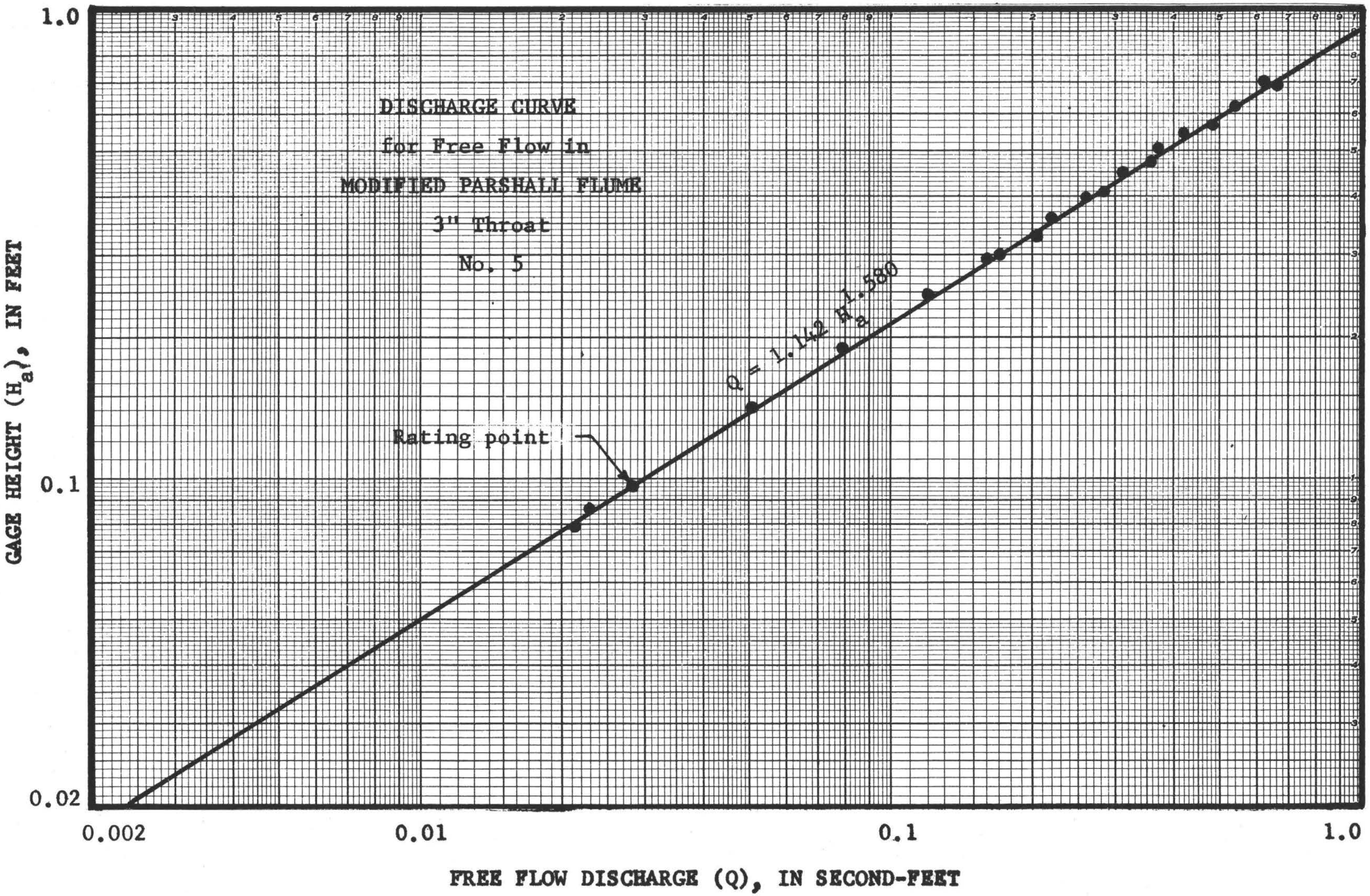


Figure 3.--Discharge curve for free flow through a 3-in modified Parshall flume.

Table 1.--Rated discharge in second feet

[Free Flow Discharge, in Second-Feet (Q)][a]

Gage height, in feet (H_a)	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.00	----	----	0.0024	0.0045	0.0071	0.010	0.013	0.017	0.021	0.025
.10	0.030	0.035	.040	.045	.051	.057	.063	.069	.076	.083
.20	.090	.097	.104	.111	.120	.127	.136	.144	.153	.162
.30	.170	.179	.189	.198	.208	.217	.227	.237	.248	.258
.40	.268	.279	.290	.301	.312	.323	.335	.346	.358	.370
.50	.382	.394	.406	.419	.431	.443	.457	.470	.483	.496
.60	.509	.523	.536	.550	.564	.578	.592	.606	.621	.635
.70	.650	.664	.679	.694	.709	----	----	----	----	----

[a] $Q = 1.142\ H_a^{1.58}$

Table 2.--Rated discharge in gallons per minute

[Free Flow Discharge in Gallons Per Minute (Q)][a]

Gage height, in feet (H_a)	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.00	----	----	1.1	2.0	3.2	4.5	5.8	7.6	9.4	11.2
.10	13.5	15.7	18.0	20.2	22.9	25.6	28.3	31.0	34.1	37.3
.20	40.4	43.5	46.7	49.8	53.8	57.0	61.0	64.6	68.7	72.7
.30	76.3	80.3	84.8	88.9	93.4	97.4	101.9	106.4	111.3	115.8
.40	120.3	125.2	130.2	135.1	140.0	145.0	150.4	155.3	160.7	166.1
.50	171.5	176.8	182.2	188.1	193.4	198.8	205.1	211.0	216.8	222.6
.60	228.5	234.7	240.6	246.9	253.1	259.4	265.7	272.0	278.7	285.0
.70	291.7	298.0	304.8	311.5	318.2	----	----	----	----	----

[a] $Q = 512.6\ H_a^{1.58}$