

Sample calculation - Partially full pipe

Assume the existing conditions are:

$$D = 6''$$

$$d = 2 \frac{3}{4}''$$

$$X = 16''$$

$$Y = 10 \frac{1}{2}''$$

Calculate flow from equation 4, where

C is found from Tables 1, as

$$X/D = 16/6 = 2.67$$

$$d/D = 3.75/6 = 0.625$$

Interpolate in Table 1, $C \approx 1.05$

a is found from Table 100, as

$$\text{depth/diam} = .625$$

Interpolate in Table 100, $a \approx .516$

$$a = .516 \left(\frac{6}{12} \right)^2 = 0.129 \text{ ft}^2$$

$$g \text{ is } 32.2 \text{ ft/sec}^2$$

$$X \text{ is } (16/12) = 1.333 \text{ ft.}$$

$$Y \text{ is } (10.5/12) = 0.875 \text{ ft.}$$

Then

$$Q = 1.05 (.129) \left(\sqrt{\frac{32.2}{2}} \right) \left(\frac{1.333}{\sqrt{0.875}} \right)$$

$$= 1.05 (.129) (4.0) (1.425)$$

$$= 0.774 \text{ cfs.}$$

Sample calculation - full pipe

Assuming the existing conditions are:

$$\begin{aligned} D &= 6" \\ d &= 6" \\ X &= 16" \\ Y &= 7\frac{1}{4}" \end{aligned}$$

Calculate Q from equation 4, where

C is found from Table 1, as

$$X/D = 16/6 = 2.67$$

$$Y/D = 7.25/6 = 1.21$$

Interpolate in Table 1, $C \approx 1.12$

$$a = \pi r^2 = 3.14 (.25 \text{ ft})^2 = 0.196 \text{ ft}^2$$

$$g = 32.2 \text{ ft/sec}^2$$

$$X = (16/12) = 1.333 \text{ ft}$$

$$Y = (7.25/12) = 0.604 \text{ ft}$$

Then

$$\begin{aligned} Q &= 1.12 (.196) \left(\sqrt{\frac{32.2}{2}} \right) \left(\frac{1.333}{0.604} \right) \\ &= 1.12 (.196) (4.01) (2.207) \\ &= 1.510 \text{ cfs} \end{aligned}$$

State of Idaho
Department of Water Resources

WATER RIGHT LICENSE

License of Water Right No. 95-7228 Priority Nov. 21, 1972 Amount 0.06 cfs

THIS IS TO CERTIFY, that RICHARD D. HOGIN
of Spokane, Washington, has complied with the terms and conditions of Permit
No. 95-7228 issued pursuant to Application for Permit dated November 21, 1972,
and has submitted proof to the Department of Water Resources on July 16, 1974,
that he has applied water to a beneficial use; an examination by the Department indicates that the works have a
capacity for the diversion of 0.06 cfs of water from a ground water source,
tributary to _____, and that the permit holder has applied to a beneficial use and
established a right to use water as follows:

Beneficial Use	Period of Use	Rate of Diversion	Annual Volume
<u>Domestic</u>	from <u>Jan. 1</u> to <u>Dec. 31</u>	at <u>0.06</u> cfs and	<u>1.2 acre feet</u>
	from _____ to _____	at _____ cfs and	_____
	from _____ to _____	at _____ cfs and	_____

(both dates inclusive)

Subject, however, to the condition that no more than 0.06 cfs of water be diverted at any one time, and
that the amount of water so diverted and to which such right is entitled and confirmed is for the purpose
aforementioned and is limited to the amount which can actually be beneficially used and shall not exceed
1.2 acre feet per year, said waters to be diverted within ~~the~~ Gov't. Lot 1 of Sec. 10,
Twp. 48 N, Rge. 4 W, B. M. in the County of Kootenai

Description and location of place of use:

Twp.	Range	Sec.	NE¼				NW¼				SW¼				SE¼				Totals
			NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	NE¼	NW¼	SW¼	SE¼	
48 N	4 W	10							L. 1										
									X (2 families)										

Total number of acres irrigated _____

NOTE: Modifications to or variance from this license must be made within the limits of Section 42-222, Idaho Code, or the applicable Idaho Law. This right may be forfeited by five years of non-use.

The right to the use of the water hereby confirmed is restricted and appurtenant to the lands or place of use herein described, as provided by the laws of Idaho.

Witness the seal and signature of the Director, affixed at Boise, Idaho, this 7 day of
November, 19 74.

Director

Identification No. 95-7228

Application No. _____

STATE OF IDAHO
DEPARTMENT OF WATER ADMINISTRATION
APPLICATION FOR PERMIT

To Appropriate the Public Waters of the State of Idaho
(TYPE OR PRINT IN INK)

LICENSE ISSUED FOR 06 SEC. FT.
LICENSE PAGE NO. _____

1. Name of applicant Richard D. Hogin
post office address S. 3926 Tekoa, Spokane, Washington
2. Source of water supply Ground water which is a tributary of _____
3. a. Location of point of diversion is Gov't Lot #1 ~~XXXX~~ $\frac{1}{4}$ of Section 10 Township 48N
Range 4W B.M. Kootenai County; additional points of diversion if any: _____

b. If water is not consumed, it will be discharged into _____ at a point in _____ $\frac{1}{4}$
of _____ $\frac{1}{4}$ of Section _____ Township _____ Range _____ B.M. _____
4. Water will be used for the following purposes:
Amount 0.06 for Domestic purpose from Jan. 1 to Dec. 31 (both dates inclusive)
(cfs or acre-feet per annum)
Amount _____ for _____ purpose from _____ to _____ (both dates inclusive)
(cfs or acre-feet per annum)
Amount _____ for _____ purpose from _____ to _____ (both dates inclusive)
(cfs or acre-feet per annum)
5. Total quantity to be appropriated:
a. 0.06 cubic feet per second and/or
b. _____ acre feet per annum.
6. Proposed diverting works:
a. Description of ditches, flumes, pumps, headgates, etc. 1½ H.P. pump and pipeline to place
of use.

b. Height of storage dam _____ feet, active reservoir capacity _____ acre feet; total reservoir
capacity _____ acre feet, materials used in storage dam: _____
Period of year during which storage will occur _____ to _____ inclusive.
(Mo. Day) (Mo. Day)
c. Proposed well diameter is 6 inches; proposed depth of well is 155 feet.
7. a. Time required for the completion of the works and application of the water to the proposed beneficial use
is 5 years.
b. Estimated construction cost is \$ _____.
8. Description of proposed uses:
a. If water is **not** for irrigation: Gov't Lot #1
(1) Give the place of use of water: XXXX $\frac{1}{4}$ of Section 10 Township 48N
Range 4W B.M. _____
(2) Amount of power to be generated: _____ hp under _____ feet of head.
(3) List number of each kind of livestock to be watered _____

(4) Name of municipality to be served _____, or number of families to be
supplied with domestic water two.
(5) If water is to be used for other purposes describe: _____

95 7228

11. Map of proposed project: show clearly the proposed point of diversion, place of use, section number, township and range number.

The diagram is drawn on a grid. It shows a path starting from a point labeled 'GOV. APT.' (Government Apartment) in the top-left area. A line goes from 'GOV. APT.' to a point labeled 'P.D.' (Police Department). From 'P.D.', a line goes to a point labeled 'PLACE OF USE'. A line also goes from 'GOV. APT.' to a point labeled 'ID' (Identification). The path from 'P.D.' to 'PLACE OF USE' is labeled 'R-4W' (Route 4 West). The path from 'ID' to 'PLACE OF USE' is labeled 'T-48N' (Trunk 48 North).

Scale: 2 inches equal 1 mile

BE IT KNOWN that the undersigned hereby makes application for permit to appropriate the public waters of the State of Idaho as herein set forth.

Lee H. D. Hargis
(Applicant)

95 7228

95-7228

Received by KK Date 11/21/72 Time 4:00 PM
Preliminary check by KK Fee \$ 11/21/72
Received by KK Date 11/21/72 # 3487
Publication prepared by CR Date 12-1-72
Published in Coeur d'Alene Press
Publication dates 12-7 & 12-14-72
Publication approved CR Date 1-4-73
Priority reduced to 11/21/72 Reason XXXX
Protests filed by: _____
Copies of protests forwarded by _____
Hearing held by _____ Date _____
Recommended for approval denial by D

ACTION OF THE DIRECTOR, DEPARTMENT OF WATER ADMINISTRATION

This is to certify that I have examined Application for Permit to appropriate the public waters of the State of Idaho No. 95-7228, and said application is hereby APPROVED.
1. Approval of said application is subject to the following limitations and conditions:
a. SUBJECT TO ALL PRIOR WATER RIGHTS.
b. Proof of construction of works and application of water to beneficial use shall be submitted on or before January 1, 19 78.
c. Other: _____

2. Denial of said application is for the following reasons: _____

Witness my hand this 10th day of January 19 73.

J. Paul H.
Director

DEPARTMENT OF WATER ADMINISTRATION
- STAFF ANALYSIS -

Item	Initial	Date	
(1)	<u>FE</u>	<u>4/24/72</u>	Application No. <u>95-7228</u> Name <u>Richard D. Higin</u>
(2)	<u>FE</u>	<u>4/24/72</u>	Check: ☒ Signature ☒ Point of Diversion ☒ Quantity of Water and Period of Use ☒ Description of Diverting Works ☒ Time required for C/W and application of water to B/U ☒ Place of Use ☒ Map ☒ Fee
(3)			Send copies to: ☐ Idaho State Health Department ☐ Idaho Fish and Game Department ☐ Bureau of Land Management
(4)			☐ Request Special Use Permit from U.S.F.S. ☐ Request Easement from B.L.M.
(5)	<u>FE</u>	<u>4/27/72</u>	In form for advertising <u>O.K.</u>
(6)	<u>CL</u>	<u>1-4-73</u>	Affidavit of Publication received <u>12-18-72</u>
(7)	<u>CL</u>	<u>12-1-72</u>	Final date for protests <u>DECEMBER 26, 1972</u> Protests received: yes ☐ no ☒
(8)			Date and Place of hearing _____ Decision reached at hearing _____
(9)			Located within Water District No. _____
(10)	<u>FE</u>	<u>4/27/72</u>	Critical groundwater area: yes ☐ no ☒
(11)			Groundwater levels: ☐ Decline (comment) _____ ☒ Stable (comment) _____ ☐ Increasing (comment) _____
(12)			Comments: _____ _____ _____
(13)	<u>FE</u>	<u>4/27/72</u>	Action recommended: ☒ Approve Priority <u>11/31/72</u> ☐ Deny Reason for Reduction _____ See attached sheet for conditions of approval <u>FE</u> <u>4/27/72</u> No conditions for approval
(14)	<u>FE</u>	<u>4/27/72</u>	District <u>Butte</u> By <u>Richard D. Higin</u> Date <u>4/27/72</u> Title <u>Superintendent</u>

AFFIDAVIT OF PUBLICATION—COEUR D'ALENE PRESS
(WEEKLY)

STATE OF IDAHO, }

County of Kootenai, }

ss.

deposes and says:

That affiant is now, and at all times herein mentioned has been, a citizen of the United States and a resident of Kootenai County, State of Idaho, over the age of 21 years and not a party to, nor interested in the event of, the above entitled matter, and the printer (principal clerk) of the "Coeur d'Alene Press", during all of the times herein mentioned being a legal daily newspaper, of Coeur d'Alene, Kootenai County, Idaho, as defined by Idaho Code Sec. 60-106 to Sec. 60-108 both inclusive, and Chapter 121 Idaho Session Laws of 1949, and acts amendatory thereof and correlated thereto, and qualified thereunder to publish to the same effect as a weekly

newspaper on Wednesdays; and that the

of which a printed copy is annexed hereto, was published in all the regular Wednesday weekly issues of said newspaper for three consecutive weeks, commencing

on the 7 day of December, 1972, and ending on the

14 day of December, 1972.

Subscribed and sworn to, before me, this 14 day of December

19 72

Notary Public for the State of Idaho,
residing at Coeur d'Alene, Idaho.

**NOTICE OF APPLICATION
FOR WATER PERMIT**

1080
Notice is hereby given that Richard D. Hugin, S. 3926 Tekoa, Spokane, Washington has on November 21, 1972 submitted Application No. 95-7228 for a permit to appropriate 0.06 cubic feet per second of water from a ground water source by means of pump and pipeline within Gov't. Lot 1, Sec. 10, T. 48N, R. 4W, B.M., Kootenai County to be used from Jan. 1 to Dec. 31 for domestic purposes within Gov't. Lot 1, Sec. 10, T. 48N, R. 4W, B.M.

If issued, this permit will be subject to all prior water rights. Protests against the granting of the permit must be filed with the Idaho Department of Water Administration, 401 Front Ave., Coeur d'Alene, Idaho, 83814 on or before December 26, 1972.

R. KEITH HIGGINSON
Director

Dec. 7, 14, 1972.

November 12, 1974

Re: Permit No. 95-7228

Mr. Richard D. Høgin
S. 3926 Tekoa
Spokane, Washington 99208

Dear Mr. Hogin:

Enclosed is a copy of the water license issued on the above referenced permit.

Sincerely,

BOBBY D. FLEENOR
Chief, Water Rights

BDF:jfr

Enclosure

11/15/74

RECEIVED

Department of Water Services
Northern District Office

3. Water will be used for the following purposes:

Other uses: _____

4. Total amount to be appropriated:

Max Rate of Diversion 0.06 cubic feet per second and annual volume _____ AF/Annum.

5. Location of Point(s) of Diversion:

Township _____ N/S, Range _____ E/W, B.M., Section _____, Subdivision _____ 1/4 _____ 1/4 _____ County _____

Other Points of Diversions: _____

Description of diverting works: 1½ hp pump, 8" & 6" comb. casing, 155' deep.

Measuring device required: yes ☐ no ☒

6. Lands to be irrigated or place of use.

[illegible]**TOTAL ACREAGE**

[illegible]

DATE OF EXAM 10/3/24

ACREAGE
Found _____
Recommended _____

Irrigation Requirement _____ Ac Ft/Ac

USE
Irrigation Q= _____ c.f.s. V= _____ AF/Ann. from _____ to _____
Domestic Q= .06 cfs c.f.s. V= 1.2 AF/Ann. from 1/1 to 12/31
Livestock Q= _____ c.f.s. V= _____ AF/Ann. from _____ to _____

Is water co-mingled? yes _____ no ☒

Name source: _____
twp. _____ N/S, Rge _____ E/W, B.M., Sec. _____, Sub. _____ 1/4 _____ 1/4 _____ County _____

Exchange? yes _____ no ☒

Name source exchanged with: _____
twp. _____ N/S, Rge _____ E/W, B.M., Sec. _____, Sub. _____ 1/4 _____ 1/4 _____ County _____

Point of injection: _____
twp. _____ N/S, Rge _____ E/W, B.M., Sec. _____, Sub. _____ 1/4 _____ 1/4 _____ County _____

Point of exchange: _____
twp. _____ N/S, Rge _____ E/W, B.M., Sec. _____, Sub. _____ 1/4 _____ 1/4 _____ County _____

Total Q measured .06 cfs Method of measurement estimated

Total Q recommended .06 cfs Meter No. _____ Type _____ Condition _____

Total V recommended 1.2 a.f./year

Recommended Amendments:

P.D. _____
Place of Use _____
Other _____
None ☒

MEASUREMENT CALCULATION:

estimated at pump capacity

SYSTEM DESCRIPTION:

1 1/2 hp pump & meter with pipeline to 2 houses.

REMARKS:

2 households

Examiner's Signature Paul Quintanilla Jr. Date 10/3/24

Checked by Michael Date 10/10/24

Approved by _____ Date _____

July 26, 1974

Re: Permit No. 95-7228

Richard D. Hogin
S. 3926 Tekoa
Spokane, WA

Dear Mr. Hogin:

We acknowledge receipt of the affidavit submitted as proof of beneficial use for the above referenced permit.

Before a license can be issued, a field examination must be made by a representative of this Department. We cannot tell just when this examination will be made, but our examiner will try to contact you at the time he makes the examination so that you may show him the system.

If you have any questions concerning the field exam, please contact our Northern District Office at 401 Front Ave., Room 209, Coeur d'Alene, Idaho.

Sincerely,

D. Darlene Reich
Water Rights Supervisor

DDR:JG

95-7228

Identification No. 95

Permit No. 95-7228

STATE OF IDAHO
DEPARTMENT OF RECLAMATION

RECEIVED

PROOF OF APPLICATION OF WATER TO BENEFICIAL USE

JUL 16 1974

Department of Water Resources
Northern District Office

1. a) Name of Permit Holder RICHARD D HOEIN
- b) Post Office Address 3326 TERCA
2. Permit Number 957228
3. Date of Priority that you are prepared to establish 11-21-72
4. a) Source from which water was appropriated GROUND WATER
- b) Location of the point of diversion: 600 FT. LOT 1/4 1/4, Section 10
Township 48 N, Range 4 W Boise Meridian, Other points of diversion: NONE

5. a) The amount of water and use to which the water has been applied:
amount .03 for DOMESTIC purposes from JAN 1 to DEC 31 incl.
(cfs and/or acre feet per annum) (Month-Day) (Month-Day)
amount _____ for _____ purposes from _____ to _____ incl.
(cfs and/or acre feet per annum) (Month-Day) (Month-Day)
amount _____ for _____ purposes from _____ to _____ incl.
(cfs and/or acre feet per annum) (Month-Day) (Month-Day)
b) Total amount appropriated .03 cfs and/or acre feet per annum
c) Describe how and by whom measurement of rate of flow or amount of storage was made and the qualifications of the person making the measurement: JOHN R. BUSCH P.E. U OF IDAHO
SEE ATTACHED SHEET

6. If the means of diversion and conveyance are owned by someone other than the Permit Holder:
a) Give the name or description of the canal, ditch or other works by which the water is conducted to the place of use: _____
b) Describe the agreement or understanding by which you take water from the works: _____

7. a) Briefly describe the works for diverting and conveying the water to the place of use, (If from a subterranean source, give the pump size, motor size, size of well casing, depth of well; if from surface water, give brief description of diversion structure and/or canal or ditch) 1 1/2 HP PUMP - 8" x 6" comb. CASING, 155' DEEP
b) Describe the type and size of measuring device which you have installed at your point of diversion: _____

- c) Give well drillers name and address and date the well was completed MAY 1971
HARRY GILMAN BOX 513 COEUR D'ALENE,
IDAHO 83814 - PH: 664-8414
COMPLETED DRILLING BY - AQUA DRILLING CO
COEUR D'ALENE, ID

Exam typed 7/26/74 by JG

95-7228

To Cecil Hagen

From John R. Busch, P.E.

Subject Request of Dec 12, 1973

UNIVERSITY OF IDAHO

Inter-Office Memorandum

Date 20 Dec, 1973

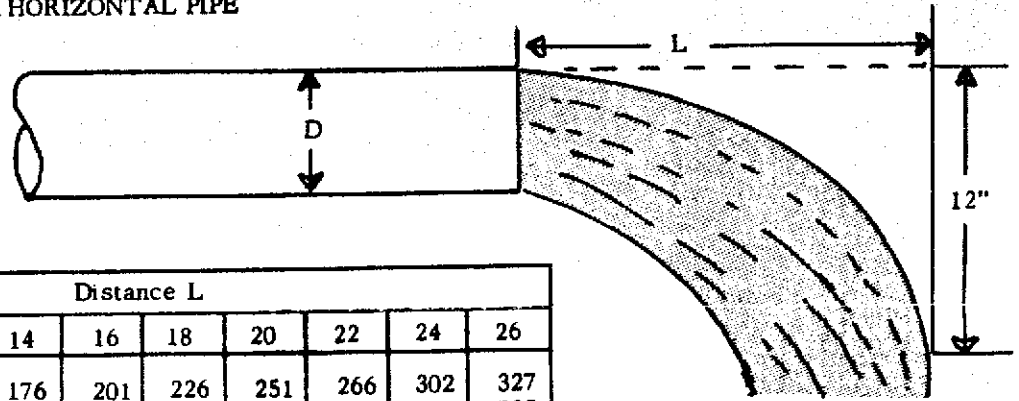
The enclosed information is very likely what your client has in mind for computing flow from a pipe. It should be noted that the method outlined is not considered to be the most accurate with errors in the range of $\pm 10\%$.

I hope the information sufficient to meet your needs.

J. Busch

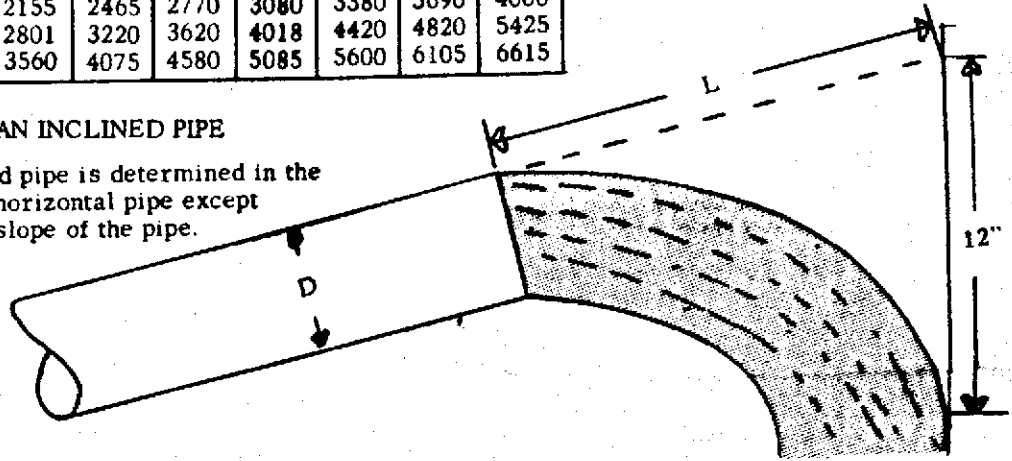
95-7228

$$\text{GPM} = (0.785) D^2 L$$

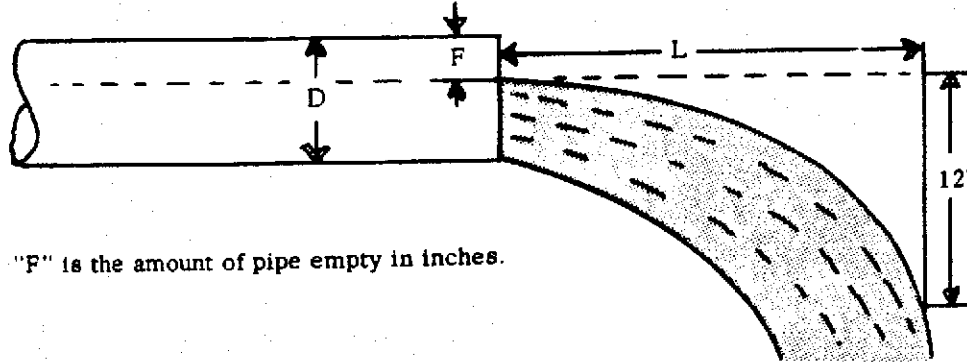


Pipe Diam D	Distance L								
	10	12	14	16	18	20	22	24	26
4	126	151	176	201	226	251	266	302	327
6	284	340	396	453	509	566	622	680	735
8	502	603	703	803	904	1005	1105	1205	1305
10	785	944	1100	1255	1412	1570	1725	1885	2040
12	1132	1359	1580	1809	2035	2260	2485	2715	2940
14	1540	1846	2155	2465	2770	3080	3380	3690	4000
16	2060	2415	2801	3220	3620	4018	4420	4820	5425
18	2542	3050	3560	4075	4580	5085	5600	6105	6615

The GPM for an inclined pipe is determined in the same manner as for a horizontal pipe except "L" is taken along the slope of the pipe.



For partially filled pipes, measure the freeboard (F) and the inside diameter (D) and calculate the ratio of F/D (in percent). Measure the stream as explained for full pipes and calculate the discharge. The actual discharge will be approximately the value for a full pipe of the same diameter multiplied by the correction factor from the following table.



"F" is the amount of pipe empty in inches.

F/D %	Factor
5	.981
10	.948
15	.905
20	.858
25	.805
30	.747
35	.688
40	.627
45	.564
50	.500
55	.436
60	.375
65	.312
70	.253
75	.195
80	.142
85	.095
90	.052
95	.019
100	.000

95-7228

WASHINGTON STATE UNIVERSITY

PULLMAN, WASHINGTON 99163

AGRICULTURAL ENGINEERING

December 18, 1973

Area Code 509 335-8244

Mr. Cecil Hagen
West 17 25th Ave.
Spokane, WA 99203

Dear Cecil:

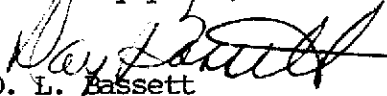
Your letter of December 12 regarding a means of measuring the flow of water from a horizontal pipe has been handed to me for reply. I am pleased to submit the enclosed information which should satisfy his need. Assuming you will pass this letter with the accompanying material to your friend, I will include in this letter a few explanatory comments.

The equation which probably appeared in the Washington Farmer is Equation 4 in the attached paper in which the coefficient C is usually assumed to be 1.0. A number of years ago, I evaluated that coefficient, since it is normally not 1.0, which is the subject of the attached paper. The values of the coefficient to be used in any given calculation are found in Table 1 on the back of the sheet. With the improved value of the coefficient as contained in this paper, Equation 4 becomes a rather accurate means of measuring flow from a horizontal pipe and somewhat better than the procedure recommended in the Washington Farmer earlier.

Your friend may recall from the earlier article that the measurements needed can be easily obtained using a carpenter's square. The depth and diameter can be measured directly, the square is then laid along the top of the pipe as shown allowing X to be any convenient distance. The scale reading on the short leg of the square where the top surface of the jet strikes the square is noted. The square is then moved in to the end of the pipe as shown by the dotted line and the position of the top surface of the jet is again noted. The difference between these scale readings gives the value of Y. With this information, the calculations indicated in Equation 4 can be carried out. For your friend's convenience, I am including two sample calculations which should explain how the flow rate is computed from Equation 4 for full pipes or partially full pipes. For his convenience in determining the area of flow of the pipe cross-section when it is flowing partially full, I am including Table 100 on the attached page.

I believe the attached material should meet his needs. If further questions arise, please feel free to contact me.

Sincerely yours,


D. L. Bassett
Associate Professor
Agricultural Engineer

DLB:mmh
Enclosures

95-7228

The Discharge Coefficient in the Coordinate Equation for Measuring Water Flow from Horizontal Pipes

D. L. Bassett and V. E. Hansen
MEMBER ASAE MEMBER ASAE

THE coordinate method of measuring flow of water from horizontal pipes has long been practiced and the subject has been treated in the literature occasionally since about 1900. Some of these treatments contain summaries of test data while others present theoretical descriptions of the phenomenon involved. Developments of this subject based upon experimental data, such as that presented by Greve (3)^o, embody a coefficient of discharge implicitly. These developments will generally yield reliable results for the conditions tested, but are limited to those conditions. Theoretical developments of the subject have, in the absence of appropriate data, generally assumed that a possible coefficient has the value of unity (2, 6).

It is desirable that the discharge coefficient involved in the coordinate method of measuring water flow from horizontal pipes be described in order that the method may be used more generally and with greater accuracy than is now possible. The authors have conducted an investigation to determine the nature of the coefficient (1). This paper contains an interim description of the coefficient and certain approximate value of it.

Nature of the Coefficient

The phenomena involved in this system of flow measurement as shown in Fig. 1 can be described in terms of the familiar relationships:

$$Y = \frac{1}{2} g t^2 \text{ (assuming initial vertical velocity = 0)} \dots \dots \dots [1]$$

$$X = \bar{v}_x t \dots \dots \dots [2]$$

$$Q = a \bar{v} \dots \dots \dots [3]$$

where g = acceleration of gravity (ft/sec²)

t = time (seconds)

$\bar{v}_x$ = average horizontal velocity of flow over the distance X (ft/sec)

$\bar{v}$ = average horizontal velocity of flow in the cross section at the end of the pipe (ft/sec)

a = vertical cross-sectional area of flow at the end of the pipe (ft²)

Q = rate of flow of water (ft³/sec)

Paper prepared expressly for publication by the American Society of Agricultural Engineers. The authors—D. L. BASSETT and V. E. HANSEN—are, respectively, associate professor of agricultural engineering, Washington State University, Pullman, and director, Utah Engineering Experiment Station, Logan.

^o Numbers in parentheses refer to the appended references.

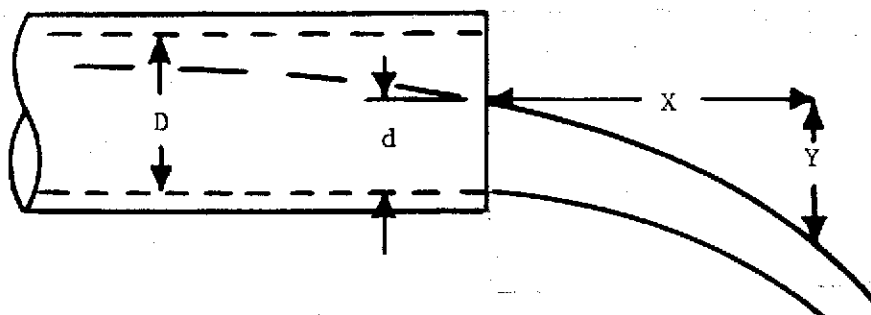


FIG. 1 Essential dimensions for measuring rate of flow of water from a horizontal pipe by the coordinate method.

X and Y are horizontal and vertical coordinates as shown in Fig. 1 (ft).

By combining these equations

$$\bar{v}_x = \sqrt{\frac{g}{2}} \frac{X}{\sqrt{Y}}$$

$$\text{and } Q = a \bar{v}_x \left\{ \frac{\bar{v}}{\bar{v}_x} \right\} = \left\{ \frac{\bar{v}}{\bar{v}_x} \right\} a \sqrt{\frac{g}{2}} \frac{X}{\sqrt{Y}}$$

$$\text{or } Q = C a \sqrt{\frac{g}{2}} \frac{X}{\sqrt{Y}} \dots \dots \dots [4]$$

where $C = \bar{v}/\bar{v}_x$ is a coefficient of discharge

If it were possible to measure the trajectory of a particle, the travel of which is governed by equations [1] and [2], the value of the coefficient would be unity. If, as is usually done in the application of the coordinate method, measurements are made to the top surface of the jet, direct application of equations [1] and [2] may establish C values other than unity. For example, equation [1] applies when the initial vertical velocity is zero. This condition is approximated for pipes flowing full at high velocity, but may not exist when pipes flow only partially full at the end where drawdown is present. The time of travel of a particle over a Y distance may therefore be less than is provided for in the derivation.

Another condition not expressly provided for in the derivation exists by virtue of the velocity distribution in the jet. It can be shown that the horizontal velocity in the jet just outside the pipe is highest near the bottom of the jet and relatively lower on the top surface. It can also be shown that the horizontal velocity of the top surface particle increases temporarily with greater distance from the end of the pipe, from less than to greater than the average

velocity in the pipe. Thus trajectory measurements of the slower moving but accelerating top surface particles gives the coefficient values which are greater than unity just outside the pipe and which decreases with increasing values of X . Assuming complete momentum exchange in the jet and neglecting air friction, C will ultimately approach unity but might, under some special intermediate conditions, be temporarily less than unity.

As a consequence of the interrelationships of these and other complex phenomena, a precise description of the discharge coefficient is not now available. Nevertheless, the coordinate method of measuring pipe flow is sufficiently useful that certain approximate values of the coefficient may be valuable even though subsequent refinement is possible.

Approximate Values of the Coefficient

One hundred thirty tests were made involving 2, 3, and 4-in. diameter pipes having lengths of 3 to 50 diameters, and relative roughness values from hydraulically smooth to $K/D = 0.02$ with Reynold's numbers between 6,000 and 196,000. The coefficients of discharge were computed and analyzed with respect to the test conditions prevailing. These analyses suggest that the coefficient can be more readily evaluated from the resulting jet than from the interrelated causing conditions. While the coefficient can be expressed as a Froude-type relationship, essentially the same results are obtained if it is expressed in the simpler terms X/D and d/D for horizontal pipes discharging water at usual field temperatures flowing partially full at the end. For pipes flowing full at the end, the coefficient is expressed in terms of X/D and Y/D .

Approximate values of the coefficient are presented in Table 1 for common ranges of values of the parameters. Coefficients for pipes flowing nearly full at the end ($d/D \approx 0.8$) are included, but unstable flow conditions in this range can cause misleading results. The coordinate method can be used in this range of relative depth, but it may be desirable to adjust the flow rate slightly to avoid this instability and corresponding loss in accuracy.

The selection of C is illustrated in the following example. Assuming a pipe of diameter 4 1/32 in. is flowing full at the end, and the coordinates X and Y are 12 and 6 1/2 in., respectively, the necessary parameters are:

$$d/D = 1.00$$

$$X/D = 2.98$$

$$Y/D = 1.61$$

From Table 1(B), the approximate value of C is seen to be 1.08.

Discharge measurements computed from equation [4] with coefficients in Table 1 will usually be less than 10 percent in error and at values of X/D greater than 5 will usually be less than 5 percent in error. Inasmuch as these coefficients are based on tests using 2, 3, and 4-in. pipe, caution is appropriate

TABLE 1. APPROXIMATE COEFFICIENTS OF DISCHARGE FOR USE IN THE COORDINATE METHOD FOR MEASURING THE RATE OF WATER FLOW FROM HORIZONTAL PIPES
(A) Flowing partially full at the end

d/D	X/D							
	0.75	1.00	1.50	2.00	3.00	4.00	6.00	8.00
0.2	1.03	1.02	1.01	1.00				
0.3	1.15	1.11	1.06	1.03	1.01	1.00		
0.4	1.24	1.17	1.10	1.06	1.02	1.01	1.00	
0.5	1.32	1.22	1.13	1.07	1.03	1.01	1.00	1.00
0.6	1.37	1.26	1.15	1.09	1.03	1.02	1.01	1.00
0.7	1.41	1.30	1.17	1.10	1.04	1.02	1.01	1.00
0.8*	1.45	1.33	1.18	1.11	1.04	1.02	1.01	1.00
0.9*	1.49	1.36	1.20	1.12	1.04	1.02	1.01	1.00

* Unstable flow conditions may prevail.

(B) Flowing completely full at the end

Y/D	X/D							
	0.75	1.00	1.50	2.00	3.00	4.00	6.00	8.00
0.2	1.48	1.29	1.17	1.10				
0.3	1.59	1.36	1.22	1.13				
0.4	1.59	1.41	1.26	1.16				
0.5	1.54	1.44	1.28	1.18	1.08	1.04	1.01	1.00
0.75		1.38	1.27	1.18	1.09	1.05	1.02	1.00
1.00			1.26	1.17	1.10	1.05	1.02	1.00
1.50			1.20	1.13	1.08	1.06	1.03	1.00
2.00				1.09	1.07	1.05	1.03	1.00
3.00				1.03	1.04	1.04	1.03	1.00
4.00					1.02	1.02	1.02	1.00
5.00					1.00	1.01	1.01	1.00

when they are applied to larger pipes. The authors expect that refinements in accuracy will be possible as the values in Table 1 are extensively tested.

References

- 1 Bassett, D. L. Discharge coefficient in the coordinate method for measuring pipe flow. M.S. thesis, Utah State University, 1952.
- 2 Christiansen, J. E. Coordinate methods of

measuring flow. University of California, mimeo publication, Davis.

3 Greve, F. W. Measurement of pipe flow by the coordinate method. Purdue Engineering Experiment Station Bulletin No. 32, 1928.

4 McDonald, H. R. Measuring well water. Reclamation Era 36:352-54, 1950.

5 Slichter, C. S. Approximate methods of measuring the yield of flowing wells. U.S. Geological Survey Water Supply Paper No. 110, 1904.

6 Stock, E. M. Measurement of irrigation water. Utah State Engineering Experiment Station and Extension Service Bulletin No. 3, 1955.

TABLE 100.—FOR DETERMINING THE AREA a OF THE CROSS-SECTION OF A CIRCULAR CONDUIT FLOWING PART FULL

Let $\frac{\text{depth of water}}{\text{diameter of channel}} = \frac{D}{d}$ and $c =$ the tabulated value. Then $a = cd^2$

$\frac{D}{d}$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0	.0000	.0013	.0037	.0069	.0105	.0147	.0192	.0242	.0294	.0350
.1	.0409	.0470	.0534	.0600	.0668	.0739	.0811	.0885	.0961	.1039
.2	.1118	.1199	.1281	.1365	.1449	.1535	.1623	.1711	.1800	.1890
.3	.1982	.2074	.2167	.2260	.2355	.2450	.2546	.2642	.2739	.2836
.4	.2934	.3032	.3130	.3229	.3328	.3428	.3527	.3627	.3727	.3827
.5	.393	.403	.413	.423	.433	.443	.453	.462	.472	.482
.6	.492	.502	.512	.521	.531	.540	.550	.559	.569	.578
.7	.587	.596	.605	.614	.623	.632	.640	.649	.657	.666
.8	.674	.681	.689	.697	.704	.712	.719	.725	.732	.738
.9	.745	.750	.755	.761	.766	.771	.775	.779	.782	.784

Sample calculation - Partially full pipe

Assume the existing conditions are:

$$D = 6"$$

$$d = 2 \frac{3}{4}"$$

$$X = 1 \frac{1}{6}"$$

$$Y = 10 \frac{1}{2}"$$

Calculate flow from equation 4, where

C is found from Table 1, as

$$Y/D = 16/6 = 2.67$$

$$d/D = 3.75/6 = 0.625$$

Interpolate in Table 1, $C \approx 1.05$

a is found from Table 100, as

$$\text{depth/diam} = .625$$

Interpolate in Table 100, $a \approx .516$

$$a = .516 \left(\frac{6}{12} \right)^2 = 0.129 \text{ ft}^2$$

$$g = 32.2 \text{ ft/sec}^2$$

$$X = (6/12) = 1.333 \text{ ft}$$

$$Y = (10.5/12) = 0.875 \text{ ft}$$

Then

$$Q = 1.05 (.129) \left(\sqrt{\frac{32.2}{2}} \right) \left(\frac{1.333}{\sqrt{0.875}} \right)$$

$$= 1.05 (.129) (4.01) (1.425)$$

$$= 0.774 \text{ c.f.s.}$$

Sample calculation - full pipe

Assuming the existing condition exists:

$$D = 6"$$

$$d = 6"$$

$$X = 16"$$

$$Y = 7 \frac{1}{4}"$$

Calculate A from equation 4, where

z is found from Table 1, $z =$

$$X/D = 16/6 = 2.67$$

$$Y/D = 7.25/6 = 1.21$$

Interpolate in Table 1, $C \approx 1.12$

$$a = \pi r^2 = 3.14 (.254)^2 = 0.196 \text{ ft}^2$$

$$g = 32.2 \text{ ft/sec}^2$$

$$X = (16/12) = 1.333 \text{ ft}$$

$$Y = (7.25/12) = 0.604 \text{ ft}$$

Then

$$\begin{aligned} Q &= 1.12 (.196) \left(\sqrt{\frac{32.2}{2}} \right) \left(\frac{1.333}{0.604} \right) \\ &= 1.12 (.196) (4.01) (1.715) \\ &= 1.510 \text{ cfs} \end{aligned}$$

RECOMMENDED

CONDITIONS OF APPROVAL

☐ A measuring device of a type approved by this Department shall be permanently installed and maintained as part of the diverting works.

☐ Measuring devices of a type approved by this Department shall be permanently installed and maintained at the point of diversion and the point of effluent discharge.

☐ Use of water under this permit is supplemental to all existing water rights with the same purpose and place of use.

☐ Maximum rate of diversion shall not exceed _____ c.f.s.

☐ Settling ponds shall be installed which are capable of reducing the silt load in the return water to such a level that the quality of the waters of _____ Creek will not be impaired for other beneficial uses.

☐ Return water shall be treated to insure that the effluent meets (interstate) (intrastate) stream water quality standards.

☐ Use of water under this permit is subject to control by the watermaster of State Water District No. _____, _____ River.

☐ The proposed well shall not be drilled within _____ feet of another well.

☐ The issuance of this permit in no way grants any right-of-way or easement across the land of another person.

☐ The permit shall not be assigned or sold without first securing the written approval of the Department of Water Administration.

☐ This permit cannot be assigned, mortgaged, or conveyed without complying with Section 42-208, Idaho Code.

☐ Other: _____

June 22, 1973

Re: Permit No. 95-7228

Richard D. Hugin
S. 3926 Takoa
Spokane, Washington

Dear Mr. Hugin:

You indicated in your June 19 letter that the use of water proposed under Permit No. 95-7228 is now completed. Therefore, please complete the enclosed proof of beneficial use form and return it to us so a field exam may be scheduled.

Thank you for letting us know your project is complete now.

Sincerely,

BOBBY D. FLENNOR
Assistant Director

BDV:je

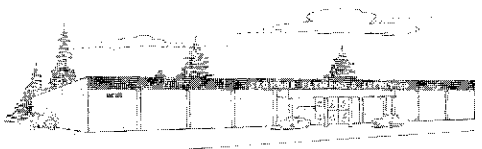
Enc: Proof affidavit

95 7228

Spokane Plywood

AND SUPPLY CO.

7501 NORTH DIVISION, SPOKANE, WASHINGTON 99208



June 19, 1973

State of Idaho
Department of Water Administration
Statehouse Annex 2
Boise, Idaho 83707

Attention: Bobby D. Fleenor
Assistant Director

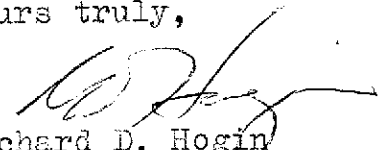
Re: Permit # 95-7228

Dear Mr. Fleenor:

To comply with the conditions of approval as listed on Page 4 of my Permit #95-7228, I am reporting the completion of works and application of water to the dwelling of Nadine Bush and my dwelling, located at Government Lot #1, Section 10, Township 48N, Range W., Kootenai County.

An inspection of the premises is invited at any time. Thank you.

Yours truly,


Richard D. Hogen

RDH:jw

CC: Mr. Kenneth Knoblock
401 Front, Room 209
Coeur d'Alene, Idaho 83814

95 7228

January 11, 1973

Re. Permit No: 95-7228

Richard D. Hogin
8. 3926 Tekoa
Spokane, Washington

Dear Mr. Hogin:

Enclosed is a copy of your approved Application for Permit No. 95-7228 . We
direct your attention to the conditions of approval as listed on the fourth page.

Very truly yours,

BOBBY D. FLEENOR
Assistant Director

BDF: cd

Enclosures

95 7228

December 1, 1972

Re: Application No. 95-7228 - Richard D. Hogin
" " 95-7229 - Argyll L. Hollinshead
Claim No. 95-4050 - George L. Kennaugh

Coeur d'Alene Press
Second & Lakeside
Coeur d'Alene, ID 83814

Gentlemen:

Enclosed you will find a legal notice which we wish to have published once a week for two consecutive weekly issues of your newspaper. We have inserted the publication dates allowing ample time for you to submit us a galley proof for review before publication.

After sending us a galley proof, proceed with the publication on the dates we have inserted, assuming the notice is correct. If we have any corrections, we will notify you before the first publication. If you cannot publish the notice on the proposed dates, please contact us immediately.

An affidavit of publication must be submitted to the Department along with the publication bill. In order to receive payment, the following certification must appear on the bill:

"I hereby certify that the foregoing account is just and correct, that the amount claimed is legally due, after allowing all just credits, and that no part of the same has been paid."

(signature of claimant)

Very truly yours,

Fred Eisenbarth
Water Resource Supervisor
Northern District

Bill submitted 1-4-73 by de

FE:CR

Enc: Legal Notices (3)

95 7228

NOTICE OF APPLICATION FOR WATER PERMIT

Notice is hereby given that Richard D. Hugin,

S. 3926 Tekoa, Spokane Washington

has on November 21, 1972 submitted Application No. 95-7228

for a permit to appropriate 0.06 cubic feet per second XXXXXXXXXXXXXXXXXXXX acre feet per annum

of water from a ground water source

by means of pump and pipeline

within the xxx Gov't. Lot 1, Sec. 10, T. 48N, R. 4W, B.M., Kootenai County

to be used from Jan. 1 to Dec. 31

for domestic purposes

within the xxx Gov't. Lot 1, Sec. 10, T. 48N, R. 4W, B.M.

If issued, this permit will be subject to all prior water rights. Protests against the granting of the permit must be filed with the Idaho Department of Water Administration, 401 Front Ave., Coeur d'Alene, Idaho, 83814 on or before December 26, 1972.

R. KEITH HIGGINSON

Director

Published in the Coeur d'Alene Press, Coeur d'Alene, Idaho

on Dec. 7 and Dec. 14, 1972

95 7228

NOTICE OF APPLICATION
FOR WATER PERMIT
Notice is hereby given that
Richard D. Hogan, S. 3926
Tekoa, Spokane, Washington
has on November 21, 1972
submitted Application No.
95-7228 for a permit to
appropriate 0.66 cubic feet per
second of water from a ground
water source by means of
pump and pipeline within
Gov't Lot 1, Sec. 10, T. 48N,
R. 4W, B.M., Kootenai County
to be used from Jan. 1 to Dec.
31 for domestic purposes
within Gov't Lot 1, Sec. 10, T.
48N, R. 4W, B.M.
If issued, this permit will be
subject to all prior water rights,
Protests against the granting of
the permit must be filed with
the Idaho Department of Water
Administration, 401 Front
Ave., Coeur d'Alene, Idaho,
83814 on or before December
26, 1972.
R. KEITH HIGGINSON
Director
Dec. 7, 14, 1972.

8662 56