Fire Research Laboratory
BUREAU OF ALCOHOL, TOBACCO, FIREARMS AND EXPLOSIVES
6000 Ammendale Road
Beltsville, MD 20705-1250

U. S. Department of Justice

Project Record

ANAB ISO/IEC 17025:2017
Accredited Forensic Testing Laboratory

Title	Gas Flow and Resulting Flame from Different Size Holes in CSST		
Test Type	Custom		
Lab Number	19FR0016-1	**Author**	David R. Tucholski
Test dates	6/22/21, 6/23/21, 6/24/21	**No. Tests**	75

Introduction

Seventy-five experiments were conducted to determine the flow rate of gas emanating from different size holes in corrugated stainless steel tubing (CSST) and to determine if the resulting flame was stable or if an obstruction was required near the hole to prevent the flame from blowing off and self-extinguishing. Experiments were conducted using either propane gas or natural gas at different gas pressures. In addition, experiments were conducted using different hole sizes and different hole orientations. Instrumentation for the experiment included a mass flow meter, a pressure transducer, and equipment to monitor the laboratory conditions. The experiments were also documented using video cameras, an infrared camera, and a digital camera. The experiments were conducted in the Medium Burn Room (MBR) of the Bureau of Alcohol, Tobacco, Firearms and Explosive Fire Research Laboratory (ATF FRL) located in Beltsville, MD.

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NOTE: All dimensional measurements were taken in English units and were later converted to metric units, unless specified. Any inconsistencies between the two units are due to rounding errors when the English units were converted to metric.

Experiment Setup

Figure 1 illustrates the experimental setup, which consisted of a gas supply system and a test section of corrugated stainless steel tubing (CSST). The gas supply system could flow either natural gas or propane gas. The test section of CSST contained different size holes, which were drilled into the tubing. Only one hole was open during a test. Gas flow through the system was achieved by opening the valves for a particular gas. The static gas pressure at the inlet to the CSST test section was set using a pressure regulator and measured using a pressure transducer. A pressure transducer was also placed after the CSST test section for several experiments. The flow rate of gas was measured using a mass flow meter.

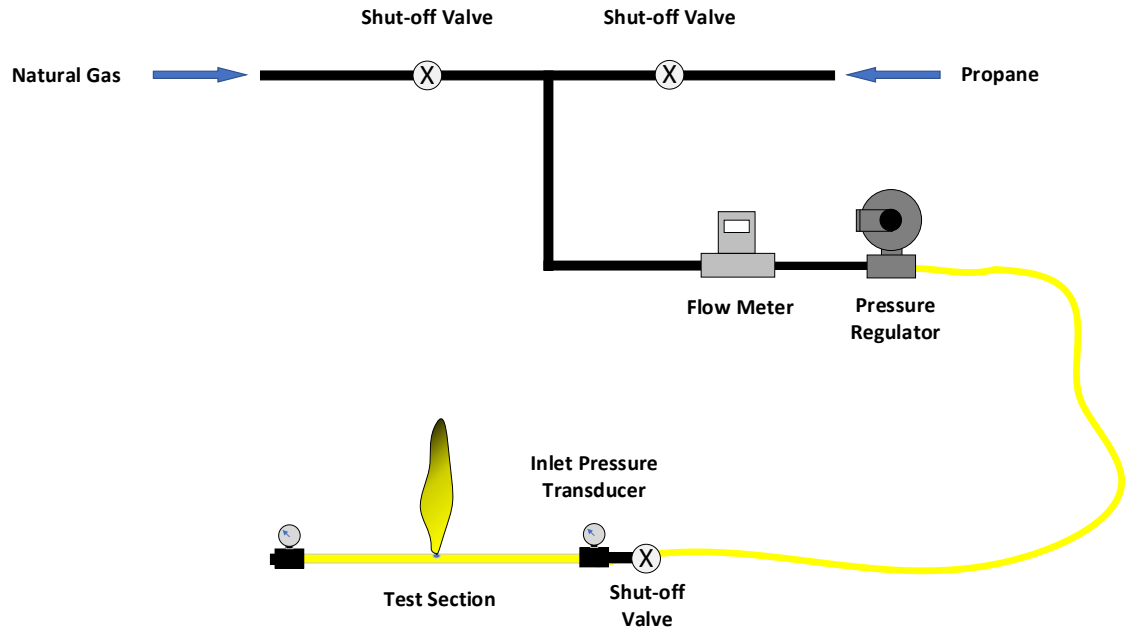

Figure 1. Experimental setup

The test section of CSST was mounted to a wood platform using threaded rods, as shown in Figure 2 and Figure 3. The bottom of the threaded rod was attached to a bracket on the platform. The top of the threaded rod was attached to a clamp, which secured the CSST in place. When the CSST was mounted with the holes facing downward, longer threaded rods were used, as shown in Figure 3. The inlet and outlet of the CSST test section were each connected to a steel pipe tee fitting, which included a shut-off valve and a pressure transducer. The pressure transducer was mounted in the hole perpendicular to the gas flow.

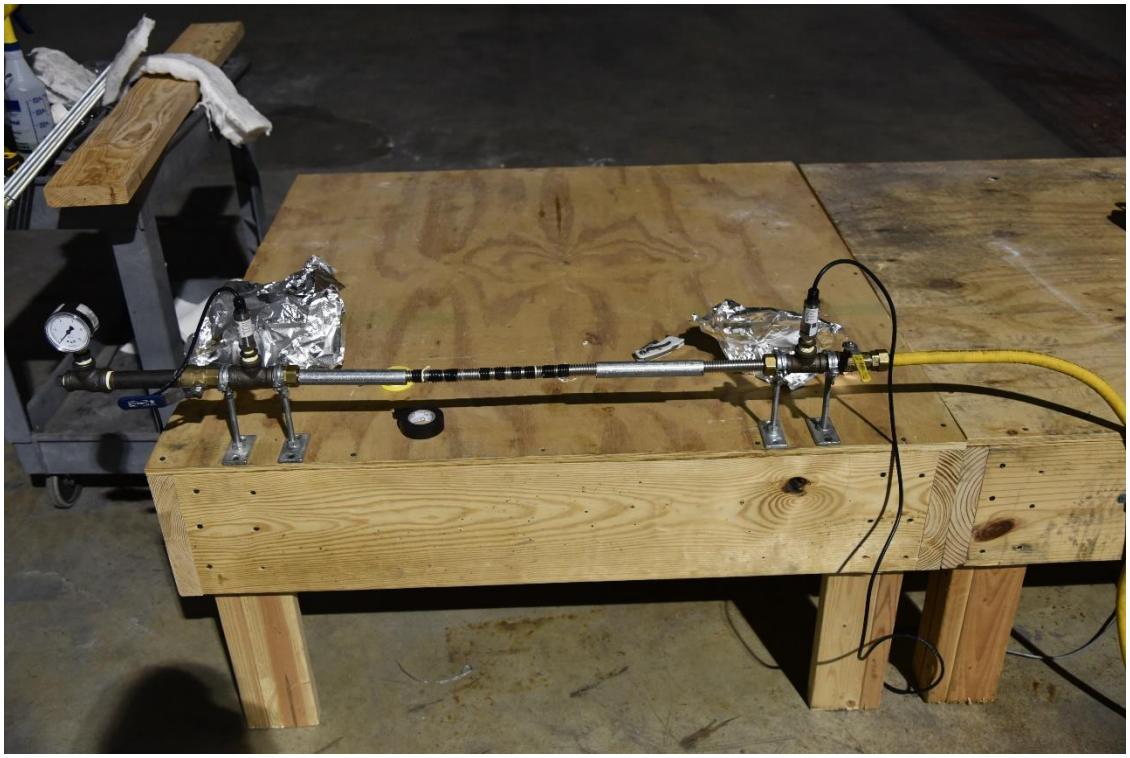

Figure 2. Setup for CSST test section with holes positioned up or to the side (348035_1191812.jpg)

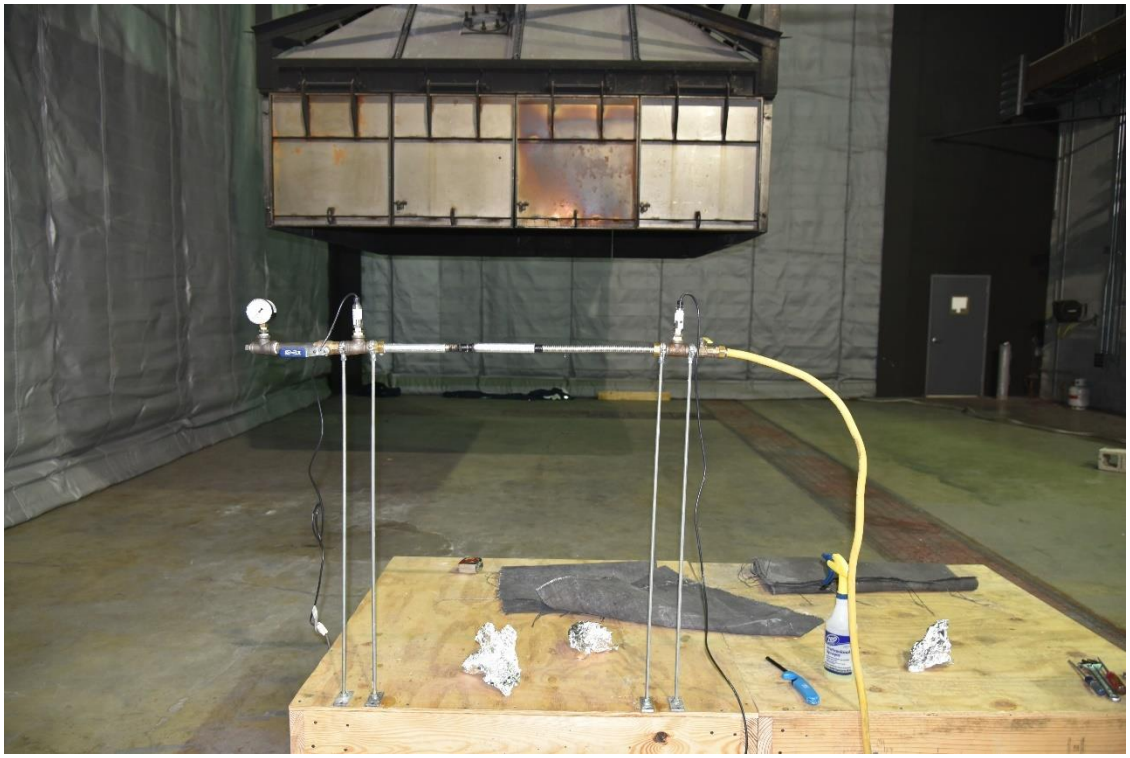

Figure 3. Setup for CSST test section with holes positioned down (348111_1193229.jpg)

Corrugated Stainless Steel Tubing

Corrugated stainless steel tubing from WARD Manufacturing was used for the experiments. The WARDFlex tubing size was nominally ½ inch (model 15A/19). The tubing was 304 stainless steel covered with a polyethylene jacket and had an internal diameter 15.0 mm (0.591 inch). [1] The test section of CSST was approximately 66 cm (26 inches) long and the polyethylene jacket was removed. Holes were drilled into the tubing with the nominal hole sizes ranging from 0.5 mm to 5 mm (0.0197 inches to 0.197 inches) in 0.5 mm (0.0197 inches) increments. The holes were spaced approximately 25.4 mm (1 inch) apart. Only one hole was tested at a time. Therefore, the other holes were covered when not in use. The non-used holes were wrapped first with Polytetrafluoroethylene (PTFE) gas thread seal tape (PROSELECT, part number PSGTTD520) and then wrapped with electrical tape. Figure 4 shows a close-up of the CSST test section. During an experiment, the tapped holes closest to the hole being tested were also protected by sliding a metal sleeve over the unused holes, as shown in Figure 5.

Figure 4. CSST test section (348035_1191808.jpg)

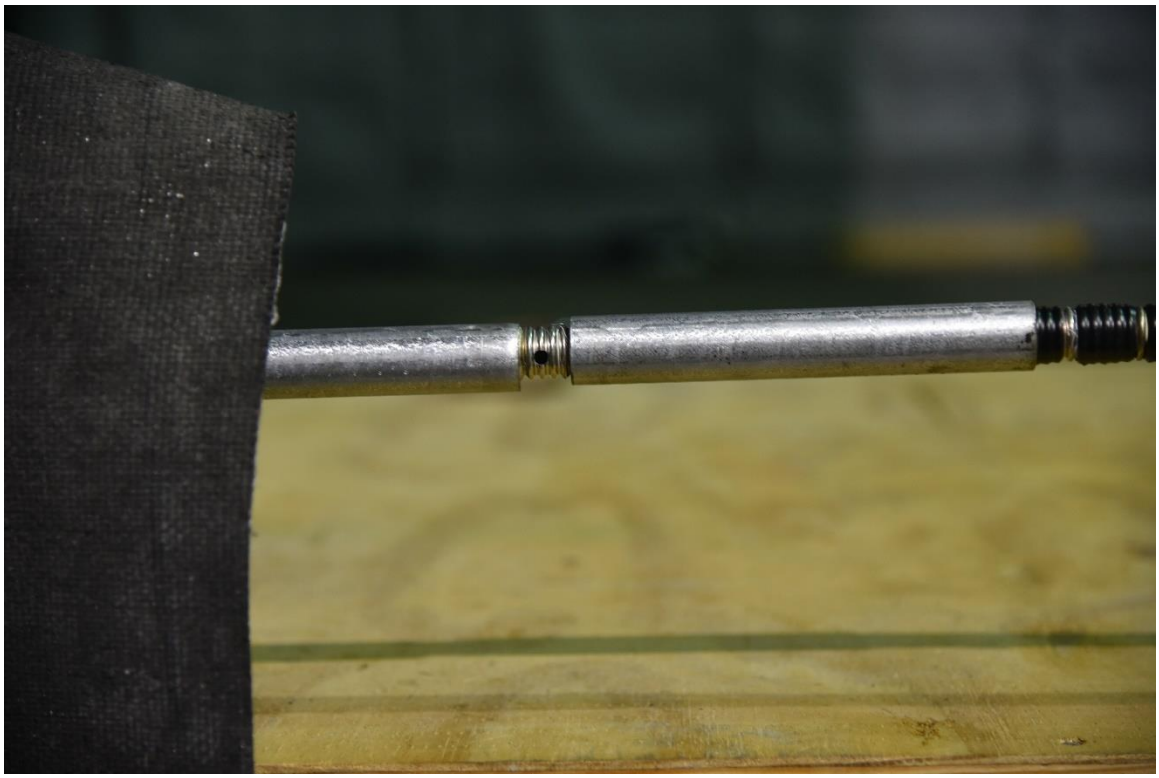

Figure 5. Metal sleeves protecting holes not in use (348105_1193195.jpg)

Gas Supply

Experiments were conducted using either natural gas or propane gas. Natural gas was obtained from the building's supply system, which is provided by the local gas utility. Commercial grade propane was obtained from a nominal 45.3 kg (100 lb) tank of propane, which was placed near the experimental setup. The flow of gas to the test section was controlled by several quarter-turn shutoff valves. The static pressure at the inlet of the CSST test section was set using a Fisher Controls type HSR pressure regulator (model HSR-CFGBMYN) with gas flowing through the system. The regulator's outlet gas pressure range was determined by the spring size in the regulator. Different ranges for the regulator's outlet pressure were obtained by changing the spring. For a given spring size, the outlet pressure could be increased or decreased by adjusting a plastic screw in the spring case assembly.

Experiment Details

The variables investigated for this test series were the hole size, the hole orientation, the gas type, and the gas pressure. The nominal hole size was presumed to be the diameter of the hole, which was based solely on the drill size; no other method was used to confirm the hole dimeter. The orientation of the holes was achieved by rotating the entire test section of CSST so that the holes were facing the desired direction. For the "Side" position, the CSST was rotated approximately 90 degrees relative to the "Up" position.

For the "Down" position, the CSST was rotated approximately 180 degrees relative to the "Up" position. The gas pressure was measured at the inlet to the test section with gas flowing through the system. In most experiments, multiple pressures were tested during the same experiment by adjusting the spring position in the gas pressure regulator. Table 1 provides a summary of each experiment and includes the test number, the associated Experimental ID, the gas type, the gas pressure(s), the nominal hole size, and the hole orientation. For most experiments, several pressures were tested during the same experiment.

Table 1. Summary of Experiments

Test #	Exp ID	Gas Type	Gas Pressure	Nominal Hole Size	Hole Orientation
1	348035	Propane	2740 Pa (11 inch H_2O) 3238 Pa (13 inch H_2O)	3.5 mm (0.138 inch)	Up
2	348038	Propane	2740 Pa (11 inch H_2O) 2989 Pa (12 inch H_2O)	4.0 mm (0.157 inch)	Up
3	348039	Propane	2740 Pa (11 inch H_2O) 3487 Pa (14 inch H_2O)	4.0 mm (0.157 inch)	Up
4	348041	Propane	2740 Pa (11 inch H_2O) 3487 Pa (14 inch H_2O)	4.5 mm (0.177 inch)	Up
5	348042	Propane	2740 Pa (11 inch H_2O) 3487 Pa (14 inch H_2O)	5.0 mm (0.197 inch)	Up
6	348044	Propane	2740 Pa (11 inch H_2O) 3487 Pa (14 inch H_2O)	3.5 mm (0.138 inch)	Up
7	348045	Propane	2740 Pa (11 inch H_2O) 3487 Pa (14 inch H_2O)	2.5 mm (0.0984 inch)	Up
8	348046	Propane	2740 Pa (11 inch H_2O) 3487 Pa (14 inch H_2O)	3.0 mm (0.118 inch)	Up
9	348047	Propane	2740 Pa (11 inch H_2O) 3487 Pa (14 inch H_2O)	2.0 mm (0.0787 inch)	Up
10	348048	Propane	2740 Pa (11 inch H_2O)	2.0 mm (0.0787 inch)	Up
11	348049	Propane	2740 Pa (11 inch H_2O) 3487 Pa (14 inch H_2O)	1.5 mm (0.0591 inch)	Up
12	348051	Propane	2740 Pa (11 inch H_2O) 3487 Pa (14 inch H_2O)	1.0 mm (0.0394 inch)	Up
13	348052	Propane	2740 Pa (11 inch H_2O) 3487 Pa (14 inch H_2O)	0.5 mm (0.0197 inch)	Up
14	348053	Natural Gas	996 Pa (4 inch H_2O) 1743 Pa (7 inch H_2O)	5.0 mm (0.197 inch)	Up

Test #	Exp ID	Gas Type	Gas Pressure	Nominal Hole Size	Hole Orientation
15	348055	Natural Gas	996 Pa (4 inch H_2O) 1743 Pa (7 inch H_2O)	5.0 mm (0.197 inch)	Up
16	348056	Natural Gas	996 Pa (4 inch H_2O) 1743 Pa (7 inch H_2O)	4.5 mm (0.177 inch)	Up
17	348057	Natural Gas	996 Pa (4 inch H_2O) 1743 Pa (7 inch H_2O)	4.0 mm (0.157 inch)	Up
18	348058	Natural Gas	996 Pa (4 inch H_2O) 1743 Pa (7 inch H_2O)	3.5 mm (0.138 inch)	Up
19	348059	Natural Gas	996 Pa (4 inch H_2O)	3.0 mm (0.118 inch)	Up
20	348061	Natural Gas	996 Pa (4 inch H_2O) 1743 Pa (7 inch H_2O)	2.5 mm (0.0984 inch)	Up
21	348063	Natural Gas	996 Pa (4 inch H_2O) 1743 Pa (7 inch H_2O) 2491 Pa (10 inch H_2O)	2.0 mm (0.0787 inch)	Up
22	348064	Natural Gas	996 Pa (4 inch H_2O) 1743 Pa (7 inch H_2O) 2491 Pa (10 inch H_2O)	1.5 mm (0.0591 inch)	Up
23	348066	Natural Gas	996 Pa (4 inch H_2O) 1743 Pa (7 inch H_2O) 2491 Pa (10 inch H_2O)	1.0 mm (0.0394 inch)	Up
24	348068	Natural Gas	996 Pa (4 inch H_2O) 1743 Pa (7 inch H_2O) 2491 Pa (10 inch H_2O)	0.5 mm (0.0197 inch)	Up
25	348070	Natural Gas	2491 Pa (10 inch H_2O)	2.5 mm (0.0984 inch)	Up
26	348071	Natural Gas	2491 Pa (10 inch H_2O)	3.0 mm (0.118 inch)	Up
27	348072	Natural Gas	2491 Pa (10 inch H_2O)	3.5 mm (0.138 inch)	Up
28	348073	Natural Gas	2491 Pa (10 inch H_2O)	4.0 mm (0.157 inch)	Up
29	348074	Natural Gas	2491 Pa (10 inch H_2O)	4.5 mm (0.177 inch)	Up
30	348075	Natural Gas	996 Pa (4 inch H_2O)	2.5 mm (0.0984 inch)	Up
31	348080	Propane	2740 Pa (11 inch H_2O) 3487 Pa (14 inch H_2O)	5.0 mm (0.197 inch)	Side
32	348082	Propane	2740 Pa (11 inch H_2O) 3487 Pa (14 inch H_2O)	5.0 mm (0.197 inch)	Side
33	348084	Propane	2740 Pa (11 inch H_2O) 3487 Pa (14 inch H_2O)	4.5 mm (0.177 inch)	Side

Test #	Exp ID	Gas Type	Gas Pressure	Nominal Hole Size	Hole Orientation
34	348085	Propane	2740 Pa (11 inch H_2O) 3487 Pa (14 inch H_2O)	4.0 mm (0.157 inch)	Side
35	348086	Propane	2740 Pa (11 inch H_2O) 3487 Pa (14 inch H_2O)	3.5 mm (0.138 inch)	Side
36	348087	Propane	2740 Pa (11 inch H_2O) 3487 Pa (14 inch H_2O)	3.0 mm (0.118 inch)	Side
37	348088	Propane	2740 Pa (11 inch H_2O) 3487 Pa (14 inch H_2O)	2.5 mm (0.0984 inch)	Side
38	348089	Propane	3487 Pa (14 inch H_2O)	2.0 mm (0.0787 inch)	Side
39	348090	Propane	2740 Pa (11 inch H_2O) 3487 Pa (14 inch H_2O)	2.0 mm (0.0787 inch)	Side
40	348091	Propane	3487 Pa (14 inch H_2O)	1.5 mm (0.0591 inch)	Side
41	348092	Propane	2740 Pa (11 inch H_2O) 3487 Pa (14 inch H_2O)	1.0 mm (0.0394 inch)	Side
42	348093	Propane	2740 Pa (11 inch H_2O) 3487 Pa (14 inch H_2O)	0.5 mm (0.0197 inch)	Side
43	348094	Natural Gas	996 Pa (4 inch H_2O) 1743 Pa (7 inch H_2O)	5.0 mm (0.197 inch)	Side
44	348095	Natural Gas	996 Pa (4 inch H_2O) 1743 Pa (7 inch H_2O)	4.5 mm (0.177 inch)	Side
45	348096	Natural Gas	996 Pa (4 inch H_2O) 1743 Pa (7 inch H_2O) 2491 Pa (10 inch H_2O)	4.0 mm (0.157 inch)	Side
46	348097	Natural Gas	996 Pa (4 inch H_2O) 1743 Pa (7 inch H_2O) 2491 Pa (10 inch H_2O)	3.5 mm (0.138 inch)	Side
47	348098	Natural Gas	996 Pa (4 inch H_2O) 1743 Pa (7 inch H_2O) 2491 Pa (10 inch H_2O)	3.0 mm (0.118 inch)	Side
48	348099	Natural Gas	996 Pa (4 inch H_2O) 1743 Pa (7 inch H_2O) 2491 Pa (10 inch H_2O)	2.5 mm (0.0984 inch)	Side
49	348100	Natural Gas	996 Pa (4 inch H_2O) 1743 Pa (7 inch H_2O) 2491 Pa (10 inch H_2O)	2.0 mm (0.0787 inch)	Side
50	348101	Natural Gas	996 Pa (4 inch H_2O) 1743 Pa (7 inch H_2O) 2491 Pa (10 inch H_2O)	1.5 mm (0.0591 inch)	Side

Test #	Exp ID	Gas Type	Gas Pressure	Nominal Hole Size	Hole Orientation
51	348102	Natural Gas	996 Pa (4 inch H_2O) 1743 Pa (7 inch H_2O) 2491 Pa (10 inch H_2O)	1.0 mm (0.0394 inch)	Side
52	348103	Natural Gas	996 Pa (4 inch H_2O) 1743 Pa (7 inch H_2O) 2491 Pa (10 inch H_2O)	0.5 mm (0.0197 inch)	Side
53	348104	Natural Gas	2491 Pa (10 inch H_2O)	4.5 mm (0.177 inch)	Side
54	348105	Natural Gas	2491 Pa (10 inch H_2O)	5.0 mm (0.197 inch)	Side
55	348111	Propane	2491 Pa (10 inch H_2O) 3487 Pa (14 inch H_2O)	5.0 mm (0.197 inch)	Down
56	348112	Propane	2491 Pa (10 inch H_2O) 3487 Pa (14 inch H_2O)	4.5 mm (0.177 inch)	Down
57	348115	Propane	2491 Pa (10 inch H_2O) 3487 Pa (14 inch H_2O)	5.0 mm (0.197 inch)	Up
58	348116	Propane	2491 Pa (10 inch H_2O) 3487 Pa (14 inch H_2O)	4.5 mm (0.177 inch)	Up
59	348117	Propane	2491 Pa (10 inch H_2O) 3487 Pa (14 inch H_2O)	4.0 mm (0.157 inch)	Up
60	348118	Propane	2491 Pa (10 inch H_2O) 3487 Pa (14 inch H_2O)	3.5 mm (0.138 inch)	Up
61	348119	Propane	2491 Pa (10 inch H_2O) 3487 Pa (14 inch H_2O)	3.0 mm (0.118 inch)	Up
62	348120	Propane	2491 Pa (10 inch H_2O) 2740 Pa (11 inch H_2O) 3487 Pa (14 inch H_2O)	2.5 mm (0.0984 inch)	Up
63	348124	Propane	2740 Pa (11 inch H_2O)	3.0 mm (0.118 inch)	Up
64	348126	Propane	2740 Pa (11 inch H_2O)	3.5 mm (0.138 inch)	Up
65	348127	Propane	2740 Pa (11 inch H_2O)	4.0 mm (0.157 inch)	Up
66	348128	Propane	2740 Pa (11 inch H_2O)	4.5 mm (0.177 inch)	Up
67	348129	Propane	2740 Pa (11 inch H_2O)	5.0 mm (0.197 inch)	Up
68	348130	Natural Gas	1743 Pa (7 inch H_2O)	5.0 mm (0.197 inch)	Up
69	348132	Natural Gas	996 Pa (4 inch H_2O) 1743 Pa (7 inch H_2O)	5.0 mm (0.197 inch)	Up
70	348133	Natural Gas	996 Pa (4 inch H_2O) 1743 Pa (7 inch H_2O)	4.5 mm (0.177 inch)	Up

Test #	Exp ID	Gas Type	Gas Pressure	Nominal Hole Size	Hole Orientation
71	348134	Natural Gas	996 Pa (4 inch H_2O) 1743 Pa (7 inch H_2O)	4.0 mm (0.157 inch)	Up
72	348135	Natural Gas	2491 Pa (10 inch H_2O)	4.0 mm (0.157 inch)	Up
73	348136	Natural Gas	996 Pa (4 inch H_2O) 1743 Pa (7 inch H_2O) 2491 Pa (10 inch H_2O)	3.5 mm (0.138 inch)	Up
74	348137	Natural Gas	996 Pa (4 inch H_2O)	3.0 mm (0.118 inch)	Up
75	348138	Natural Gas	2491 Pa (10 inch H_2O)	4.5 mm (0.177 inch)	Up

Procedures

All experiments followed the same general procedure. For a given experiment, the CSST tubing was arranged so that the holes were positioned in a desired orientation (Up, Side, or Down). The tape was removed from one hole, while the other holes remained covered. The metal sleeves were then positioned over the adjacent holes. A pressure regulator spring was selected and installed to provide the desired range of gas pressures. To start the experiment, the valves for the desired gas supply line were opened and the valve to the CSST test section was opened. The gas being emitted from the hole was then ignited using a multipurpose butane lighter. The inlet pressure to the test section was checked and adjusted as needed. Adjustments to the gas pressure were made by adjusting the plastic screw in the spring case assembly of the pressure regulator. After the desired pressure was achieved, data was collected for an additional 30-60 seconds. If a new pressure was desired, the pressure regulator was adjusted, and the data was collected. After all the desired pressures had been tested, the experiment was terminated and the valve to the to the CSST test section was closed. The open hole was then covered with the tapes and a different hole was opened. The test procedure was then repeated for the next experiment.

For certain experiments, it was necessary to place an obstruction near the hole to help prevent the flame from blowing off and self-extinguishing. Figure 6 illustrates this concept. The obstructions consisted of either a metal rod or metal plate, as shown in Figure 7. If an obstruction was required, then the furthest distance that the object could be placed away from the hole without the flame blowing off was determined. A tape measure was then used to obtain the approximate distance between the hole and the obstruction. Photographs were taken of these distances and are included in the project record.

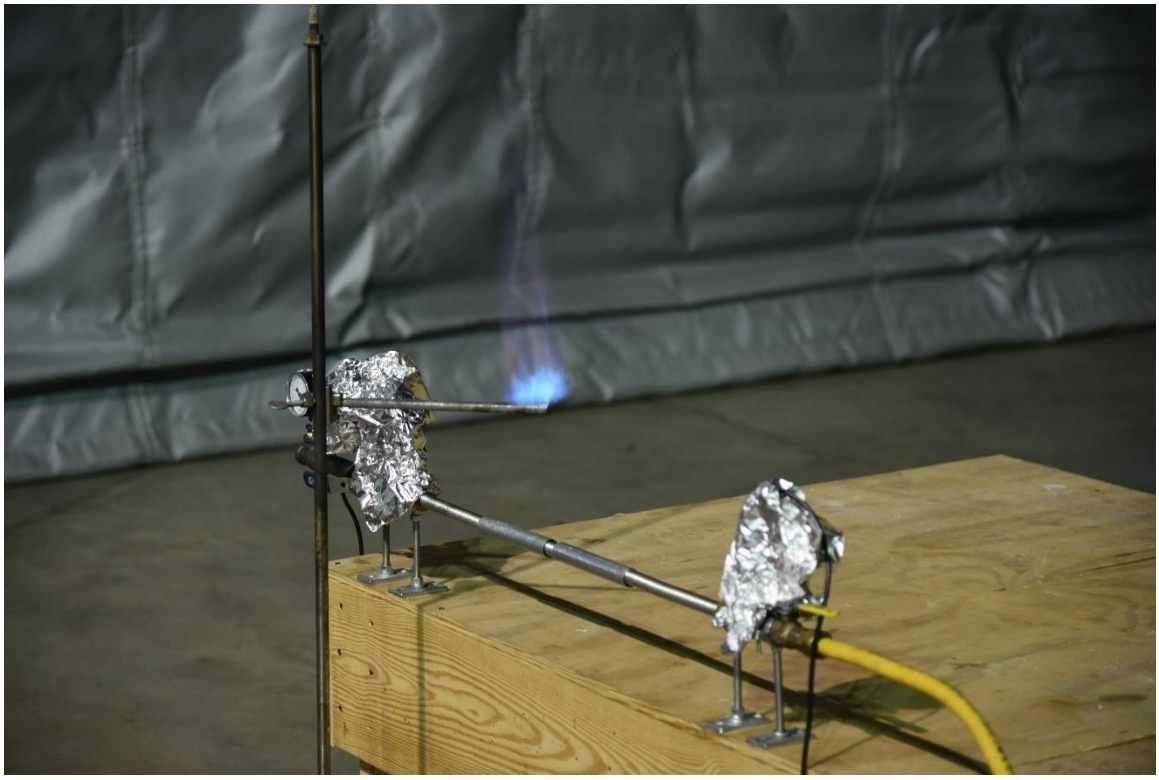

Figure 6. Obstructions placed near the hole to prevent the flame from blowing off (348047_1191945.jpg)

(a) Metal rod (348064_1192328.jpg) **(b) Metal plate (348052_1192016.jpg)**

Figure 7. Types of obstructions placed near the hole to prevent the flame from blowing off during certain experiments

Two experiments were conducted with the holes facing in the downward direction (Experiment IDs 348111 and 348112). Additional experiments were not conducted with this orientation, because the flame enveloped the CSST, as shown in Figure 8. As the flame contacted the CSST, the metal tubing was heated, and the tape covering the adjacent holes started to melt. Figure 9 shows the tape on an adjacent hole after one of these experiments. The melted tape was removed and replaced prior to the start of the next experiment.

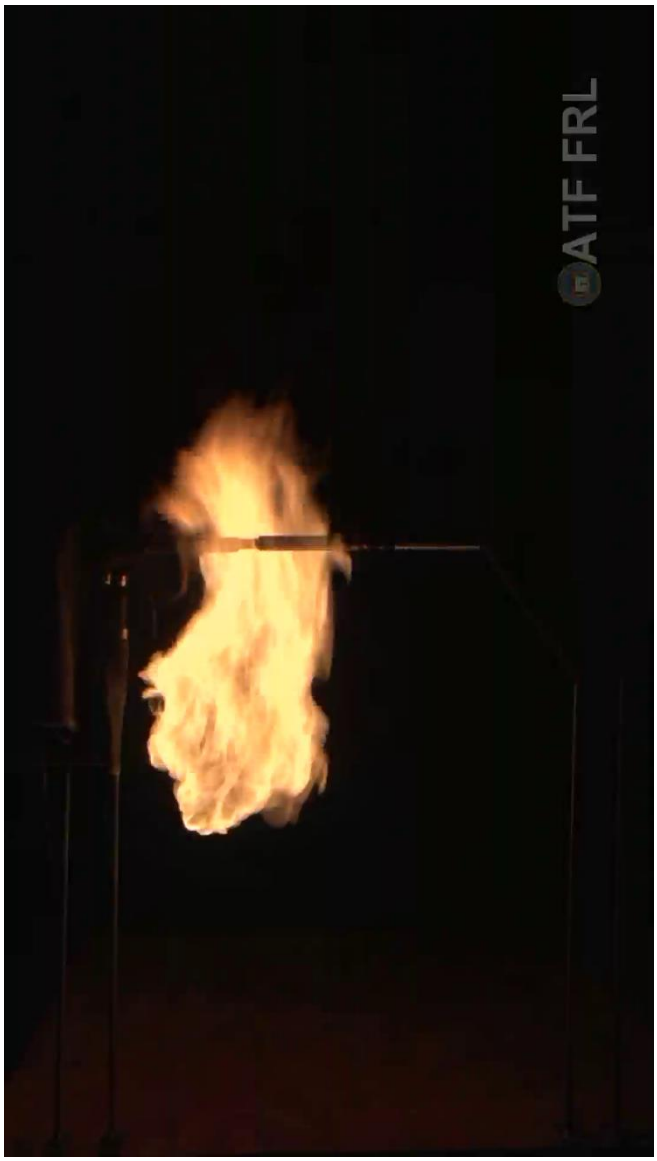

Figure 8. Resulting flame with the hole in the downward direction for Test 55 (still image obtained from video 348111_20210624_10.mov)

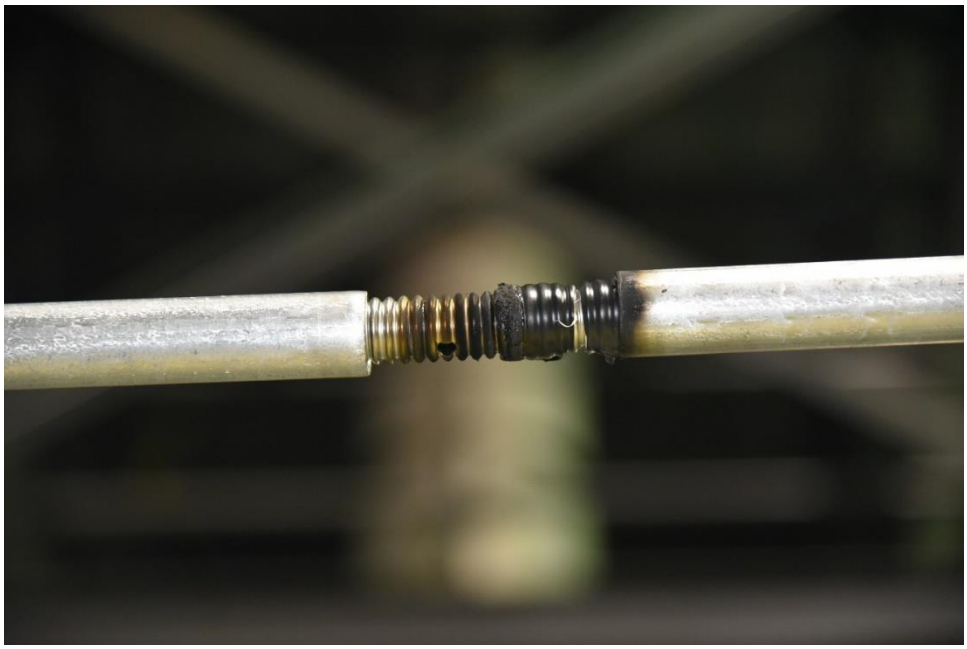

Figure 9. Melted tape covering adjacent holes for Test 55 (348111_1193232.jpg)

During several experiments, the flow rate exceeded the full-scale capacity of the mass flow meter. However, the instrument is capable of measuring flow rates up to 128% of its full-scale capacity. [2] Although the analog output signal from the instrument was limited to the full-scale range (0-100%), the digital display of the instrument could display flows up to 128% full-scale. Therefore, when the flow rate exceeded the full-scale flow capacity of the instrument, a photograph of the flow meter's display was taken to document the flow rate. These photographs are included in the project record.

Flow Correction

The mass flow meter used during the experiments was an Alicat Scientific model M-50SLPM-D. Different gases can be used with the meter by selecting a specific gas from its onboard software. During several experiments (Test 20-28), it was discovered that the mass flow meter had been set to propane and not methane (natural gas). This resulted in the flow measurement being incorrect for these experiments. However, the measured flow rate can be corrected using Equation 1.1, if the viscosity of the selected gas is known and the viscosity of the actual gas is known. [3]

$$Q_{actual} = Q_{indicated}\left(\frac{\eta_{selected}}{\eta_{actual}}\right) \quad [1.1]$$

For Equation 1.1, $\eta_{selected}$ is the absolute viscosity of the gas selected on the meter, η_{actual} is the absolute viscosity of the actual gas desired, $Q_{indicated}$ is the indicated mass flow, and Q_{actual} is the flow of the actual gas desired. Using the data provided by Alicat [4], the flow correction equation is

$$Q_{actual} = Q_{indicated}\left(\frac{\eta_{propane}}{\eta_{methane}}\right) = Q_{indicated}\left(\frac{81.226187}{110.759546}\right) = 0.733\ Q_{indicated}$$

A subsequent experiment was conducted (Exp ID 348145) to verify this flow correction factor. For this experiment, propane gas was flowed through the meter and the flow data was recorded with the meter set to both propane and methane. The experimental correction factor was determined to be 0.750, compared to 0.733 obtained from the calculated value. These values are within approximately 2% of each other. Therefore, the flow data for Tests 20-28 were manually corrected using a correction factor of 0.750.

Instrumentation

The instrumentation used during the experiment included a mass flow meter, a pressure transducer, and equipment to measure the laboratory conditions. In addition, the experiments were documented using a digital camera, video cameras, and a thermal imaging camera.

Figure 10 shows the pressure transducer mounted before the inlet to the CSST test section. The pressure transducer was mounted in a steel pipe tee fitting, perpendicular to the gas flow. A similar pressure transducer was located after the test section, although it was not used in every experiment.

Figure 10. Pressure transducers (348035_1191810.jpg)

Each experiment was also documented using two high definition (HD) video cameras and one thermal imaging camera (FLIR ThermaCam SC640). The thermal imaging camera was used only to show differences in temperatures and not to measure the actual flame temperature.

Laboratory Conditions

The ambient laboratory temperature, barometric pressure, and relative humidity were measured during the experiment(s). Barometric pressure measurement is accomplished using a silicon capacitive absolute sensor. The micromechanical sensor uses dimensional changes in its silicon membrane to measure pressure. Humidity measurement is achieved using a capacitive humidity sensor. The capacitance of the thin-film polymer sensor changes as the relative humidity changes. Temperature measurement is attained using a platinum Resistance Temperature Detector (RTD) sensor. The RTD contains a resistor that changes resistance as the temperature changes. The Laboratory Conditions were measured in accordance with the method defined in FRL Laboratory Instruction "LI017 Laboratory Conditions" [5].

The following table provides a description of the instrumentation used to collect the ambient laboratory conditions measurements during the experiments.

Table 2. Lab Conditions Description

Description	Manufacturer	Model	Bar Code
Vaisala MBR	Vaisala	PTU301	99001064

The following table provides a summary of the initial conditions at the start of the experiment(s). The 'Description' column shows the location of the measurements. RH shows the initial relative humidity.

Table 3. Ambient Laboratory Initial Condition Summary

Test Number	Description	Temperature (C)	Pressure (kPa)	RH (%)
1	Vaisala MBR	26	100	70
2	Vaisala MBR	26	100	69
3	Vaisala MBR	26	100	68
4	Vaisala MBR	26	100	68
5	Vaisala MBR	26	100	67
6	Vaisala MBR	26	100	67
7	Vaisala MBR	26	100	66
8	Vaisala MBR	26	100	65
9	Vaisala MBR	25	100	65
10	Vaisala MBR	25	100	65
11	Vaisala MBR	25	100	65
12	Vaisala MBR	25	100	65
13	Vaisala MBR	25	100	64
14	Vaisala MBR	25	100	64
15	Vaisala MBR	25	100	63
16	Vaisala MBR	25	100	63
17	Vaisala MBR	25	100	63

Test Number	Description	Temperature (C)	Pressure (kPa)	RH (%)
18	Vaisala MBR	25	100	63
19	Vaisala MBR	25	100	62
20	Vaisala MBR	24	102	41
21	Vaisala MBR	24	102	40
22	Vaisala MBR	24	102	39
23	Vaisala MBR	24	102	39
24	Vaisala MBR	25	102	38
25	Vaisala MBR	25	102	38
26	Vaisala MBR	25	102	38
27	Vaisala MBR	25	102	37
28	Vaisala MBR	25	102	37
29	Vaisala MBR	25	102	37
30	Vaisala MBR	25	102	37
31	Vaisala MBR	25	102	34
32	Vaisala MBR	25	102	33
33	Vaisala MBR	25	102	33
34	Vaisala MBR	25	102	34
35	Vaisala MBR	25	102	35
36	Vaisala MBR	25	102	35
37	Vaisala MBR	25	102	35
38	Vaisala MBR	25	102	34
39	Vaisala MBR	25	102	35
40	Vaisala MBR	25	102	36
41	Vaisala MBR	25	102	35
42	Vaisala MBR	25	102	35
43	Vaisala MBR	25	102	35
44	Vaisala MBR	25	102	34
45	Vaisala MBR	25	102	34
46	Vaisala MBR	25	102	33
47	Vaisala MBR	25	102	34
48	Vaisala MBR	25	102	34
49	Vaisala MBR	25	102	35
50	Vaisala MBR	25	102	37
51	Vaisala MBR	25	102	36
52	Vaisala MBR	25	102	37
53	Vaisala MBR	25	102	35
54	Vaisala MBR	25	102	36
55	Vaisala MBR	24	102	49
56	Vaisala MBR	24	102	47
57	Vaisala MBR	24	102	44
58	Vaisala MBR	24	102	44
59	Vaisala MBR	24	102	43
60	Vaisala MBR	24	102	44
61	Vaisala MBR	24	102	43
62	Vaisala MBR	24	102	44
63	Vaisala MBR	24	102	47
64	Vaisala MBR	24	102	47
65	Vaisala MBR	24	102	47
66	Vaisala MBR	24	102	47
67	Vaisala MBR	24	102	47

Test Number	Description	Temperature (C)	Pressure (kPa)	RH (%)
68	Vaisala MBR	24	102	47
69	Vaisala MBR	25	102	46
70	Vaisala MBR	25	102	46
71	Vaisala MBR	25	102	46
72	Vaisala MBR	25	102	45
73	Vaisala MBR	25	102	46
74	Vaisala MBR	25	102	45
75	Vaisala MBR	25	102	45

Gauge pressure Transducers

Pressure in a fluid at rest is defined as the normal force per unit area exerted on a plane surface (real or imaginary) immersed in a fluid and is created by the bombardment of the surface with the fluid molecules [6]. Pressure is expressed in terms of force per unit area. A common System International (SI) unit of pressure is expressed as Newton(s) per square meter (N/m^2) or more commonly referred to as Pascal. The common English unit for expressing pressure is in pounds per square inch (psi). Absolute pressure (abs) is measured relative to absolute zero pressure or a pressure that would only occur in a near perfect vacuum. Standard sea-level atmospheric pressure is 101 kPa (abs) or 14.7 psi (abs) [6]. In engineering it is common practice to measure pressure relative to the local atmospheric pressure, this pressure is called gauge pressure (kPa_g or psig).

A gauge pressure transducer is a device which measures the pressure of a fluid relative to the local atmospheric pressure and produces an electrical signal that is proportional to the amount of pressure being generated. The gauge pressure transducer(s) used during the experiment(s) conducted for this test series is provided in the "Gauge Pressure Transducer Description" table.

Table 4. Gauge Pressure Transducer Description

Location	Manufacturer	Model	Pressure Range	Bar Code
Inlet	OmegaDyne Inc.	PX309-001G5V	0-6895 Pa	99001090
Outlet	OmegaDyne Inc.	PX309-001G5V	0-6895 Pa	99001091

Flow Meter - Laminar

The flow rate of gas was measured using a laminar flow meter. Laminar flow meters operate on the Hagan-Poiseuille law, which states that that the pressure drop along a length of pipe for a fluid in laminar flow is proportional to the flow rate of the fluid [7]. To obtain laminar flow, the flow meter contains a laminar flow element that converts turbulent flow into laminar flow. Flow rate is typically expressed in terms of volume per unit time, but it can also be expressed in mass per unit time, if the density of the fluid is known at a specified temperature and pressure. The laminar flow meter may also include an integral flow controller, which allows the gas flow to be controlled remotely.

The following table provides a description of the mass flow meter used during the experiments. The mass flow units are given in "standard" volumetric flow units that reference a specific temperature and pressure combination. The default standard temperature and pressure (STP) reference are 25°C (77°F) and 101 kPa (1 atm). The maximum measurable flow rate of the flow meter is 128% of the full scale. [2] Although the display on the meter can show flows up to 128% full scale, the analog output signal of the meter is limited to the range of the meter (0-100% full scale).

Table 5. Flow Meter Description

Manufacturer	Model	Mass Flow Range	Maximum Measurable Flow	Bar Code
Alicat Scientific	M-50SLPM-D	0-50 slpm	64 slpm	99001076

Set Up Photos

The following shows photographs of the experiment setup.

Table 6. Setup Photos

Figure 11. 348035_1191805

Figure 12. 348035_1191806

Figure 13. 348035_1191807

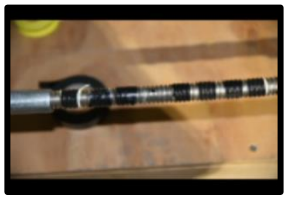

Figure 14. 348035_1191808

Figure 15. 348035_1191809

Figure 16. 348035_1191810

Figure 17. 348035_1191811

Figure 18. 348035_1191812

Figure 19. 348035_1191813

Figure 20. 348035_1191814

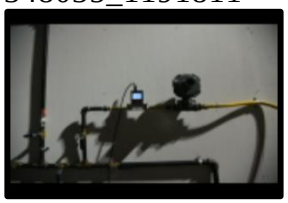

Figure 21. 348035_1191815

Figure 22. 348035_1191816

Figure 23.
348035_1191817

Figure 24.
348035_1191818

Figure 25.
348035_1191819

Figure 26.
348035_1212480

Figure 27.
348035_1212481

Figure 28.
348035_1212482

Figure 29.
348035_1212483

Figure 30.
348035_1212484

Figure 31.
348035_1212485

Figure 32.
348035_1212486

Figure 33.
348035_1212487

Figure 34.
348035_1212488

Figure 35.
348035_1212489

Figure 36.
348035_1212490

Figure 37.
348035_1212491

Figure 38.
348035_1212492

Figure 39.
348105_1193193

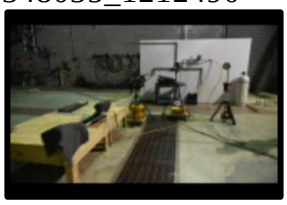

Figure 40.
348105_1193194

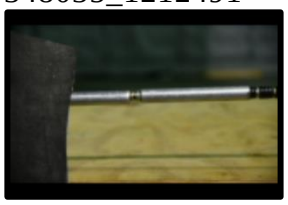

Figure 41.
348105_1193195

Experiment Photographs

Digital Cameras are used within the FRL to record digital still photographs during experiments. Digital Cameras used during this test series were used in accordance with the method defined in FRL Laboratory Instruction “LI003 Digital Cameras” [8].

Results for Test 1 (ID 348035)

The following table lists selected events that occurred during the experiment.

Table 7. Experiment Events

Description	Time (s)
13" WC	129
11" WC	300

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

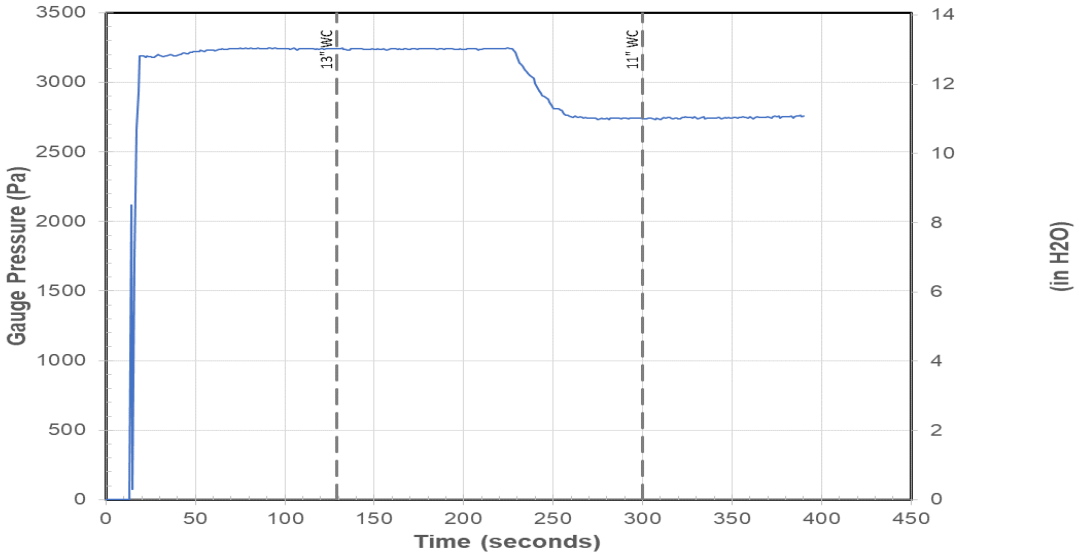

Figure 42. Gauge Pressure Data - Inlet

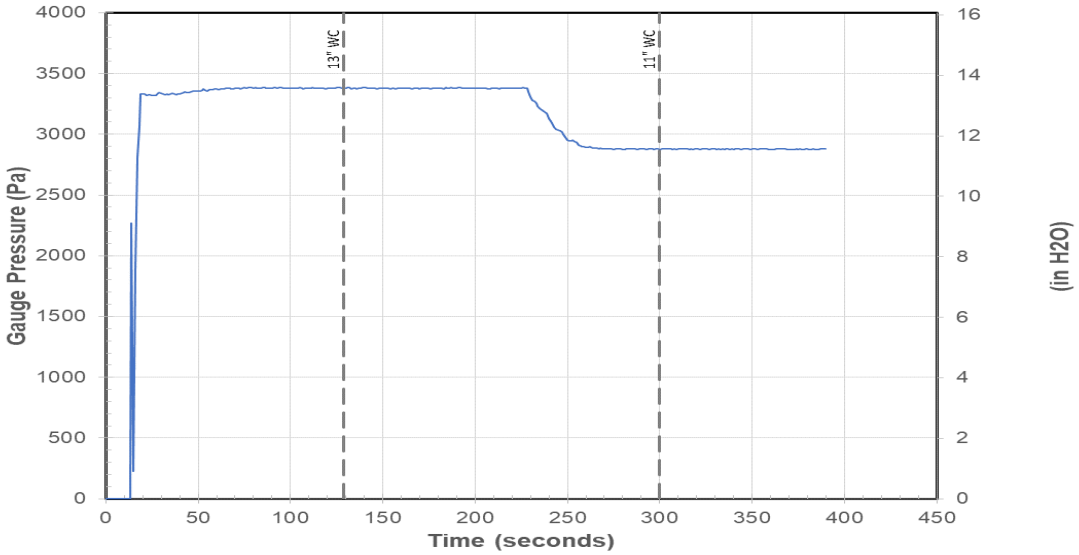

Figure 43. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

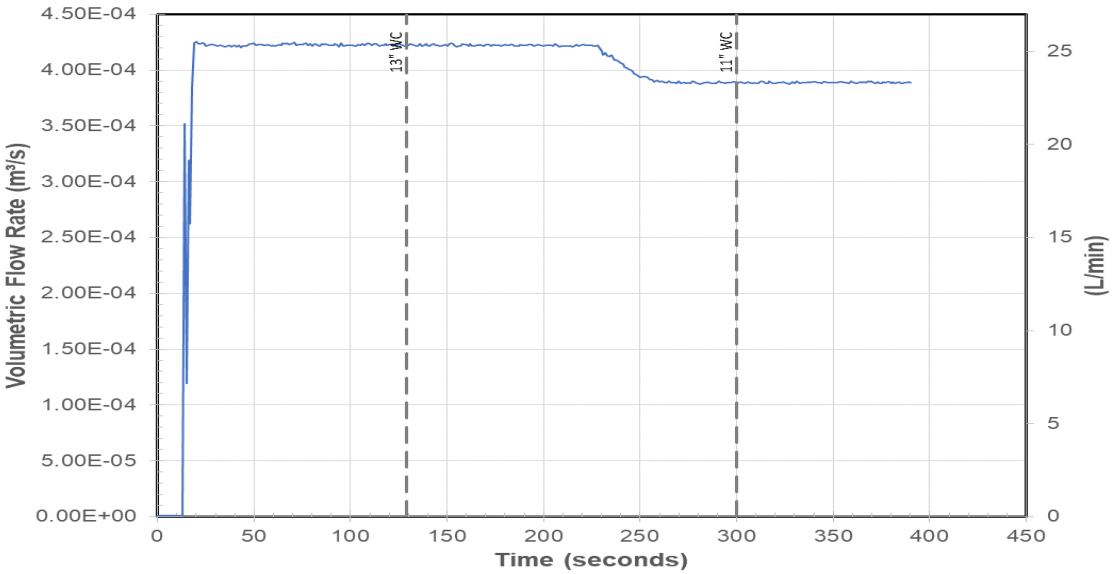

Figure 44. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 8. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	09:49:31	457	348035_20210622_094931_22A.mov
Close up	09:49:38	461	348035_20210622_094939_23A.mov
Overall	09:49:46	465	348035_20210622_094946_24A.mov
FLIR	09:50:03	465	348035_20210622_095003_6.mov
CLOSE UP	09:50:05	464	348035_20210622_095005_9.mov
OVERALL	09:50:06	463	348035_20210622_095006_10.mov
MASTER			348035_1246436.mov

Results for Test 2 (ID 348038)

The following table lists selected events that occurred during the experiment.

Table 9. Experiment Events

Description	Time (s)
11" WC	80
12" WC	308

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

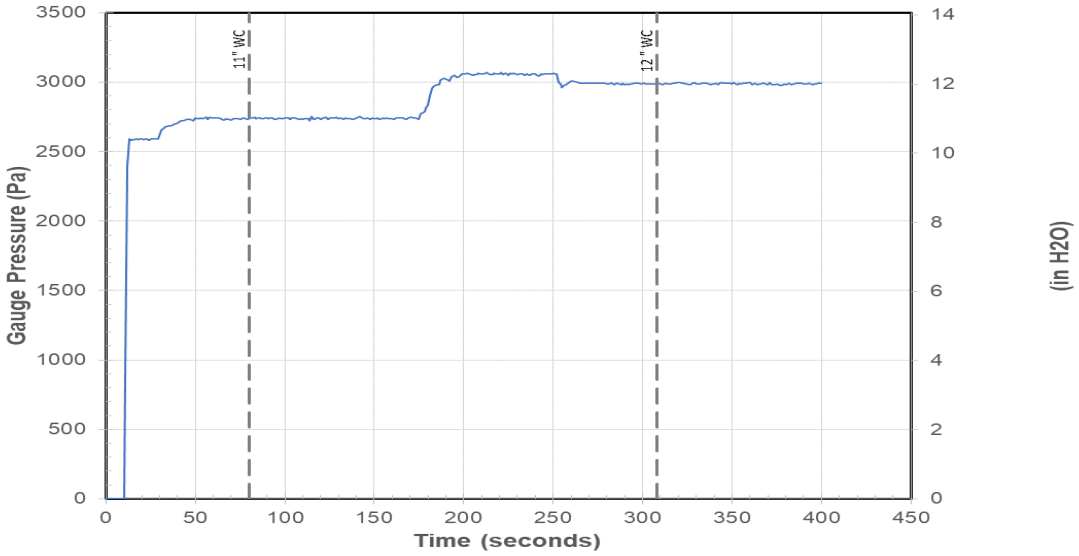

Figure 45. Gauge Pressure Data - Inlet

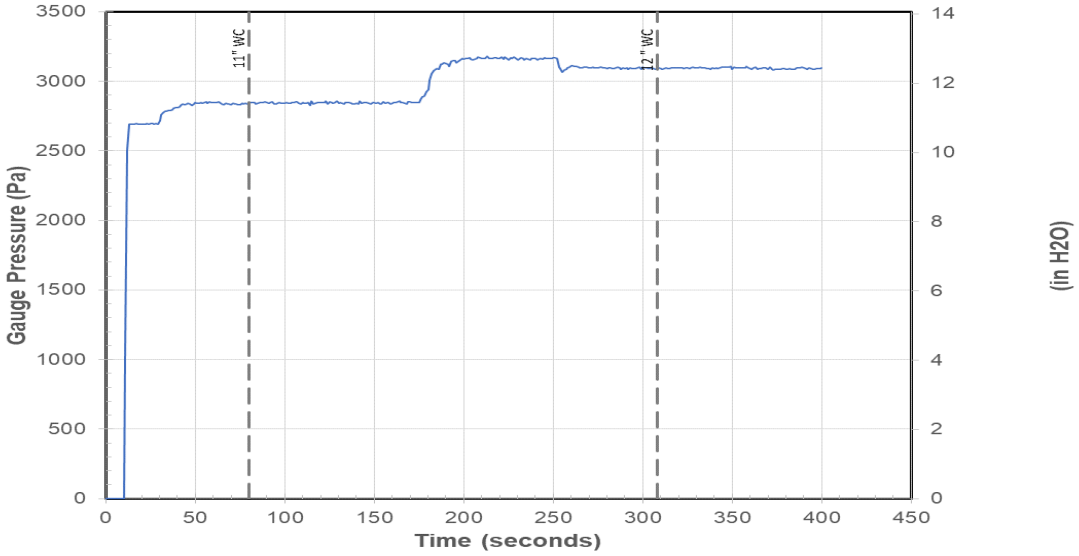

Figure 46. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

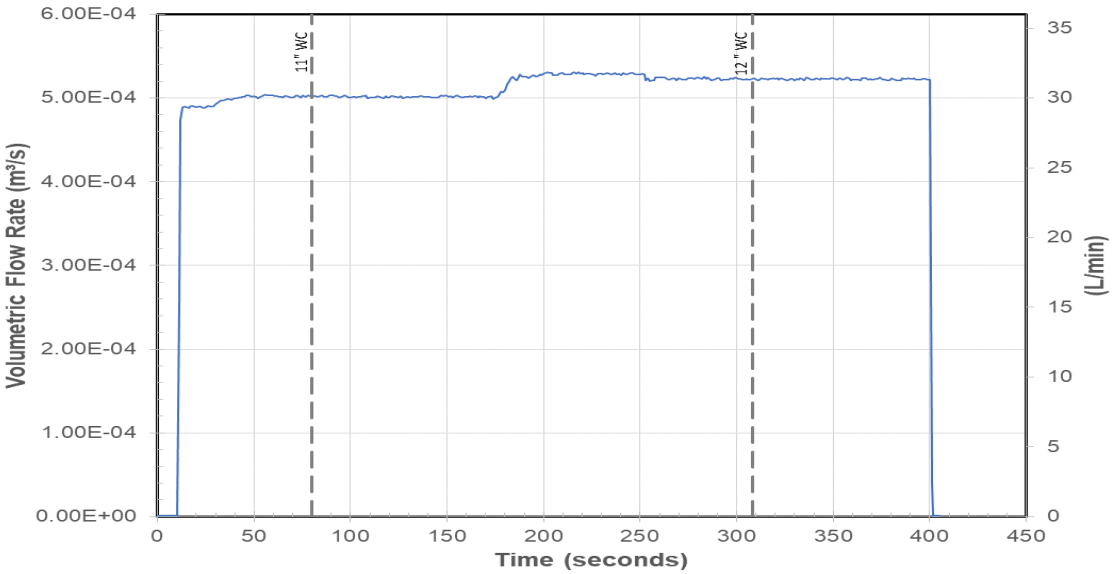

Figure 47. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 10. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	10:06:42	465	348038_20210622_100642_22A.mov
Close up	10:06:49	469	348038_20210622_100650_23A.mov
Overall	10:06:57	473	348038_20210622_100657_24A.mov
FLIR	10:07:15	470	348038_20210622_100715_6.mov
CLOSE UP	10:07:16	470	348038_20210622_100716_9.mov
OVERALL	10:07:17	474	348038_20210622_100717_10.mov
MASTER			348038_1246437.mov

Results for Test 3 (ID 348039)

The following table lists selected events that occurred during the experiment.

Table 11. Experiment Events

Description	Time (s)
14" WC	57
11" WC	174

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

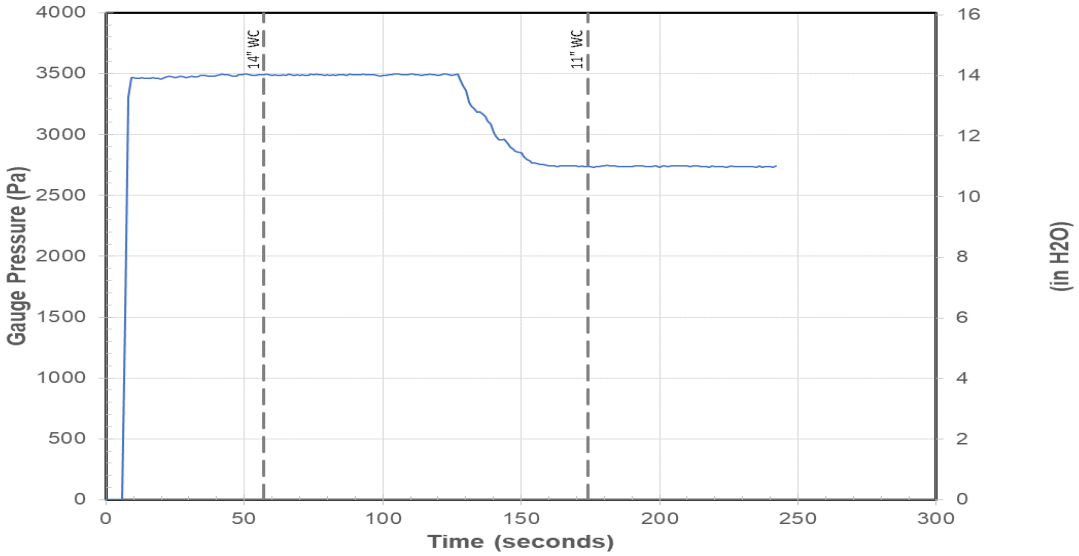

Figure 48. Gauge Pressure Data - Inlet

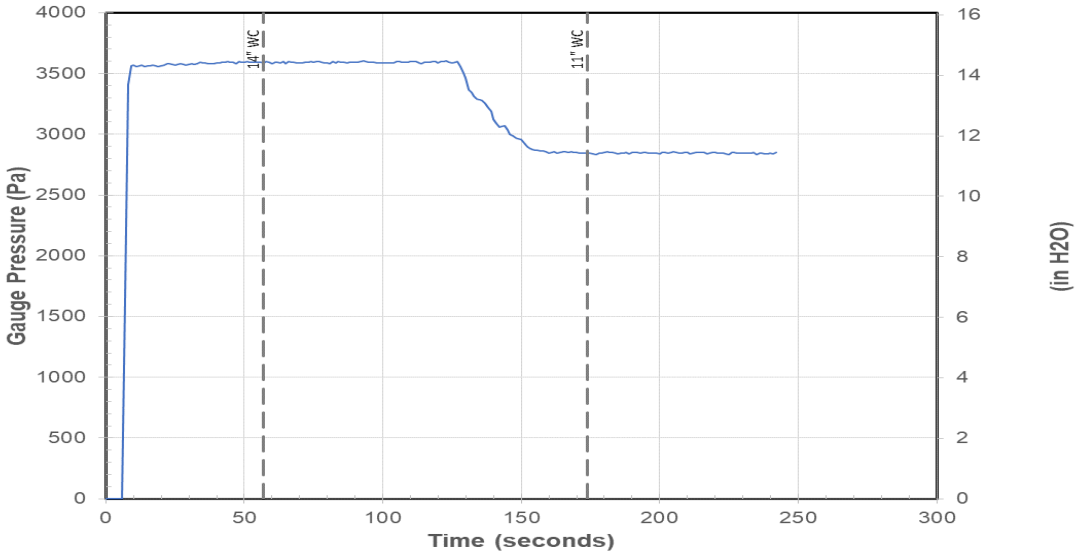

Figure 49. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

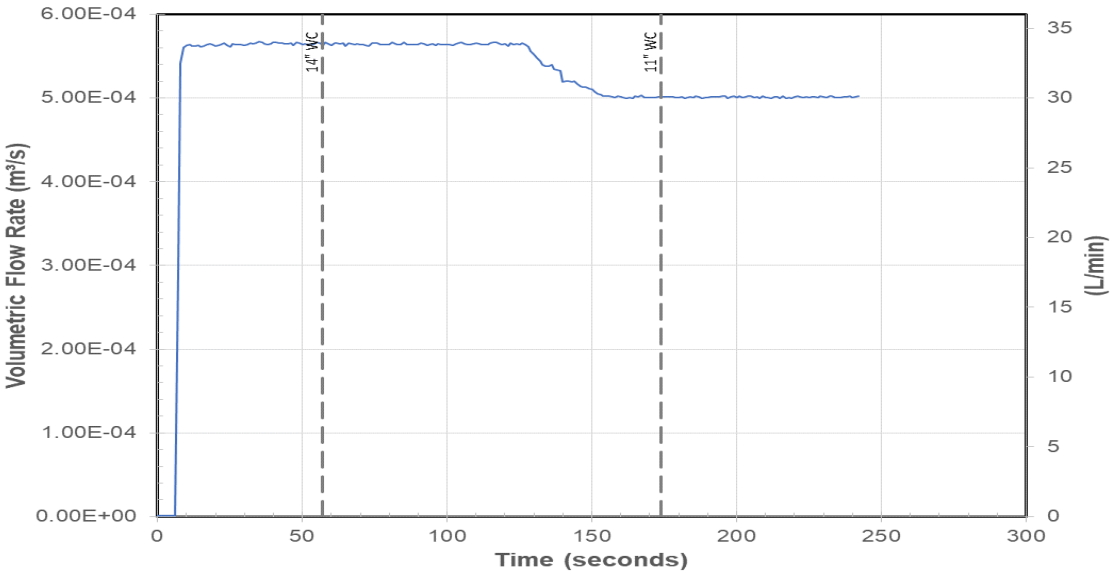

Figure 50. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 12. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	10:21:09	309	348039_20210622_102110_22A.mov
Close up	10:21:17	312	348039_20210622_102117_23A.mov
Overall	10:21:24	317	348039_20210622_102125_24A.mov
FLIR	10:21:42	314	348039_20210622_102142_6.mov
CLOSE UP	10:21:43	314	348039_20210622_102143_9.mov
OVERALL	10:21:44	319	348039_20210622_102144_10.mov
MASTER			348039_1246438.mov

Results for Test 4 (ID 348041)

The following table lists selected events that occurred during the experiment.

Table 13. Experiment Events

Description	Time (s)
11" WC	65
14" WC	167

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

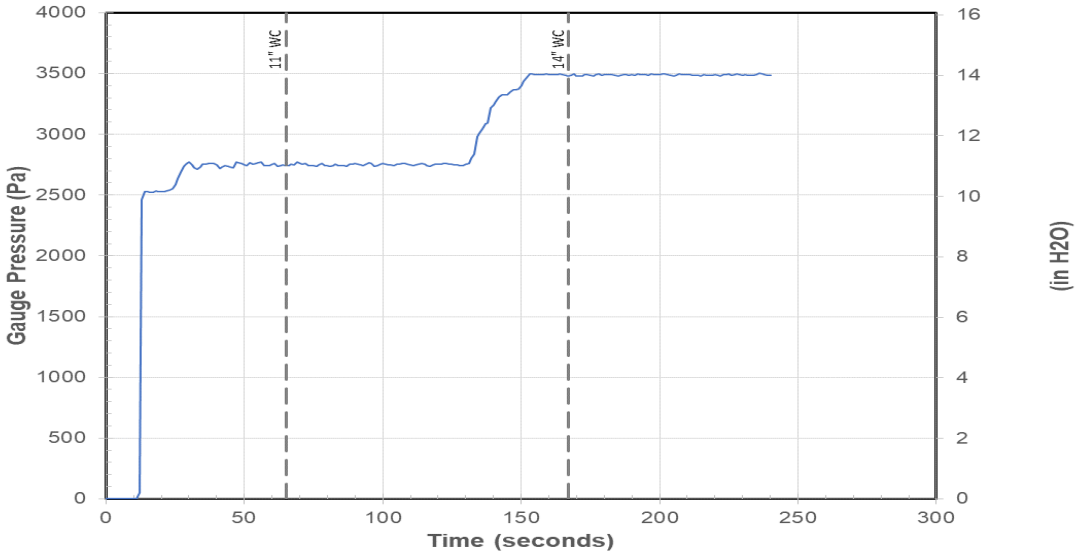

Figure 51. Gauge Pressure Data - Inlet

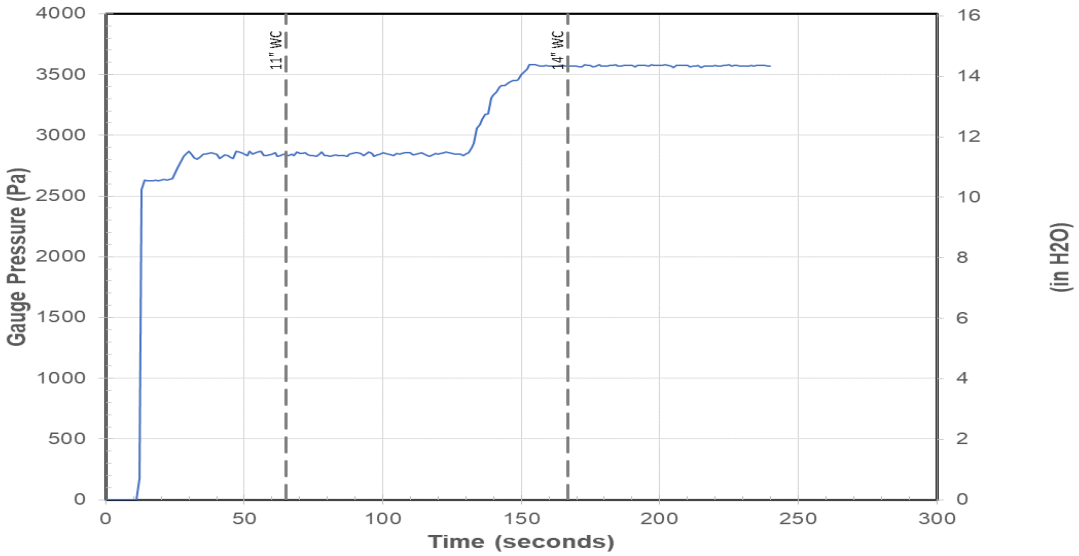

Figure 52. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

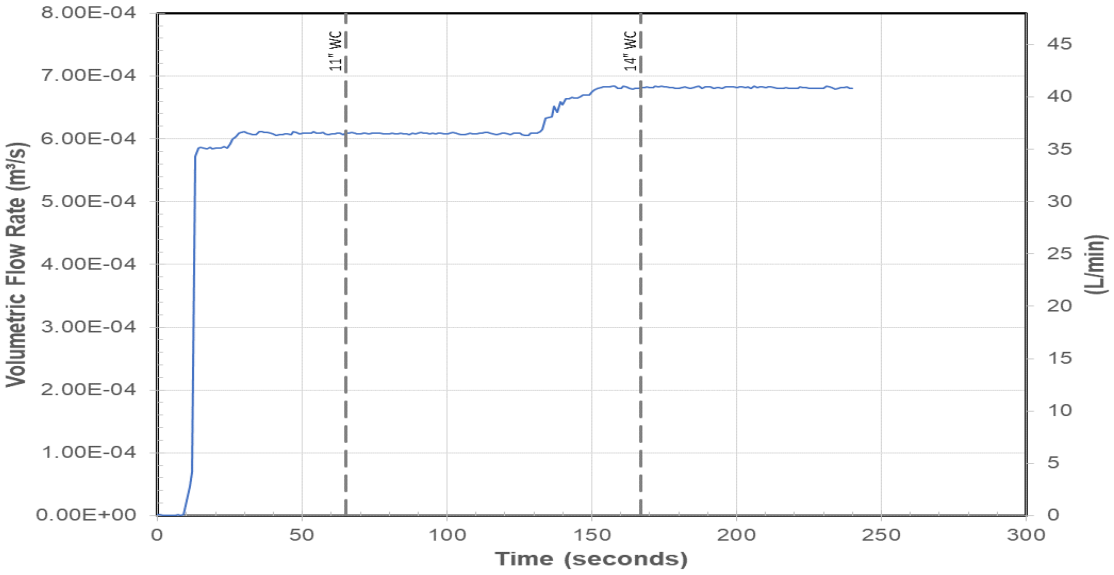

Figure 53. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 14. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	10:43:52	303	348041_20210622_104352_22A.mov
Close up	10:43:59	310	348041_20210622_104400_23A.mov
Overall	10:44:07	313	348041_20210622_104407_24A.mov
FLIR	10:44:24	309	348041_20210622_104424_6.mov
CLOSE UP	10:44:25	314	348041_20210622_104425_9.mov
OVERALL	10:44:26	314	348041_20210622_104426_10.mov
MASTER			348041_1246439.mov

Results for Test 5 (ID 348042)

The following table lists selected events that occurred during the experiment.

Table 15. Experiment Events

Description	Time (s)
14" WC	54
11" WC	185

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

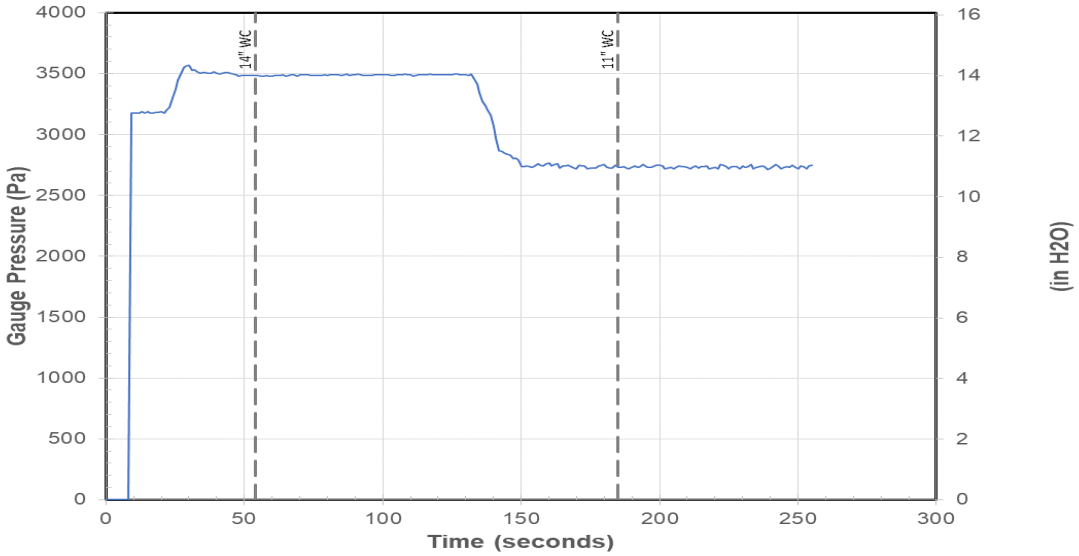

Figure 54. Gauge Pressure Data - Inlet

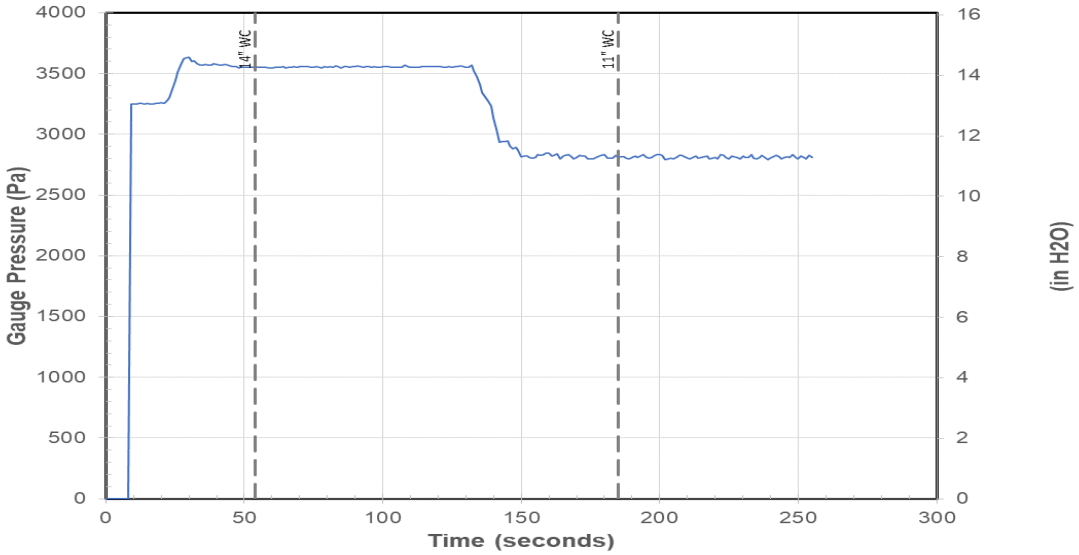

Figure 55. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

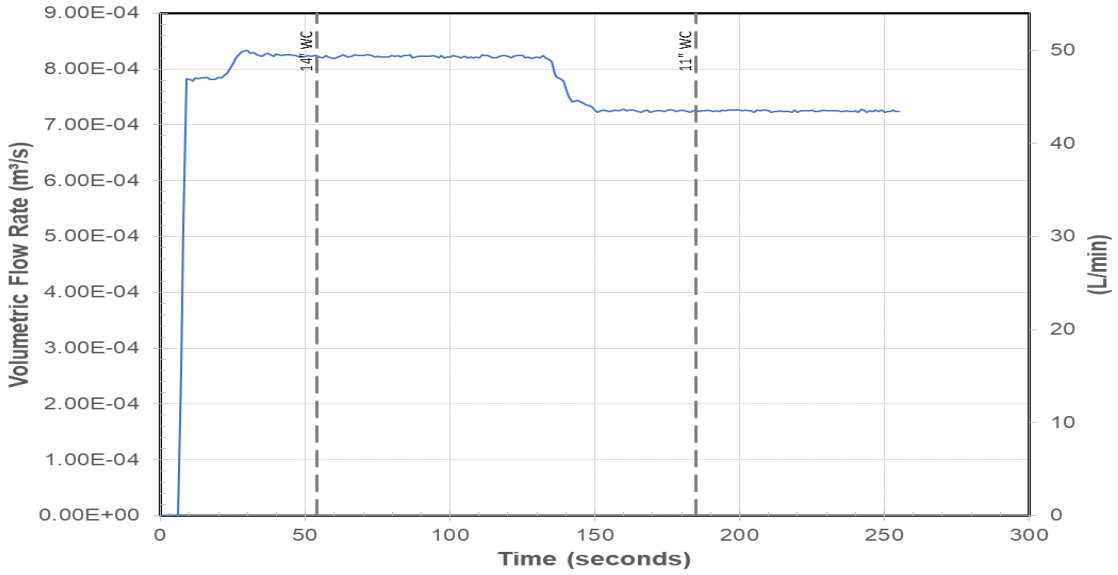

Figure 56. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 16. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	10:54:37	314	348042_20210622_105438_22A.mov
Close up	10:54:45	317	348042_20210622_105445_23A.mov
Overall	10:54:52	321	348042_20210622_105453_24A.mov
FLIR	10:55:10	320	348042_20210622_105510_6.mov
CLOSE UP	10:55:12	319	348042_20210622_105512_9.mov
OVERALL	10:55:13	318	348042_20210622_105513_10.mov
CUSTOM 1			348042_1211082.mov
CUSTOM 2			348042_1211083.mov
MASTER			348042_1246440.mov

Results for Test 6 (ID 348044)

The following table lists selected events that occurred during the experiment.

Table 17. Experiment Events

Description	Time (s)
11" WC	40
14" WC	151

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

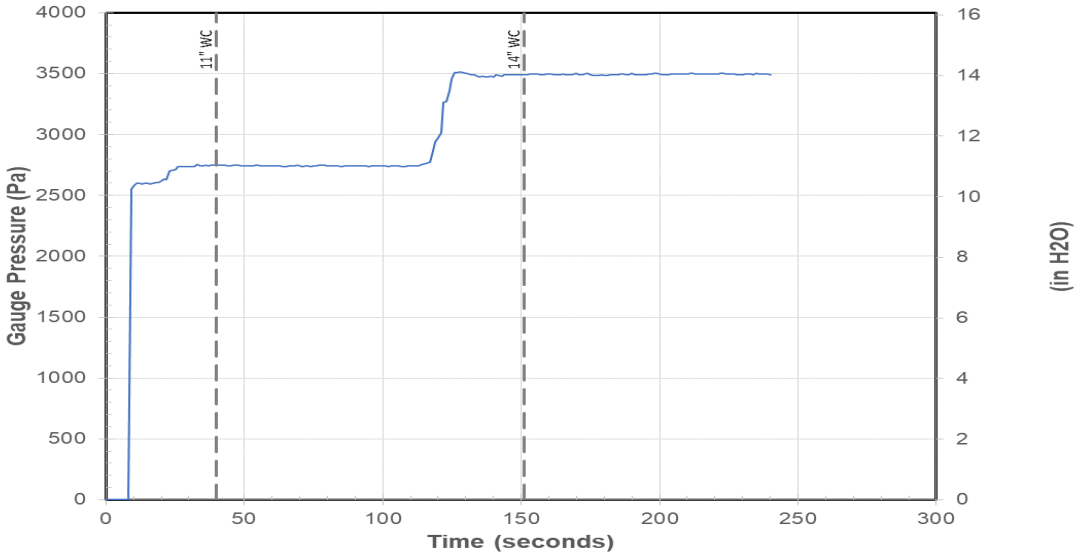

Figure 57. Gauge Pressure Data - Inlet

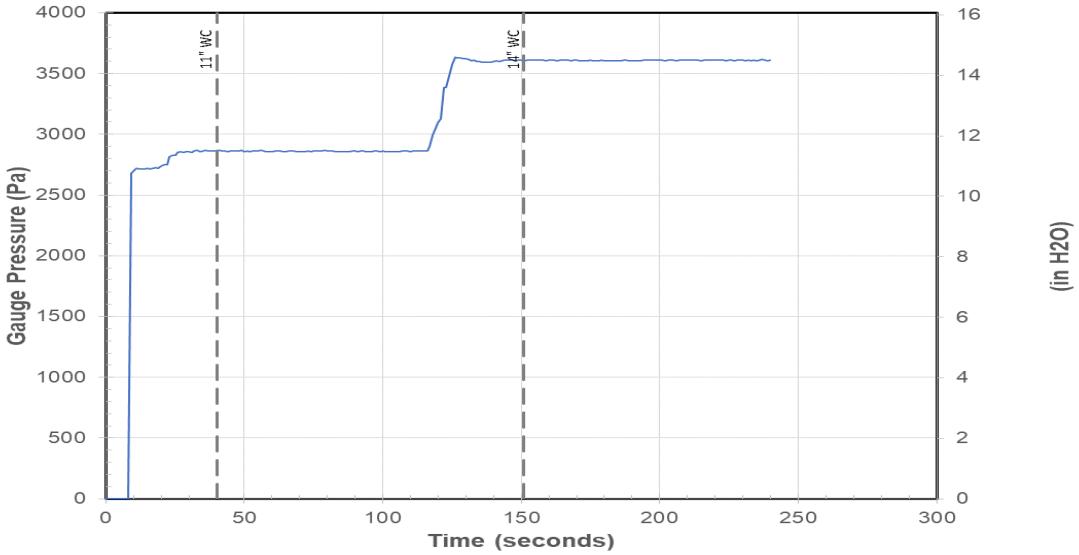

Figure 58. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

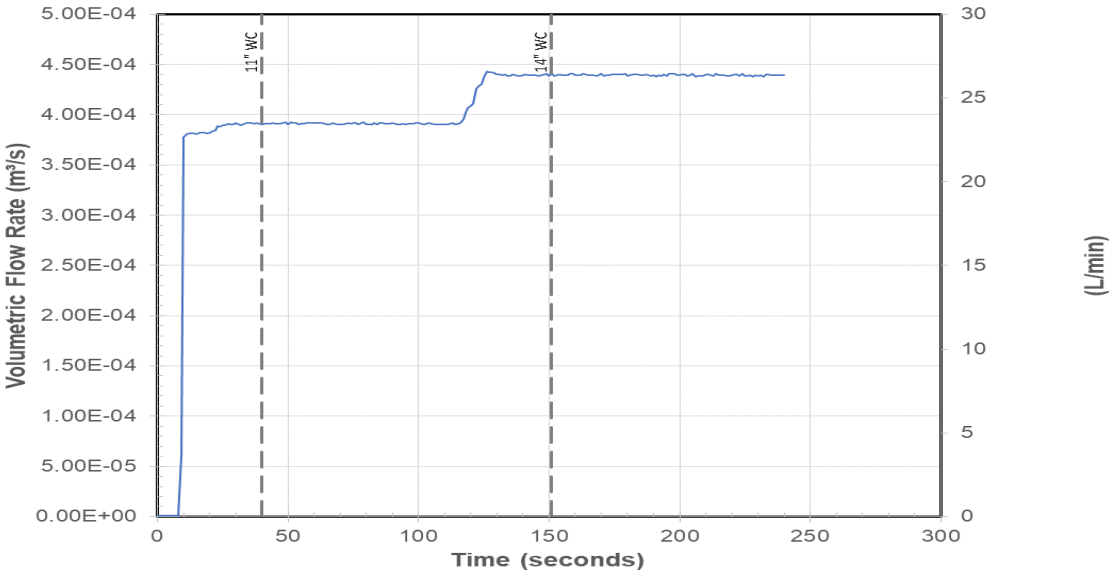

Figure 59. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 18. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	11:04:20	290	348044_20210622_110421_22A.mov
Close up	11:04:28	293	348044_20210622_110428_23A.mov
Overall	11:04:35	297	348044_20210622_110436_24A.mov
FLIR	11:04:52	294	348044_20210622_110452_6.mov
CLOSE UP	11:04:53	299	348044_20210622_110453_9.mov
OVERALL	11:04:54	299	348044_20210622_110454_10.mov
MASTER			348044_1246441.mov

Results for Test 7 (ID 348045)

The following table lists selected events that occurred during the experiment.

Table 19. Experiment Events

Description	Time (s)
14" WC	44
11" WC	148

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

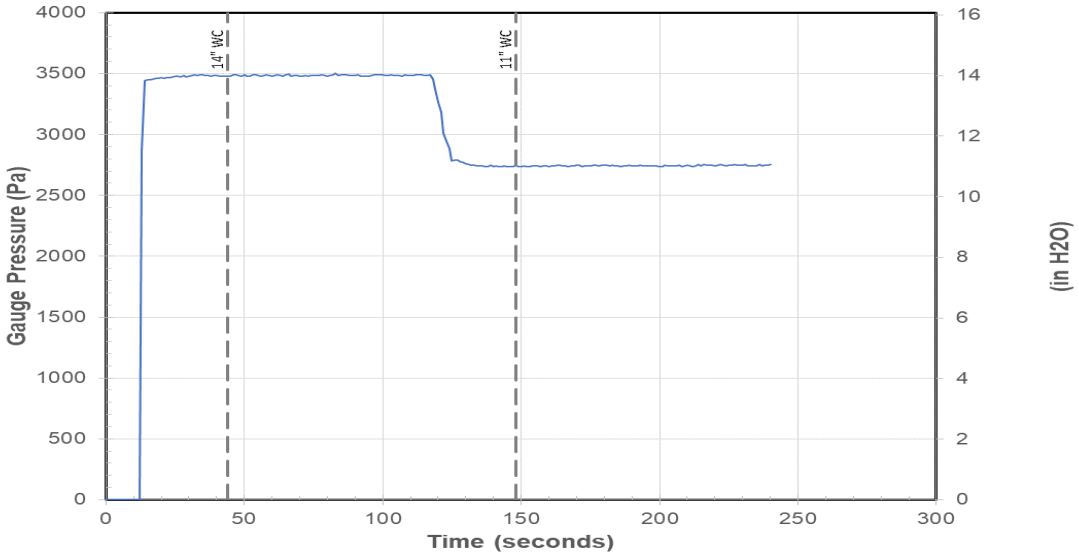

Figure 60. Gauge Pressure Data - Inlet

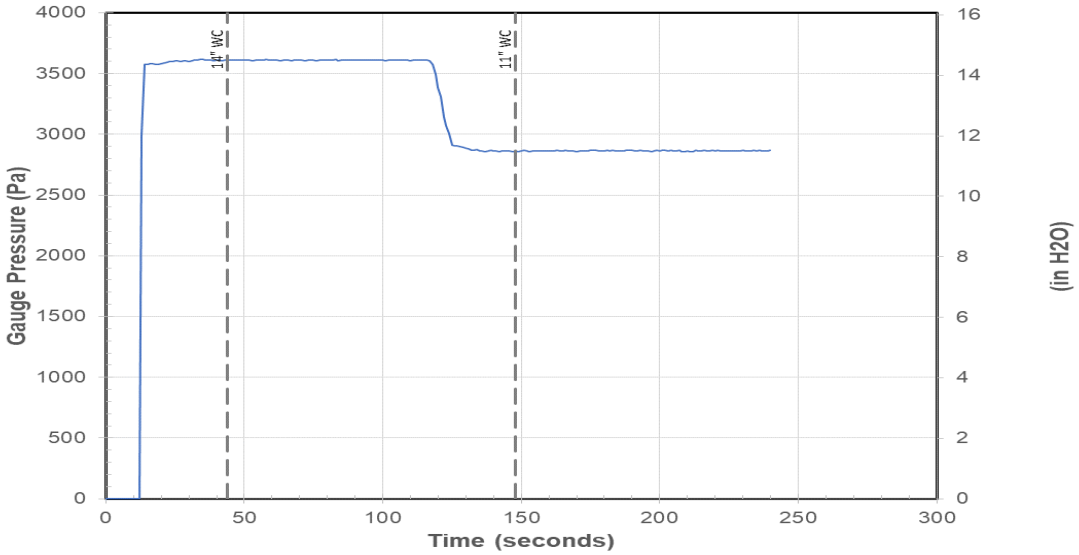

Figure 61. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

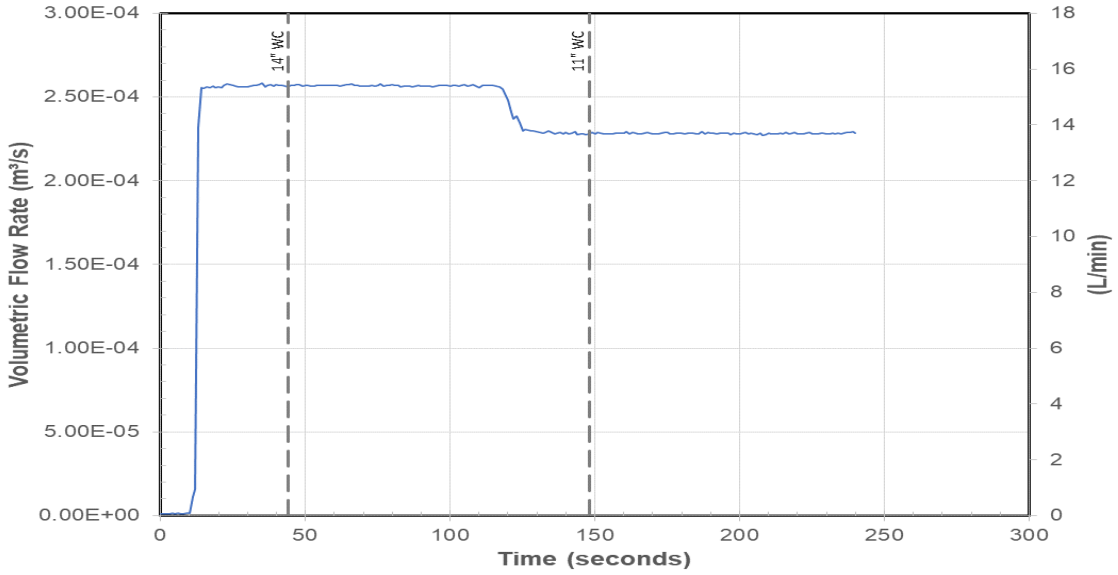

Figure 62. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 20. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	11:19:42	292	348045_20210622_111942_22A.mov
Close up	11:19:50	297	348045_20210622_111950_23A.mov
Overall	11:19:57	301	348045_20210622_111958_24A.mov
FLIR	11:20:14	299	348045_20210622_112014_6.mov
CLOSE UP	11:20:15	299	348045_20210622_112015_9.mov
OVERALL	11:20:16	304	348045_20210622_112016_10.mov
MASTER			348045_1246442.mov

Results for Test 8 (ID 348046)

The following table lists selected events that occurred during the experiment.

Table 21. Experiment Events

Description	Time (s)
11" WC	34
14" WC	139

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

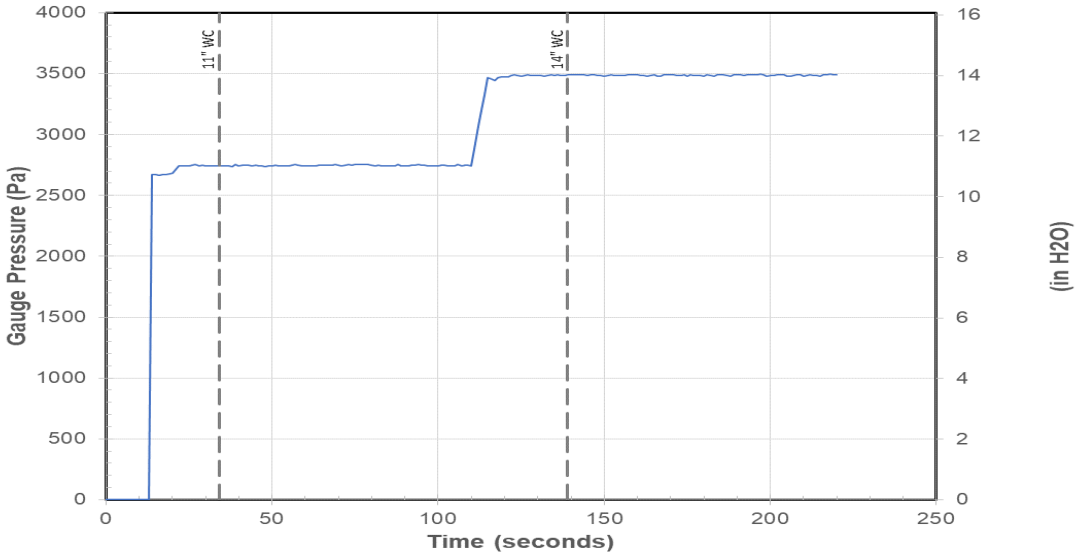

Figure 63. Gauge Pressure Data - Inlet

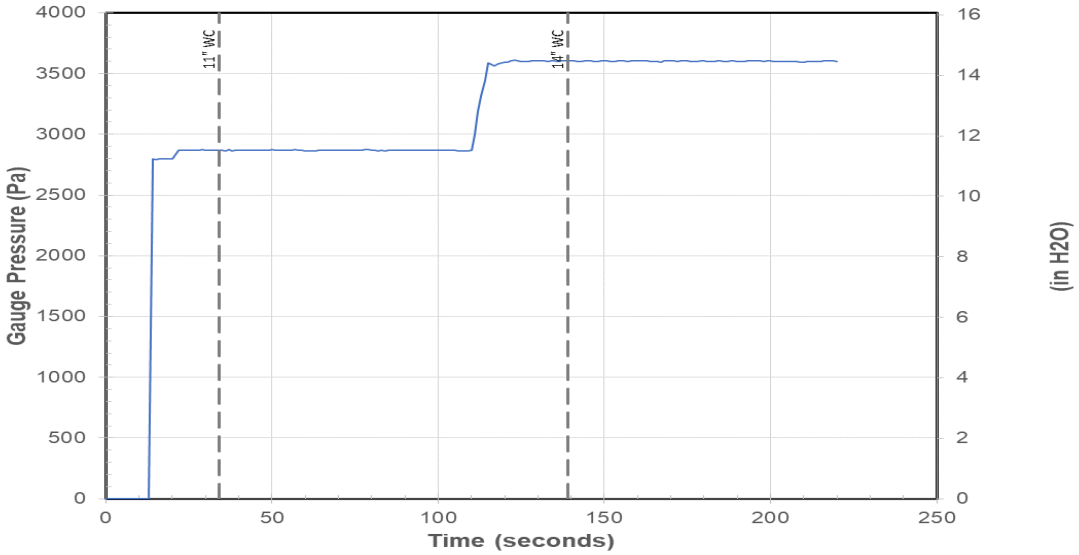

Figure 64. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

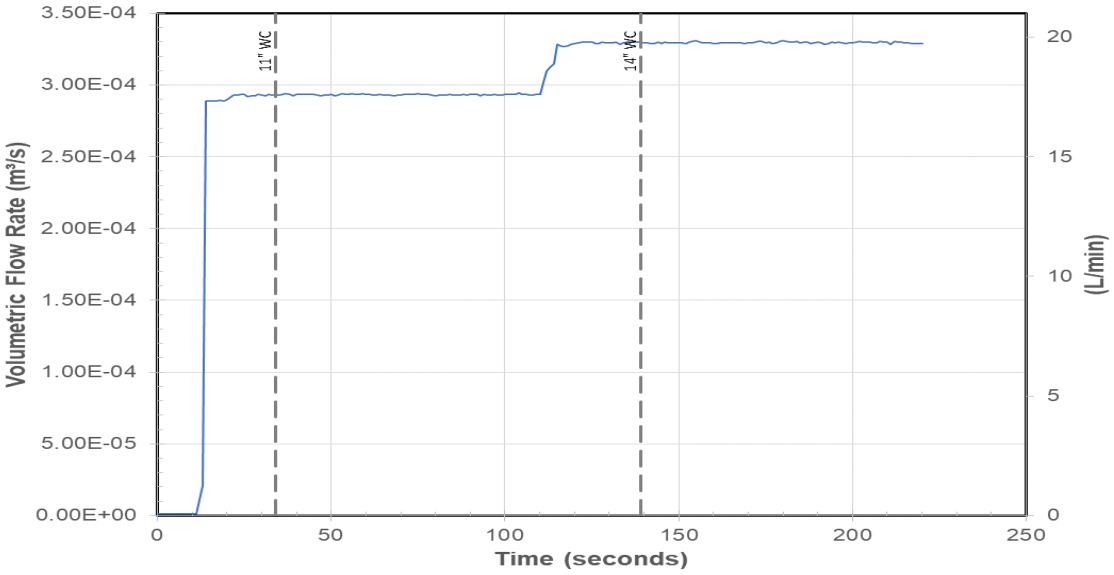

Figure 65. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 22. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	11:27:54	279	348046_20210622_112755_22A.mov
Close up	11:28:02	281	348046_20210622_112802_23A.mov
Overall	11:28:09	286	348046_20210622_112810_24A.mov
FLIR	11:28:25	284	348046_20210622_112825_6.mov
CLOSE UP	11:28:26	284	348046_20210622_112826_9.mov
OVERALL	11:28:27	289	348046_20210622_112827_10.mov
MASTER			348046_1246443.mov

Results for Test 9 (ID 348047)

The following table lists selected events that occurred during the experiment.

Table 23. Experiment Events

Description	Time (s)
14" WC	20
11" WC	172

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

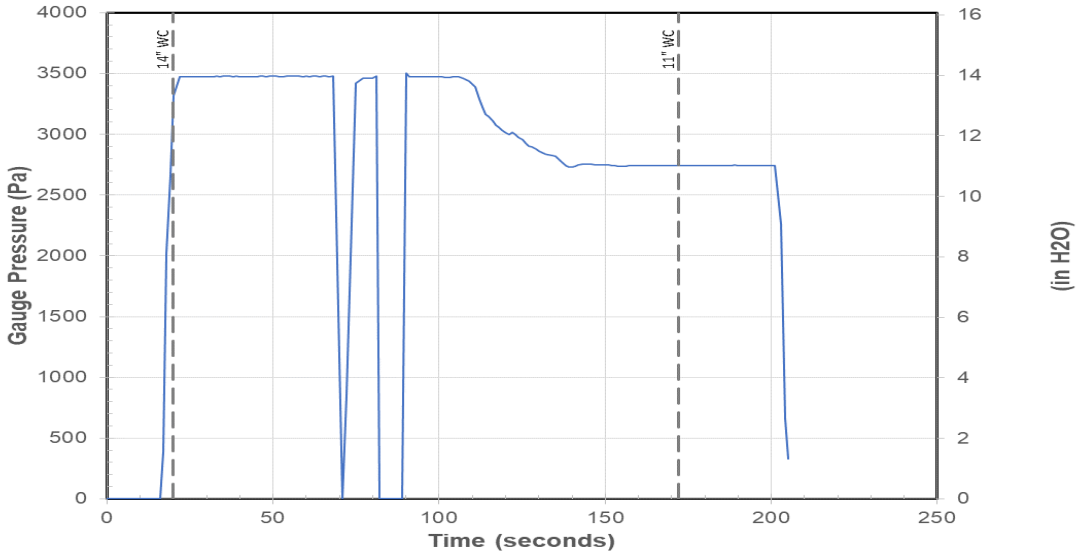

Figure 66. Gauge Pressure Data - Inlet

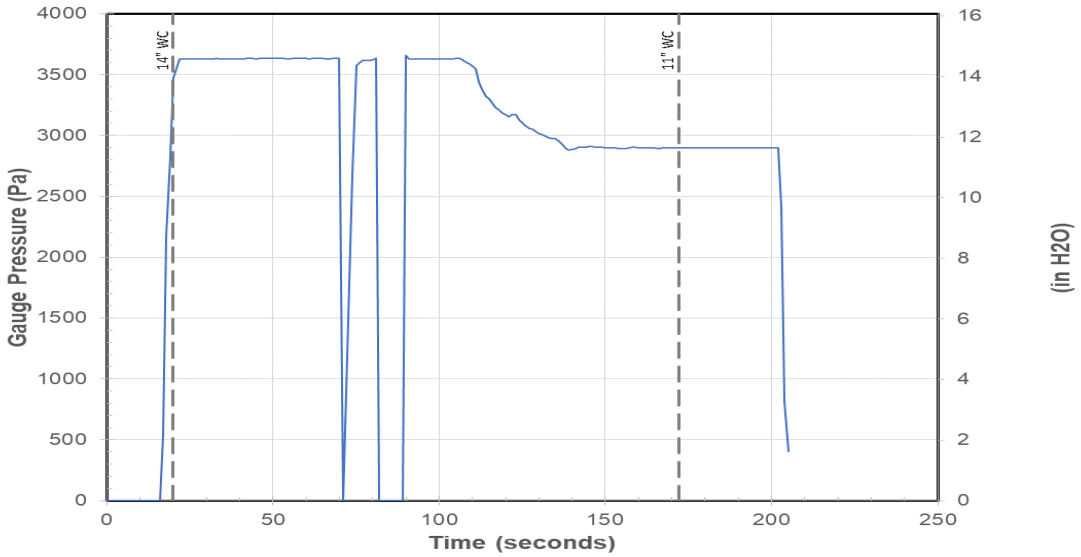

Figure 67. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

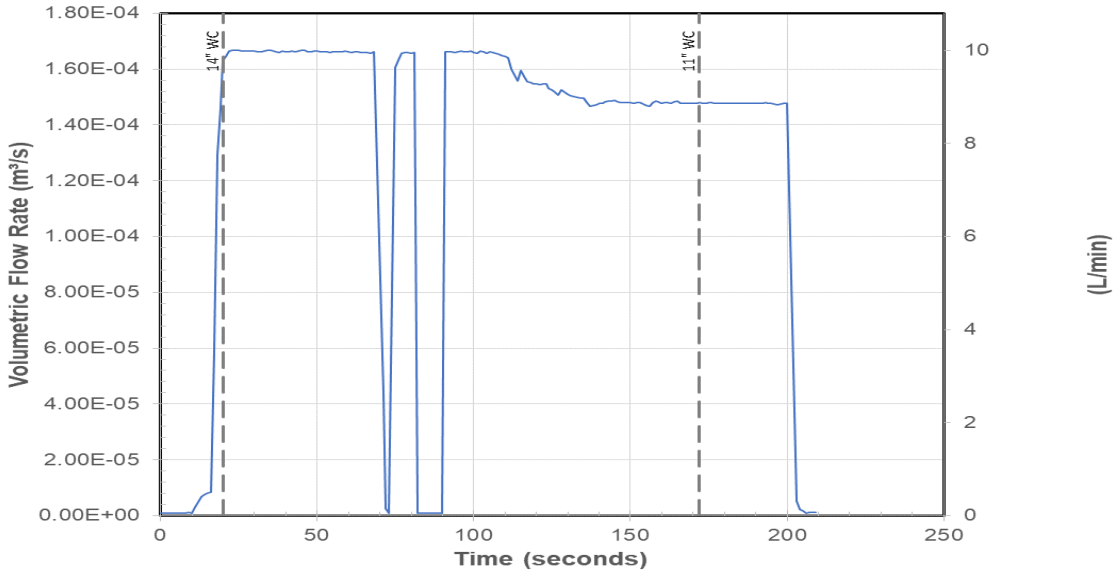

Figure 68. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 24. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	01:12:51	265	348047_20210622_131251_22A.mov
Close up	01:12:58	270	348047_20210622_131259_23A.mov
Overall	01:13:06	273	348047_20210622_131306_24A.mov
FLIR	01:13:21	276	348047_20210622_131321_6.mov
CLOSE UP	01:13:23	275	348047_20210622_131323_9.mov
OVERALL	01:13:24	274	348047_20210622_131324_10.mov
MASTER			348047_1246444.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

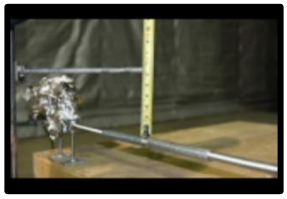

Figure 69. Pre test 36 seconds, 348047_1191944

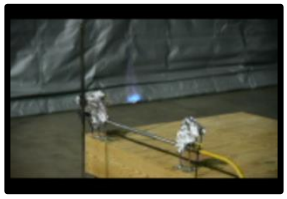

Figure 70. 28 seconds, 348047_1191945

Results for Test 10 (ID 348048)

The following table lists selected events that occurred during the experiment.

Table 25. Experiment Events

Description	Time (s)
11" WC	70

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

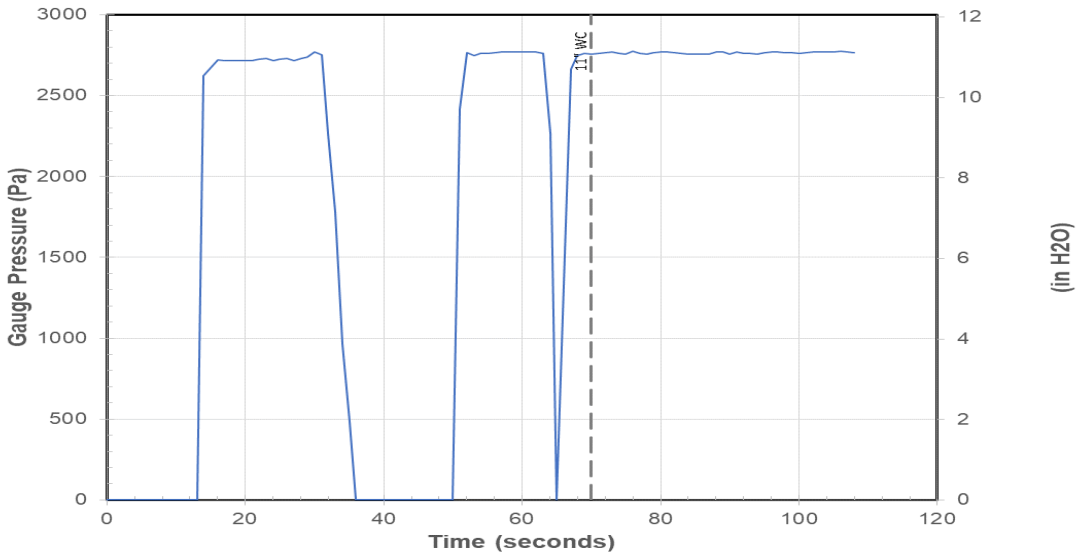

Figure 71. Gauge Pressure Data - Inlet

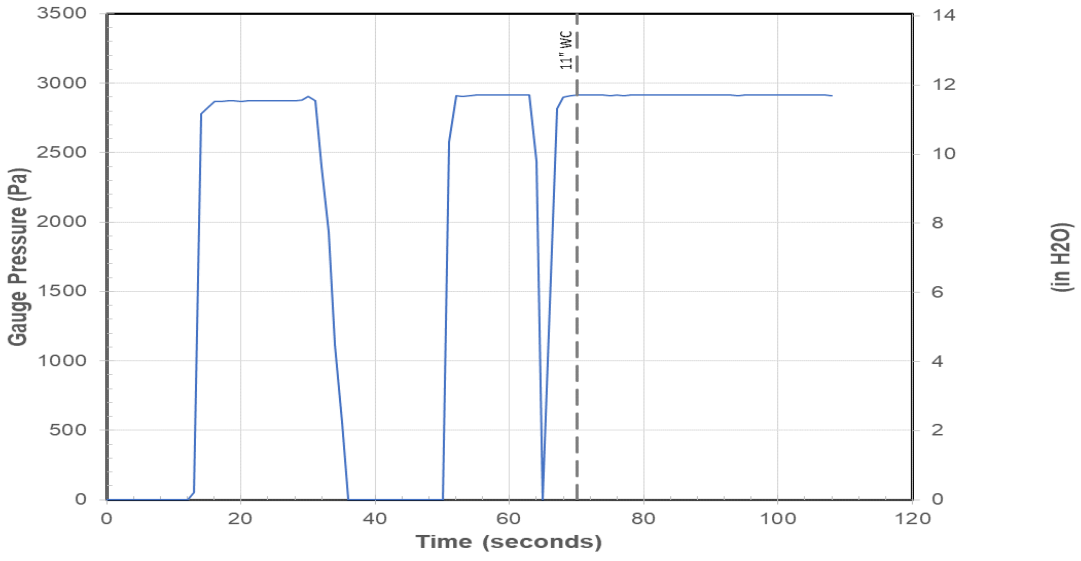

Figure 72. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

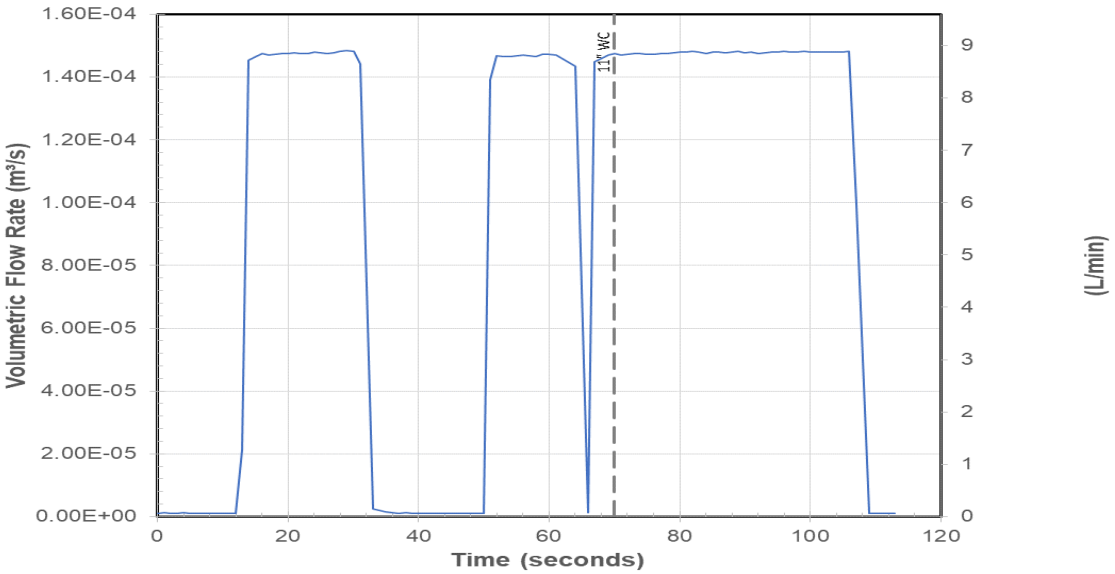

Figure 73. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 26. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	01:22:06	167	348048_20210622_132206_22A.mov
Close up	01:22:13	173	348048_20210622_132214_23A.mov
Overall	01:22:21	177	348048_20210622_132221_24A.mov
FLIR	01:22:39	175	348048_20210622_132239_6.mov
CLOSE UP	01:22:41	173	348048_20210622_132241_9.mov
OVERALL	01:22:42	178	348048_20210622_132242_10.mov
MASTER			348048_1246445.mov

Results for Test 11 (ID 348049)

The following table lists selected events that occurred during the experiment.

Table 27. Experiment Events

Description	Time (s)
11" WC	22
14" WC	144

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

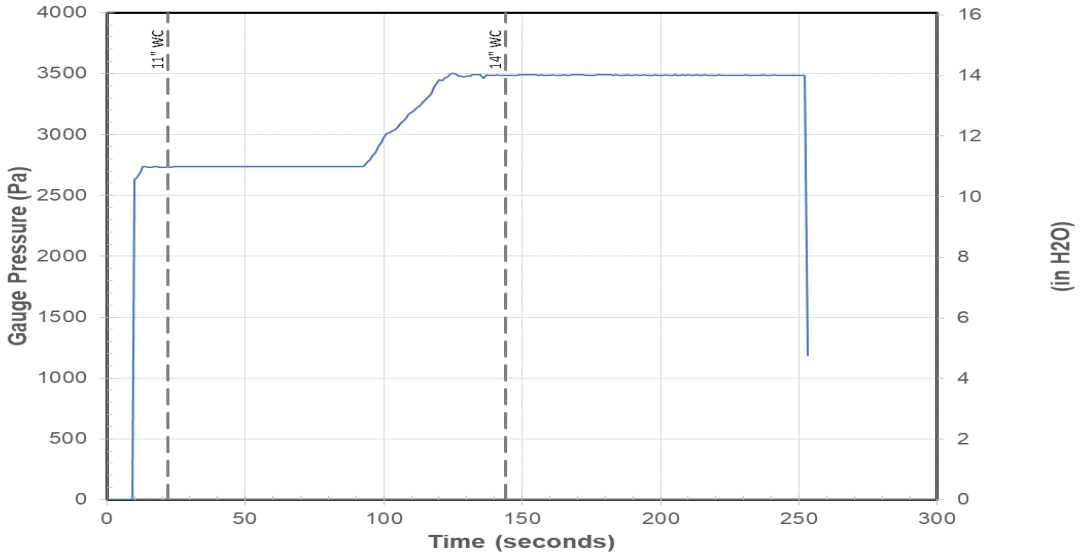

Figure 74. Gauge Pressure Data - Inlet

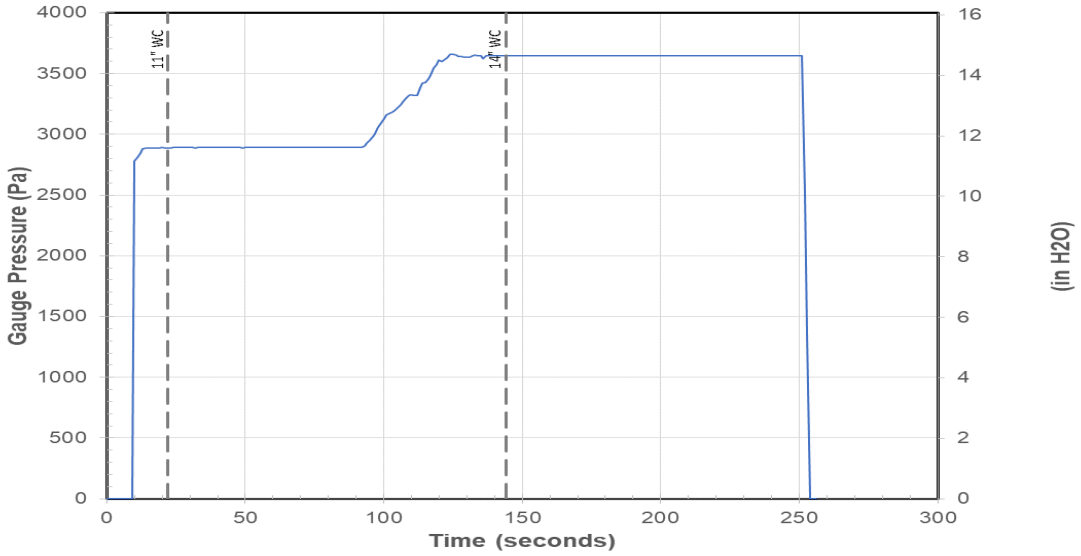

Figure 75. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

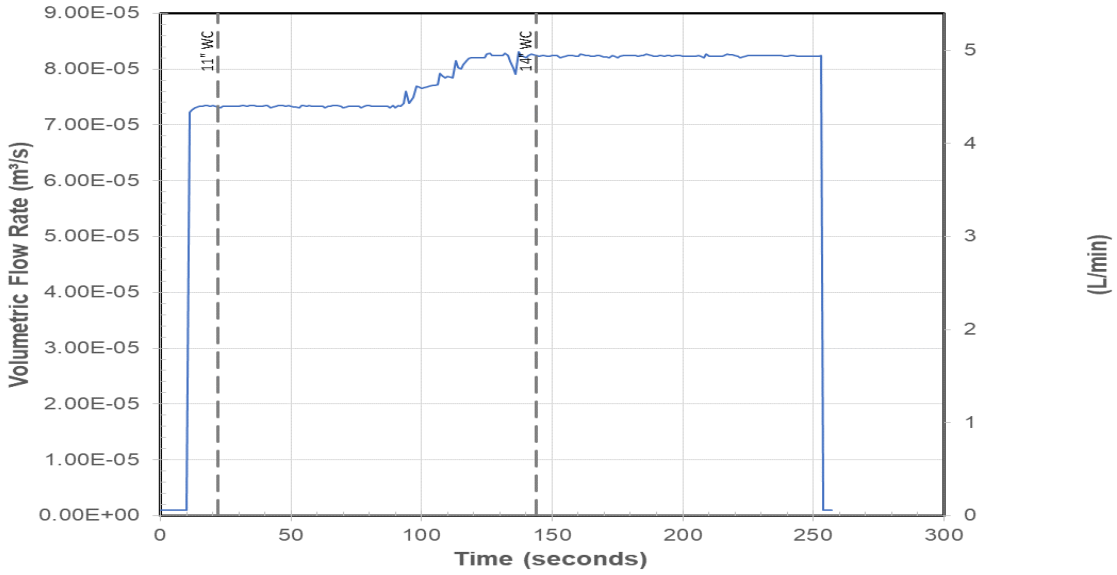

Figure 76. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 28. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	02:08:27	309	348049_20210622_140827_22A.mov
Close up	02:08:34	313	348049_20210622_140835_23A.mov
Overall	02:08:42	317	348049_20210622_140842_24A.mov
FLIR	02:09:00	314	348049_20210622_140900_6.mov
CLOSE UP	02:09:01	314	348049_20210622_140901_9.mov
OVERALL	02:09:02	319	348049_20210622_140902_10.mov
MASTER			348049_1246446.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

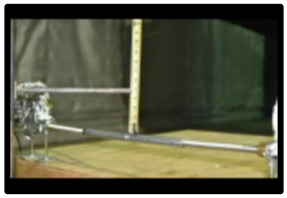

Figure 77. Pre test 6 minutes, 348049_1191992

Results for Test 12 (ID 348051)

The following table lists selected events that occurred during the experiment.

Table 29. Experiment Events

Description	Time (s)
14" WC	5
11" WC	127

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

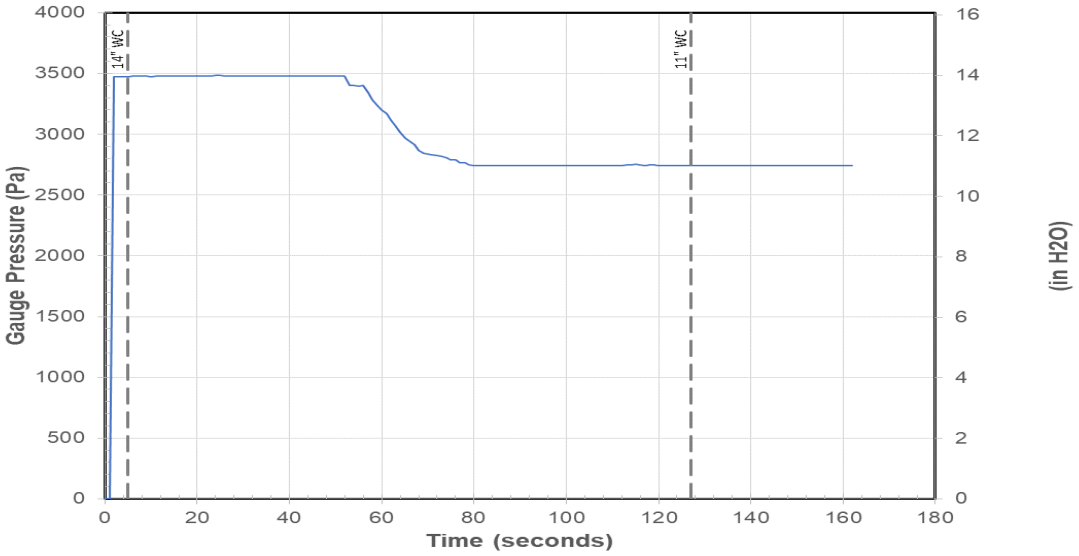

Figure 78. Gauge Pressure Data - Inlet

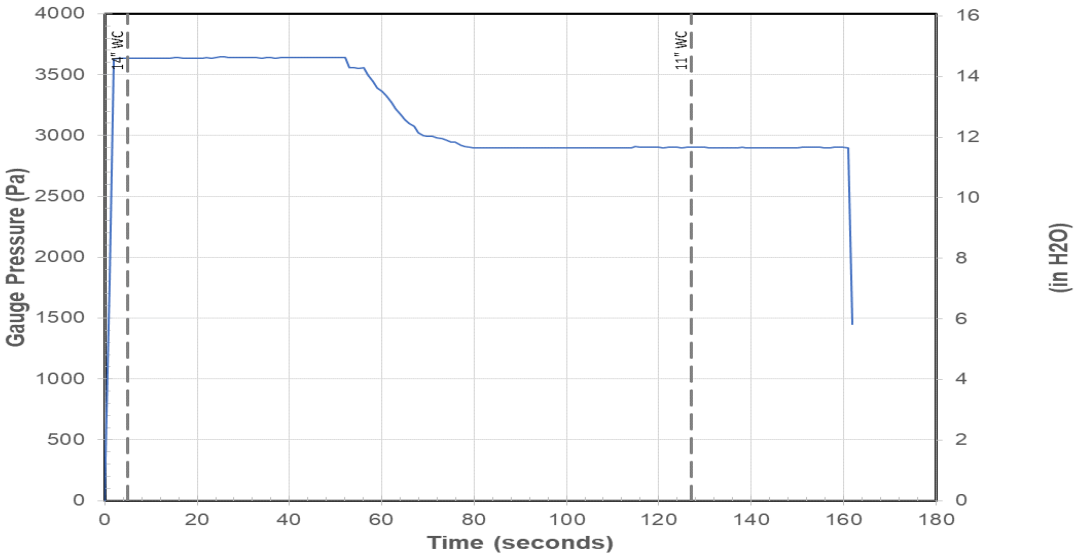

Figure 79. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

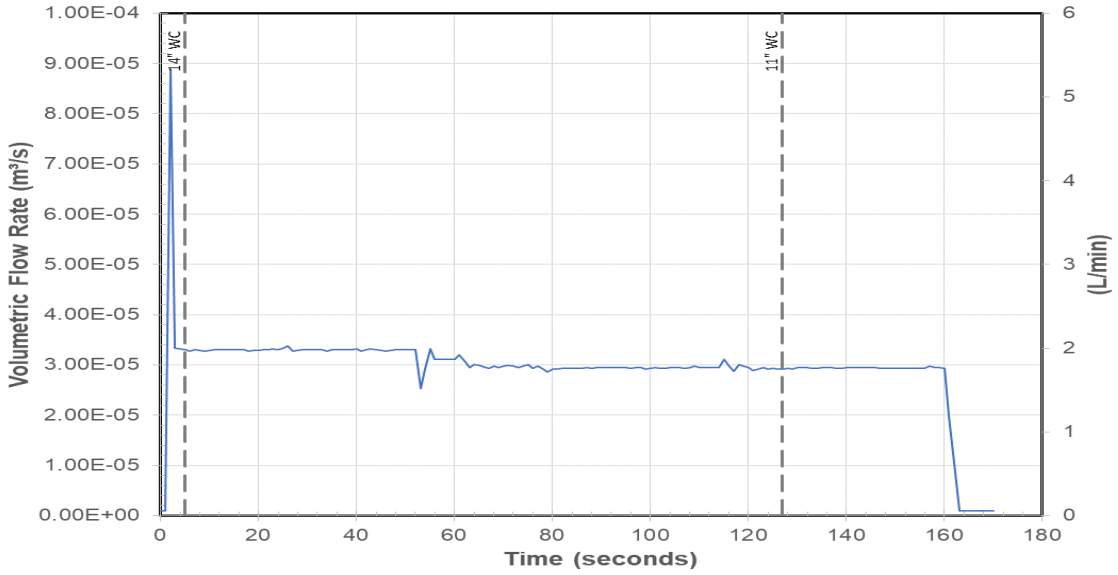

Figure 80. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 30. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	02:19:25	223	348051_20210622_141926_22A.mov
Close up	02:19:33	229	348051_20210622_141933_23A.mov
Overall	02:19:40	233	348051_20210622_141941_24A.mov
FLIR	02:19:56	235	348051_20210622_141956_6.mov
CLOSE UP	02:19:58	233	348051_20210622_141958_9.mov
OVERALL	02:19:58	234	348051_20210622_141958_10.mov
MASTER			348051_1246447.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 81. Pre test 102 seconds, 348051_1192002

Figure 82. Pre test 99 seconds, 348051_1192003

Results for Test 13 (ID 348052)

The following table lists selected events that occurred during the experiment.

Table 31. Experiment Events

Description	Time (s)
11" WC	22
14" WC	141

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

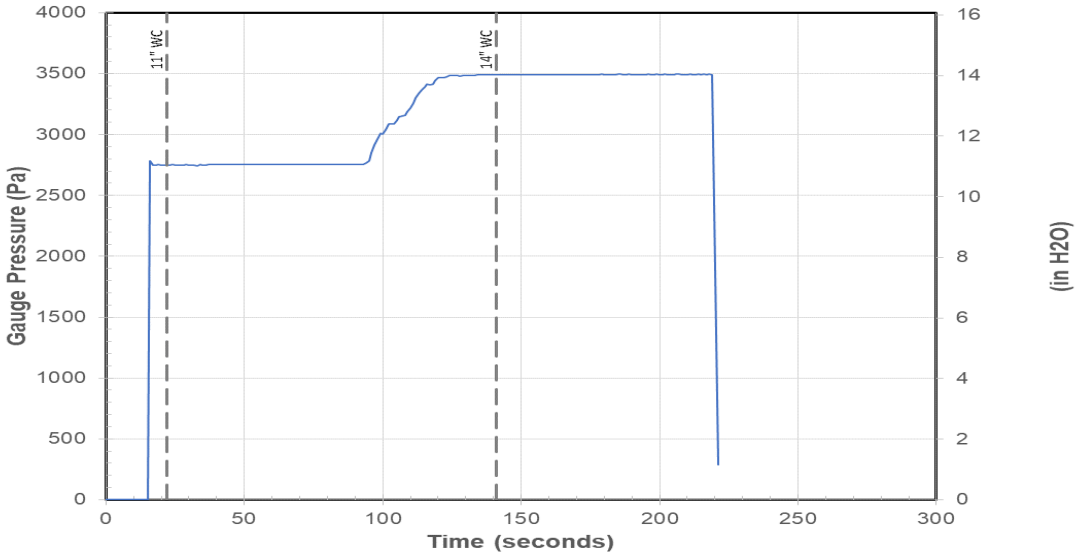

Figure 83. Gauge Pressure Data - Inlet

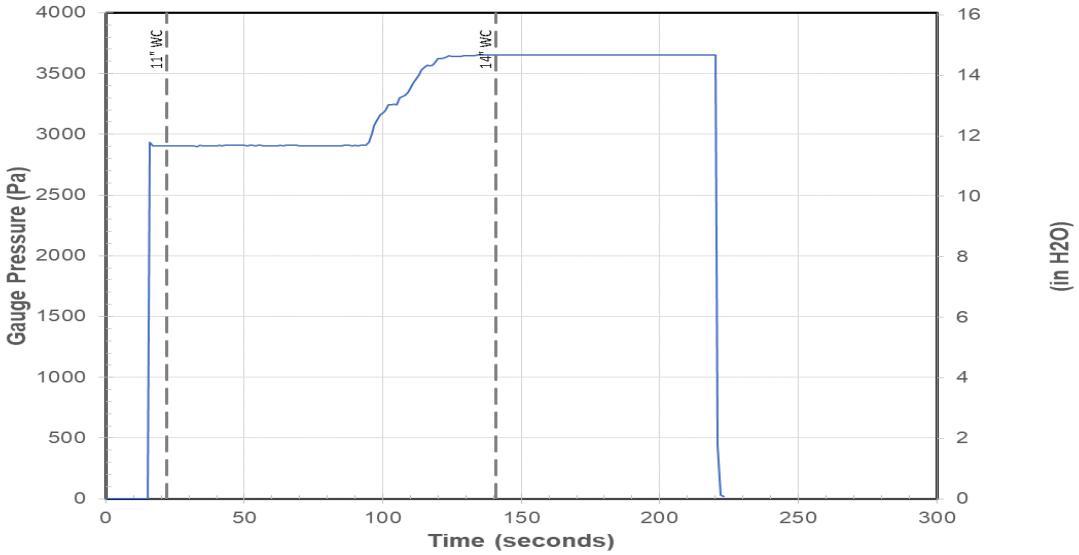

Figure 84. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

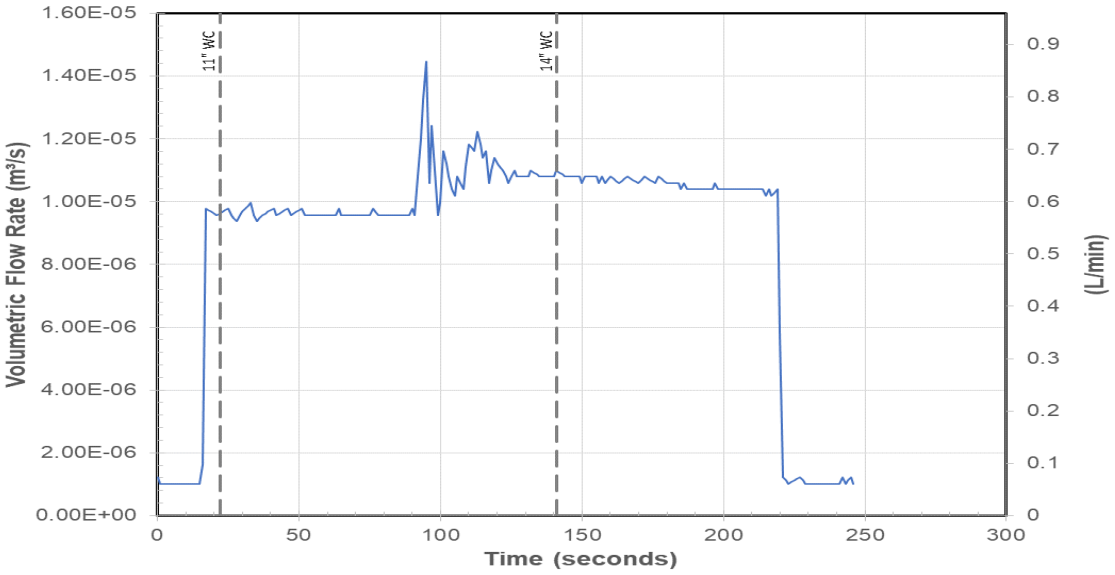

Figure 85. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 32. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	02:26:43	308	348052_20210622_142644_22A.mov
Close up	02:26:51	313	348052_20210622_142651_23A.mov
Overall	02:26:58	318	348052_20210622_142659_24A.mov
FLIR	02:27:12	320	348052_20210622_142712_6.mov
CLOSE UP	02:27:14	319	348052_20210622_142714_9.mov
OVERALL	02:27:15	318	348052_20210622_142715_10.mov
MASTER			348052_1246448.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 86. Pre test 22 seconds, 348052_1192015

Figure 87. Pre test 16 seconds, 348052_1192016

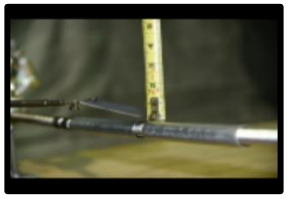

Figure 88. Pre test 14 seconds, 348052_1192017

Results for Test 14 (ID 348053)

The following table lists selected events that occurred during the experiment.

Table 33. Experiment Events

Description	Time (s)
7" WC	14
4" WC	157

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

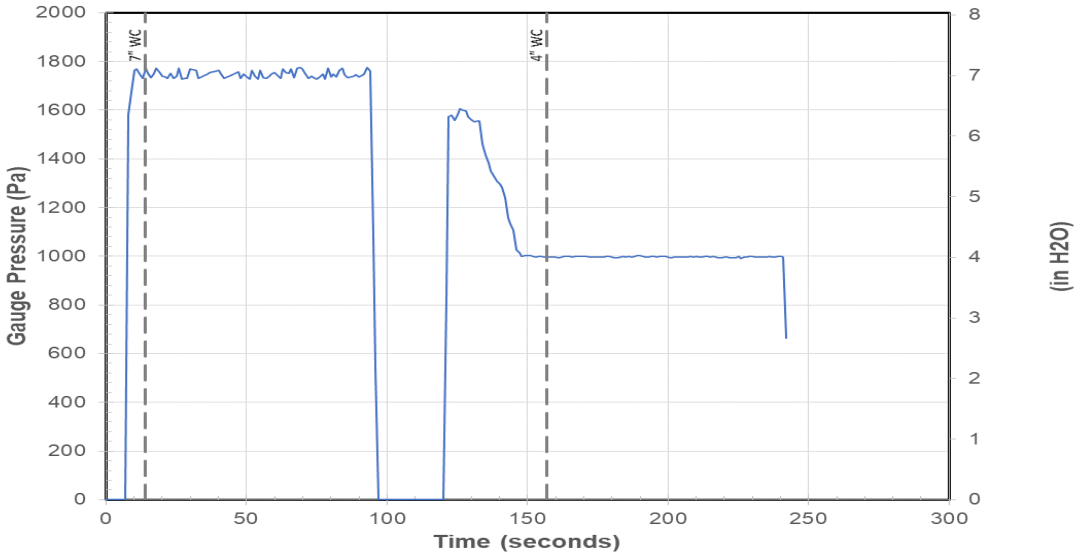

Figure 89. Gauge Pressure Data - Inlet

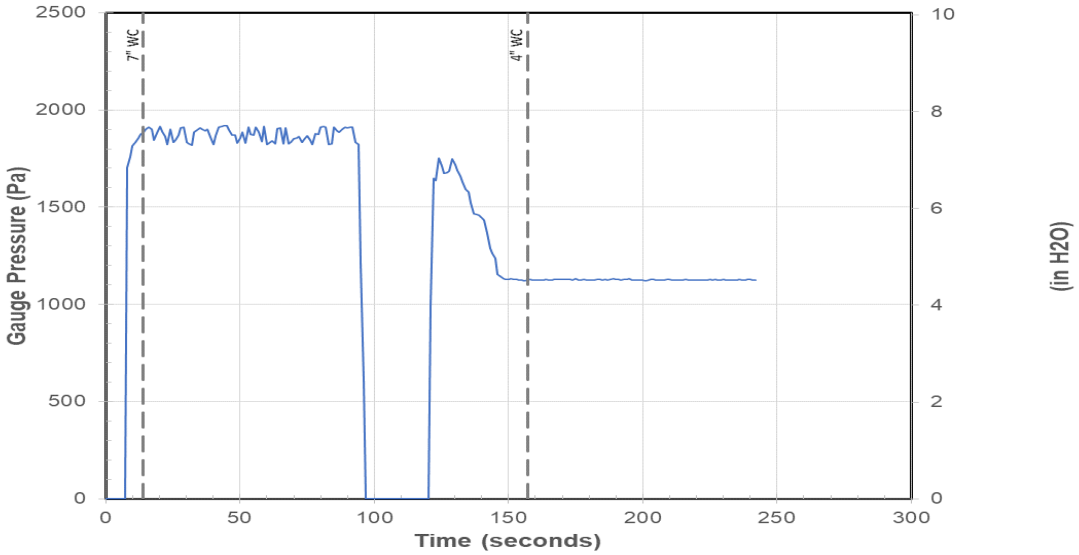

Figure 90. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

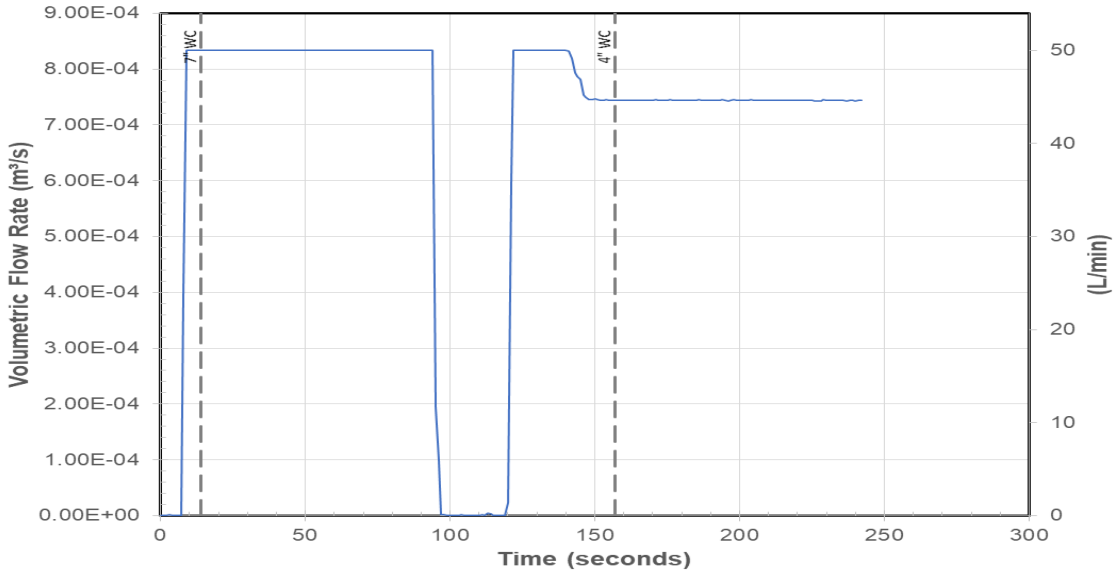

Figure 91. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 34. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	02:44:57	292	348053_20210622_144457_22A.mov
Close up	02:45:04	298	348053_20210622_144505_23A.mov
Overall	02:45:12	301	348053_20210622_144512_24A.mov
FLIR	02:45:29	300	348053_20210622_144529_6.mov
CLOSE UP	02:45:31	299	348053_20210622_144531_9.mov
OVERALL	02:45:32	298	348053_20210622_144532_10.mov
MASTER			348053_1246449.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 92. 37 seconds, 348053_1192029

Results for Test 15 (ID 348055)

The following table lists selected events that occurred during the experiment.

Table 35. Experiment Events

Description	Time (s)
4" WC	34
7" WC	172

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

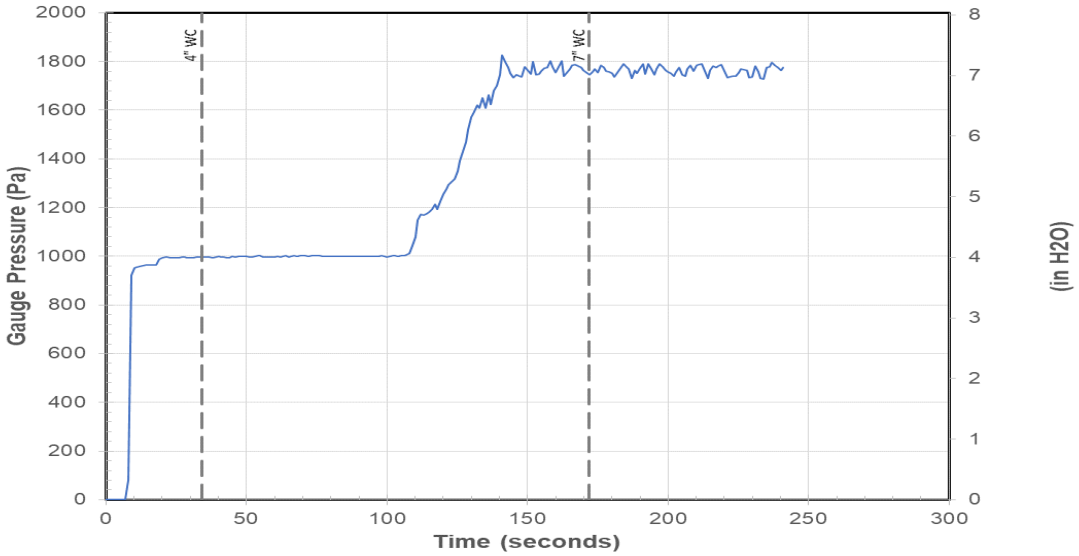

Figure 93. Gauge Pressure Data - Inlet

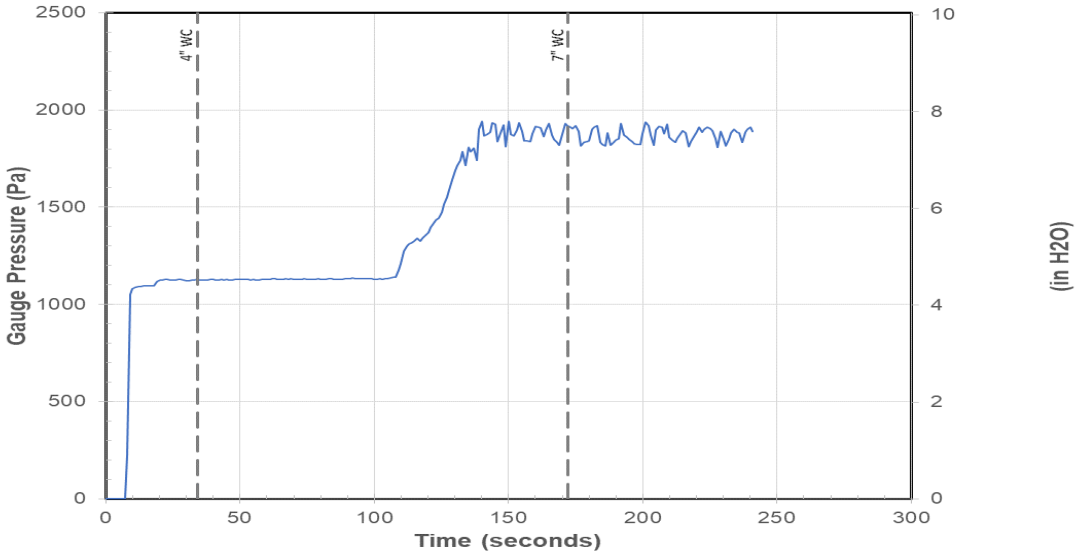

Figure 94. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

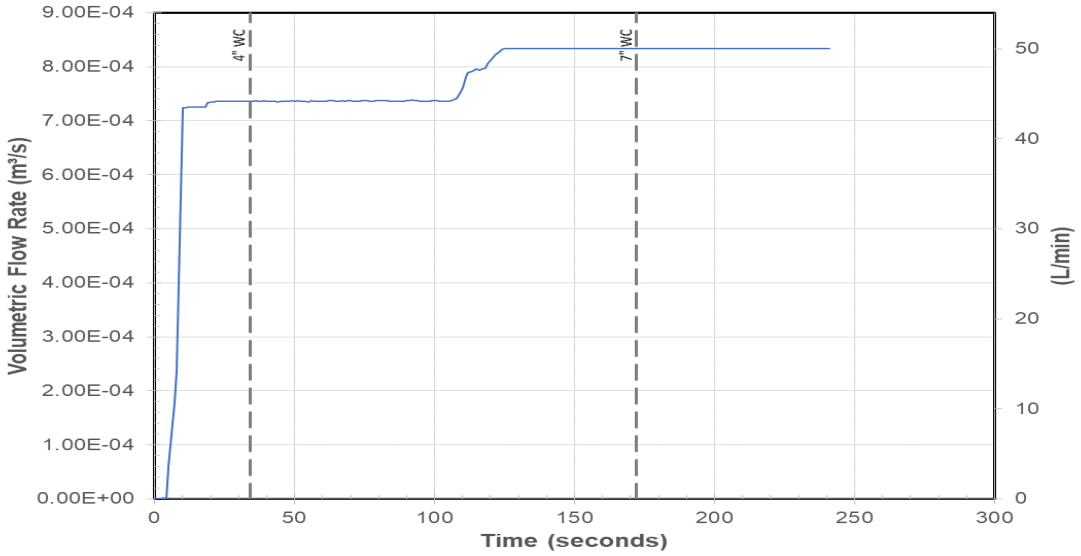

Figure 95. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 36. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	03:51:09	291	348055_20210622_155110_22A.mov
Close up	03:51:17	297	348055_20210622_155117_23A.mov
Overall	03:51:24	302	348055_20210622_155125_24A.mov
FLIR	03:51:40	299	348055_20210622_155140_6.mov
CLOSE UP	03:51:41	304	348055_20210622_155141_9.mov
OVERALL	03:51:42	304	348055_20210622_155142_10.mov
CUSTOM 6			348055_1211084.mov
CUSTOM 7			348055_1211085.mov
MASTER			348055_1246450.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 96. Pre test 27 seconds, 348055_1192139

Figure 97. 197 seconds, 348055_1192140

Results for Test 16 (ID 348056)

The following table lists selected events that occurred during the experiment.

Table 37. Experiment Events

Description	Time (s)
7" WC	88
4" WC	207

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

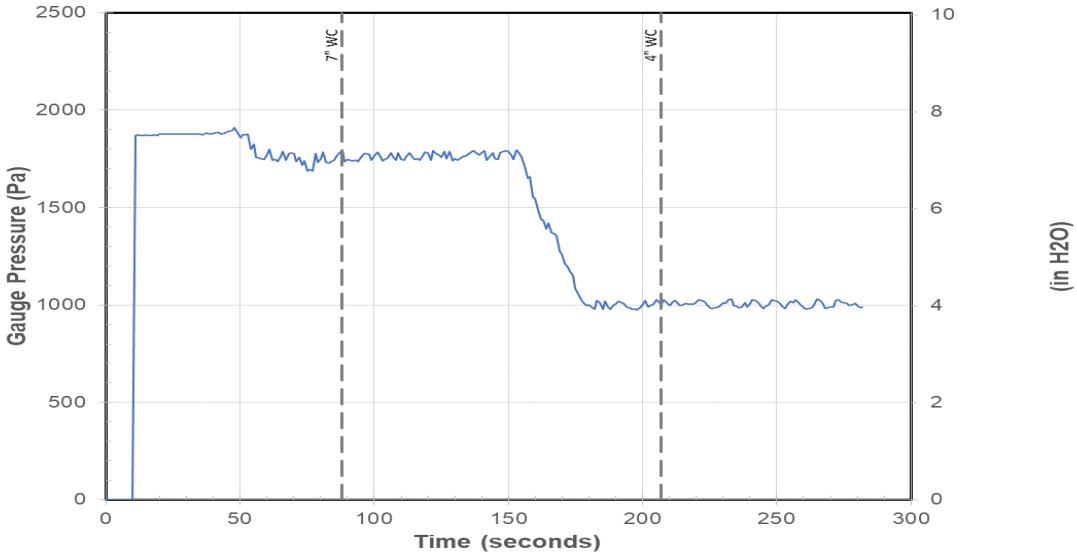

Figure 98. Gauge Pressure Data - Inlet

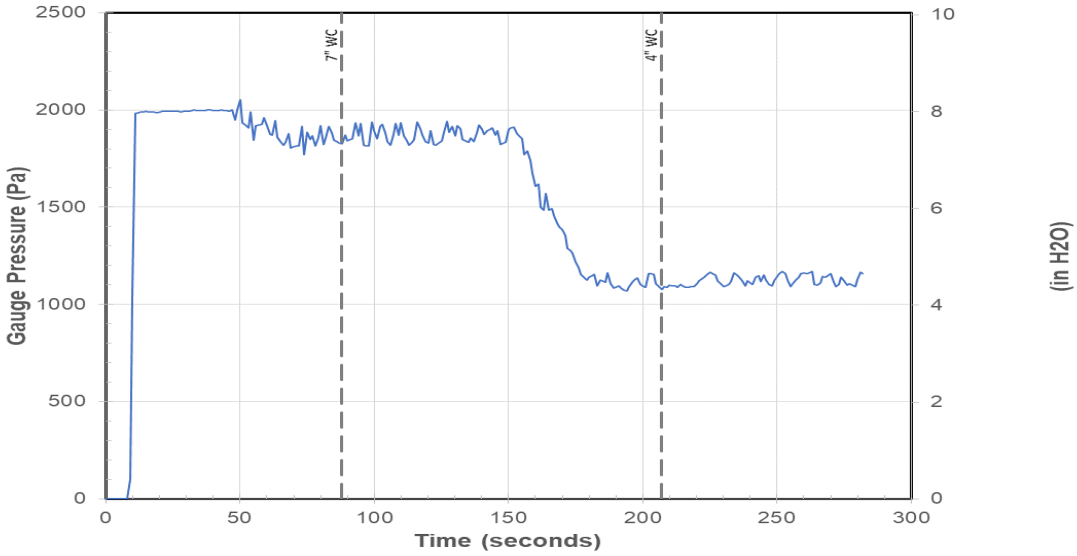

Figure 99. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

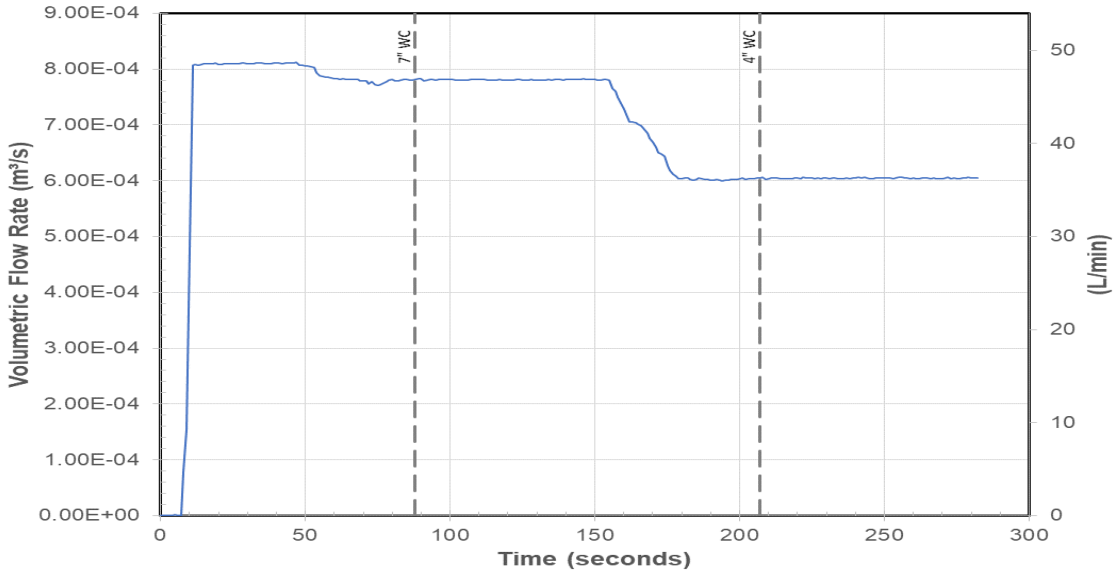

Figure 100. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 38. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	03:58:47	335	348056_20210622_155848_22A.mov
Close up	03:58:55	341	348056_20210622_155855_23A.mov
Overall	03:59:02	346	348056_20210622_155903_24A.mov
FLIR	03:59:16	345	348056_20210622_155916_6.mov
CLOSE UP	03:59:18	348	348056_20210622_155918_9.mov
OVERALL	03:59:18	349	348056_20210622_155918_10.mov
MASTER			348056_1246451.mov

Results for Test 17 (ID 348057)

The following table lists selected events that occurred during the experiment.

Table 39. Experiment Events

Description	Time (s)
4" WC	46
7" WC	161

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

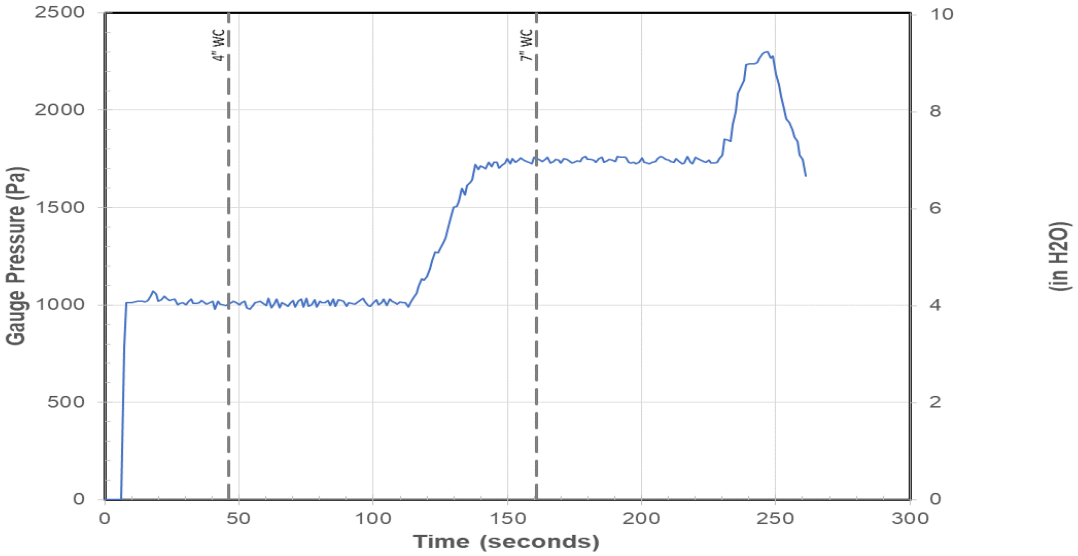

Figure 101. Gauge Pressure Data - Inlet

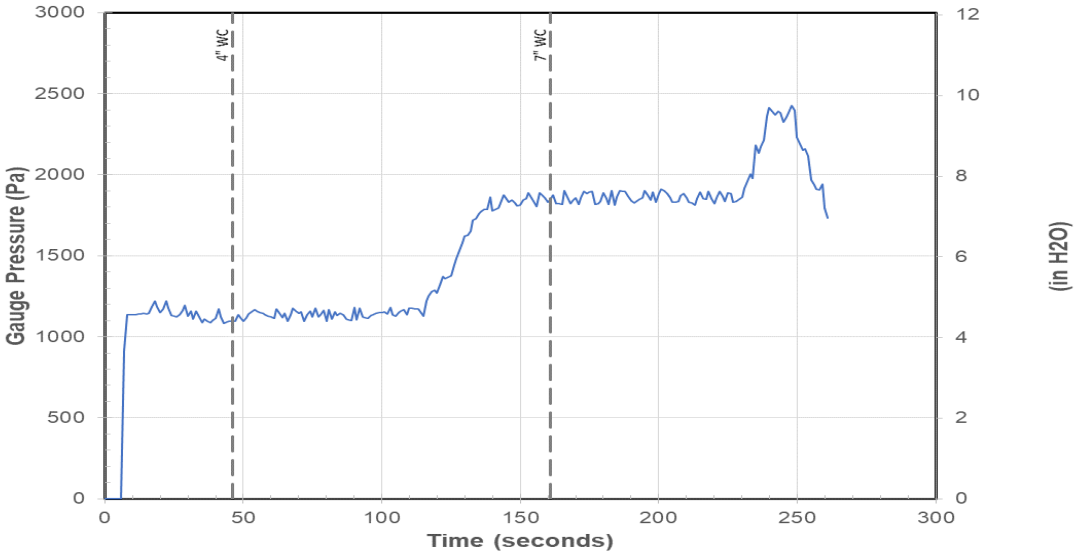

Figure 102. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

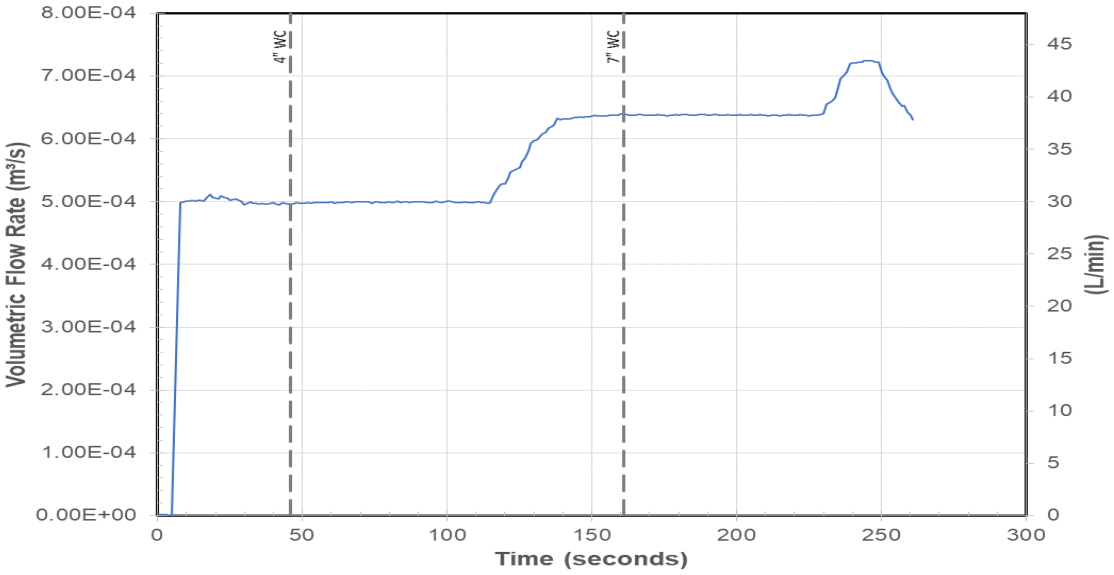

Figure 103. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 40. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	04:07:14	313	348057_20210622_160714_22A.mov
Close up	04:07:21	317	348057_20210622_160722_23A.mov
Overall	04:07:29	321	348057_20210622_160729_24A.mov
FLIR	04:07:47	320	348057_20210622_160747_6.mov
CLOSE UP	04:07:49	319	348057_20210622_160749_9.mov
OVERALL	04:07:50	319	348057_20210622_160750_10.mov
MASTER			348057_1246452.mov

Results for Test 18 (ID 348058)

The following table lists selected events that occurred during the experiment.

Table 41. Experiment Events

Description	Time (s)
7" WC	29
4" WC	132

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

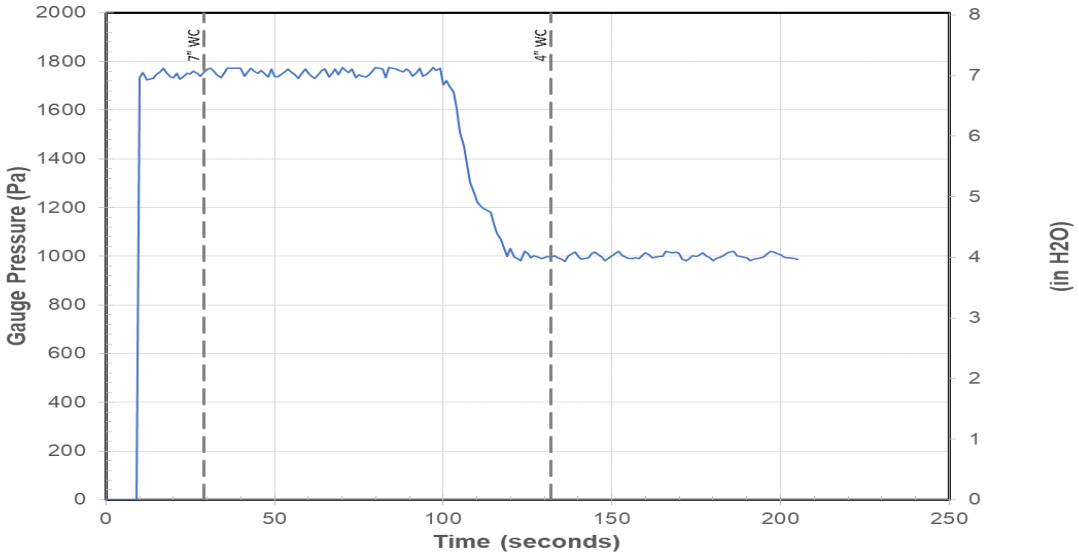

Figure 104. Gauge Pressure Data - Inlet

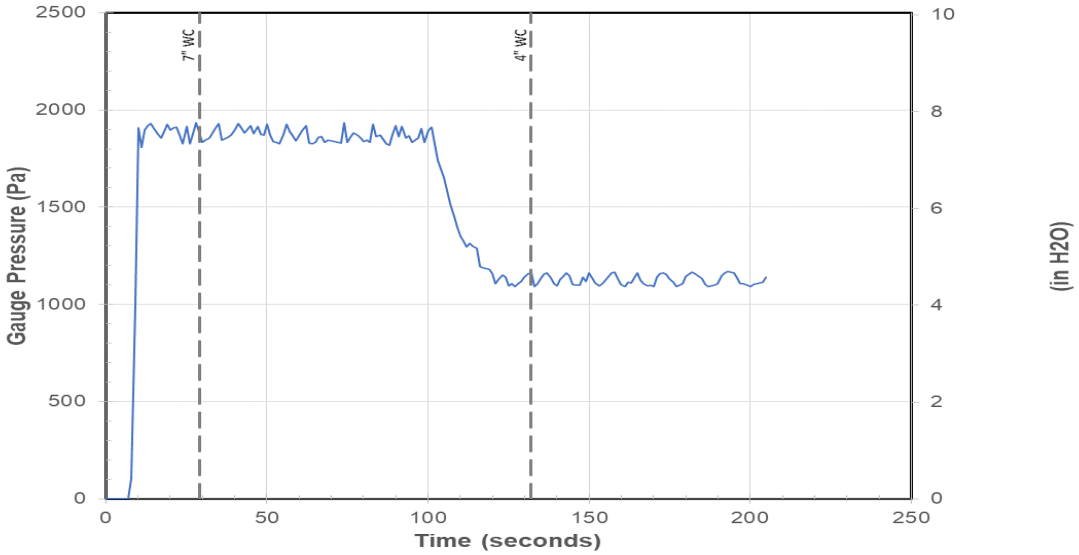

Figure 105. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

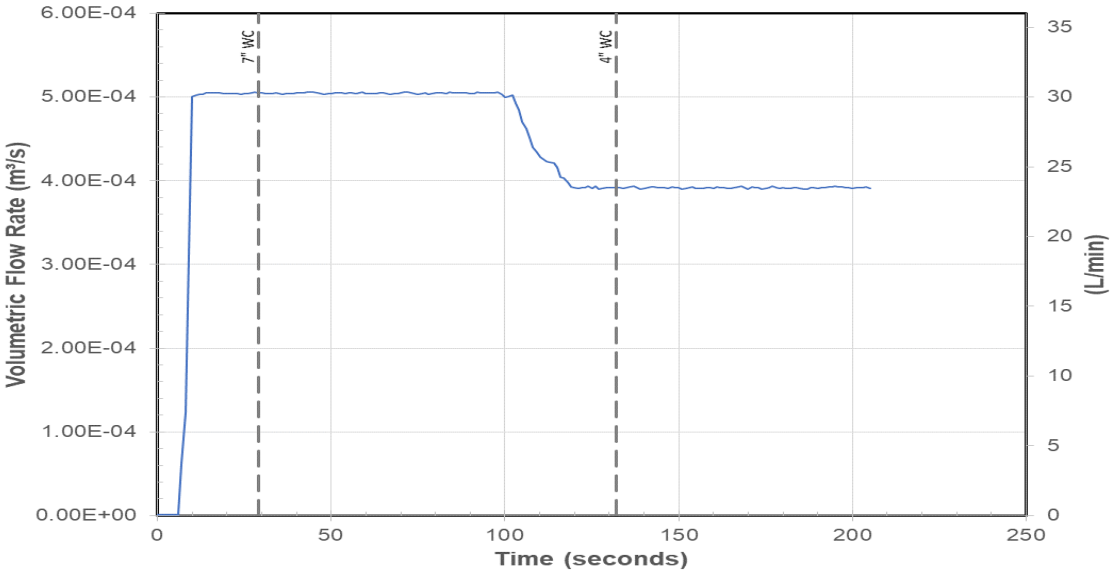

Figure 106. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 42. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	04:14:29	251	348058_20210622_161430_22A.mov
Close up	04:14:37	253	348058_20210622_161437_23A.mov
Overall	04:14:44	258	348058_20210622_161445_24A.mov
FLIR	04:14:59	259	348058_20210622_161459_6.mov
CLOSE UP	04:15:01	258	348058_20210622_161501_9.mov
OVERALL	04:15:01	259	348058_20210622_161501_10.mov
MASTER			348058_1246453.mov

Results for Test 19 (ID 348059)

The following table lists selected events that occurred during the experiment.

Table 43. Experiment Events

Description	Time (s)
4" WC	83

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

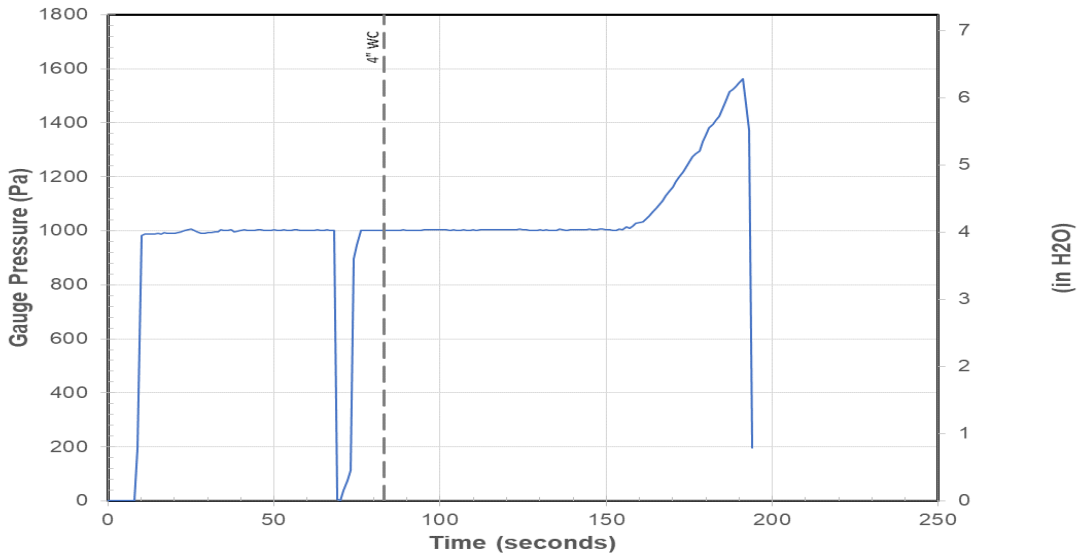

Figure 107. Gauge Pressure Data - Inlet

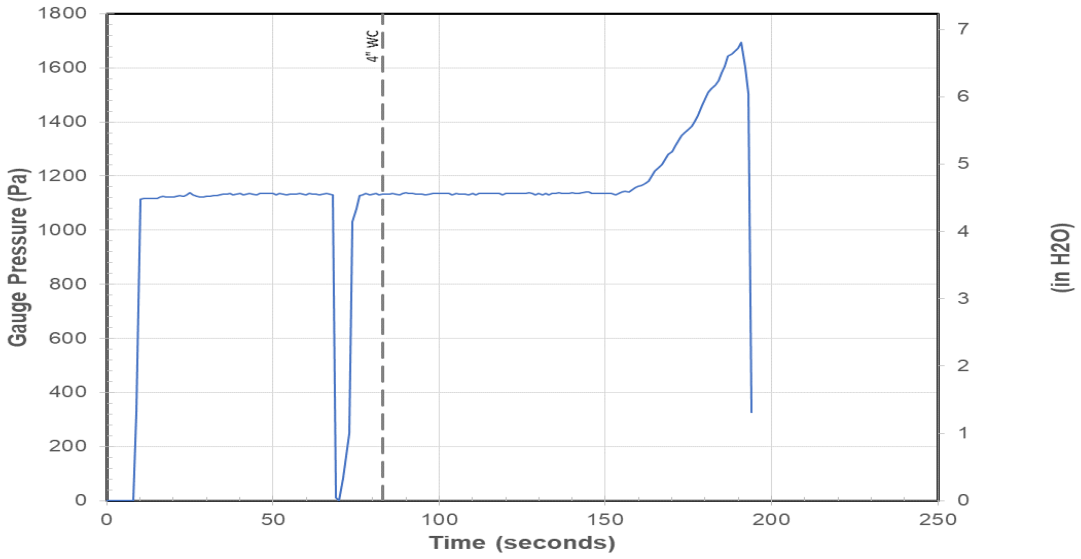

Figure 108. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

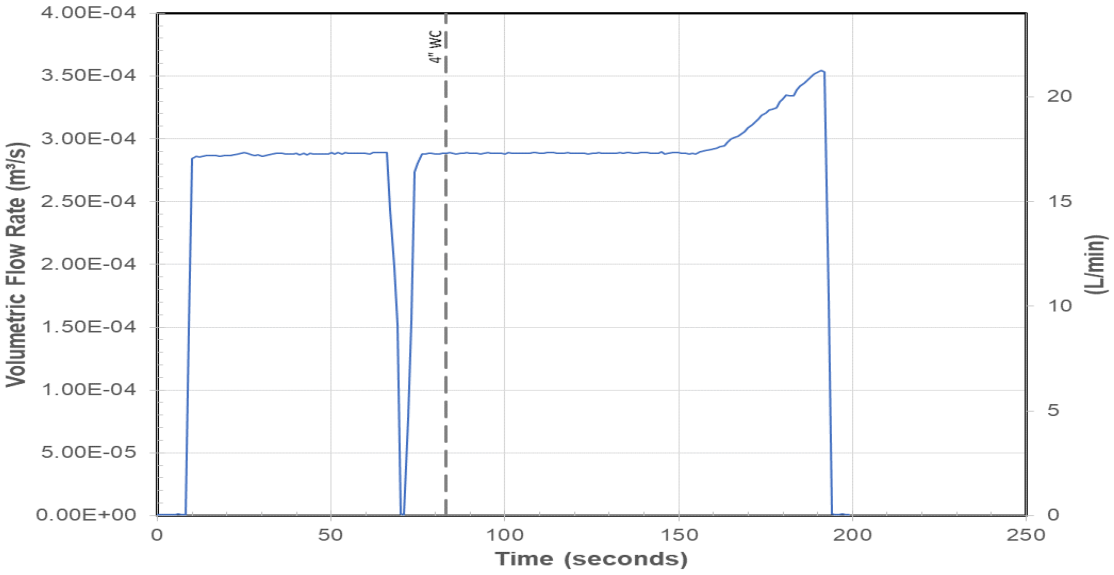

Figure 109. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 44. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	04:20:48	250	348059_20210622_162048_22A.mov
Close up	04:20:55	257	348059_20210622_162056_23A.mov
Overall	04:21:03	261	348059_20210622_162103_24A.mov
FLIR	04:21:20	260	348059_20210622_162120_6.mov
CLOSE UP	04:21:22	259	348059_20210622_162122_9.mov
OVERALL	04:21:23	258	348059_20210622_162123_10.mov
MASTER			348059_1253058.mov

Results for Test 20 (ID 348061)

The following table lists selected events that occurred during the experiment.

Table 45. Experiment Events

Description	Time (s)
7" WC	84
4" WC	255

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

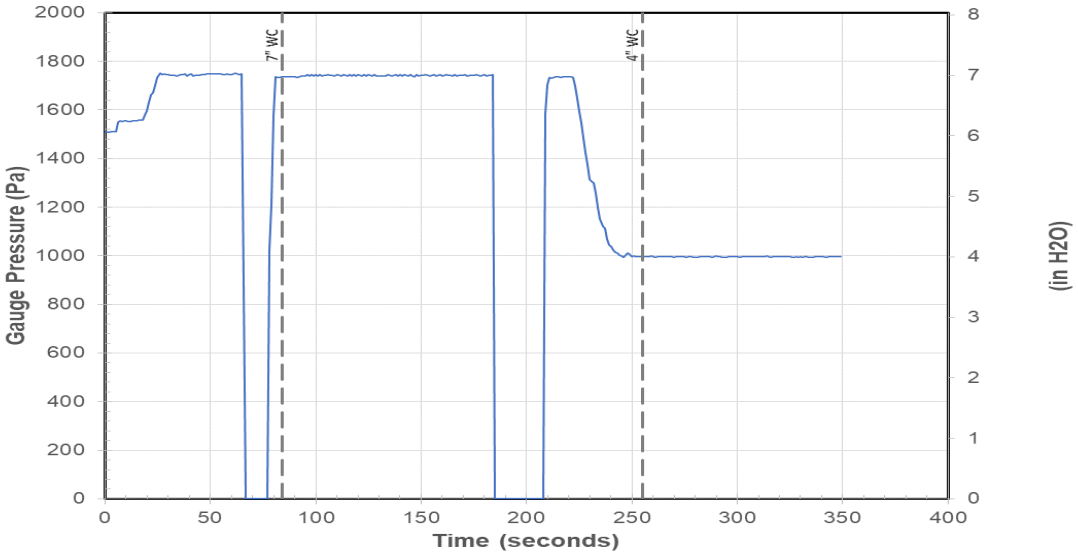

Figure 110. Gauge Pressure Data - Inlet

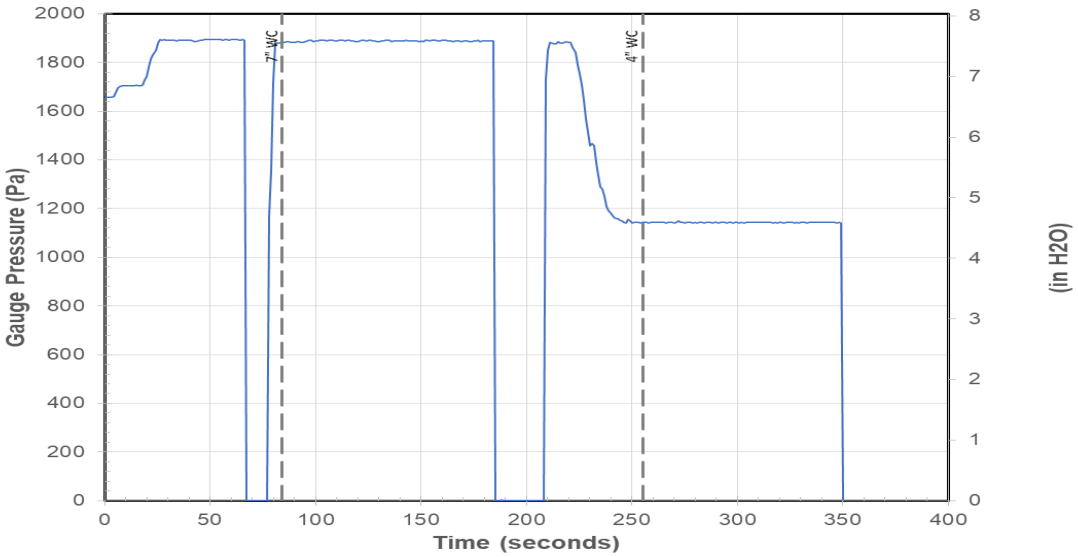

Figure 111. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

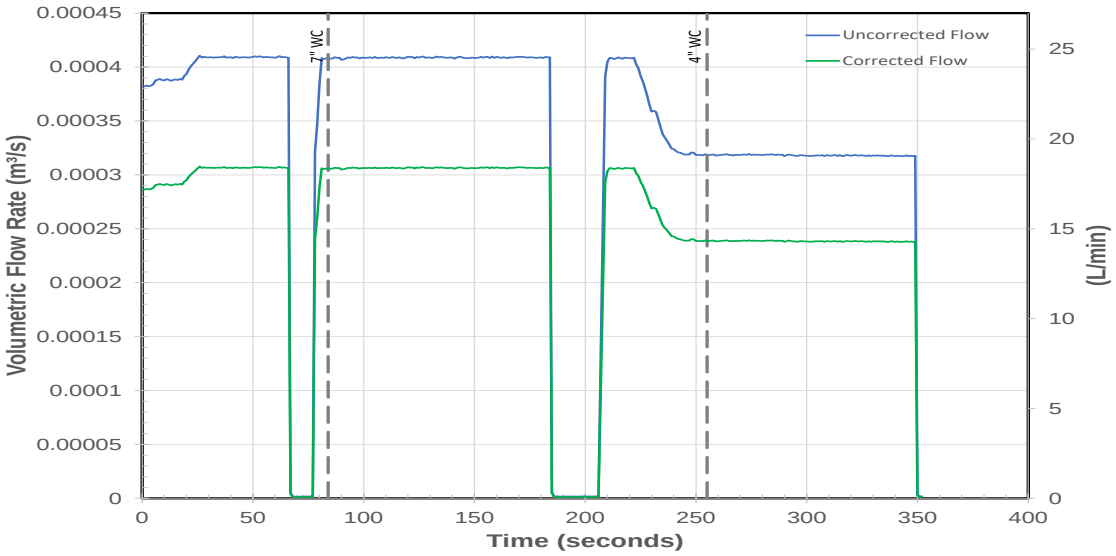

Figure 112. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 46. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	08:24:55	411	348061_20210623_082456_22A.mov
Close up	08:25:03	437	348061_20210623_082503_23A.mov
Overall	08:25:10	441	348061_20210623_082511_24A.mov
FLIR	08:25:26	440	348061_20210623_082526_6.mov
CLOSE UP	08:25:28	444	348061_20210623_082528_9.mov
OVERALL	08:25:29	444	348061_20210623_082529_10.mov
MASTER			348061_1246454.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 113. 174 seconds, 348061_1192297

Figure 114. 178 seconds, 348061_1192298

Figure 115. 196 seconds, 348061_1192299

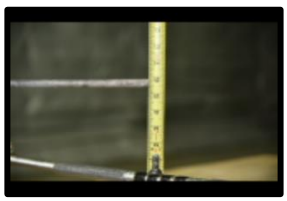

Figure 116. 199 seconds, 348061_1192300

Results for Test 21 (ID 348063)

The following table lists selected events that occurred during the experiment.

Table 47. Experiment Events

Description	Time (s)
4" WC	20
7" WC	137
10" WC	263

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

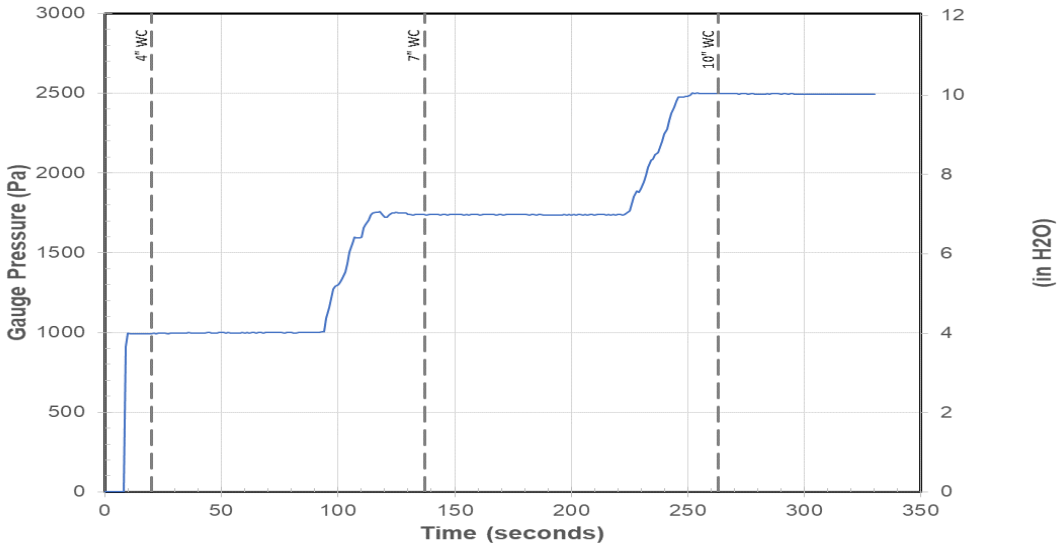

Figure 117. Gauge Pressure Data - Inlet

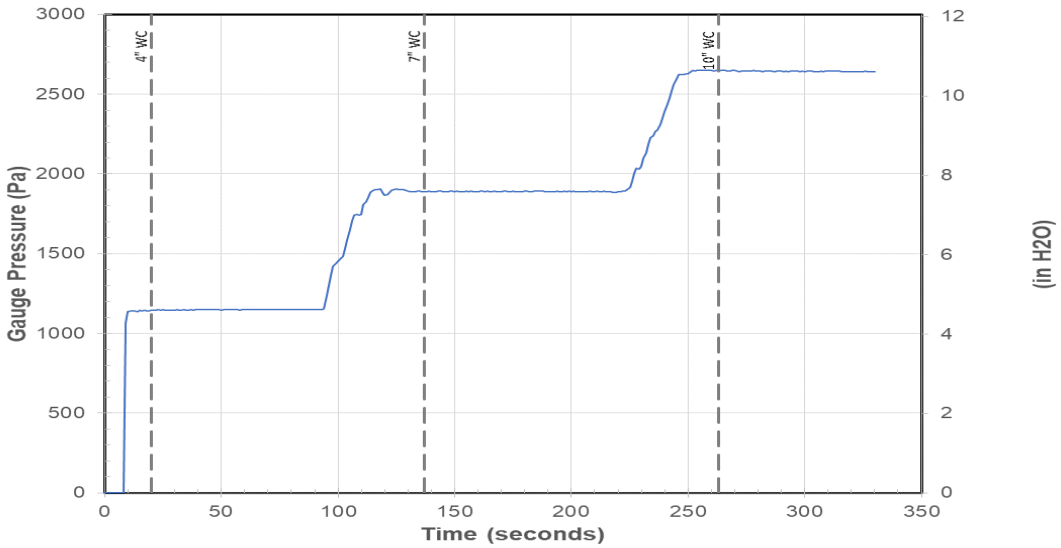

Figure 118. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

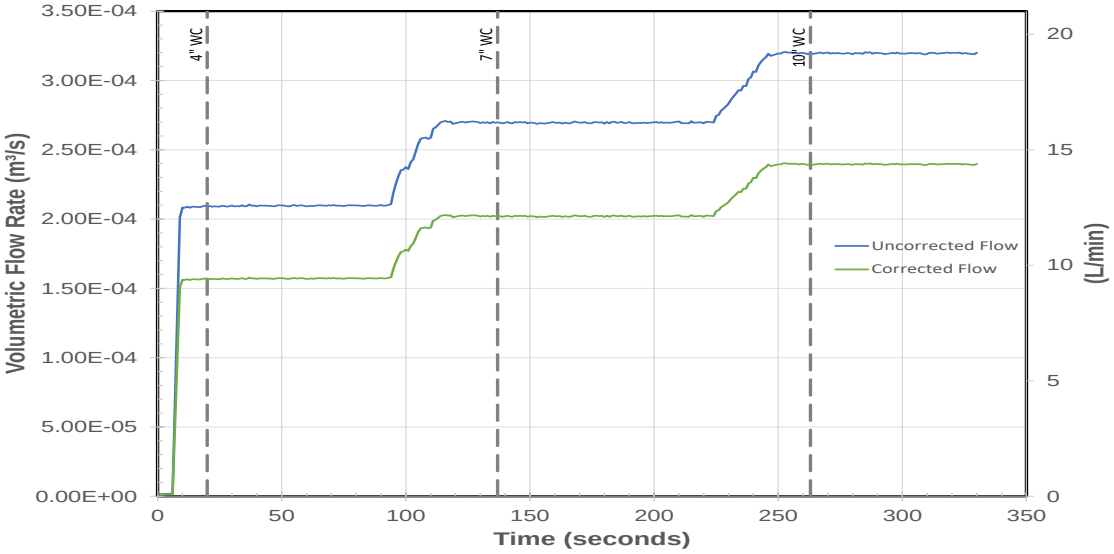

Figure 119. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 48. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	08:37:27	386	348063_20210623_083727_22A.mov
Close up	08:37:37	401	348063_20210623_083738_23A.mov
Overall	08:37:45	405	348063_20210623_083745_24A.mov
FLIR	08:38:03	404	348063_20210623_083803_6.mov
CLOSE UP	08:38:04	404	348063_20210623_083804_9.mov
OVERALL	08:38:05	404	348063_20210623_083805_10.mov
MASTER			348063_1246455.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 120. Pre test 74 seconds, 348063_1192312

Figure 121. Pre test 70 seconds, 348063_1192313

Results for Test 22 (ID 348064)

The following table lists selected events that occurred during the experiment.

Table 49. Experiment Events

Description	Time (s)
10" WC	45
7" WC	167
4" WC	281

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

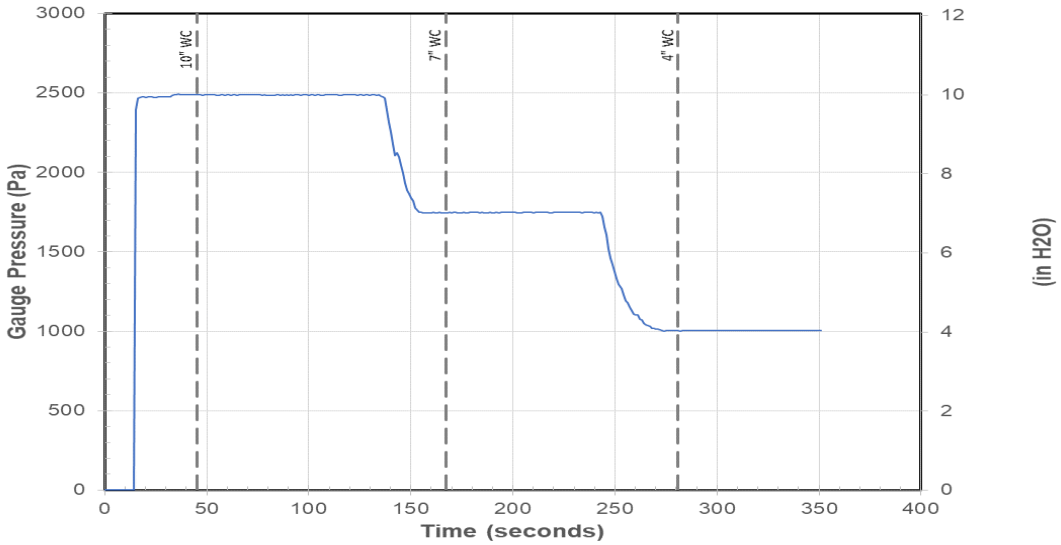

Figure 122. Gauge Pressure Data - Inlet

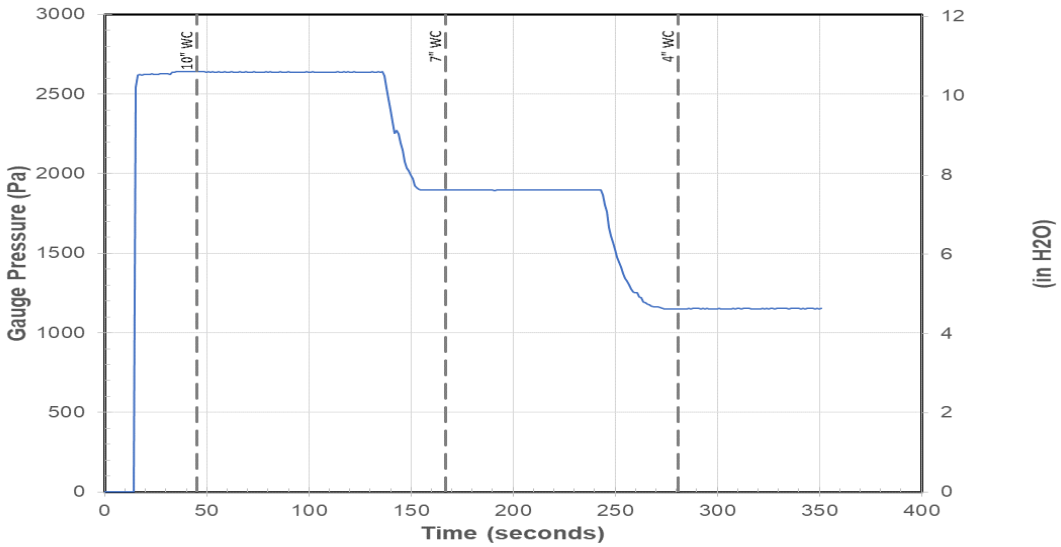

Figure 123. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

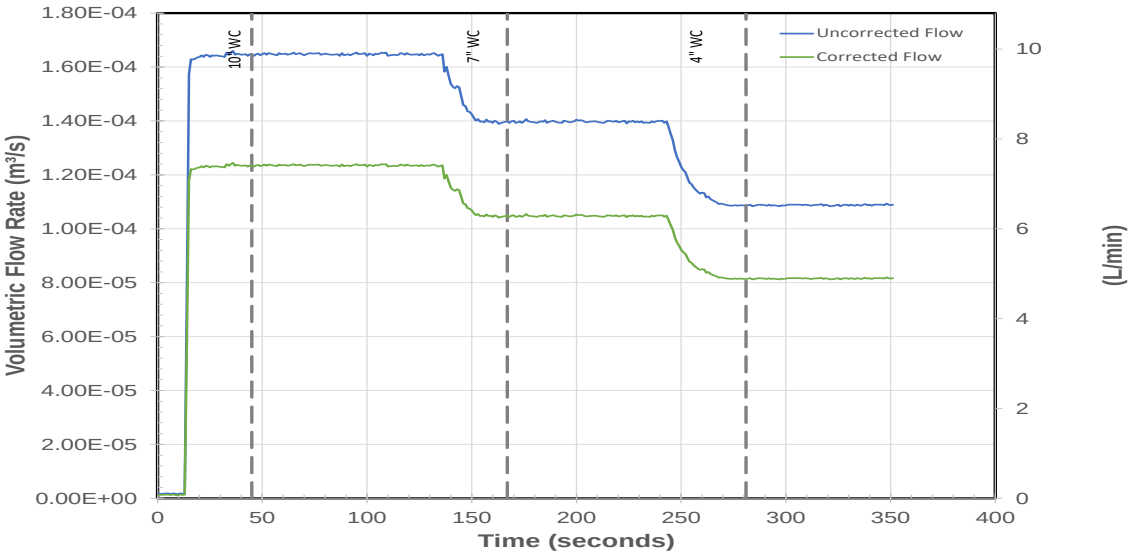

Figure 124. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 50. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	08:50:00	453	348063_20210623_083727_22A.mov
FLIR	08:58:59	399	348064_20210623_085859_22A.mov
Close up	08:59:06	418	348064_20210623_085907_23A.mov
Overall	08:59:14	421	348064_20210623_085914_24A.mov
FLIR	08:59:30	419	348064_20210623_085930_6.mov
CLOSE UP	08:59:31	424	348064_20210623_085931_9.mov
OVERALL	08:59:32	424	348064_20210623_085932_10.mov
MASTER			348064_1246456.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

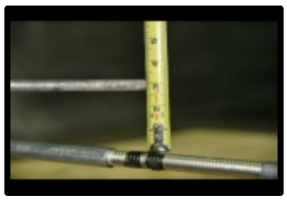

Figure 125. Pre test 10 minutes, 348064_1192327

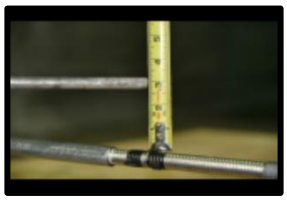

Figure 126. Pre test 10 minutes, 348064_1192328

Results for Test 23 (ID 348066)

The following table lists selected events that occurred during the experiment.

Table 51. Experiment Events

Description	Time (s)
4" WC	18
7" WC	159
10" WC	274

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

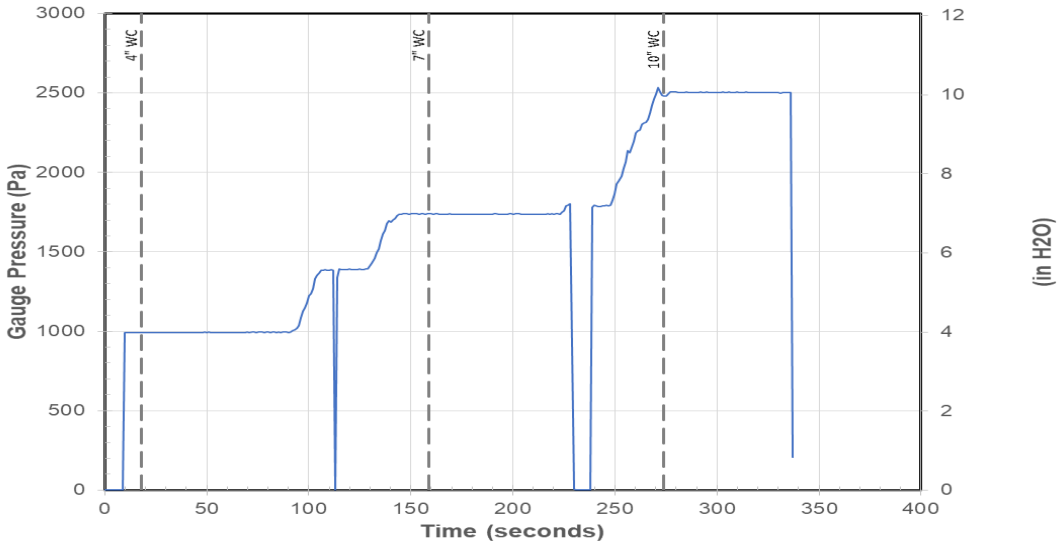

Figure 127. Gauge Pressure Data - Inlet

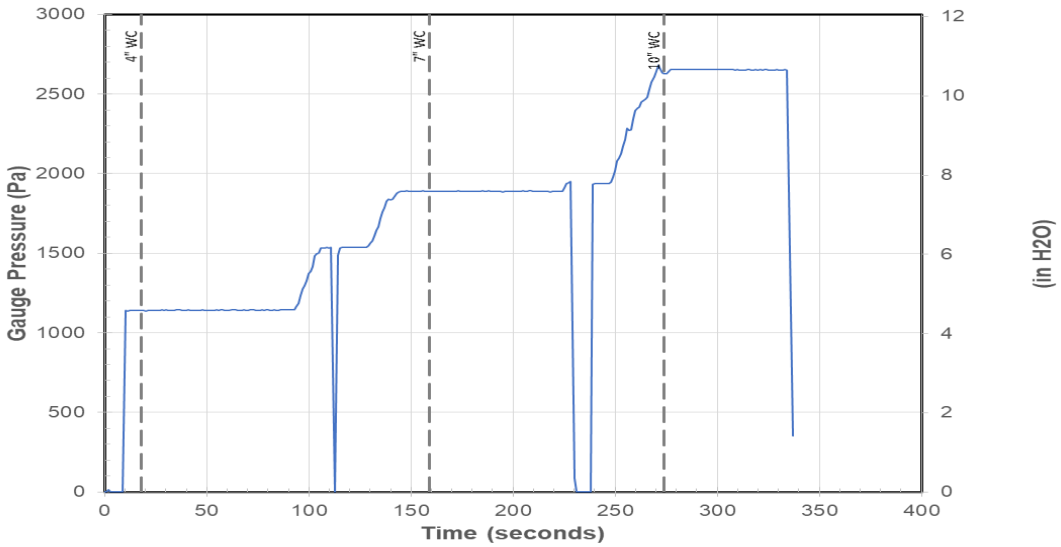

Figure 128. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

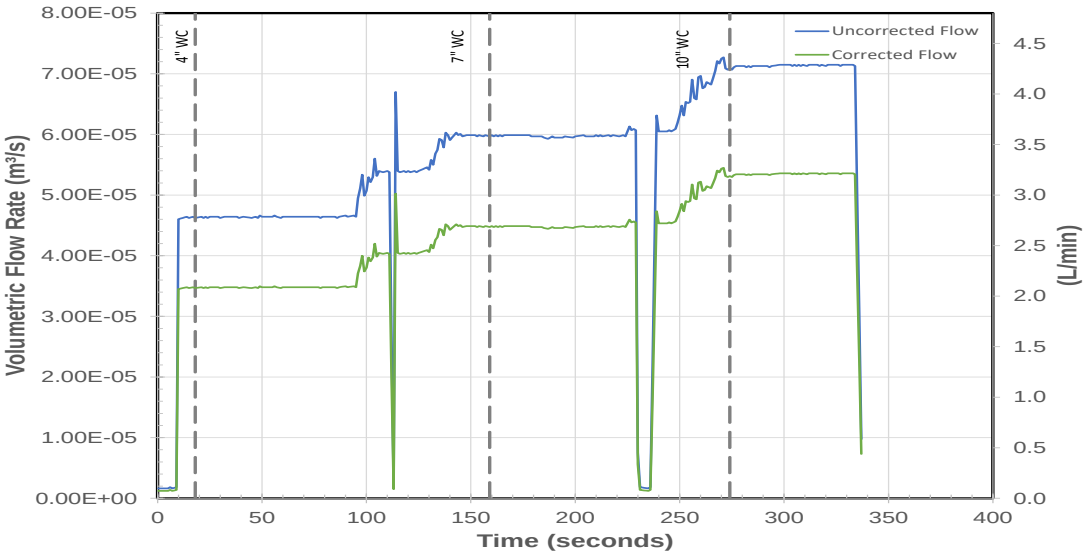

Figure 129. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 52. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	09:09:26	415	348066_20210623_090927_22A.mov
Close up	09:09:34	417	348066_20210623_090935_23A.mov
Overall	09:09:42	422	348066_20210623_090943_24A.mov
FLIR	09:09:57	420	348066_20210623_090957_6.mov
CLOSE UP	09:09:58	425	348066_20210623_090958_9.mov
OVERALL	09:09:59	425	348066_20210623_090959_10.mov
MASTER			348066_1246457.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 130. Pre test 78 seconds, 348066_1192346

Figure 131. Pre test 76 seconds, 348066_1192347

Figure 132. Post test 0 minutes, 348066_1192348

Figure 133. Post test 0 minutes, 348066_1192349

Results for Test 24 (ID 348068)

The following table lists selected events that occurred during the experiment.

Table 53. Experiment Events

Description	Time (s)
10" WC	13
7" WC	170
4" WC	314

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

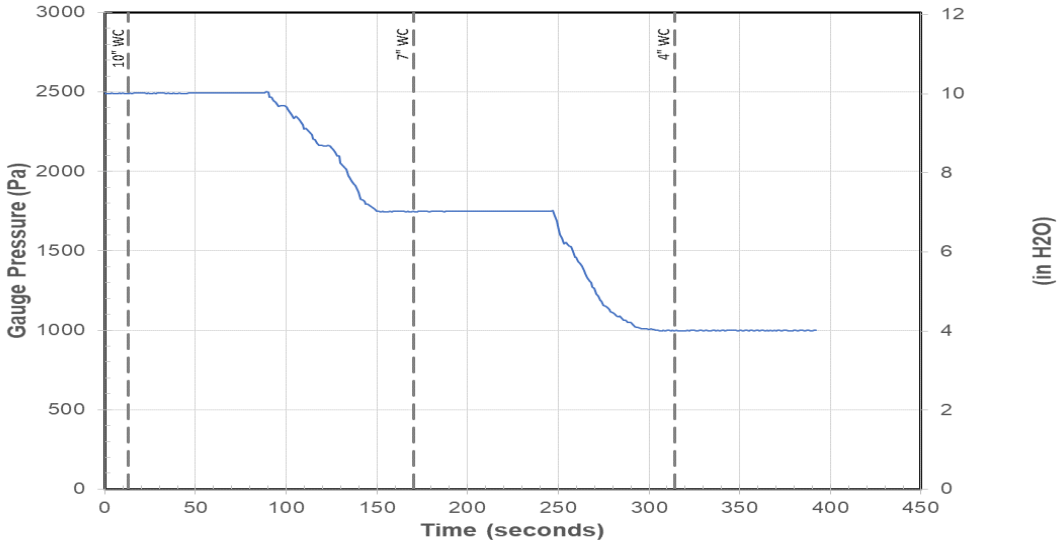

Figure 134. Gauge Pressure Data - Inlet

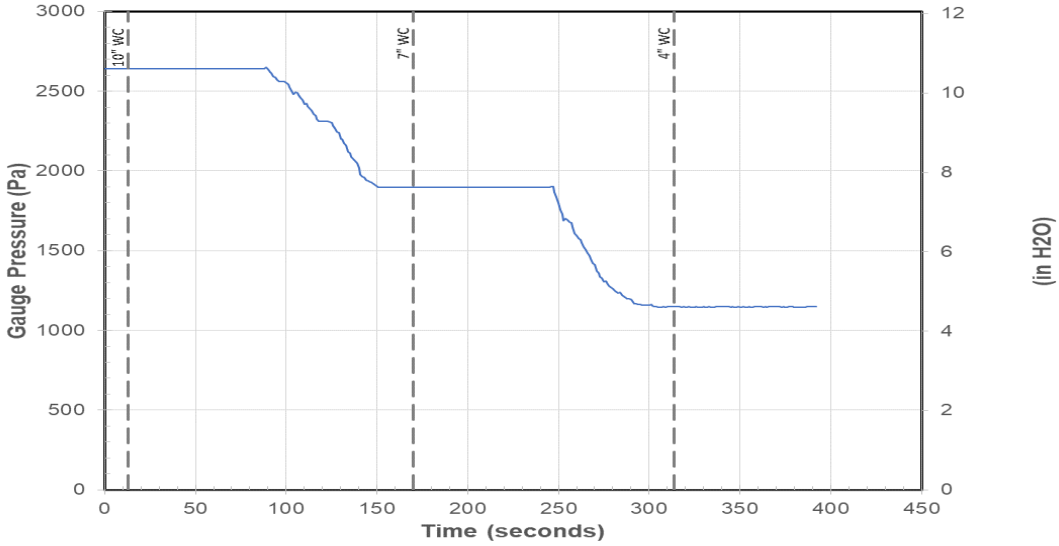

Figure 135. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

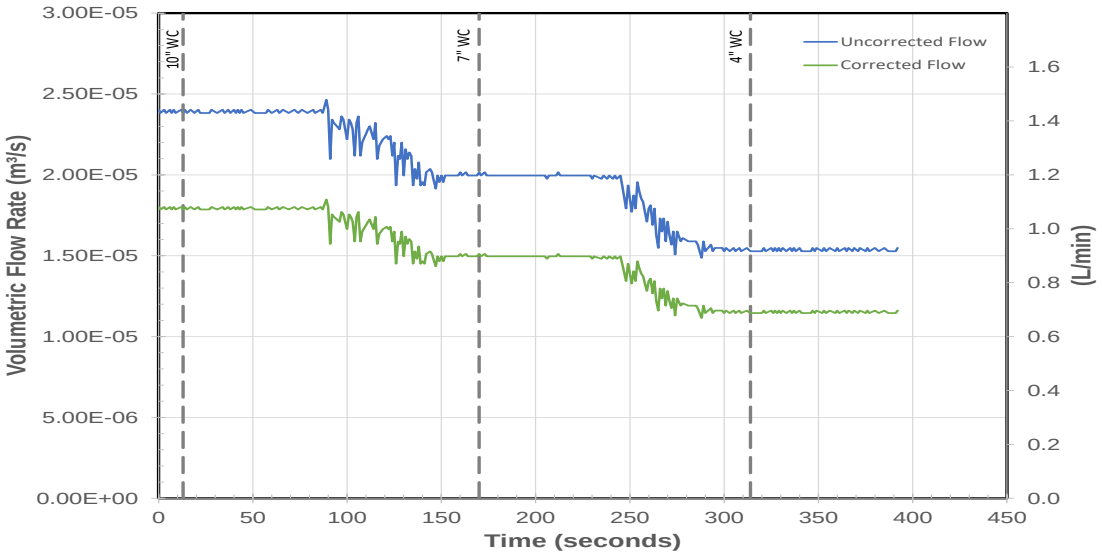

Figure 136. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 54. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	09:24:06	460	348068_20210623_092406_22A.mov
Close up	09:24:13	465	348068_20210623_092414_23A.mov
Overall	09:24:21	468	348068_20210623_092421_24A.mov
FLIR	09:24:34	471	348068_20210623_092434_6.mov
CLOSE UP	09:24:36	470	348068_20210623_092436_9.mov
OVERALL	09:24:37	475	348068_20210623_092437_10.mov
MASTER			348068_1246458.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 137. Pre test 79 seconds, 348068_1192365

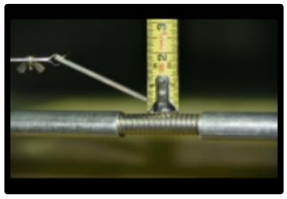

Figure 138. Pre test 75 seconds, 348068_1192366

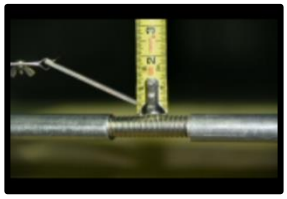

Figure 139. Pre test 73 seconds, 348068_1192367

Results for Test 25 (ID 348070)

The following table lists selected events that occurred during the experiment.

Table 55. Experiment Events

Description	Time (s)
10" WC	9

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

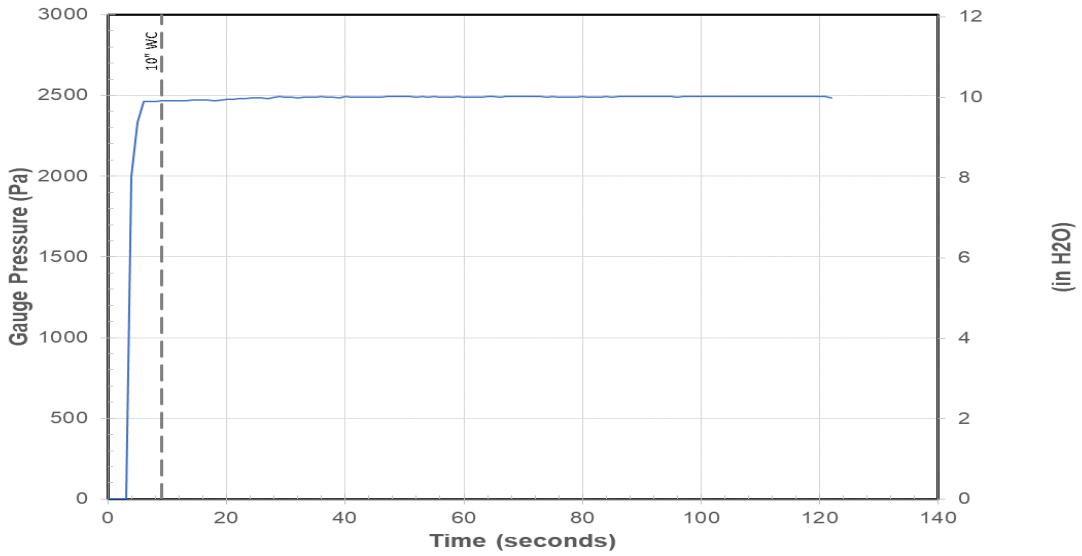

Figure 140. Gauge Pressure Data - Inlet

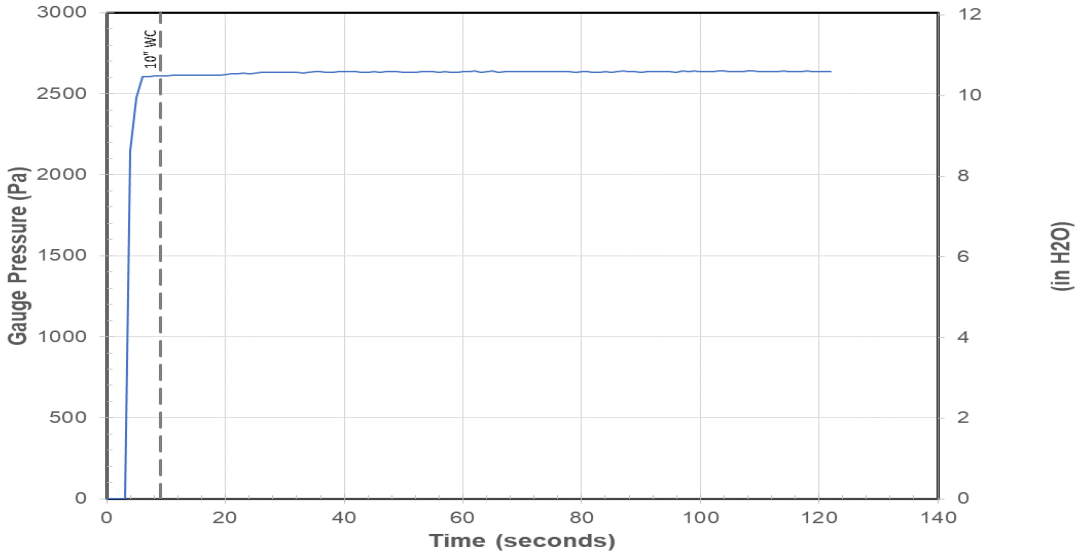

Figure 141. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

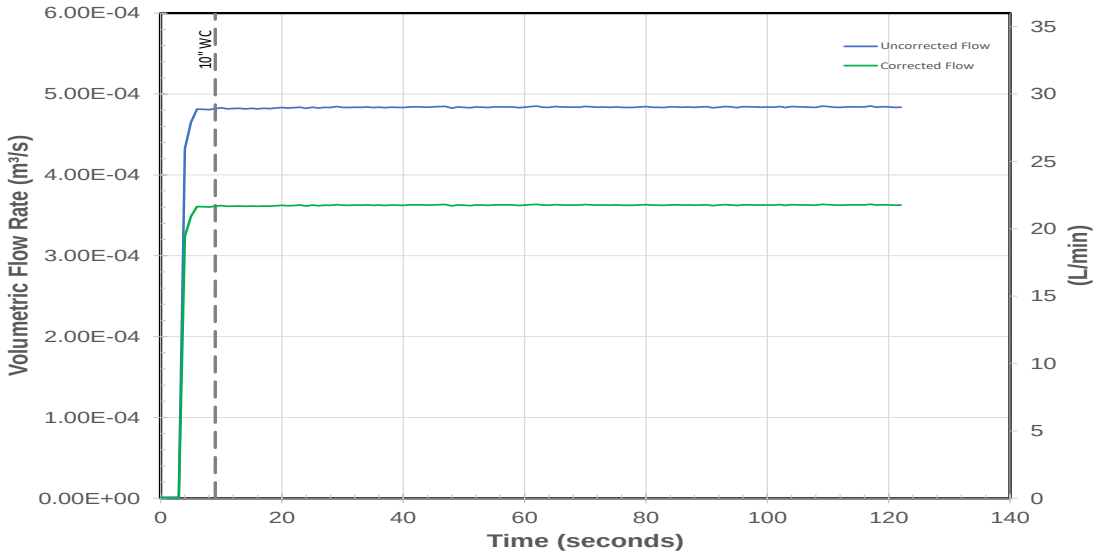

Figure 142. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 56. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	09:42:56	175	348070_20210623_094256_22A.mov
Close up	09:43:04	181	348070_20210623_094304_23A.mov
Overall	09:43:12	184	348070_20210623_094312_24A.mov
FLIR	09:43:27	185	348070_20210623_094327_6.mov
CLOSE UP	09:43:29	184	348070_20210623_094329_9.mov
OVERALL	09:43:30	188	348070_20210623_094330_10.mov
MASTER			348070_1246459.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

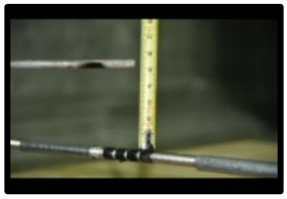

Figure 143. Pre test 68 seconds, 348070_1192378

Figure 144. Pre test 63 seconds, 348070_1192379

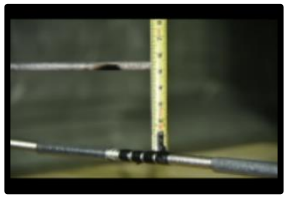

Figure 145. Pre test 61 seconds, 348070_1192380

Results for Test 26 (ID 348071)

The following table lists selected events that occurred during the experiment.

Table 57. Experiment Events

Description	Time (s)
10" WC	45

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

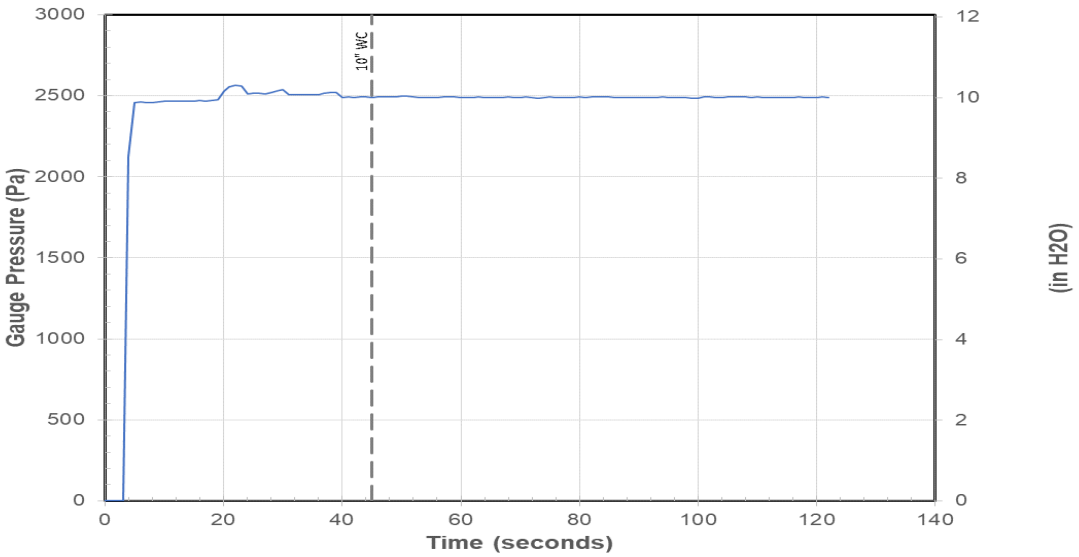

Figure 146. Gauge Pressure Data - Inlet

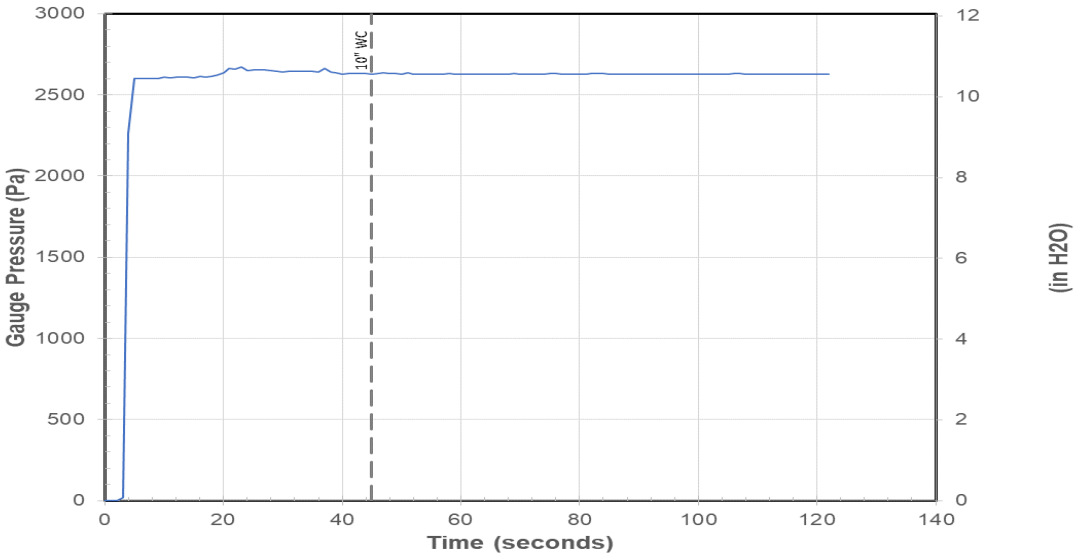

Figure 147. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

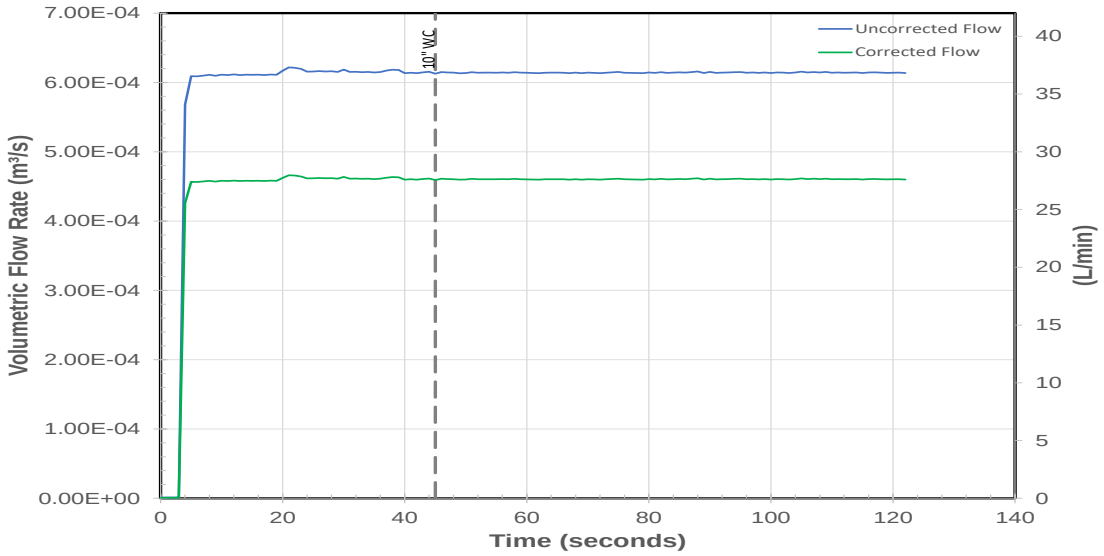

Figure 148. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 58. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	09:50:13	174	348071_20210623_095014_22A.mov
Close up	09:50:21	179	348071_20210623_095022_23A.mov
Overall	09:50:29	185	348071_20210623_095029_24A.mov
FLIR	09:50:44	184	348071_20210623_095044_6.mov
CLOSE UP	09:50:45	189	348071_20210623_095045_9.mov
OVERALL	09:50:46	189	348071_20210623_095046_10.mov
MASTER			348071_1246460.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

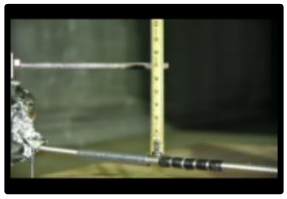

Figure 149. Pre test 50 seconds, 348071_1192391

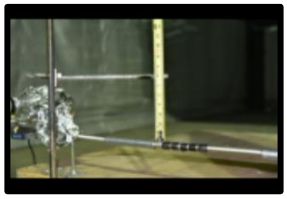

Figure 150. Pre test 38 seconds, 348071_1192392

Results for Test 27 (ID 348072)

The following table lists selected events that occurred during the experiment.

Table 59. Experiment Events

Description	Time (s)
10" WC	39

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

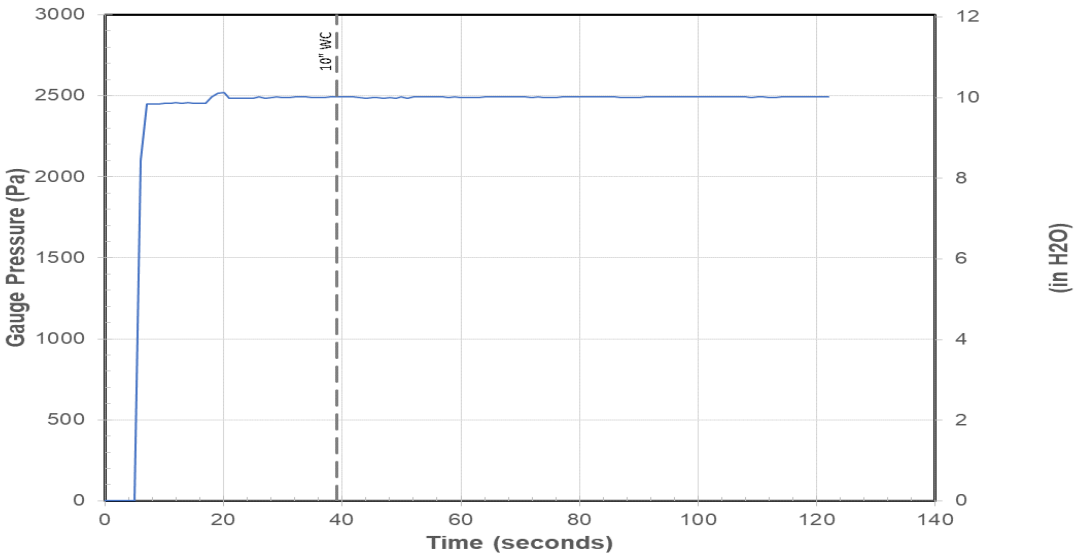

Figure 151. Gauge Pressure Data - Inlet

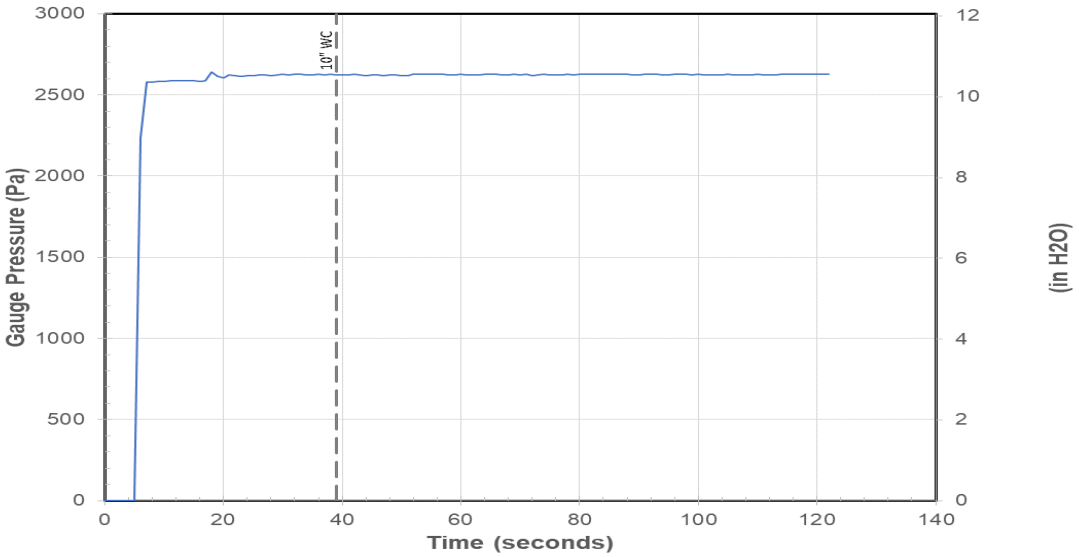

Figure 152. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

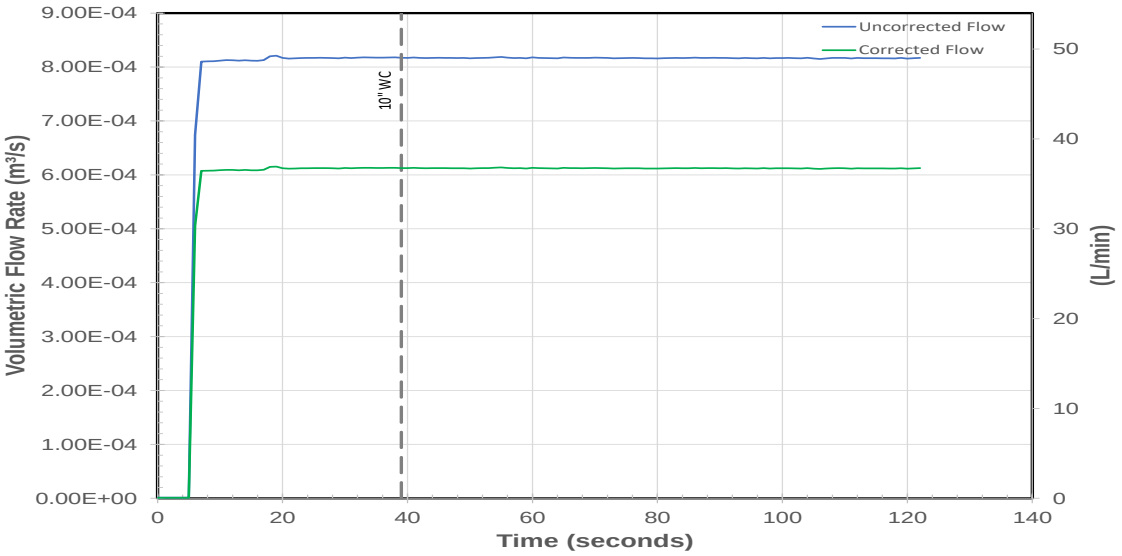

Figure 153. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 60. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	09:56:51	172	348072_20210623_095651_22A.mov
Close up	09:56:59	177	348072_20210623_095659_23A.mov
Overall	09:57:06	182	348072_20210623_095707_24A.mov
FLIR	09:57:20	184	348072_20210623_095720_6.mov
CLOSE UP	09:57:22	183	348072_20210623_095722_9.mov
OVERALL	09:57:22	184	348072_20210623_095722_10.mov
MASTER			348072_1246461.mov

Results for Test 28 (ID 348073)

The following table lists selected events that occurred during the experiment.

Table 61. Experiment Events

Description	Time (s)
10" WC	19

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

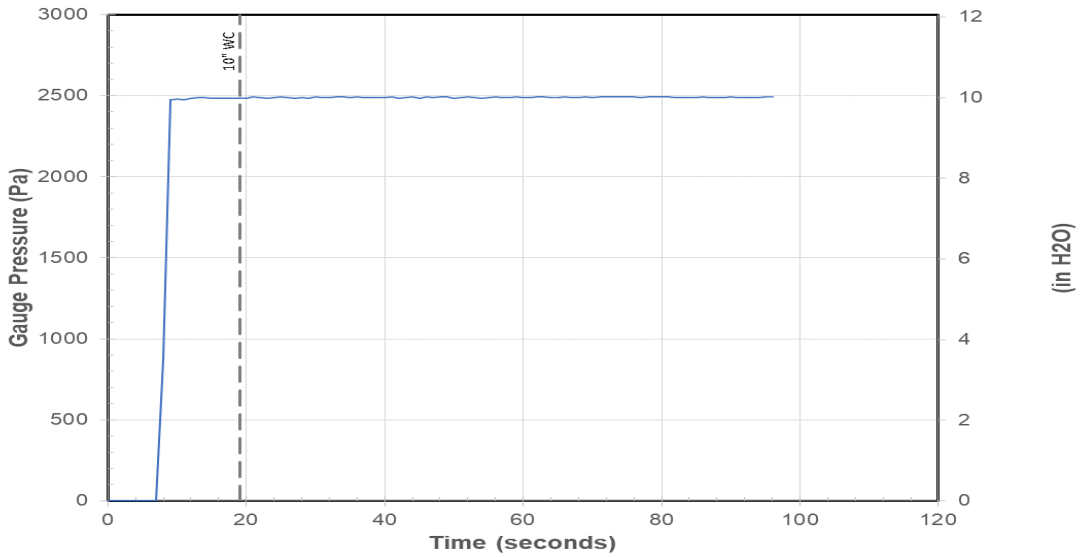

Figure 154. Gauge Pressure Data - Inlet

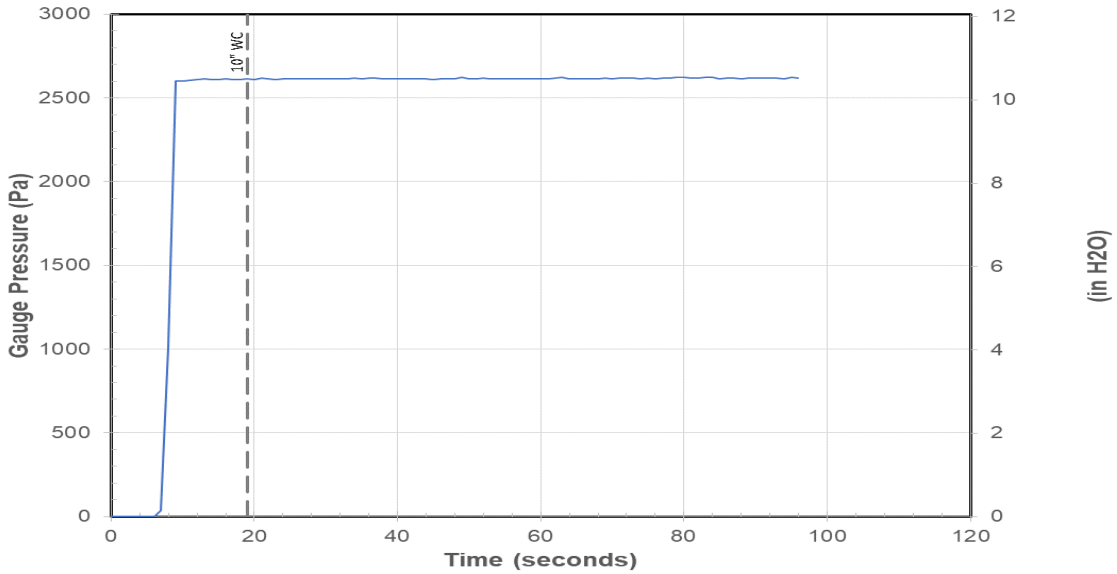

Figure 155. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

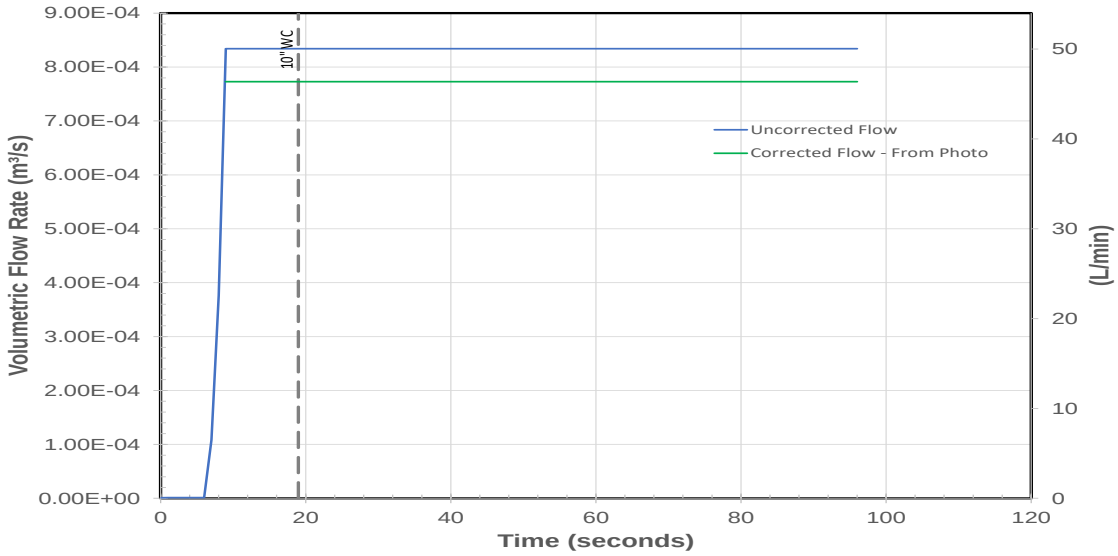

Figure 156. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 62. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	10:03:53	150	348073_20210623_100353_22A.mov
Close up	10:04:00	158	348073_20210623_100401_23A.mov
Overall	10:04:08	161	348073_20210623_100408_24A.mov
FLIR	10:04:22	164	348073_20210623_100422_6.mov
CLOSE UP	10:04:23	164	348073_20210623_100423_9.mov
OVERALL	10:04:29	159	348073_20210623_100429_10.mov
MASTER			348073_1246462.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 157. 23 seconds, 348073_1192411

Figure 158. 55 seconds, 348073_1192412

Results for Test 29 (ID 348074)

The following table lists selected events that occurred during the experiment.

Table 63. Experiment Events

Description	Time (s)
10" WC	65

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

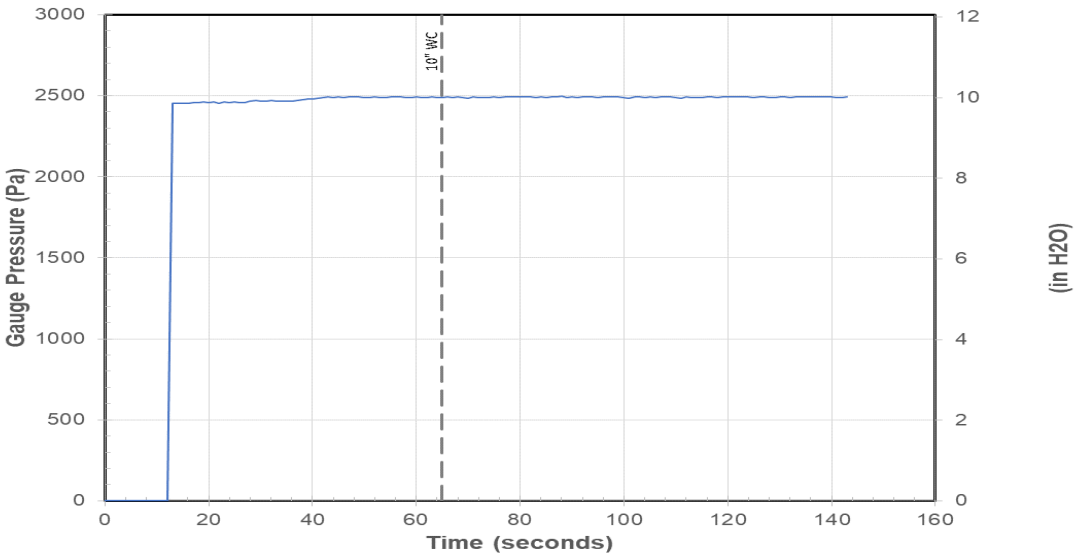

Figure 159. Gauge Pressure Data - Inlet

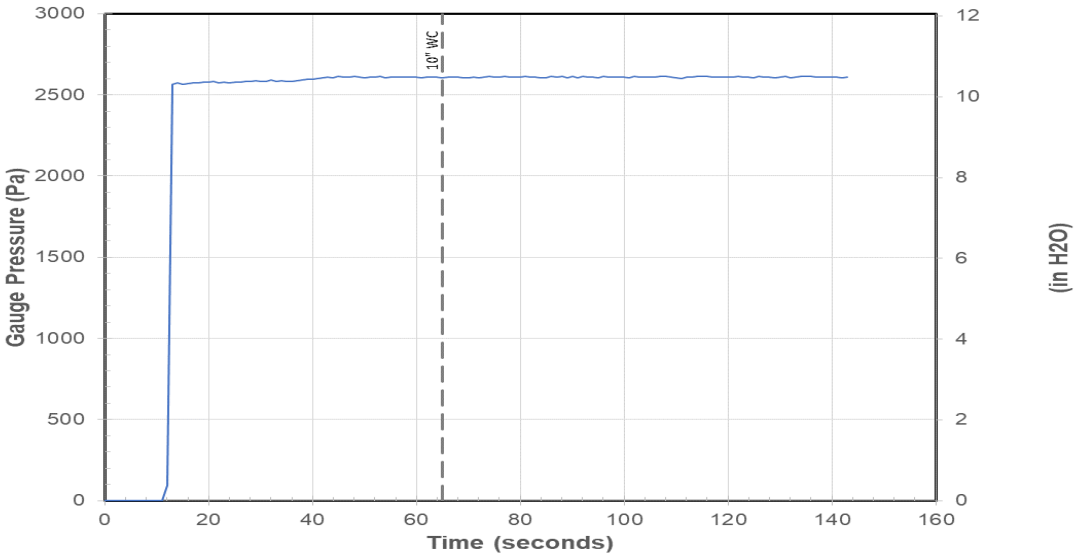

Figure 160. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

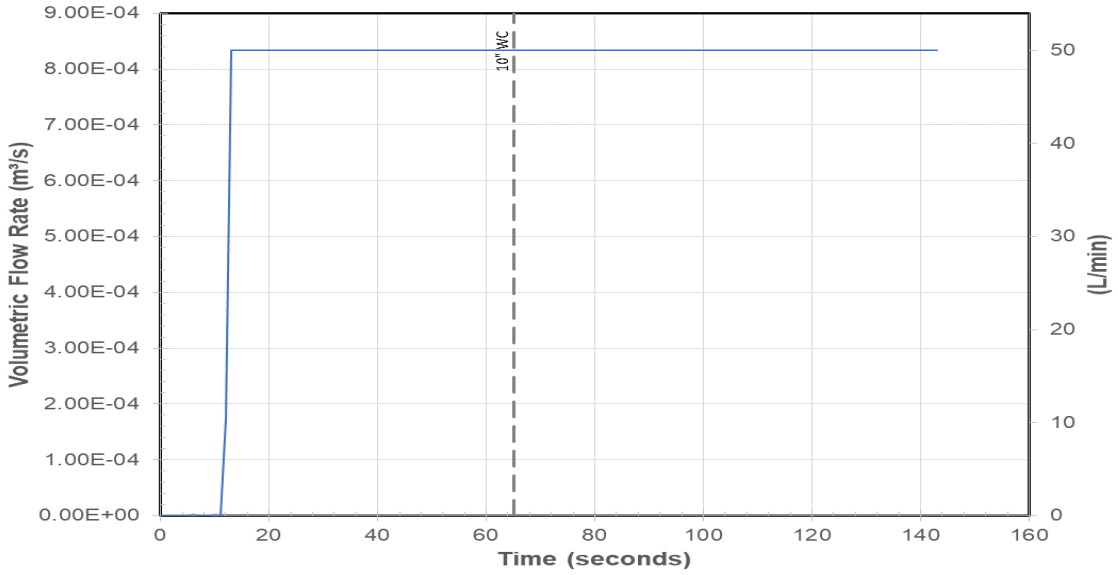

Figure 161. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 64. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	10:11:51	199	348074_20210623_101151_22A.mov
Close up	10:11:58	206	348074_20210623_101159_23A.mov
Overall	10:12:06	209	348074_20210623_101206_24A.mov
FLIR	10:12:23	205	348074_20210623_101223_6.mov
CLOSE UP	10:12:25	209	348074_20210623_101225_9.mov
OVERALL	10:12:25	210	348074_20210623_101225_10.mov
CUSTOM 5			348074_1211086.mov
MASTER			348074_1246463.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 162. Pre test 5 minutes, 348074_1192430

Figure 163. 74 seconds, 348074_1192428

Figure 164. 76 seconds, 348074_1192429

Results for Test 30 (ID 348075)

The following table lists selected events that occurred during the experiment.

Table 65. Experiment Events

Description	Time (s)
4" WC	20

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

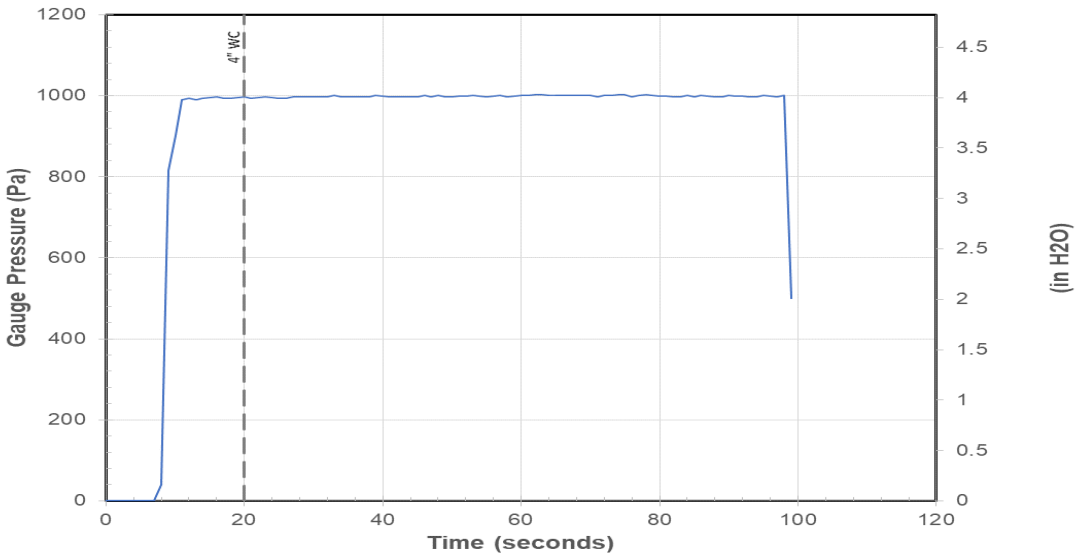

Figure 165. Gauge Pressure Data - Inlet

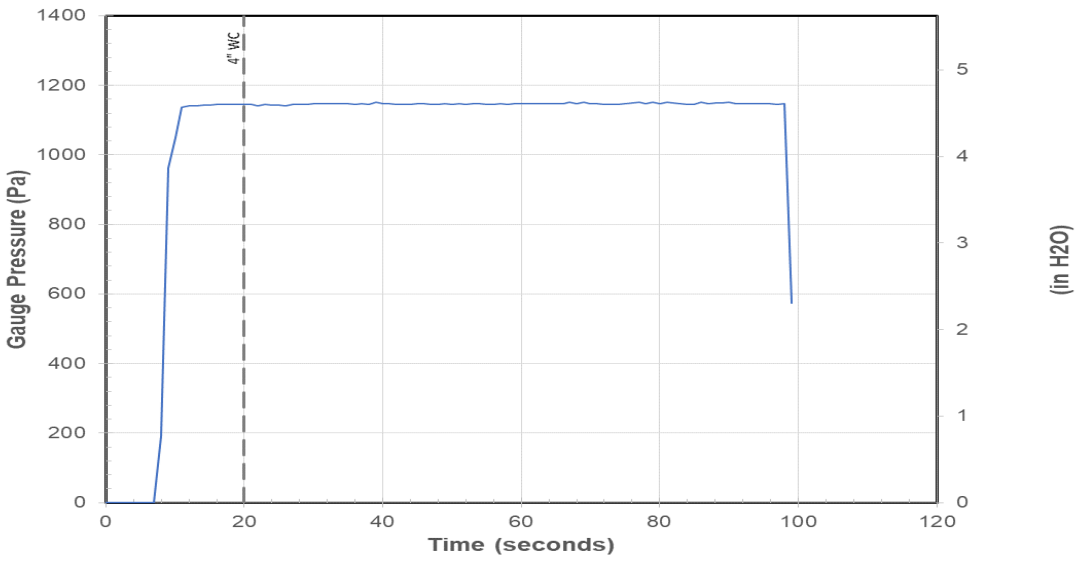

Figure 166. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

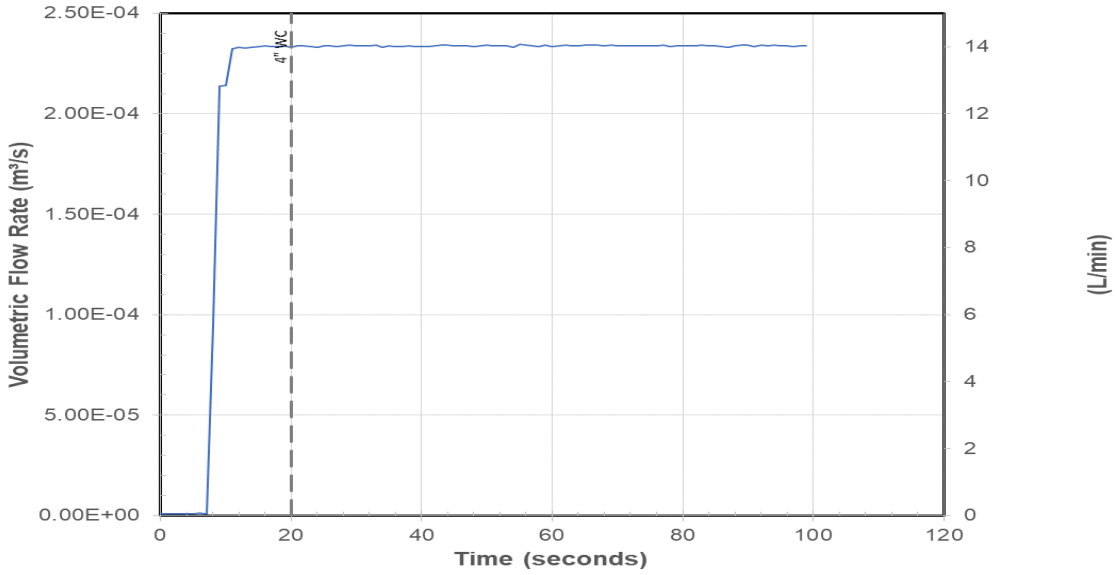

Figure 167. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 66. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	10:25:46	157	348075_20210623_102546_22A.mov
Close up	10:25:53	162	348075_20210623_102554_23A.mov
Overall	10:26:01	165	348075_20210623_102601_24A.mov
FLIR	10:26:15	165	348075_20210623_102615_6.mov
CLOSE UP	10:26:17	169	348075_20210623_102617_9.mov
OVERALL	10:26:18	168	348075_20210623_102618_10.mov
MASTER			348075_1246464.mov

Results for Test 31 (ID 348080)

The following table lists selected events that occurred during the experiment.

Table 67. Experiment Events

Description	Time (s)
14" WC	54
11" WC	181

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

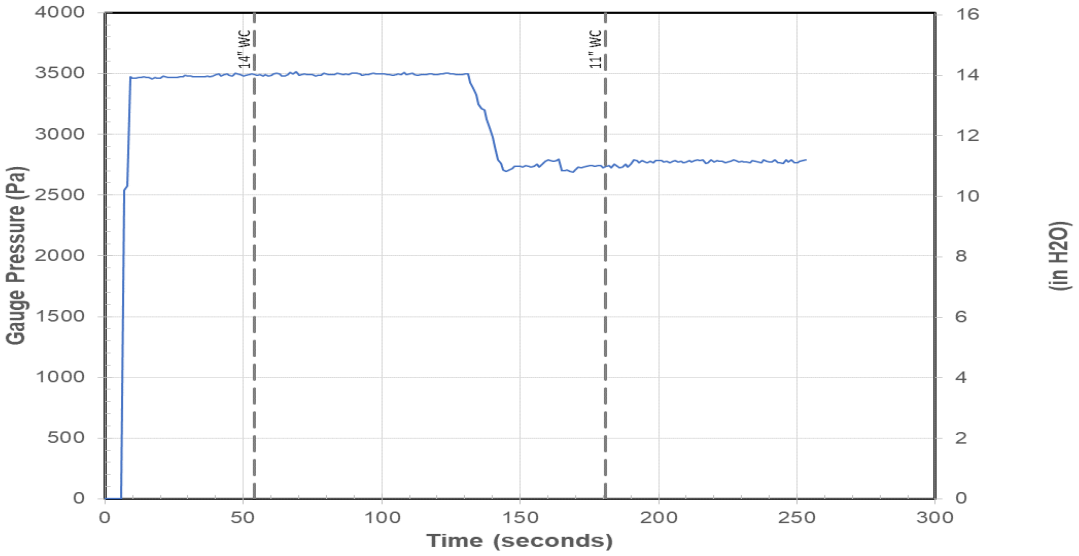

Figure 168. Gauge Pressure Data - Inlet

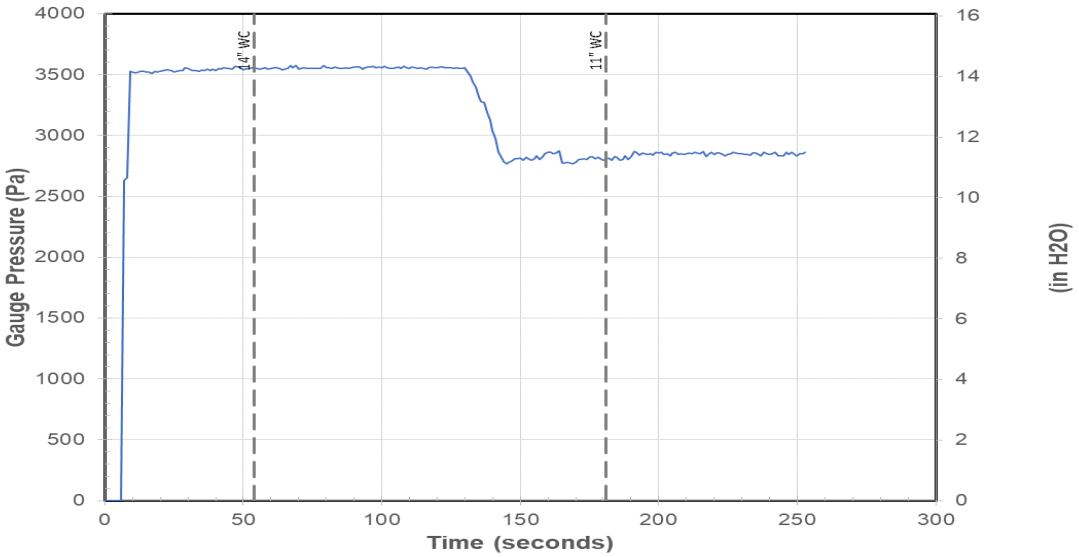

Figure 169. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

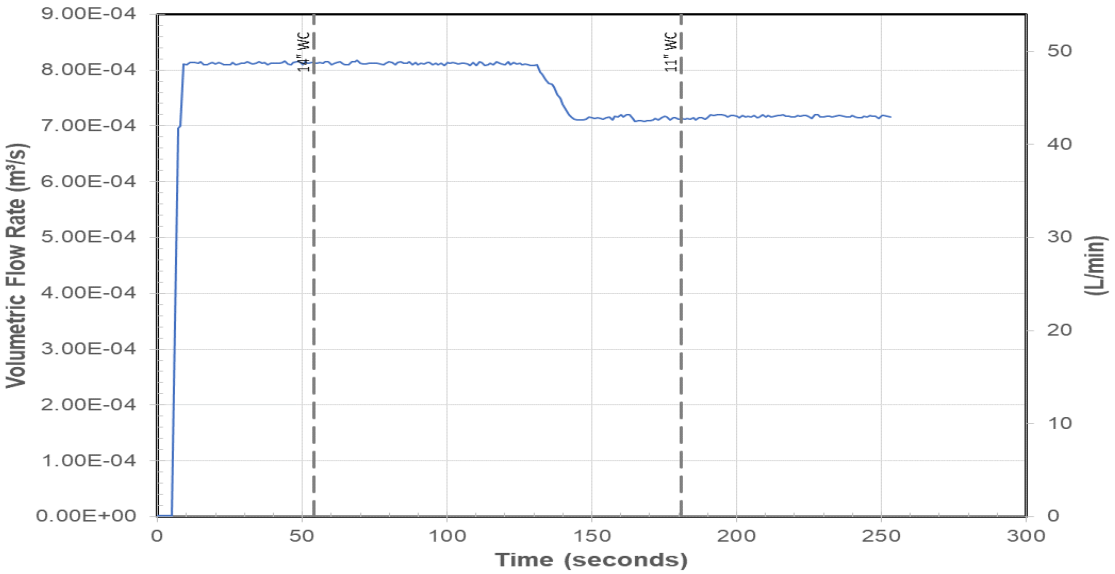

Figure 170. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 68. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	12:50:43	300	348080_20210623_125043_22A.mov
Overall	12:50:50	305	348080_20210623_125050_23A.mov
Close Up	12:50:57	309	348080_20210623_125058_24A.mov
FLIR	12:51:13	309	348080_20210623_125113_6.mov
OVERALL	12:51:14	309	348080_20210623_125114_9.mov
CLOSE UP	12:51:15	314	348080_20210623_125115_10.mov
MASTER			348080_1246465.mov

Results for Test 32 (ID 348082)

The following table lists selected events that occurred during the experiment.

Table 69. Experiment Events

Description	Time (s)
11" WC	25
14" WC	125

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

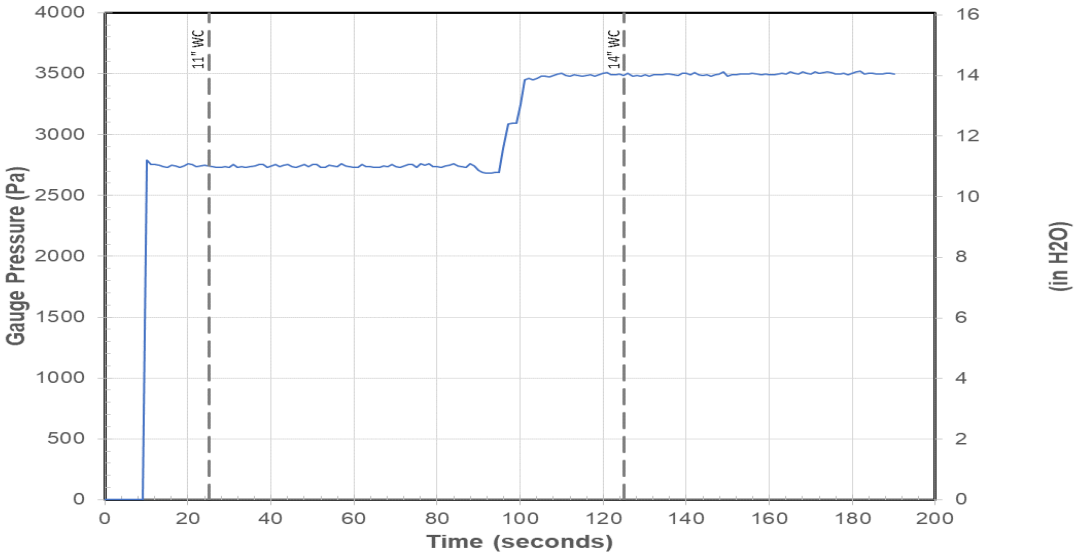

Figure 171. Gauge Pressure Data - Inlet

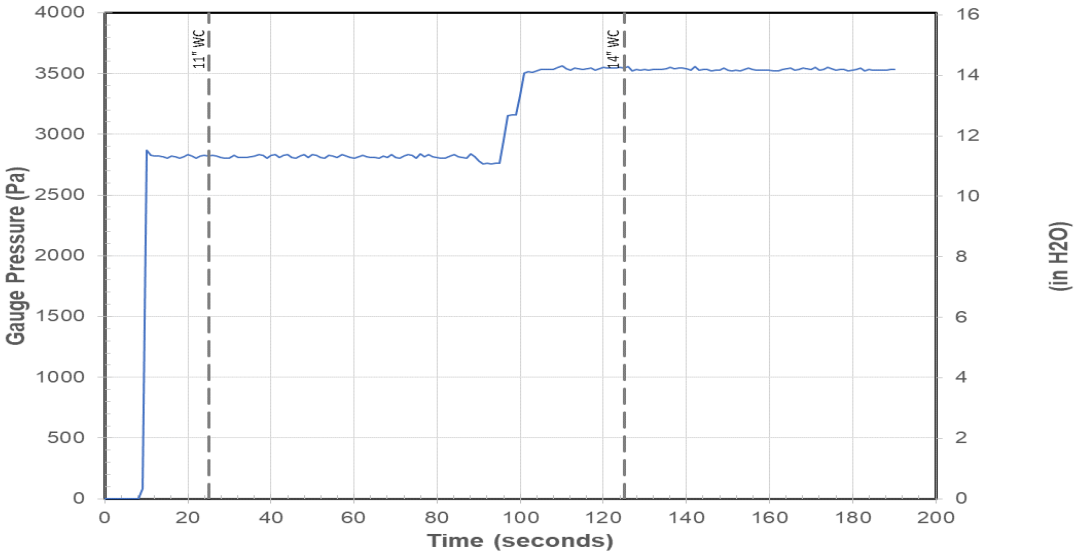

Figure 172. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

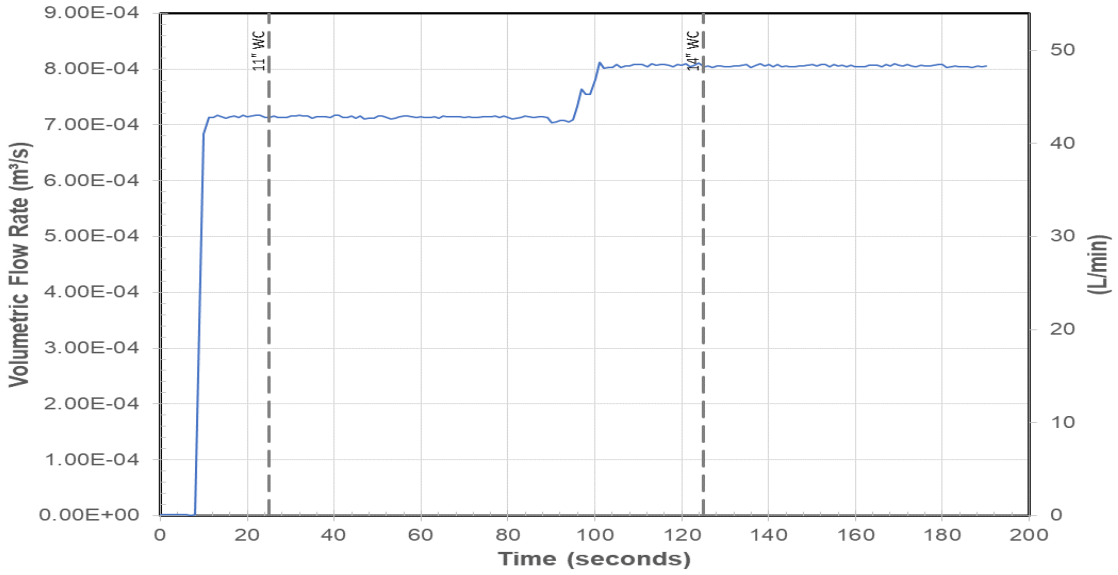

Figure 173. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 70. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	01:04:58	242	348082_20210623_130458_22A.mov
Overall	01:05:05	249	348082_20210623_130506_23A.mov
Close Up	01:05:13	253	348082_20210623_130513_24A.mov
FLIR	01:05:30	251	348082_20210623_130530_6.mov
OVERALL	01:05:32	250	348082_20210623_130532_9.mov
CLOSE UP	01:05:33	255	348082_20210623_130533_10.mov
CUSTOM 3			348082_1211087.mov
CUSTOM 4			348082_1211088.mov
MASTER			348082_1246466.mov

Results for Test 33 (ID 348084)

The following table lists selected events that occurred during the experiment.

Table 71. Experiment Events

Description	Time (s)
14" WC	44
11" WC	132

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

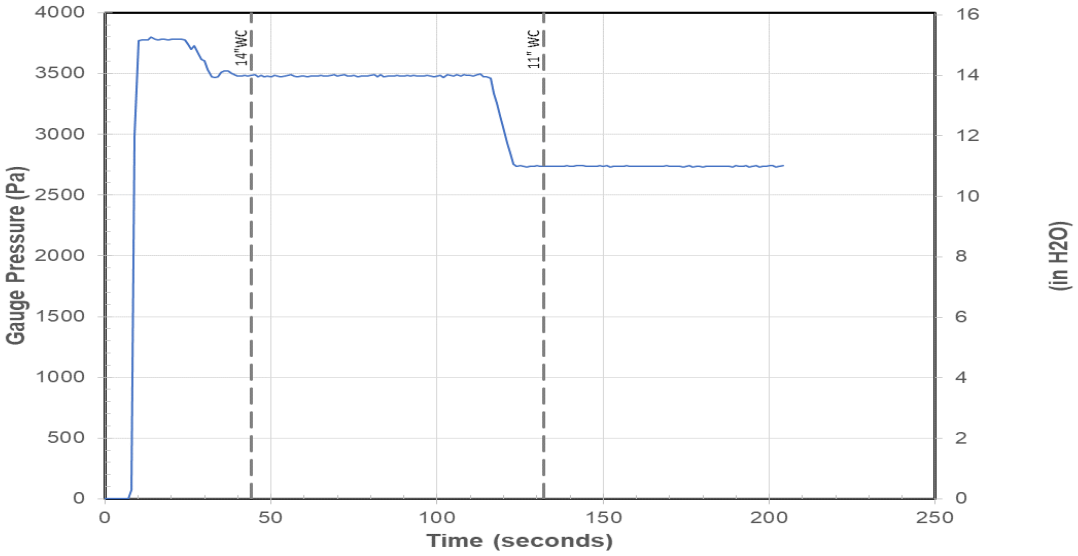

Figure 174. Gauge Pressure Data - Inlet

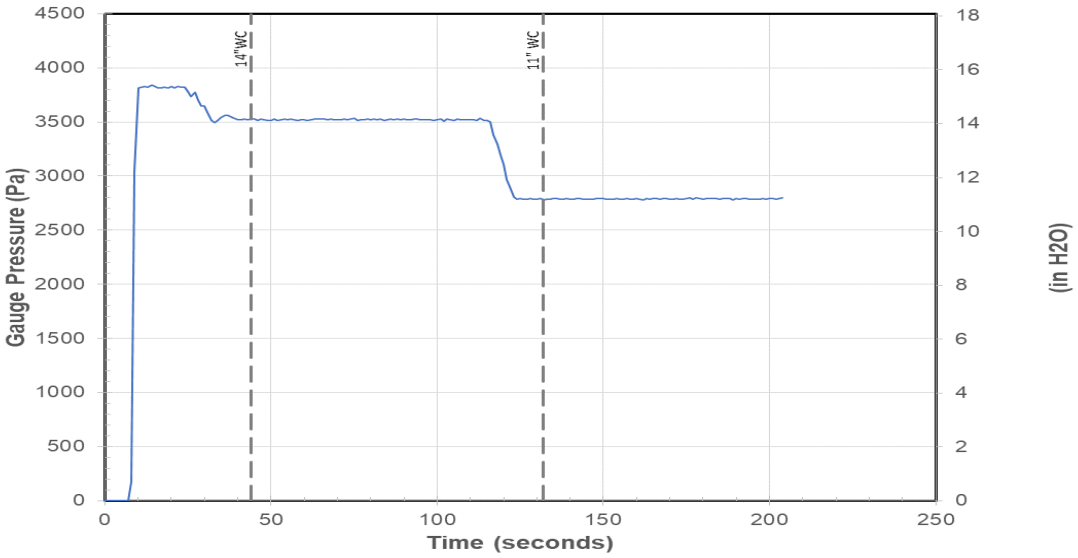

Figure 175. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

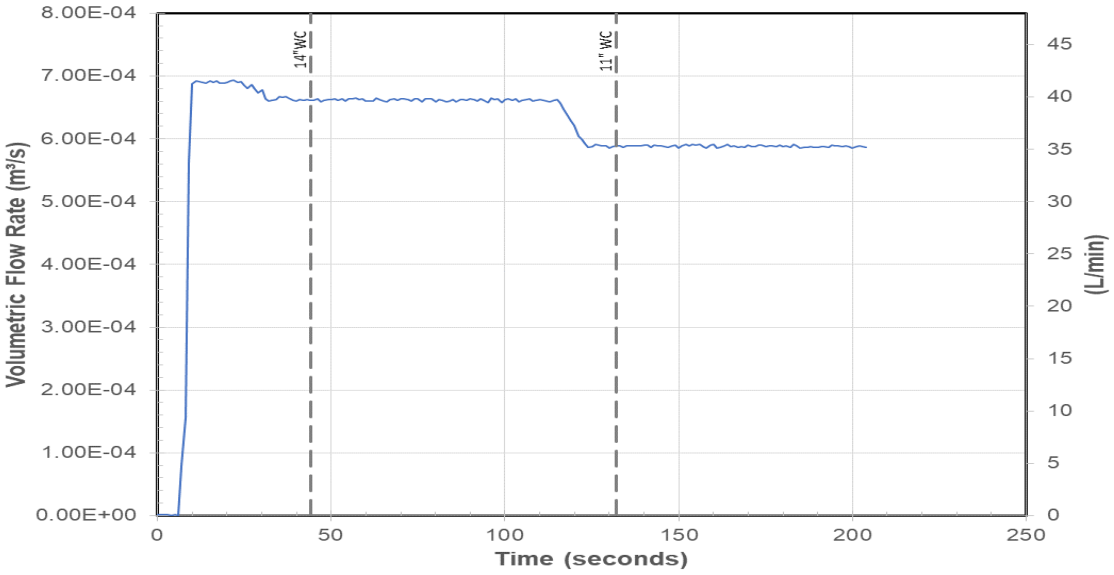

Figure 176. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 72. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	01:11:51	256	348084_20210623_131152_22A.mov
Close up	01:11:59	261	348084_20210623_131159_23A.mov
Overall	01:12:06	265	348084_20210623_131207_24A.mov
FLIR	01:12:23	264	348084_20210623_131223_6.mov
CLOSE UP	01:12:24	264	348084_20210623_131224_9.mov
OVERALL	01:12:25	264	348084_20210623_131225_10.mov
MASTER			348084_1246467.mov

Results for Test 34 (ID 348085)

The following table lists selected events that occurred during the experiment.

Table 73. Experiment Events

Description	Time (s)
11" WC	30
14" WC	138

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

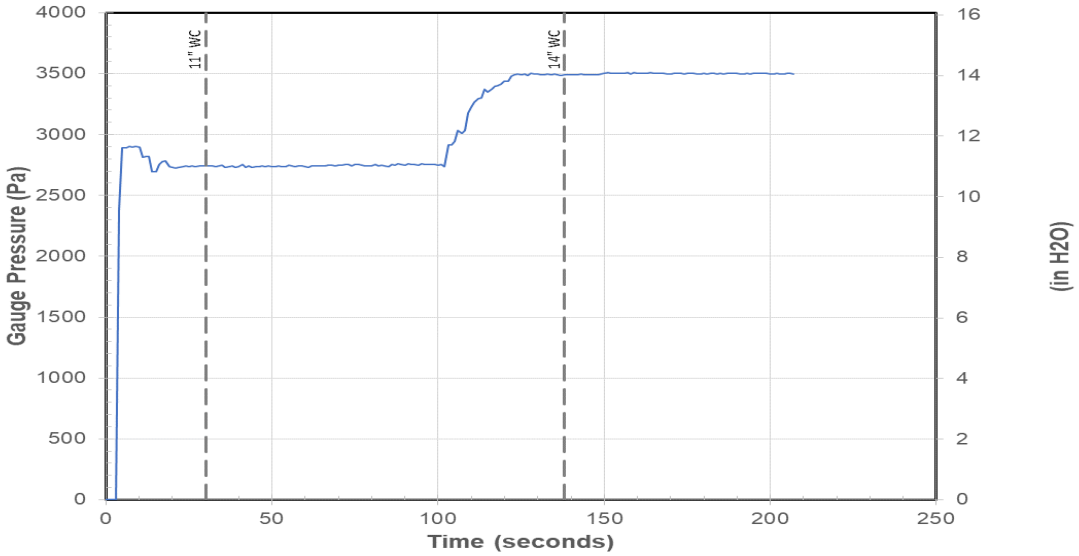

Figure 177. Gauge Pressure Data - Inlet

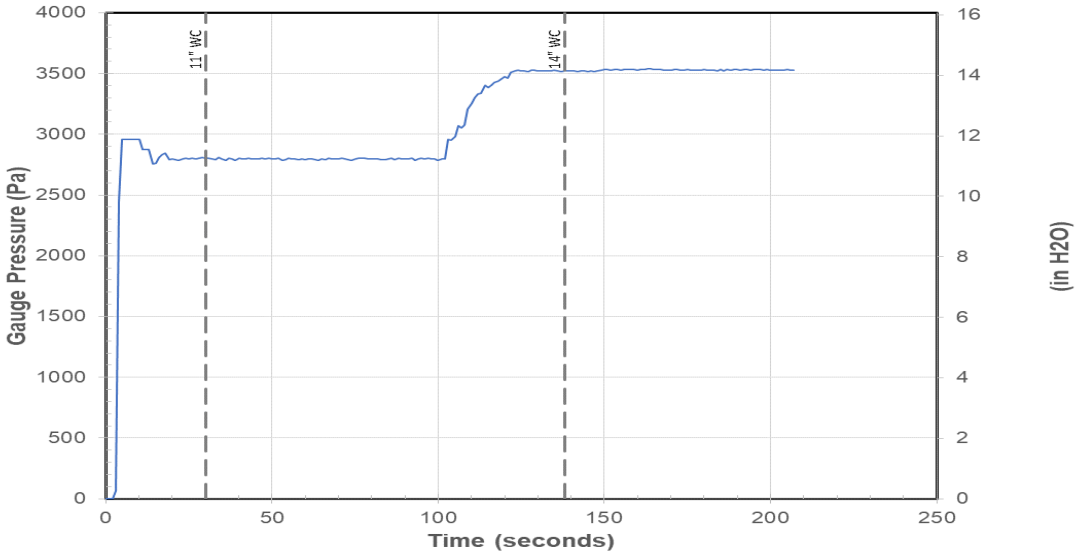

Figure 178. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

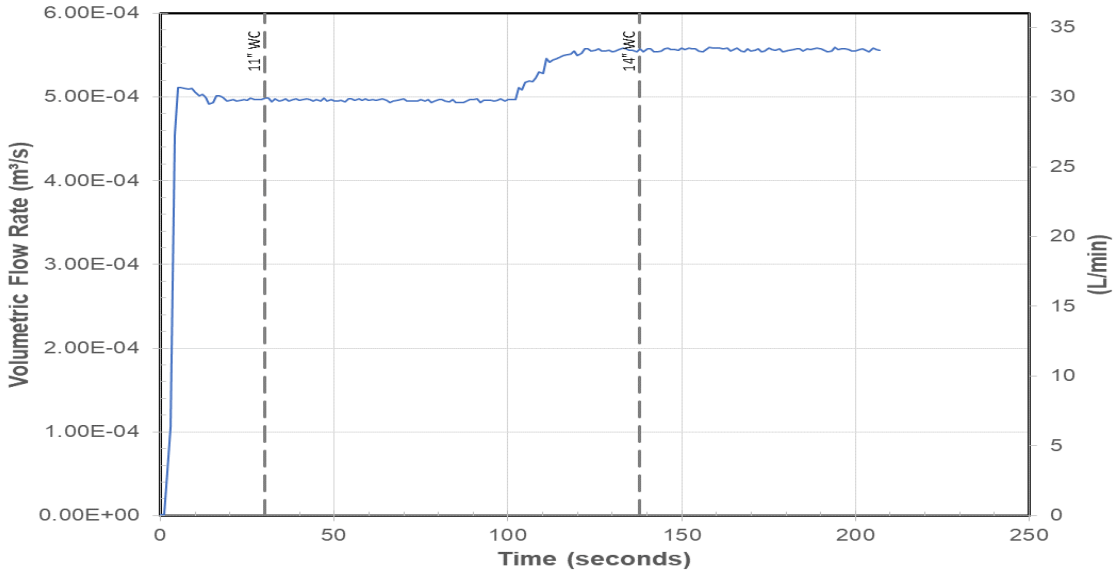

Figure 179. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 74. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	01:18:14	262	348085_20210623_131814_22A.mov
Close up	01:18:21	265	348085_20210623_131822_23A.mov
Overall	01:18:29	269	348085_20210623_131829_24A.mov
FLIR	01:18:44	269	348085_20210623_131844_6.mov
CLOSE UP	01:18:46	268	348085_20210623_131846_9.mov
OVERALL	01:18:46	274	348085_20210623_131846_10.mov
MASTER			348085_1246468.mov

Results for Test 35 (ID 348086)

The following table lists selected events that occurred during the experiment.

Table 75. Experiment Events

Description	Time (s)
14" WC	26
11" WC	127

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

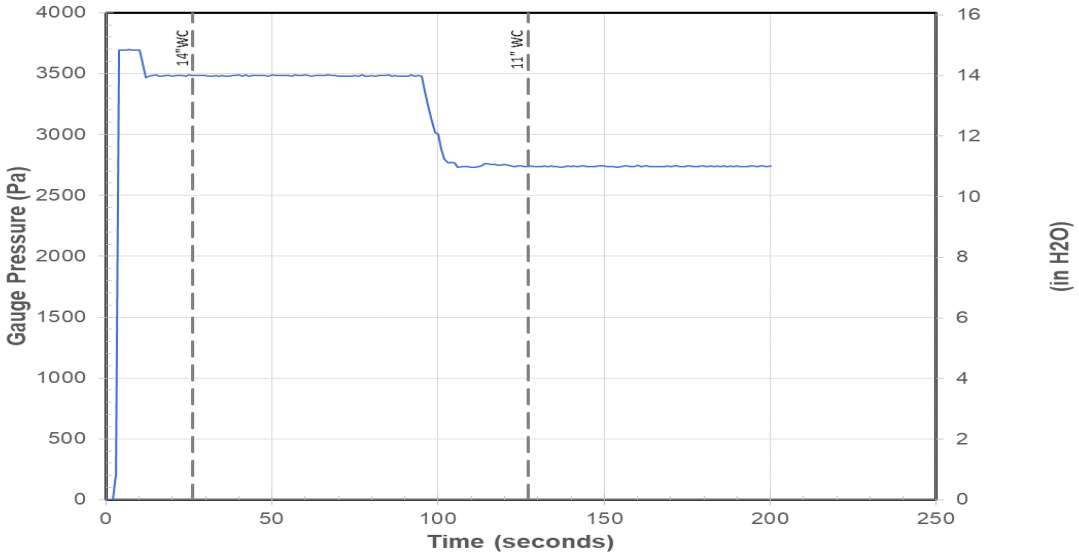

Figure 180. Gauge Pressure Data - Inlet

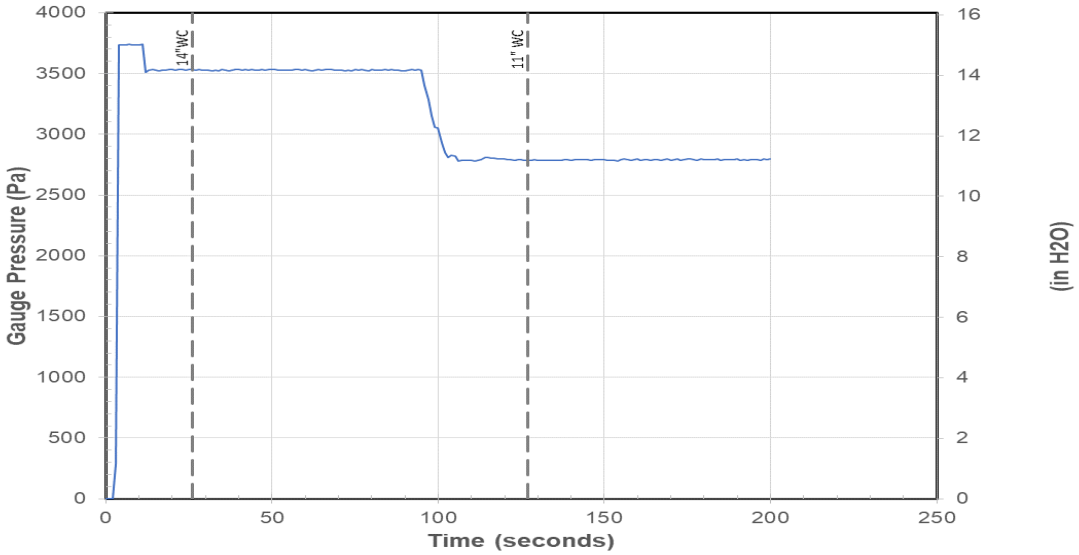

Figure 181. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

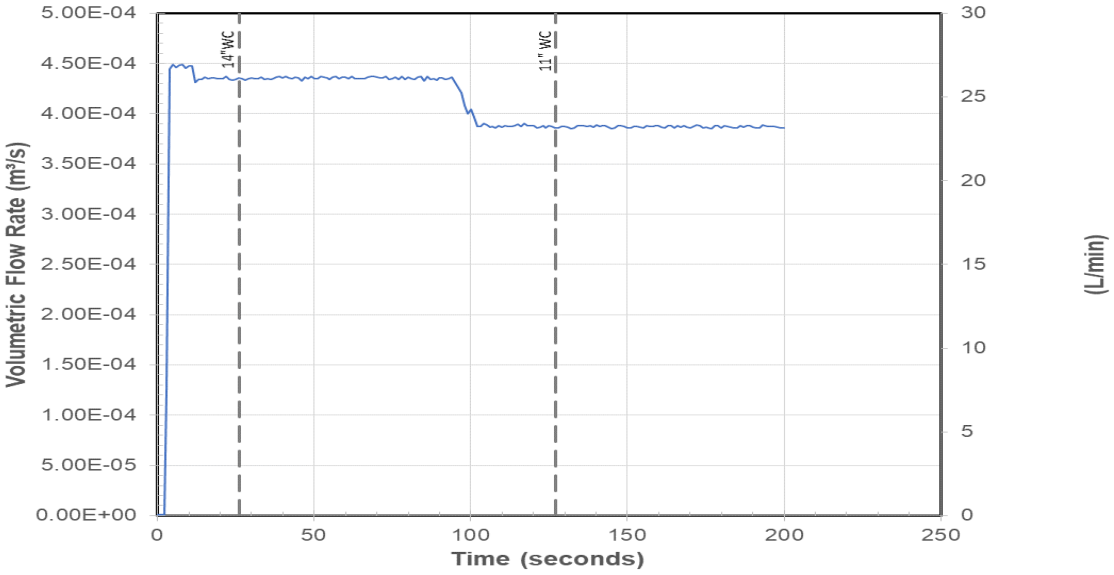

Figure 182. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 76. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	01:24:58	256	348086_20210623_132458_22A.mov
Close up	01:25:05	262	348086_20210623_132506_23A.mov
Overall	01:25:13	265	348086_20210623_132513_24A.mov
FLIR	01:25:31	260	348086_20210623_132531_6.mov
CLOSE UP	01:25:33	263	348086_20210623_132533_9.mov
OVERALL	01:25:34	263	348086_20210623_132534_10.mov
MASTER			348086_1246469.mov

Results for Test 36 (ID 348087)

The following table lists selected events that occurred during the experiment.

Table 77. Experiment Events

Description	Time (s)
11" WC	11
14" WC	120

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

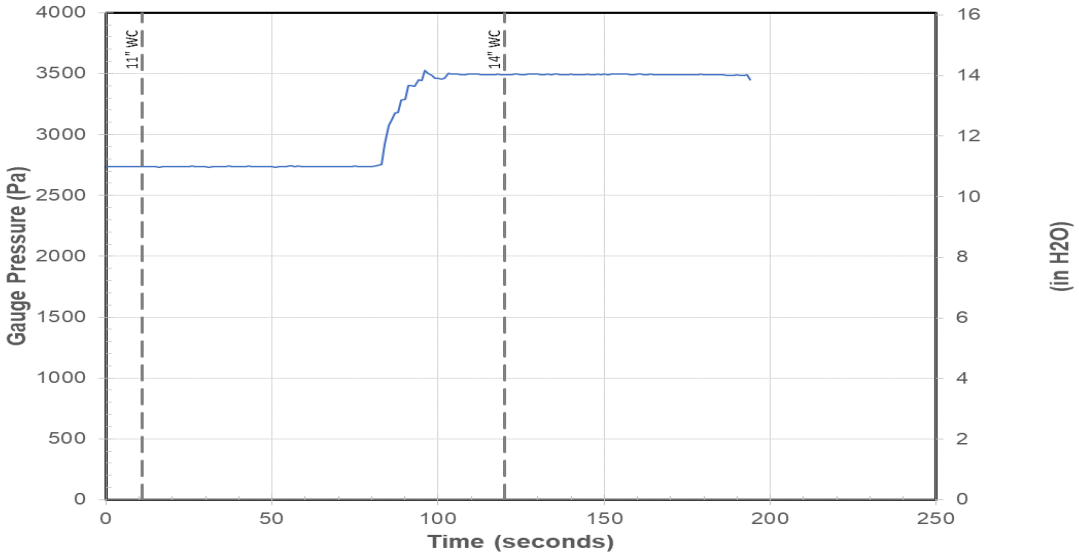

Figure 183. Gauge Pressure Data - Inlet

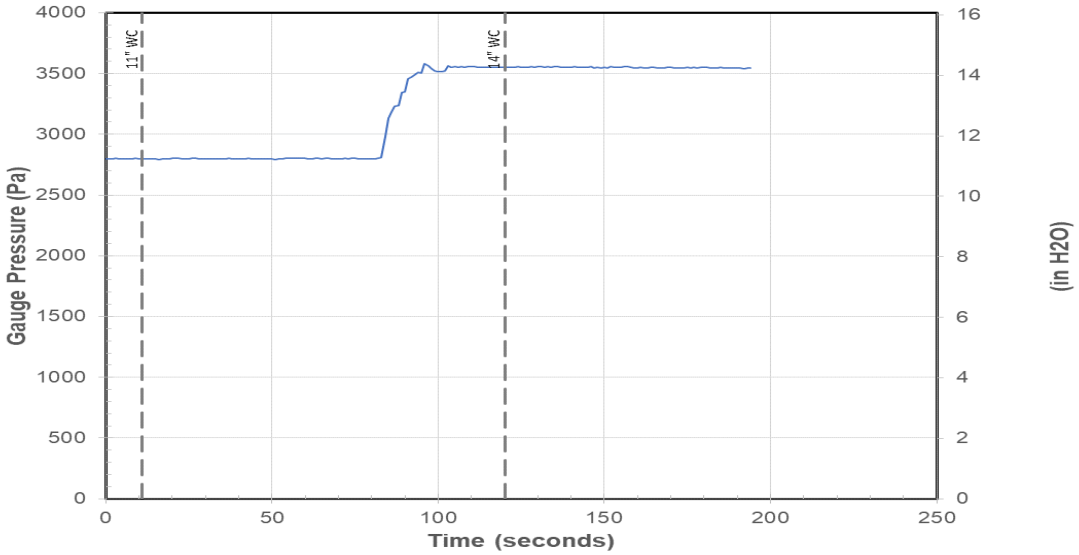

Figure 184. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

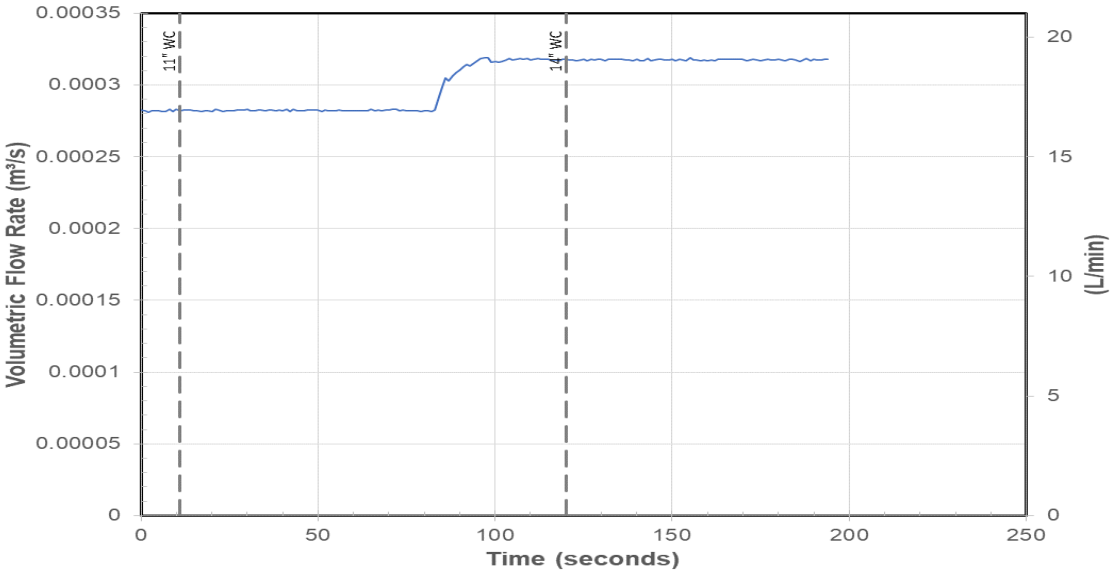

Figure 185. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 78. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	01:31:25	268	348087_20210623_133126_22A.mov
Close up	01:31:33	273	348087_20210623_133133_23A.mov
Overall	01:31:40	277	348087_20210623_133141_24A.mov
FLIR	01:31:57	275	348087_20210623_133157_6.mov
CLOSE UP	01:31:59	279	348087_20210623_133159_9.mov
OVERALL	01:32:00	278	348087_20210623_133200_10.mov
MASTER			348087_1246470.mov

Results for Test 37 (ID 348088)

The following table lists selected events that occurred during the experiment.

Table 79. Experiment Events

Description	Time (s)
11" WC	59
14" WC	272

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

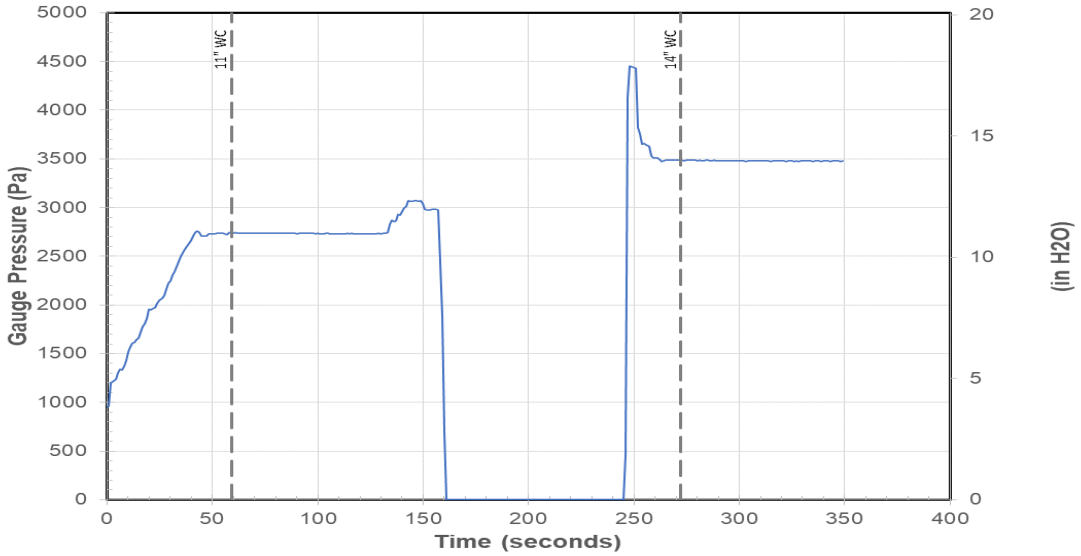

Figure 186. Gauge Pressure Data - Inlet

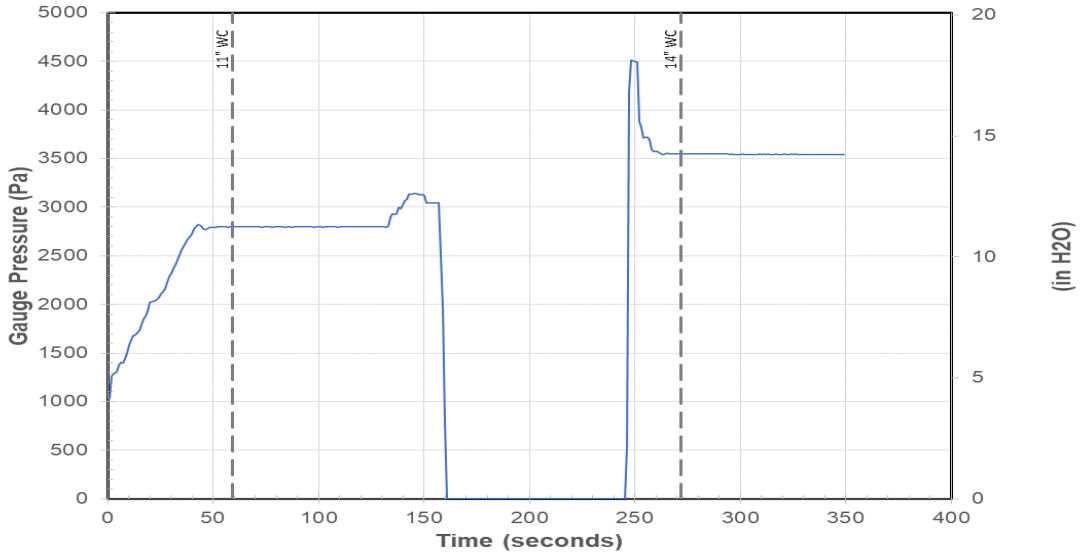

Figure 187. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

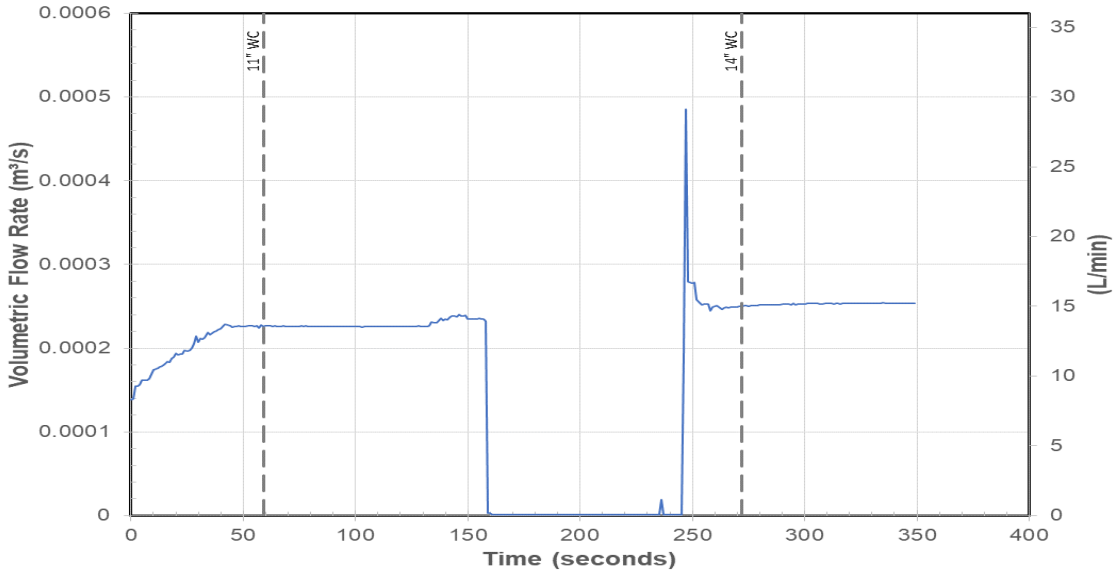

Figure 188. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 80. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	01:38:08	409	348088_20210623_133809_22A.mov
Close up	01:38:16	415	348088_20210623_133816_23A.mov
Overall	01:38:23	422	348088_20210623_133824_24A.mov
FLIR	01:38:39	420	348088_20210623_133839_6.mov
CLOSE UP	01:38:40	424	348088_20210623_133840_9.mov
OVERALL	01:38:41	424	348088_20210623_133841_10.mov
MASTER			348088_1246471.mov

Results for Test 38 (ID 348089)

The following table lists selected events that occurred during the experiment.

Table 81. Experiment Events

Description	Time (s)
14" WC	25

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

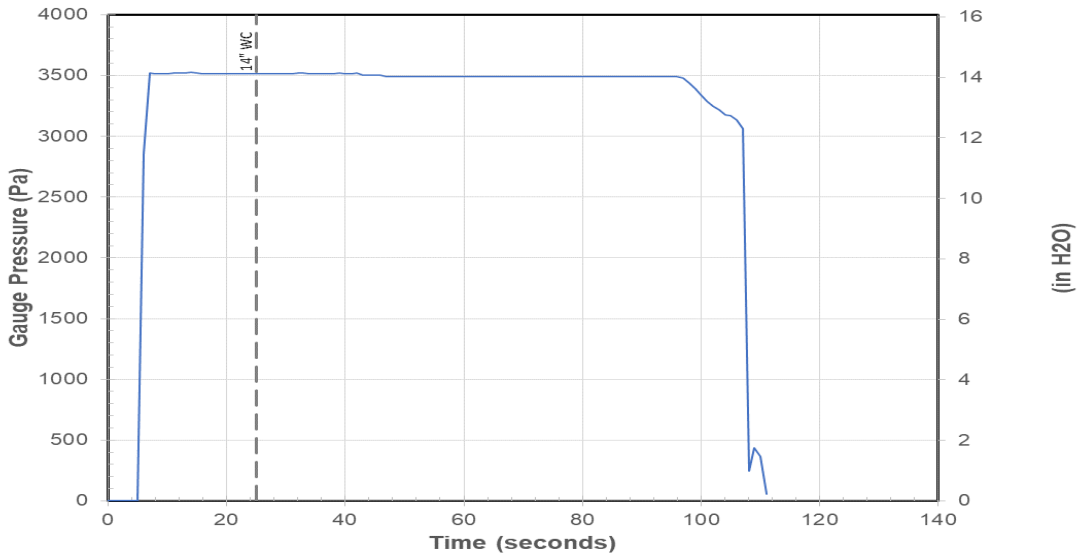

Figure 189. Gauge Pressure Data - Inlet

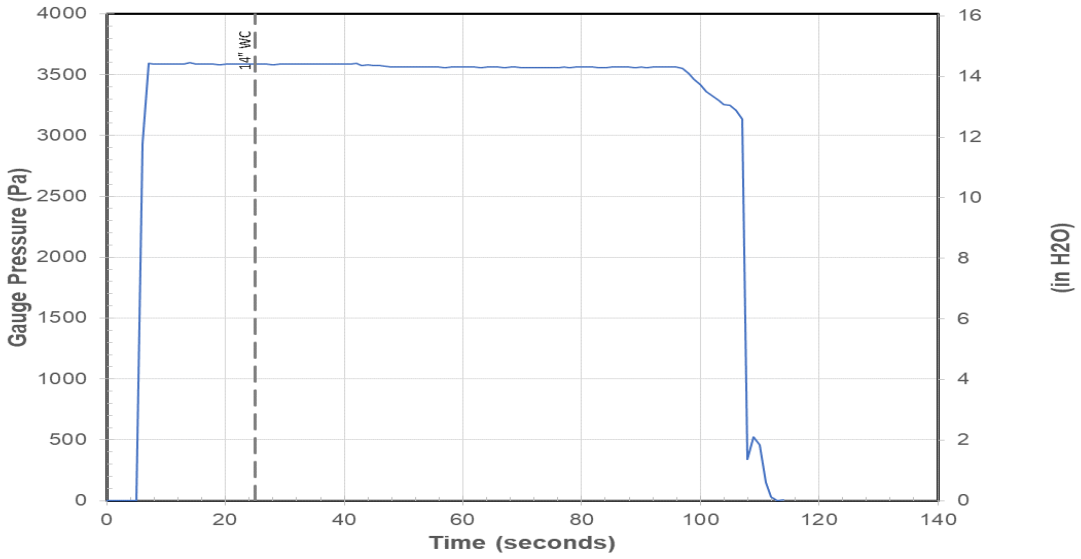

Figure 190. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

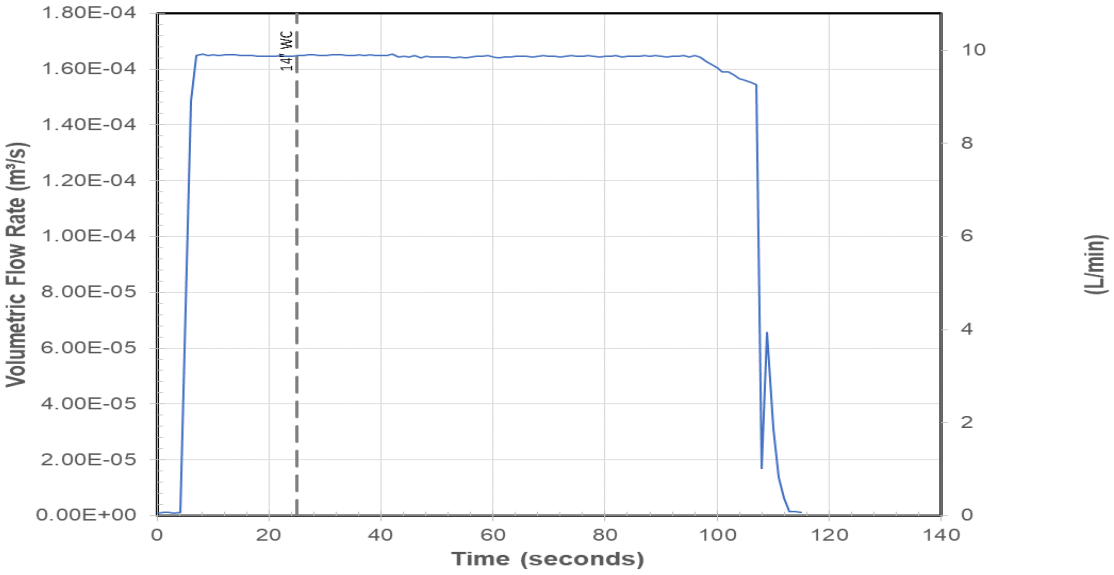

Figure 191. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 82. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	01:47:19	184	348089_20210623_134719_22A.mov
Close up	01:47:31	186	348089_20210623_134731_23A.mov
Overall	01:47:38	194	348089_20210623_134739_24A.mov
FLIR	01:47:55	190	348089_20210623_134755_6.mov
CLOSE UP	01:47:57	193	348089_20210623_134757_9.mov
OVERALL	01:47:57	194	348089_20210623_134757_10.mov
MASTER			348089_1246472.mov

Results for Test 39 (ID 348090)

The following table lists selected events that occurred during the experiment.

Table 83. Experiment Events

Description	Time (s)
11" WC	21
14" WC	127

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

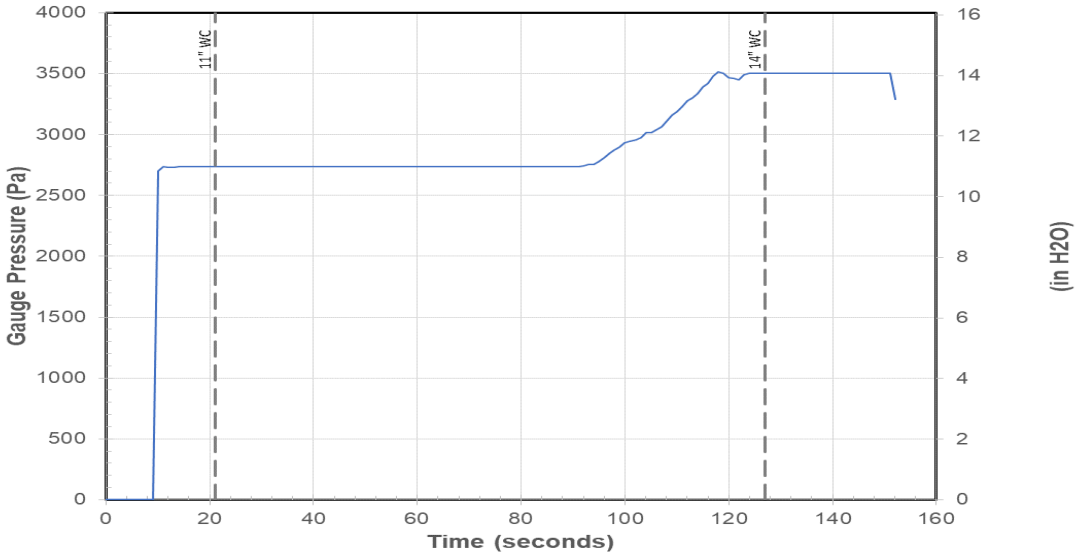

Figure 192. Gauge Pressure Data - Inlet

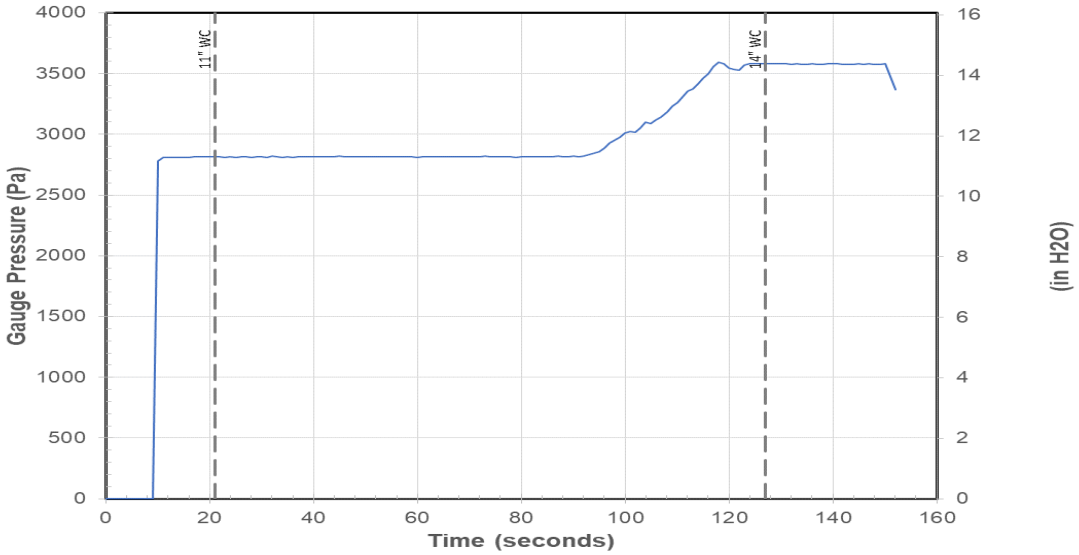

Figure 193. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

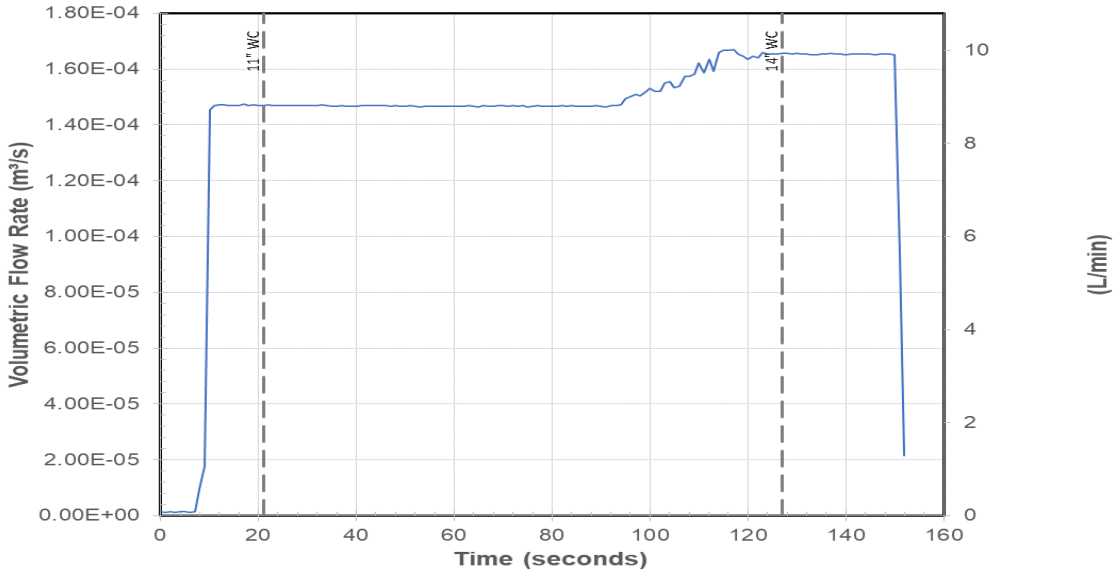

Figure 194. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 84. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	01:55:00	203	348090_20210623_135501_22A.mov
Close up	01:55:08	210	348090_20210623_135508_23A.mov
Overall	01:55:16	213	348090_20210623_135516_24A.mov
FLIR	01:55:31	215	348090_20210623_135531_6.mov
CLOSE UP	01:55:33	214	348090_20210623_135533_9.mov
OVERALL	01:55:34	213	348090_20210623_135534_10.mov
MASTER			348090_1246473.mov

Results for Test 40 (ID 348091)

The following table lists selected events that occurred during the experiment.

Table 85. Experiment Events

Description	Time (s)
14" WC	39

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

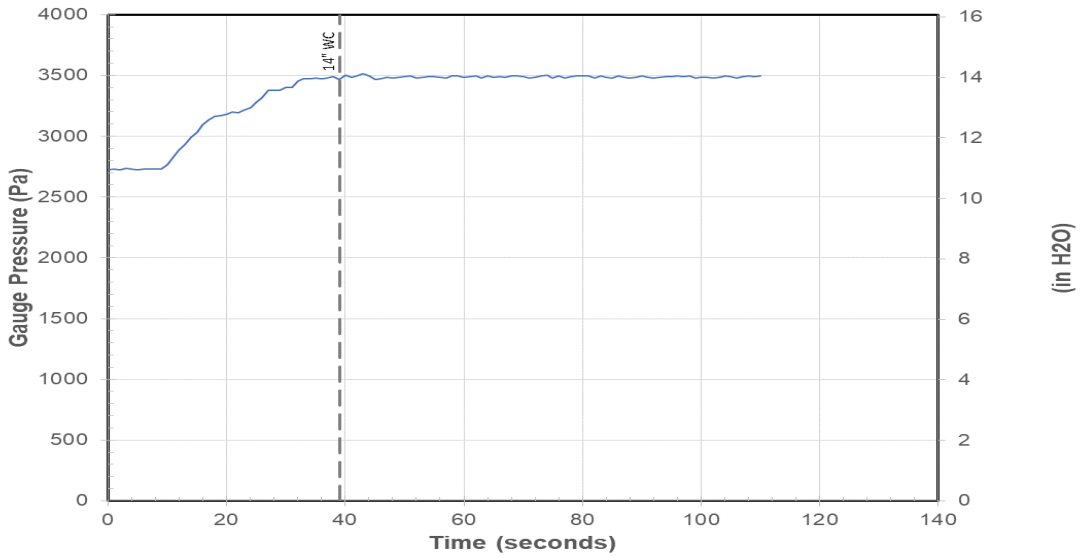

Figure 195. Gauge Pressure Data - Inlet

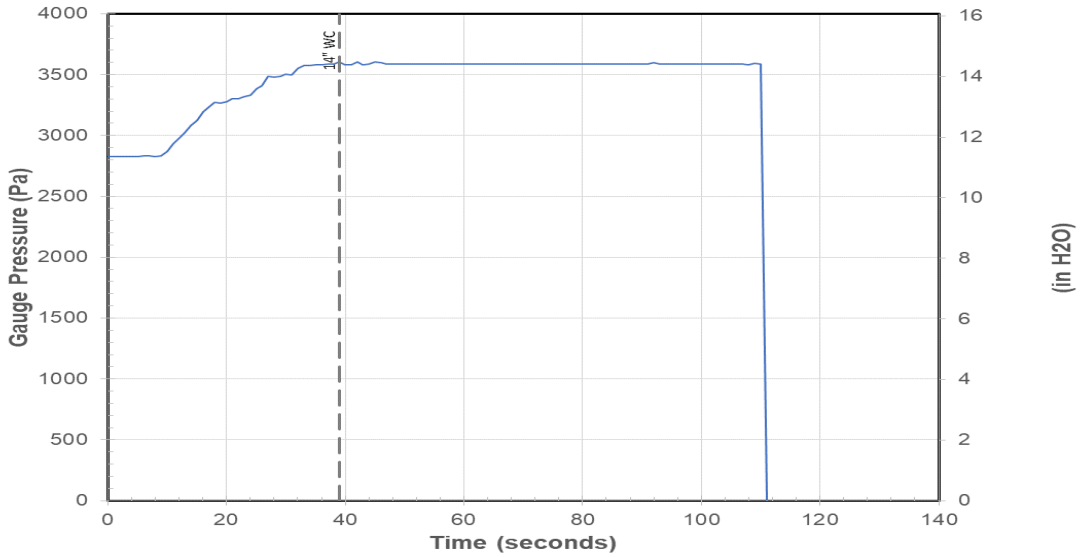

Figure 196. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

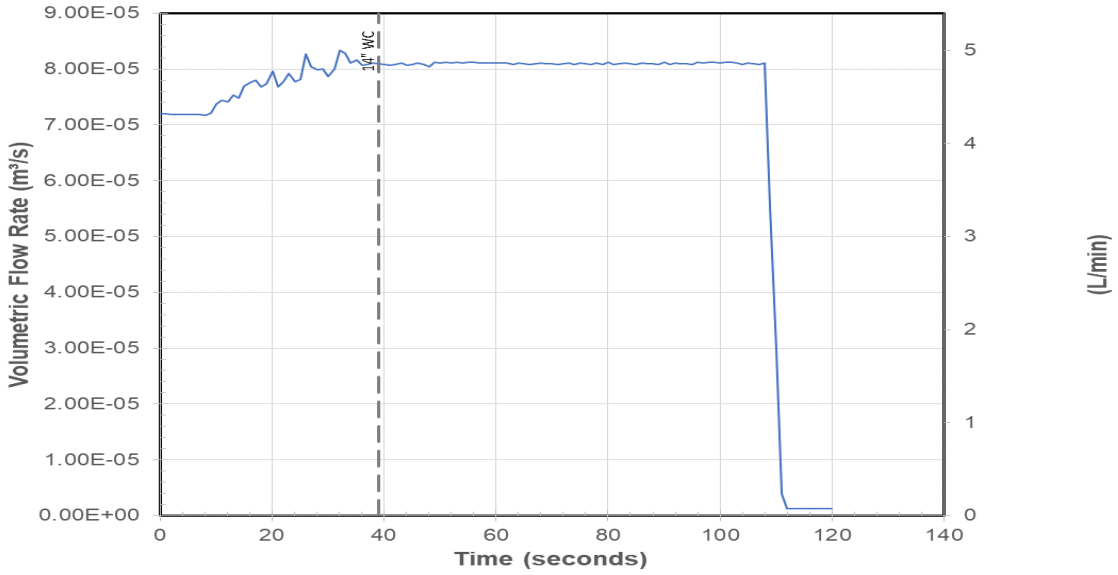

Figure 197. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 86. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	02:03:18	431	348091_20210623_140318_22A.mov
Close up	02:03:25	437	348091_20210623_140326_23A.mov
Overall	02:03:33	440	348091_20210623_140333_24A.mov
FLIR	02:03:48	440	348091_20210623_140348_6.mov
CLOSE UP	02:03:49	444	348091_20210623_140349_9.mov
OVERALL	02:03:50	444	348091_20210623_140350_10.mov
MASTER			348091_1246474.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 198. Pre test 33 seconds, 348091_1192847

Figure 199. Pre test 29 seconds, 348091_1192848

Figure 200. Post test 2 minutes, 348091_1192849

Figure 201. Post test 2 minutes, 348091_1192850

Results for Test 41 (ID 348092)

The following table lists selected events that occurred during the experiment.

Table 87. Experiment Events

Description	Time (s)
14" WC	61
11" WC	135

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

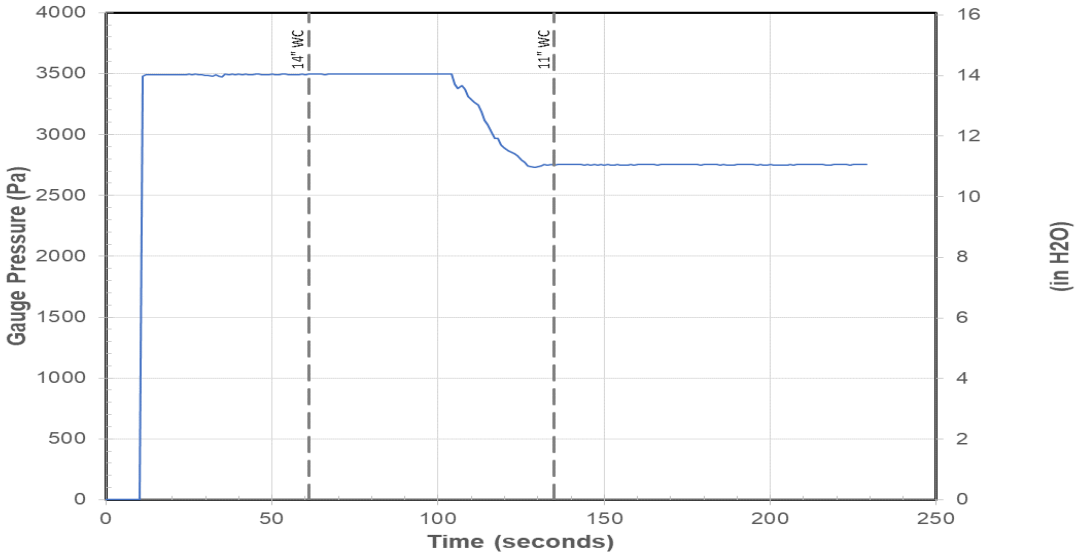

Figure 202. Gauge Pressure Data - Inlet

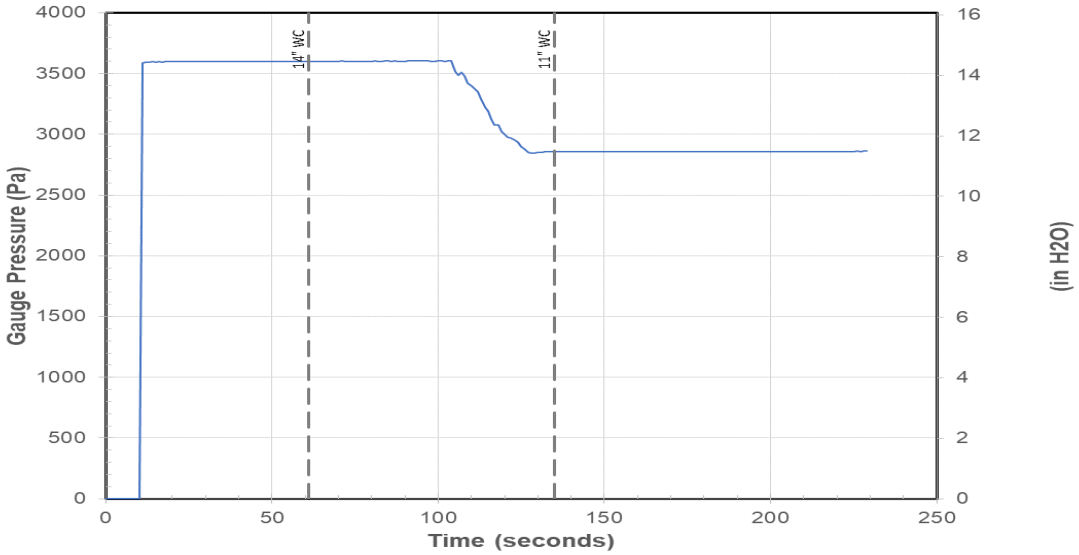

Figure 203. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

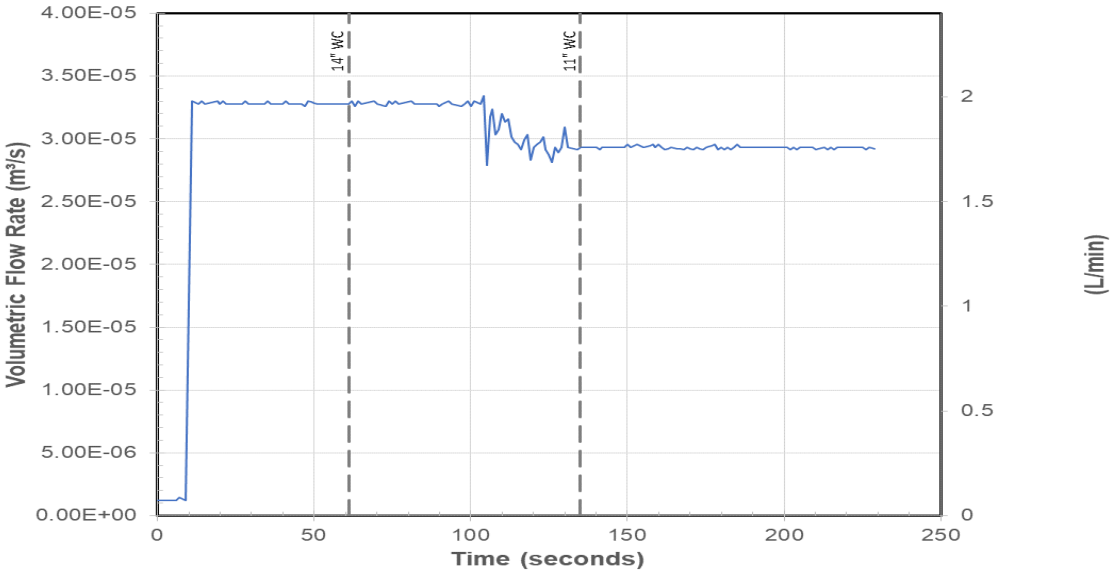

Figure 204. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 88. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	02:20:42	283	348092_20210623_142042_22A.mov
Close up	02:20:49	290	348092_20210623_142050_23A.mov
Overall	02:20:57	293	348092_20210623_142057_24A.mov
FLIR	02:21:15	289	348092_20210623_142115_6.mov
CLOSE UP	02:21:16	294	348092_20210623_142116_9.mov
OVERALL	02:21:17	294	348092_20210623_142117_10.mov
MASTER			348092_1246475.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 205. Pre test 4 minutes, 348092_1192861

Figure 206. Pre test 4 minutes, 348092_1192862

Figure 207. 197 seconds, 348092_1192863

Figure 208. 200 seconds, 348092_1192864

Figure 209. 208 seconds, 348092_1192865

Figure 210. 211 seconds, 348092_1192866

Figure 211. 217 seconds, 348092_1192867

Figure 212. 220 seconds, 348092_1192868

Figure 213. 222 seconds, 348092_1192869

Results for Test 42 (ID 348093)

The following table lists selected events that occurred during the experiment.

Table 89. Experiment Events

Description	Time (s)
11" WC	13
14" WC	88

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

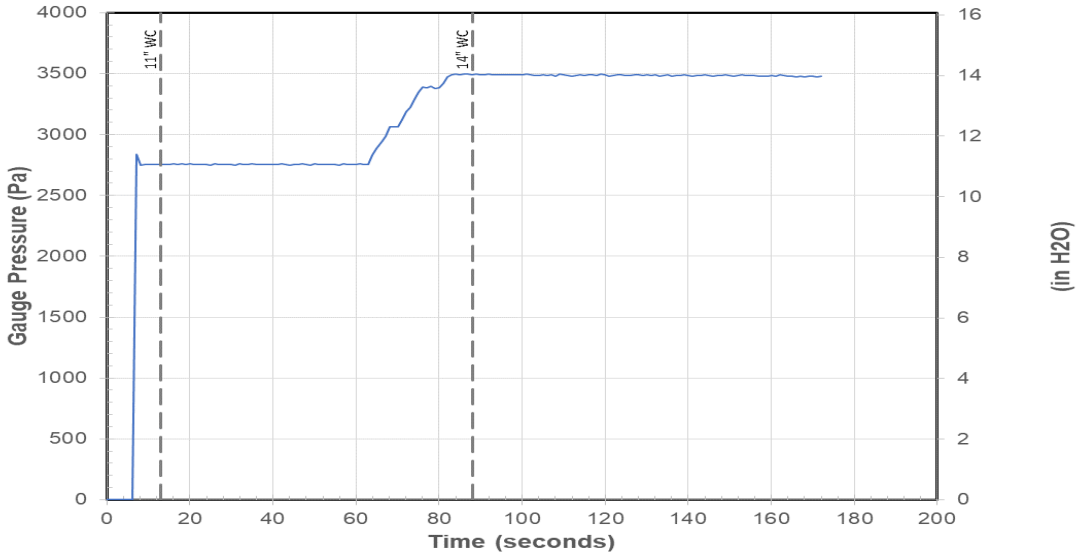

Figure 214. Gauge Pressure Data - Inlet

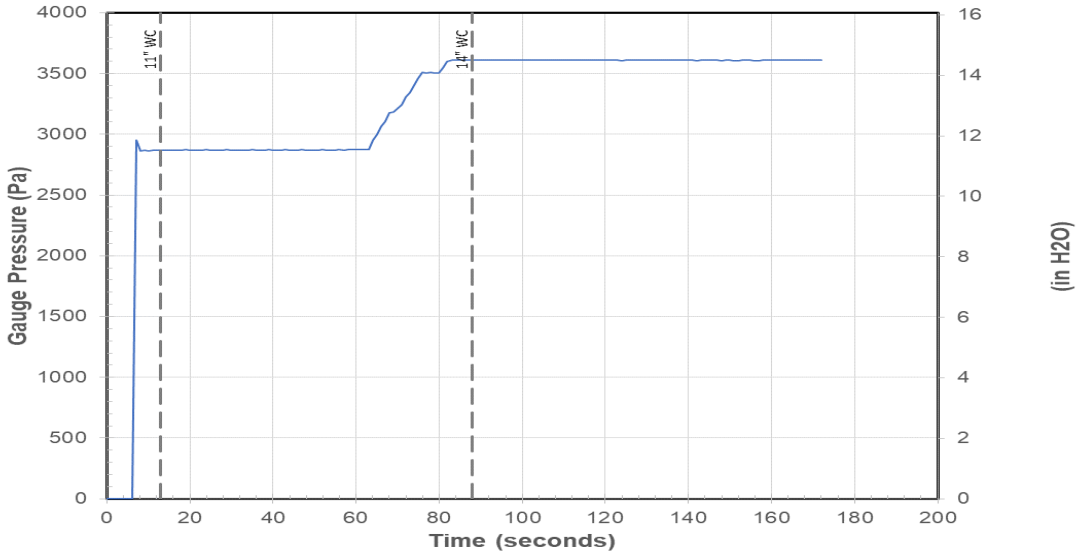

Figure 215. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

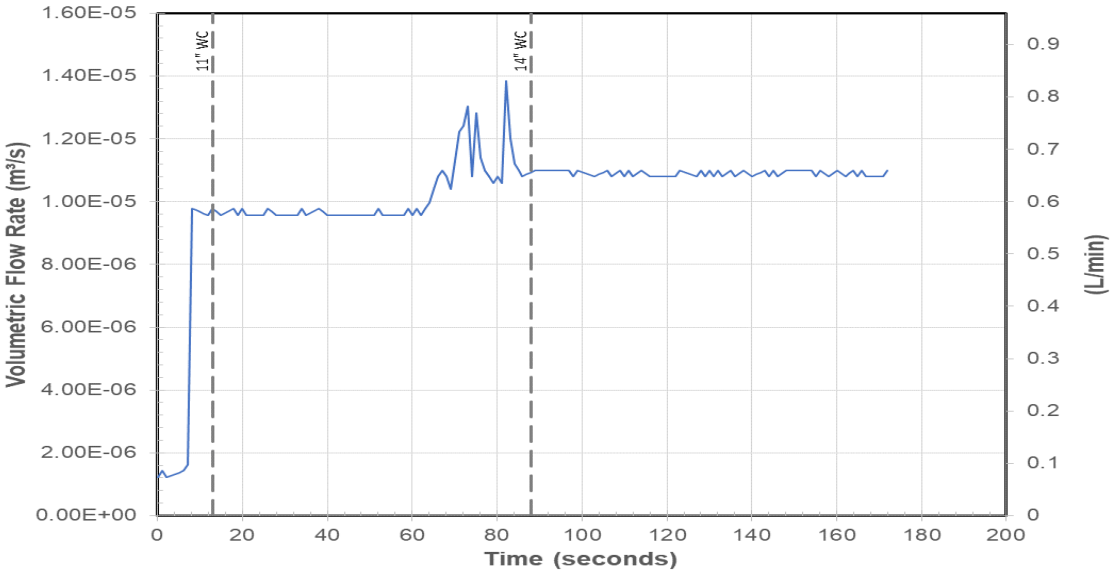

Figure 216. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 90. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	02:29:55	223	348093_20210623_142955_22A.mov
Close up	02:30:02	230	348093_20210623_143003_23A.mov
Overall	02:30:10	233	348093_20210623_143010_24A.mov
FLIR	02:30:27	230	348093_20210623_143027_6.mov
CLOSE UP	02:30:29	233	348093_20210623_143029_9.mov
OVERALL	02:30:29	234	348093_20210623_143029_10.mov
MASTER			348093_1246476.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 217. 21 seconds, 348093_1192880

Figure 218. 21 seconds, 348093_1192881

Figure 219. 27 seconds, 348093_1192882

Figure 220. 29 seconds, 348093_1192883

Figure 221. 29 seconds, 348093_1192884

Results for Test 43 (ID 348094)

The following table lists selected events that occurred during the experiment.

Table 91. Experiment Events

Description	Time (s)
4" WC	12
7" WC	120

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

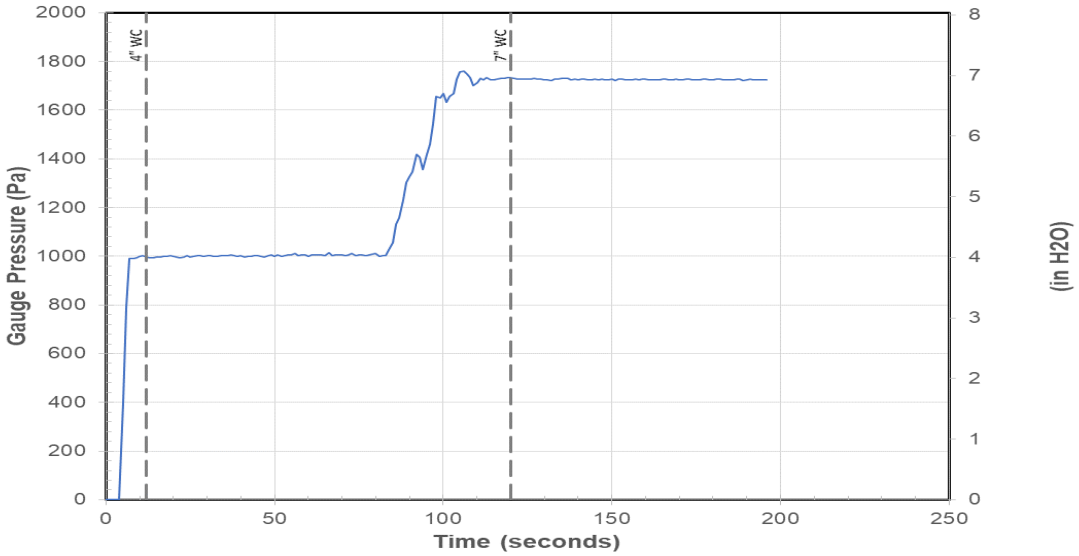

Figure 222. Gauge Pressure Data - Inlet

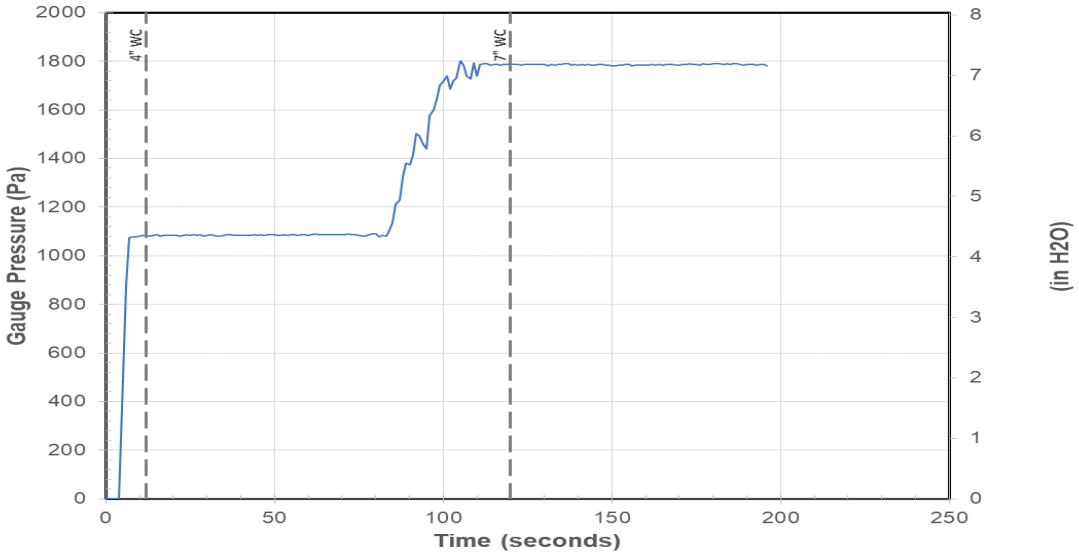

Figure 223. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

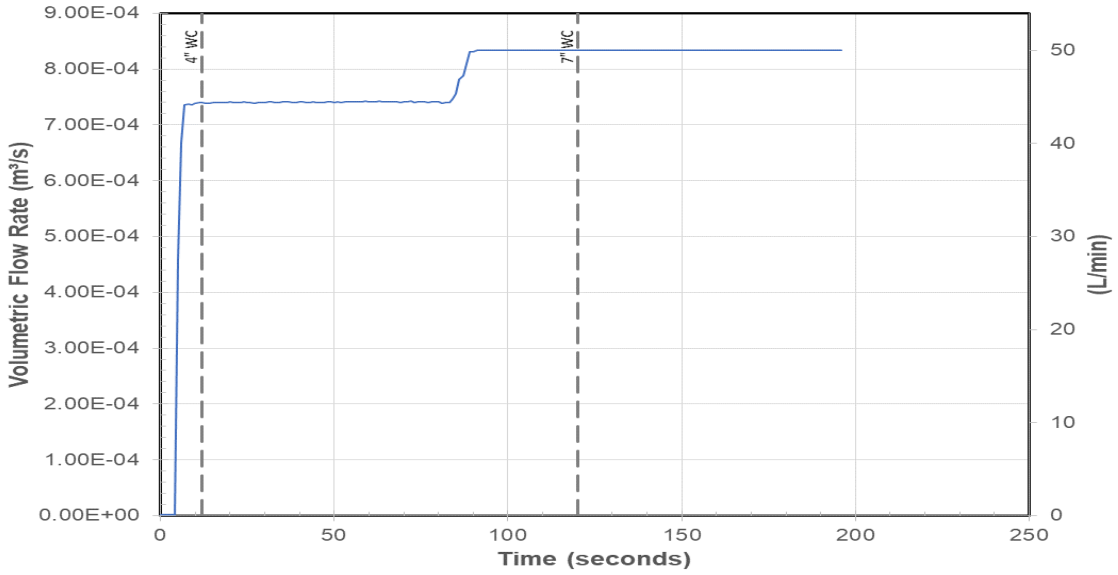

Figure 224. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 92. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	02:46:57	255	348094_20210623_144657_22A.mov
Close up	02:47:04	261	348094_20210623_144705_23A.mov
Overall	02:47:12	265	348094_20210623_144712_24A.mov
FLIR	02:47:29	264	348094_20210623_144729_6.mov
CLOSE UP	02:47:30	264	348094_20210623_144730_9.mov
OVERALL	02:47:31	264	348094_20210623_144731_10.mov
CUSTOM 8			348094_1211089.mov
CUSTOM 9			348094_1211090.mov
MASTER			348094_1246477.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 225. 186 seconds, 348094_1192895

Results for Test 44 (ID 348095)

The following table lists selected events that occurred during the experiment.

Table 93. Experiment Events

Description	Time (s)
7" WC	45
4"WC	166

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

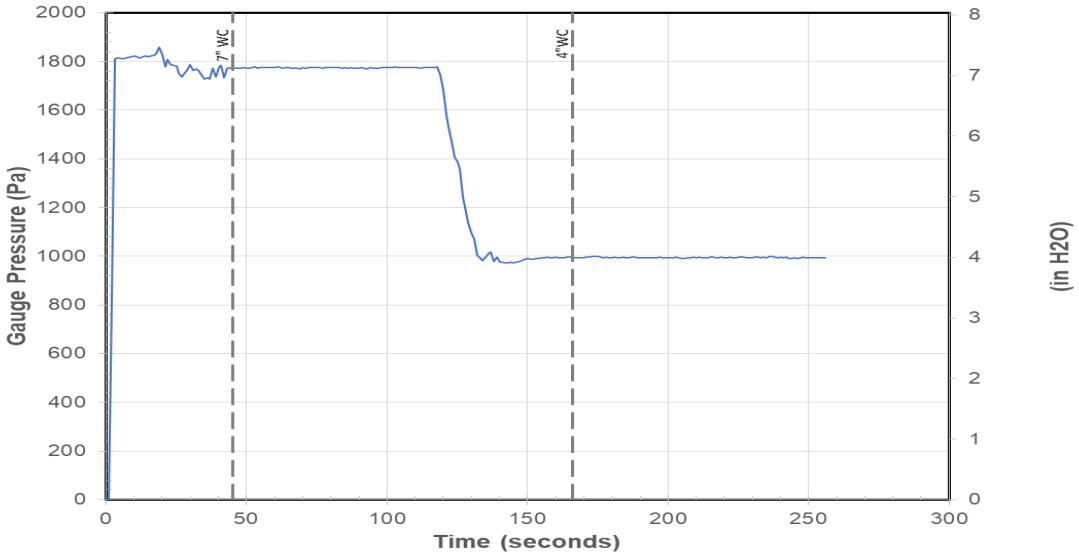

Figure 226. Gauge Pressure Data - Inlet

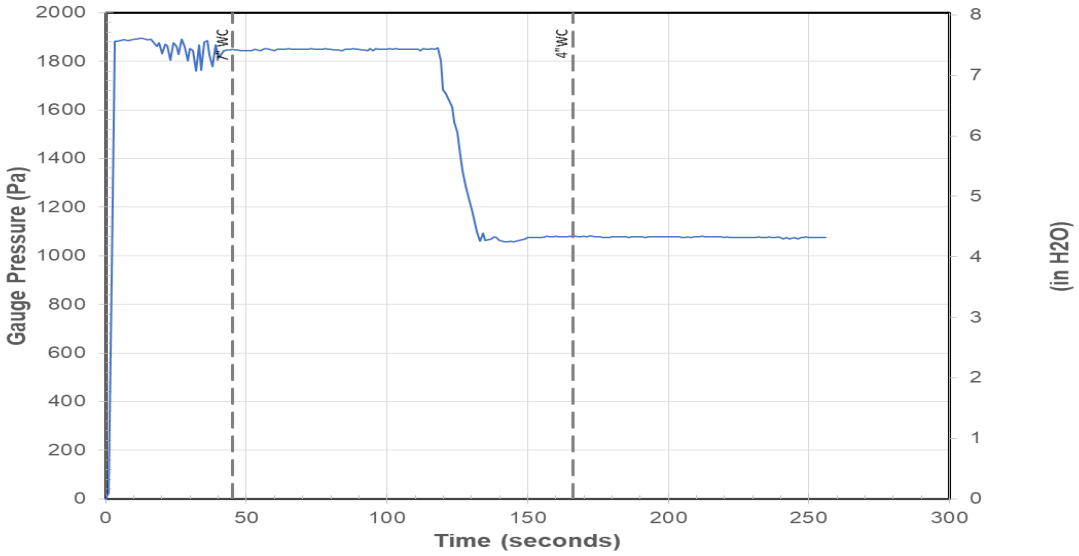

Figure 227. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

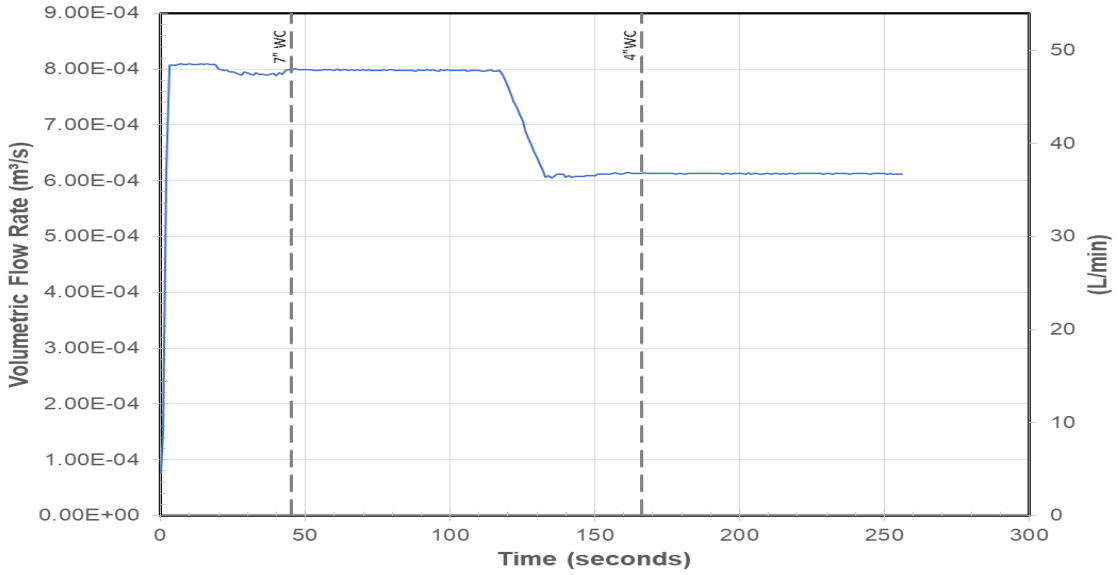

Figure 228. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 94. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	02:57:24	316	348095_20210623_145724_22A.mov
Close up	02:57:31	321	348095_20210623_145732_23A.mov
Overall	02:57:39	325	348095_20210623_145739_24A.mov
FLIR	02:57:55	325	348095_20210623_145755_6.mov
CLOSE UP	02:57:57	324	348095_20210623_145757_9.mov
OVERALL	02:57:58	328	348095_20210623_145758_10.mov
MASTER			348095_1246478.mov

Results for Test 45 (ID 348096)

The following table lists selected events that occurred during the experiment.

Table 95. Experiment Events

Description	Time (s)
4" WC	42
7" WC	146
10" WC	252

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

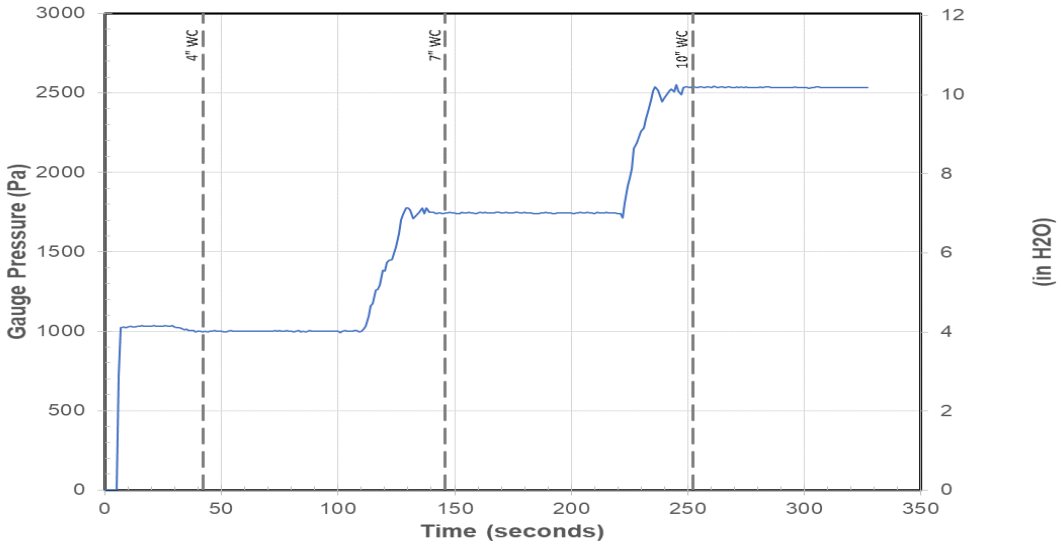

Figure 229. Gauge Pressure Data - Inlet

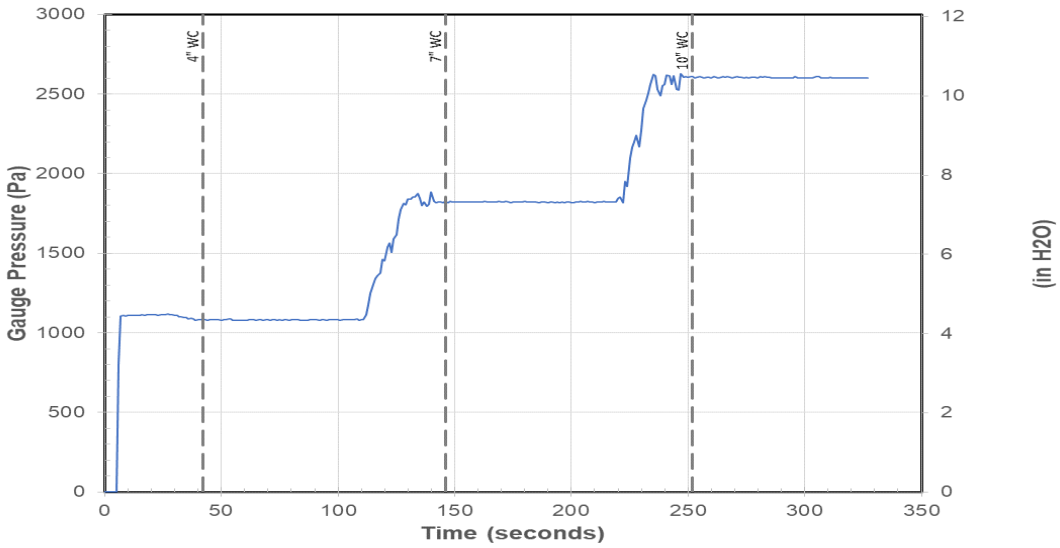

Figure 230. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

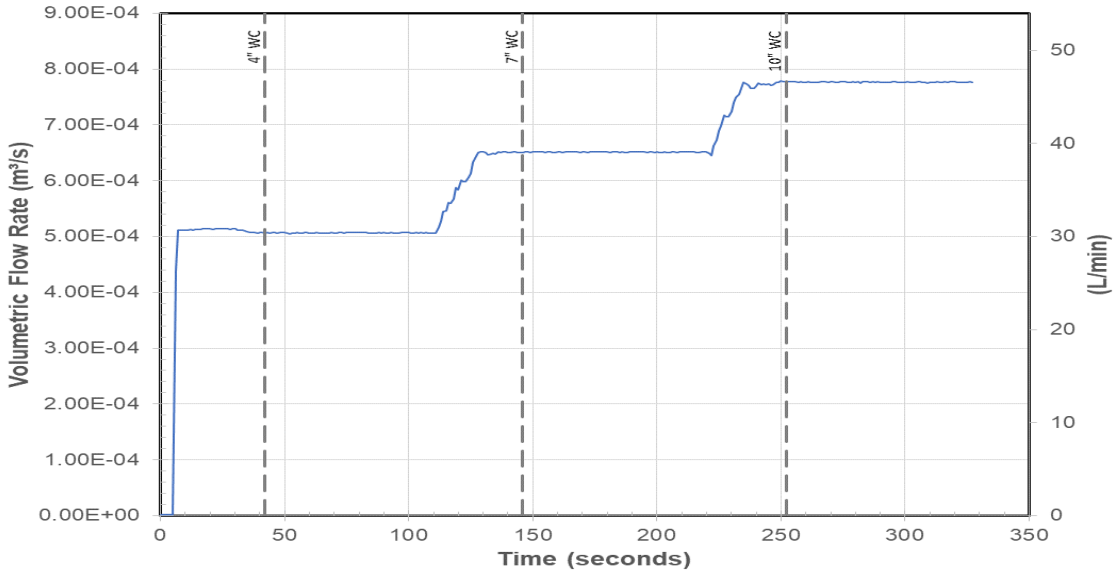

Figure 231. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 96. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	03:05:04	379	348096_20210623_150505_22A.mov
Close up	03:05:12	385	348096_20210623_150512_23A.mov
Overall	03:05:19	390	348096_20210623_150520_24A.mov
FLIR	03:05:37	384	348096_20210623_150537_6.mov
CLOSE UP	03:05:38	389	348096_20210623_150538_9.mov
OVERALL	03:05:39	389	348096_20210623_150539_10.mov
MASTER			348096_1246479.mov

Results for Test 46 (ID 348097)

The following table lists selected events that occurred during the experiment.

Table 97. Experiment Events

Description	Time (s)
10" WC	64
7" WC	175
4" WC	270

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

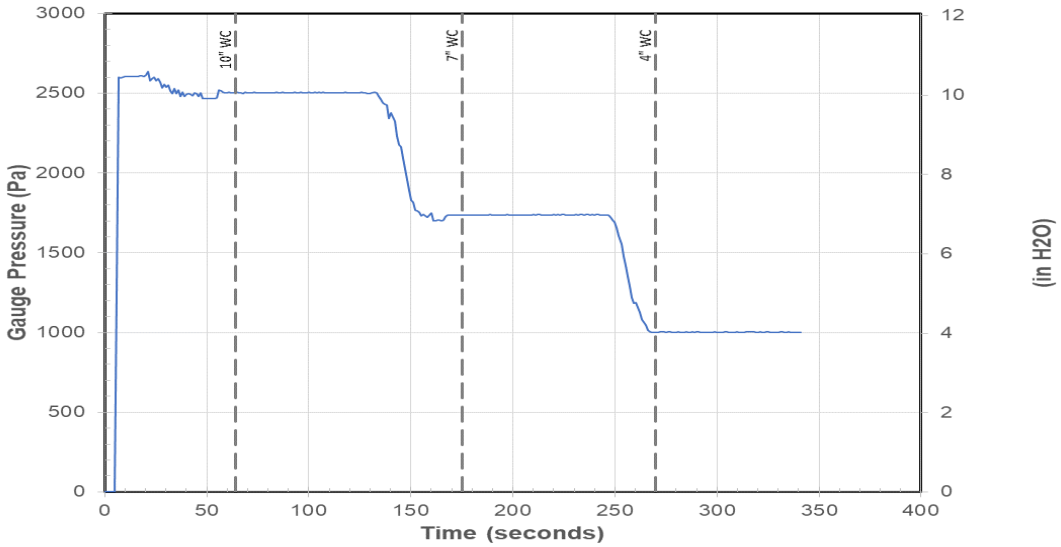

Figure 232. Gauge Pressure Data - Inlet

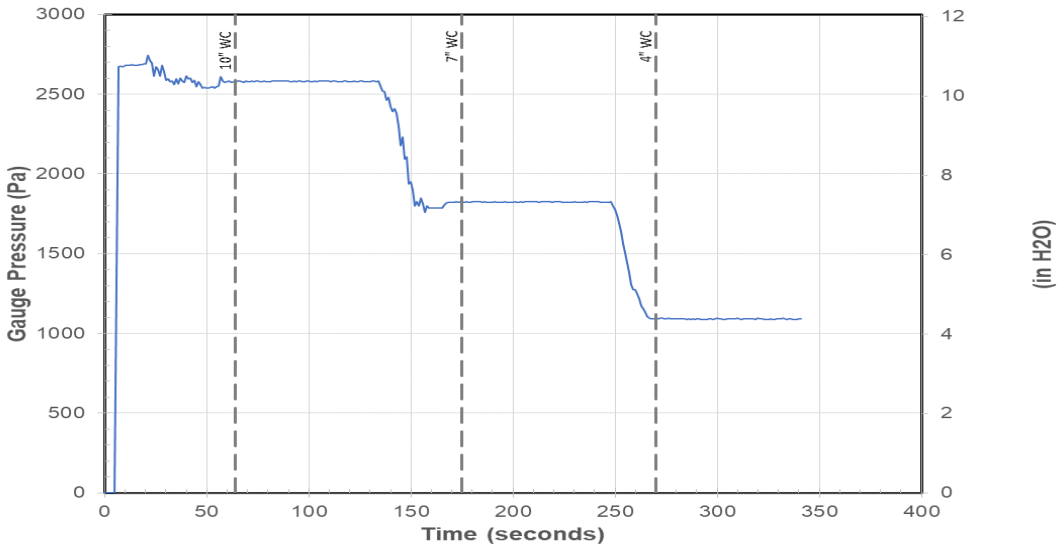

Figure 233. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

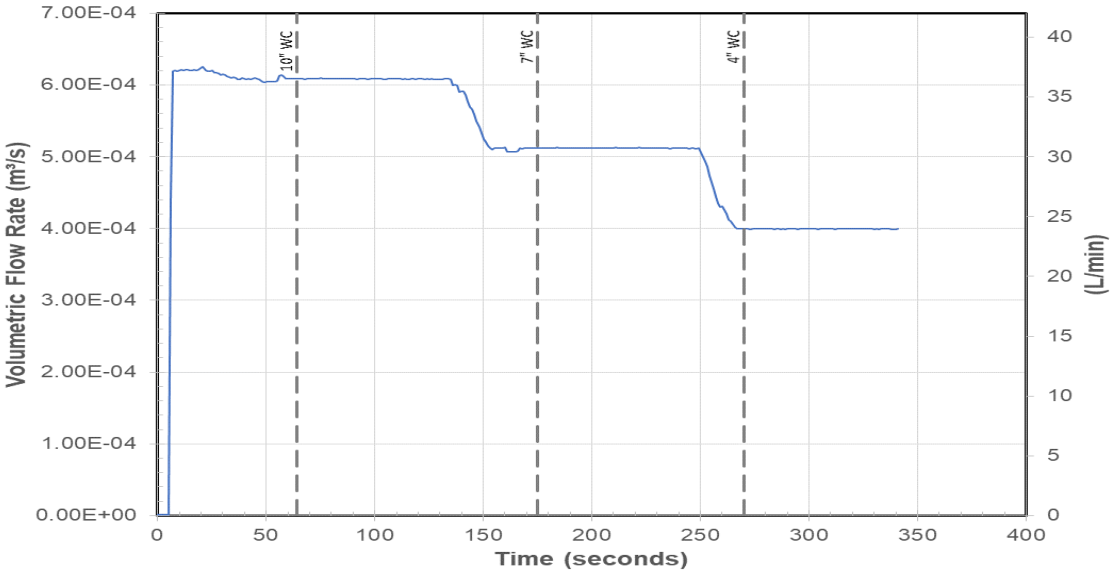

Figure 234. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 98. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	03:17:52	391	348097_20210623_151753_22A.mov
Close up	03:18:00	395	348097_20210623_151800_23A.mov
Overall	03:18:07	402	348097_20210623_151808_24A.mov
FLIR	03:18:23	400	348097_20210623_151823_6.mov
CLOSE UP	03:18:25	404	348097_20210623_151825_9.mov
OVERALL	03:18:26	404	348097_20210623_151826_10.mov
MASTER			348097_1246480.mov

Results for Test 47 (ID 348098)

The following table lists selected events that occurred during the experiment.

Table 99. Experiment Events

Description	Time (s)
4" WC	14
7" WC	200
10" WC	396

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

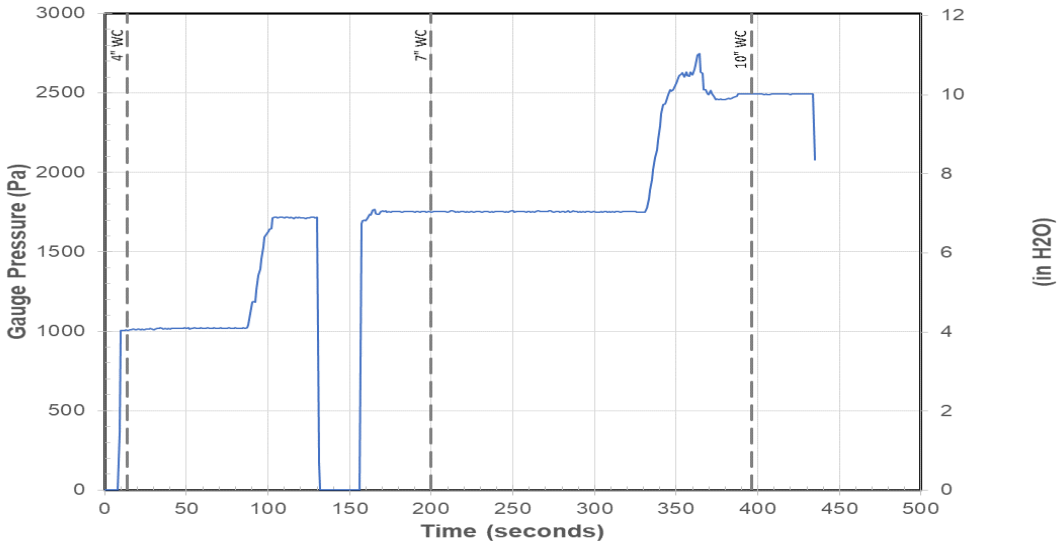

Figure 235. Gauge Pressure Data - Inlet

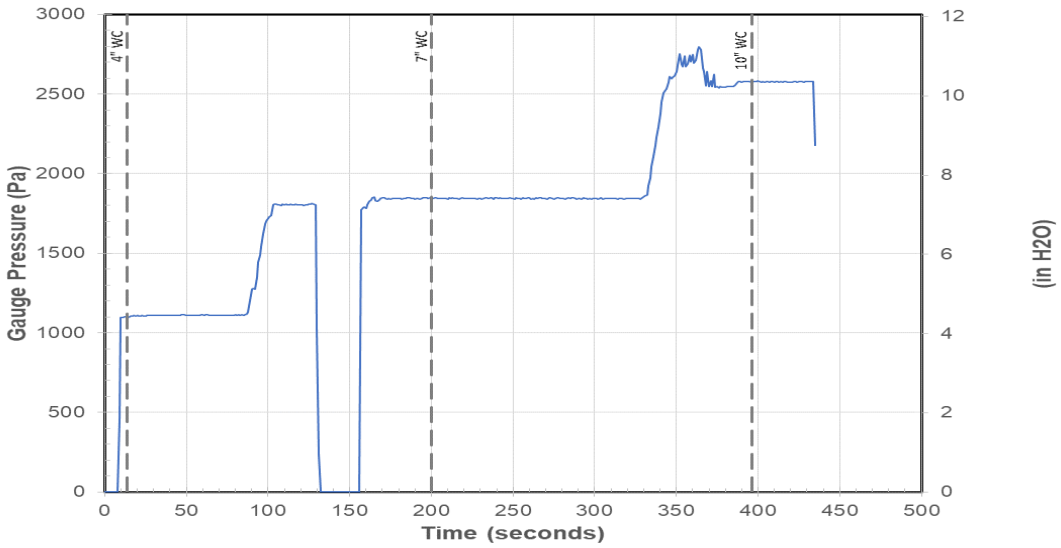

Figure 236. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

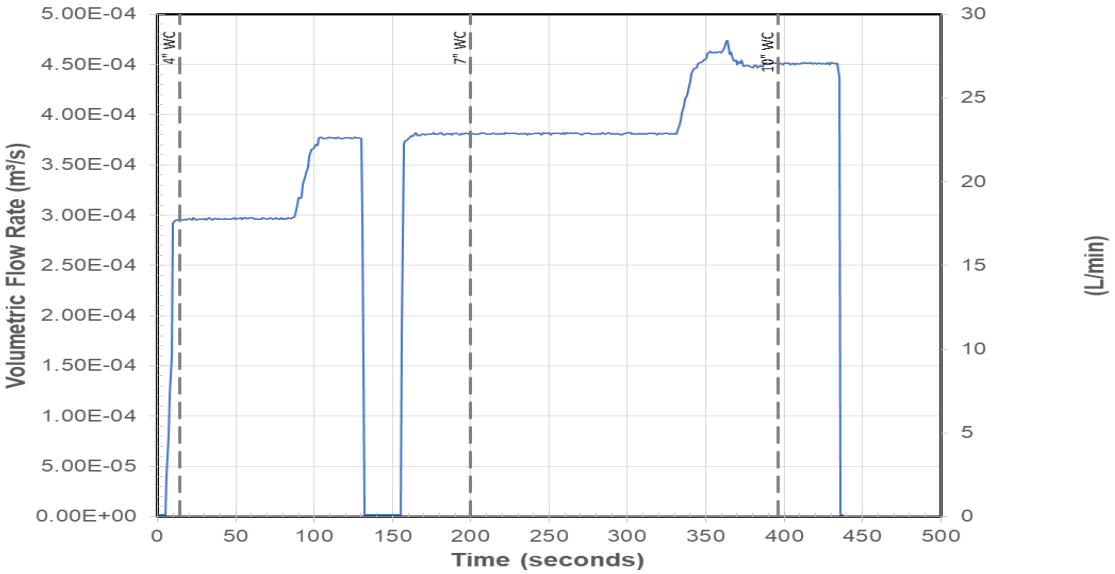

Figure 237. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 100. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	03:26:39	493	348098_20210623_152640_22A.mov
Close up	03:26:51	494	348098_20210623_152651_23A.mov
Overall	03:26:58	497	348098_20210623_152659_24A.mov
FLIR	03:27:15	494	348098_20210623_152715_6.mov
CLOSE UP	03:27:16	499	348098_20210623_152716_9.mov
OVERALL	03:27:17	499	348098_20210623_152717_10.mov
MASTER			348098_1246481.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 238. 290 seconds, 348098_1193071

Figure 239. 292 seconds, 348098_1193072

Figure 240. 294 seconds, 348098_1193073

Figure 241. 298 seconds, 348098_1193074

Figure 242. 304 seconds, 348098_1193075

Figure 243. 306 seconds, 348098_1193076

Figure 244. 412 seconds, 348098_1193077

Figure 245. 414 seconds, 348098_1193078

Figure 246. 418 seconds, 348098_1193079

Figure 247. 422 seconds, 348098_1193080

Figure 248. 424 seconds, 348098_1193081

Results for Test 48 (ID 348099)

The following table lists selected events that occurred during the experiment.

Table 101. Experiment Events

Description	Time (s)
4" WC	46
Obstruction added	200
7" WC	230
10" WC	348

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

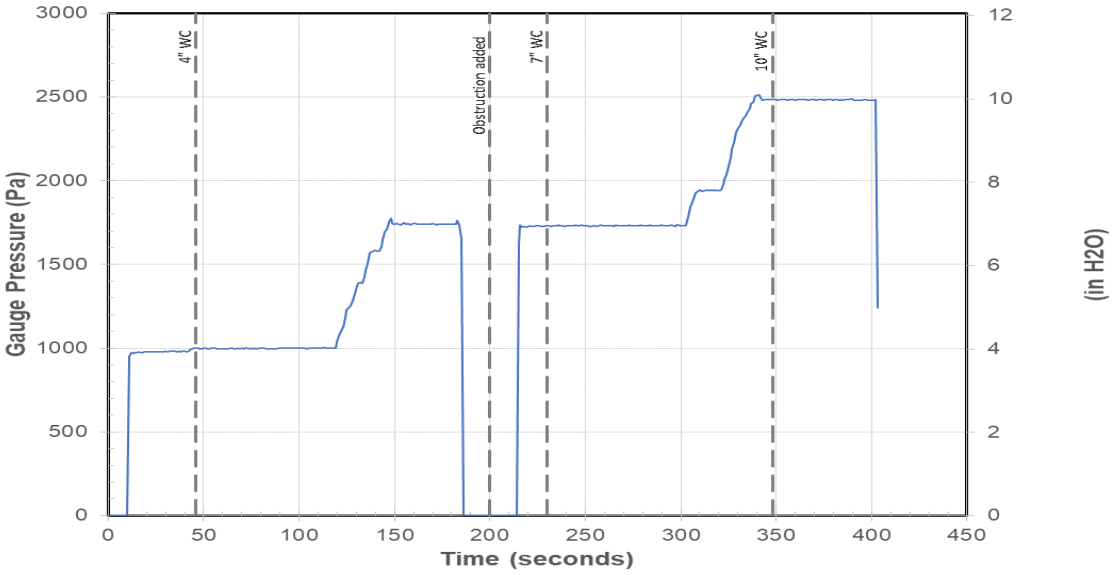

Figure 249. Gauge Pressure Data - Inlet

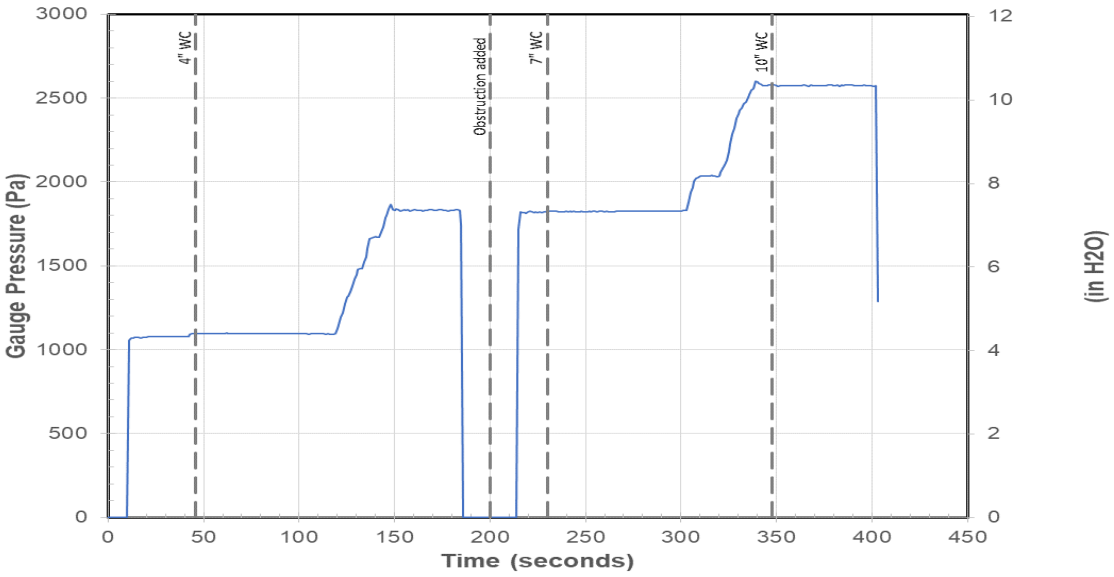

Figure 250. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

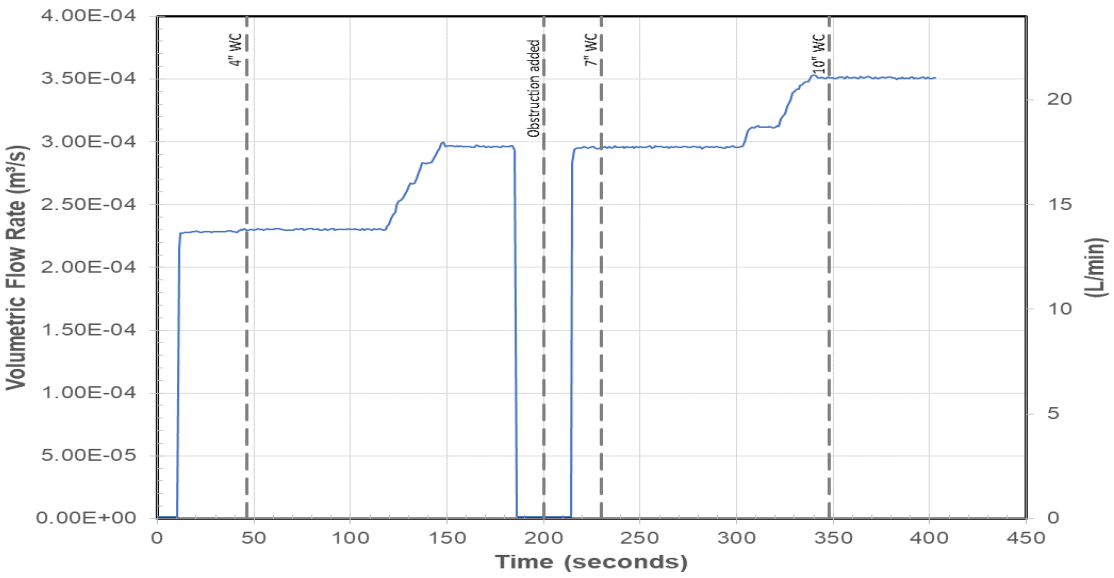

Figure 251. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 102. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	03:38:53	492	348099_20210623_153853_22A.mov
Close up	03:39:00	498	348099_20210623_153901_23A.mov
Overall	03:39:08	501	348099_20210623_153908_24A.mov
FLIR	03:39:26	500	348099_20210623_153926_6.mov
CLOSE UP	03:39:28	499	348099_20210623_153928_9.mov
OVERALL	03:39:29	499	348099_20210623_153929_10.mov
MASTER			348099_1246482.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 252. 273 seconds, 348100_1193105

Figure 253. 275 seconds, 348100_1193106

Figure 254. 277 seconds, 348100_1193107

Figure 255. 283 seconds, 348100_1193108

Figure 256. 285 seconds, 348100_1193109

Figure 257. 288 seconds, 348100_1193110

Figure 258. 376 seconds, 348100_1193111

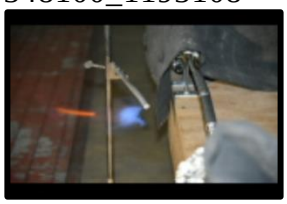

Figure 259. 378 seconds, 348100_1193112

Figure 260. 385 seconds, 348100_1193113

Figure 261. 388 seconds, 348100_1193114

Results for Test 49 (ID 348100)

The following table lists selected events that occurred during the experiment.

Table 103. Experiment Events

Description	Time (s)
4" WC	9
7" WC	92
10" WC	157

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

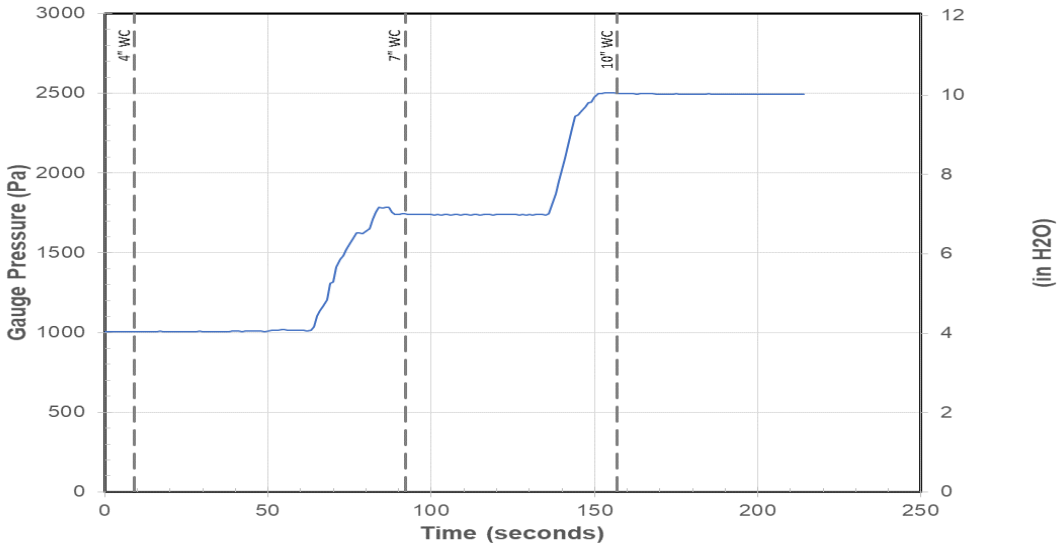

Figure 262. Gauge Pressure Data - Inlet

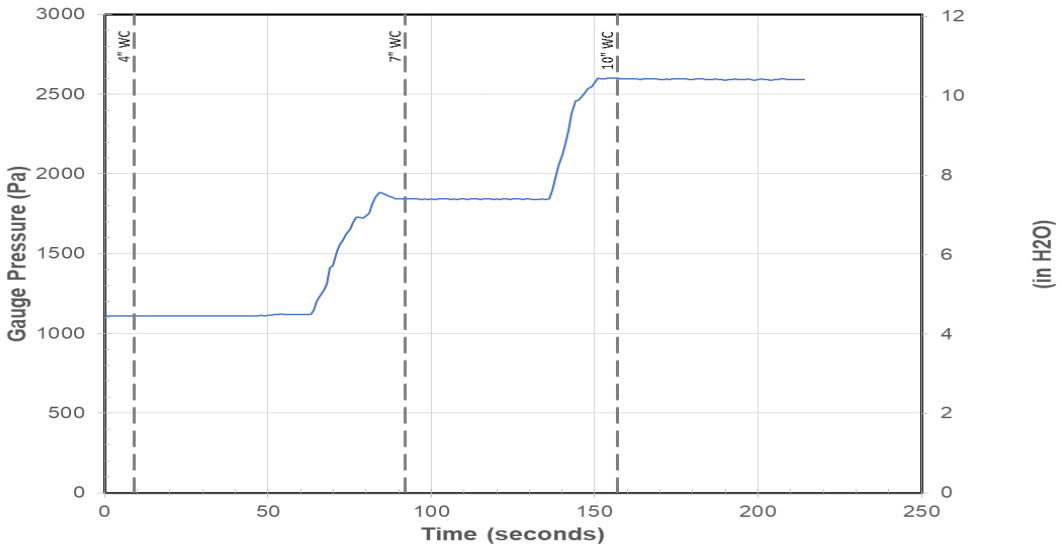

Figure 263. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

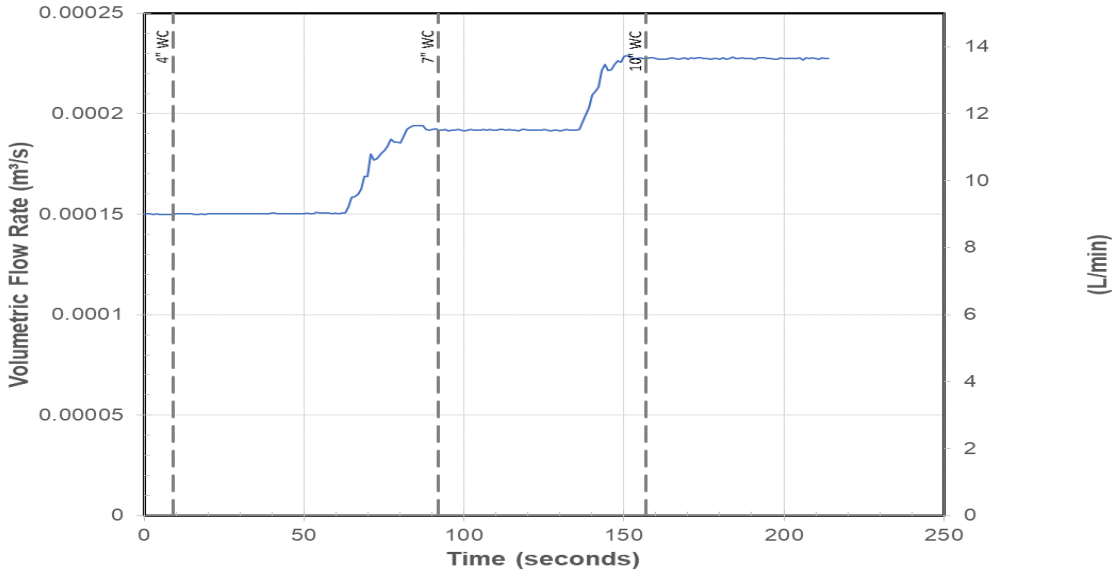

Figure 264. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 104. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	03:50:33	286	348100_20210623_155034_22A.mov
Close up	03:50:45	285	348100_20210623_155045_23A.mov
Overall	03:50:52	289	348100_20210623_155052_24A.mov
FLIR	03:51:08	290	348100_20210623_155108_6.mov
CLOSE UP	03:51:10	289	348100_20210623_155110_9.mov
OVERALL	03:51:10	289	348100_20210623_155110_10.mov
MASTER			348100_1246483.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 265. 21 seconds, 348100_1193115

Figure 266. 23 seconds, 348100_1193116

Figure 267. 31 seconds, 348100_1193117

Figure 268. 33 seconds, 348100_1193118

Figure 269. 198 seconds, 348100_1193119

Figure 270. 202 seconds, 348100_1193120

Figure 271. 203 seconds, 348100_1193121

Results for Test 50 (ID 348101)

The following table lists selected events that occurred during the experiment.

Table 105. Experiment Events

Description	Time (s)
10" WC	48
7" WC	100
4" WC	200

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

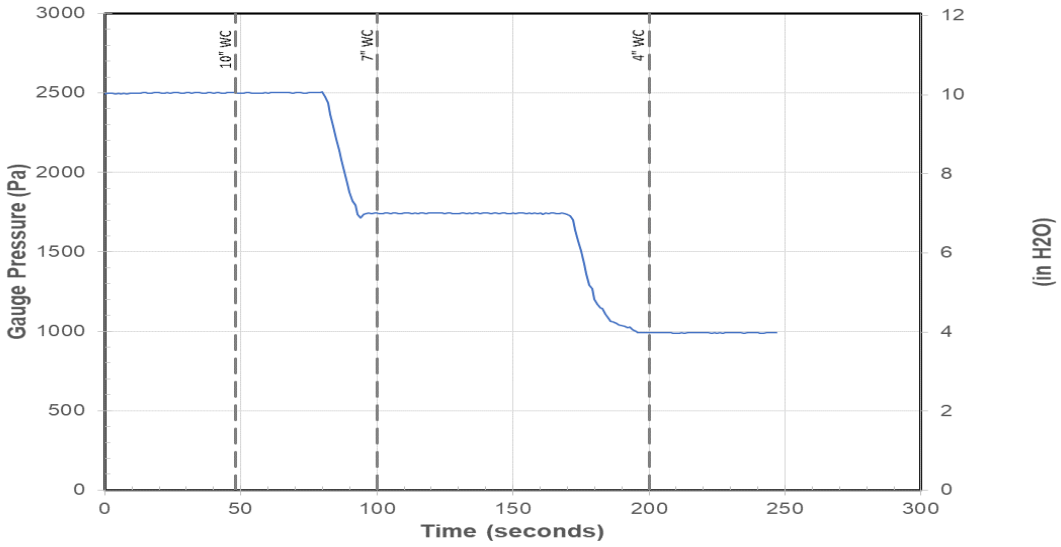

Figure 272. Gauge Pressure Data - Inlet

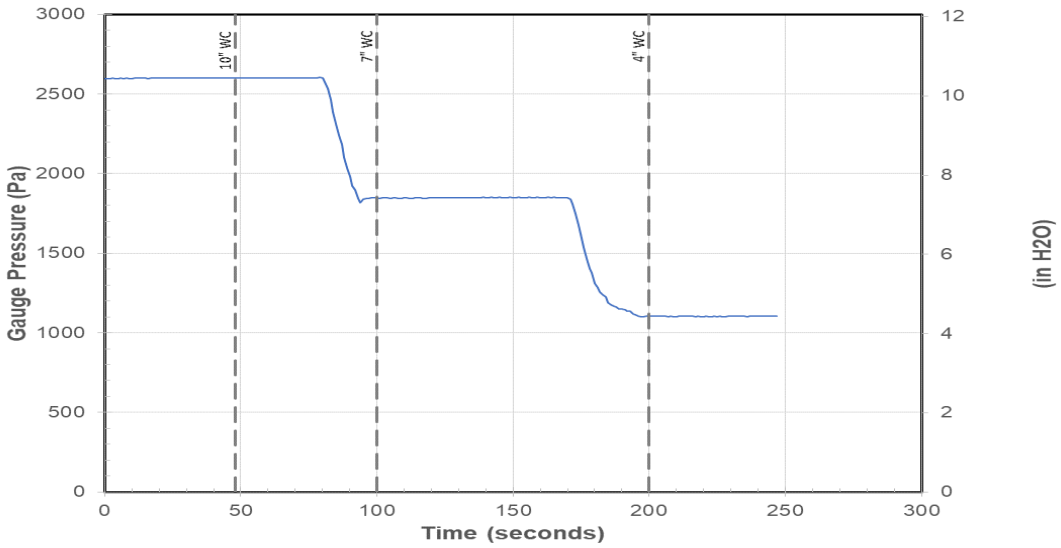

Figure 273. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

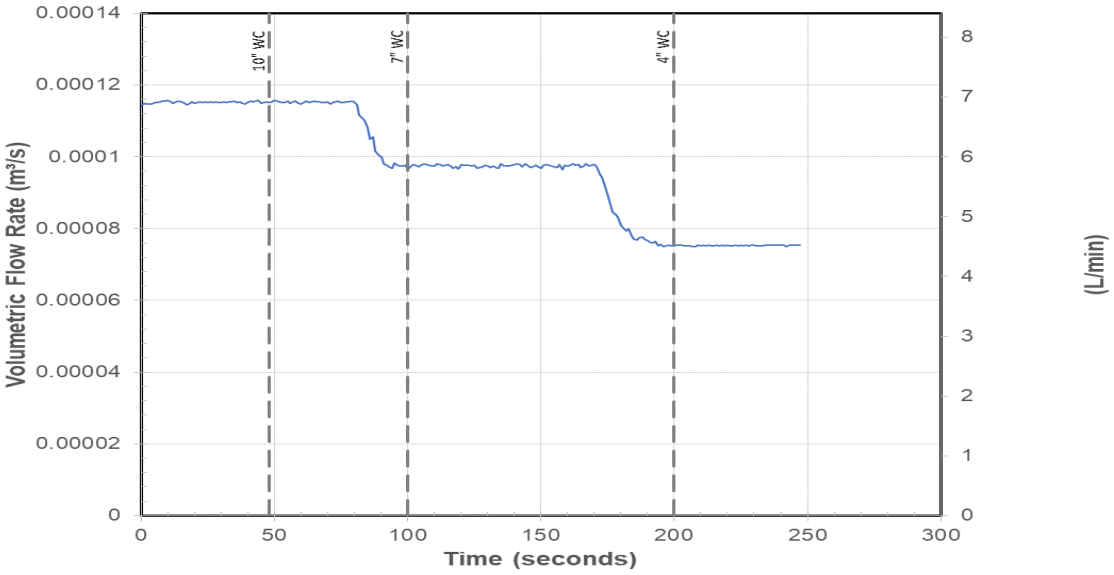

Figure 274. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 106. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	03:59:04	308	348101_20210623_155904_22A.mov
Close up	03:59:11	314	348101_20210623_155912_23A.mov
Overall	03:59:19	317	348101_20210623_155919_24A.mov
FLIR	03:59:35	314	348101_20210623_155935_6.mov
CLOSE UP	03:59:36	319	348101_20210623_155936_9.mov
OVERALL	03:59:37	319	348101_20210623_155937_10.mov
MASTER			348101_1246484.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 275. 24 seconds, 348101_1193133

Figure 276. 34 seconds, 348101_1193134

Figure 277. 40 seconds, 348101_1193135

Figure 278. 48 seconds, 348101_1193136

Figure 279. 48 seconds, 348101_1193137

Figure 280. 114 seconds, 348101_1193138

Figure 281. 120 seconds, 348101_1193139

Figure 282. 234 seconds, 348101_1193140

Figure 283. 236 seconds, 348101_1193141

Results for Test 51 (ID 348102)

The following table lists selected events that occurred during the experiment.

Table 107. Experiment Events

Description	Time (s)
4" WC	27
7" WC	91
10" WC	171

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

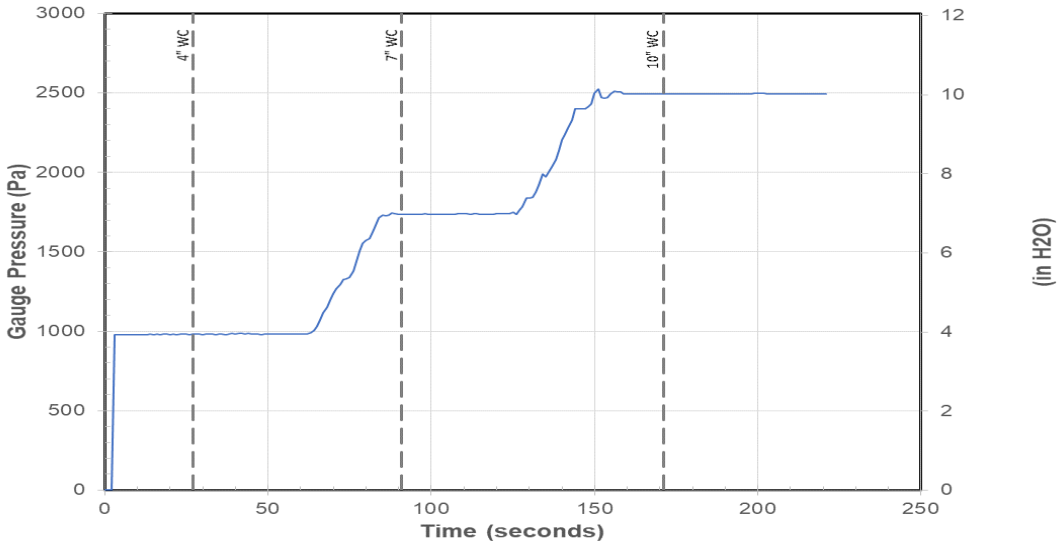

Figure 284. Gauge Pressure Data - Inlet

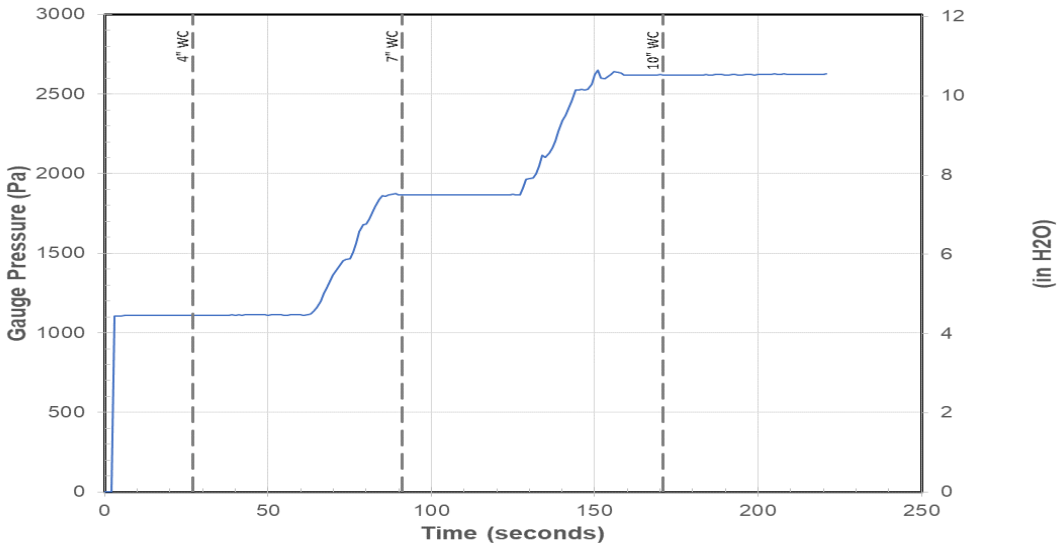

Figure 285. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

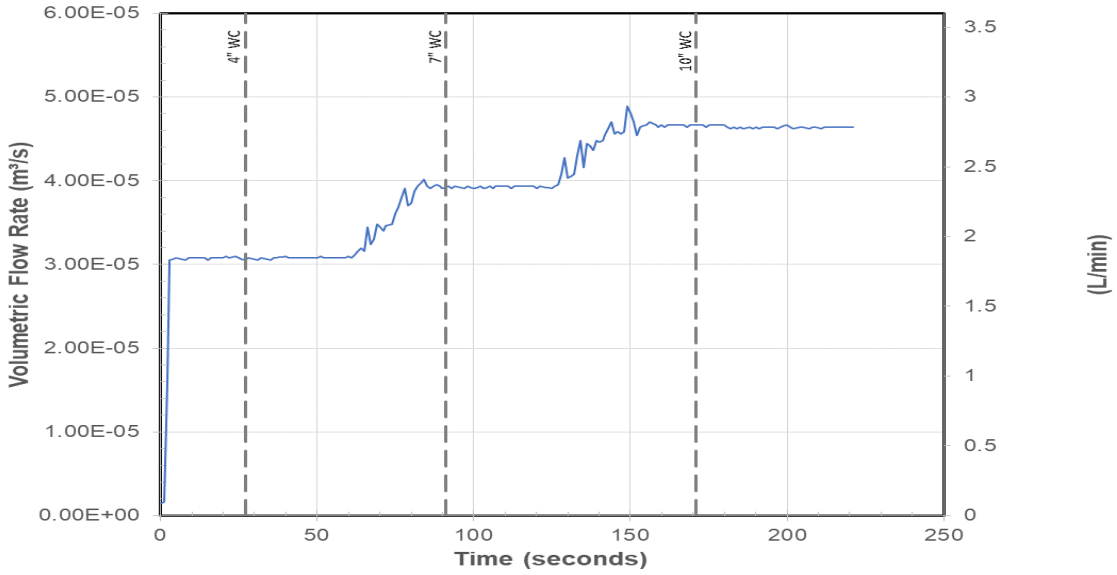

Figure 286. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 108. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	04:07:41	275	348102_20210623_160741_22A.mov
Close up	04:07:48	282	348102_20210623_160749_23A.mov
Overall	04:07:56	285	348102_20210623_160756_24A.mov
FLIR	04:08:11	285	348102_20210623_160811_6.mov
CLOSE UP	04:08:13	283	348102_20210623_160813_9.mov
OVERALL	04:08:13	289	348102_20210623_160813_10.mov
MASTER			348102_1246485.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 287. 39 seconds, 348102_1193153

Figure 288. 39 seconds, 348102_1193154

Figure 289. 43 seconds, 348102_1193155

Figure 290. 47 seconds, 348102_1193156

Figure 291. 205 seconds, 348102_1193157

Figure 292. 209 seconds, 348102_1193158

Figure 293. 211 seconds, 348102_1193159

Results for Test 52 (ID 348103)

The following table lists selected events that occurred during the experiment.

Table 109. Experiment Events

Description	Time (s)
10" WC	20
7" WC	104
4" WC	178

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

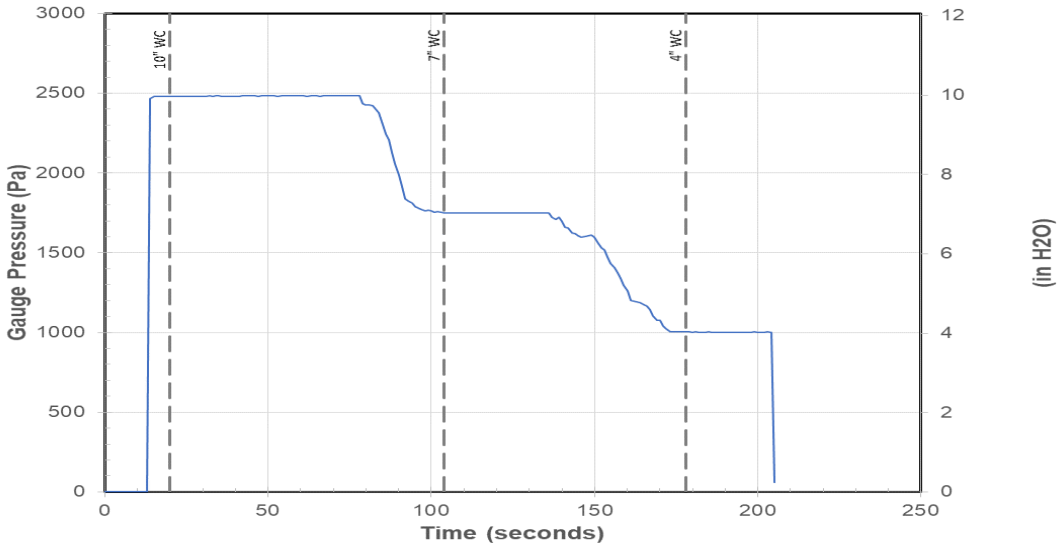

Figure 294. Gauge Pressure Data - Inlet

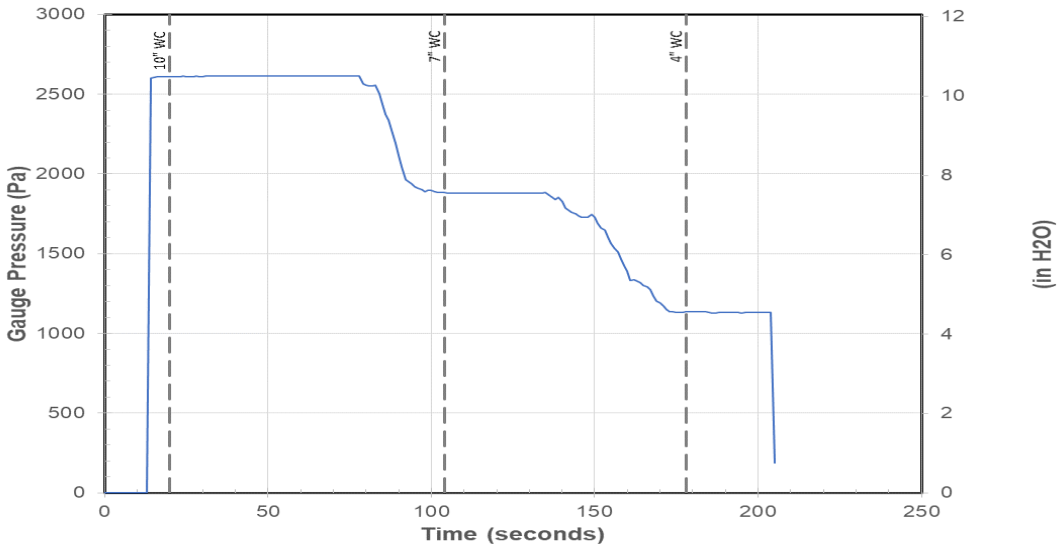

Figure 295. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

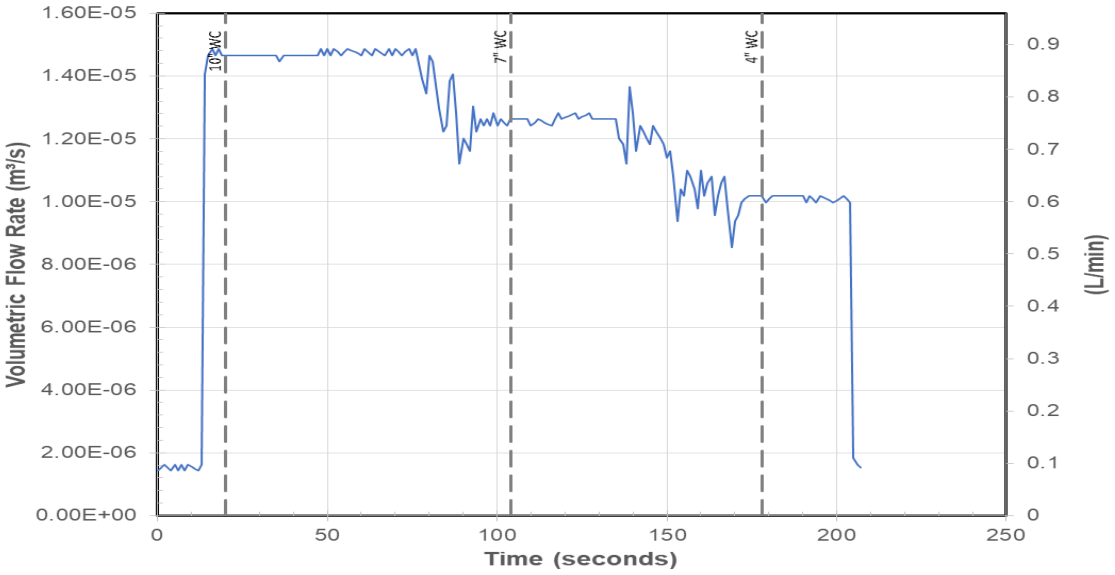

Figure 296. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 110. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	04:15:43	268	348103_20210623_161543_22A.mov
Close up	04:15:50	274	348103_20210623_161551_23A.mov
Overall	04:15:58	277	348103_20210623_161558_24A.mov
FLIR	04:16:12	280	348103_20210623_161612_6.mov
CLOSE UP	04:16:14	279	348103_20210623_161614_9.mov
OVERALL	04:16:15	278	348103_20210623_161615_10.mov
MASTER			348103_1246486.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 297. 43 seconds, 348103_1193171

Figure 298. 45 seconds, 348103_1193172

Figure 299. 53 seconds, 348103_1193173

Figure 300. 55 seconds, 348103_1193174

Results for Test 53 (ID 348104)

The following table lists selected events that occurred during the experiment.

Table 111. Experiment Events

Description	Time (s)
10" WC	34

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

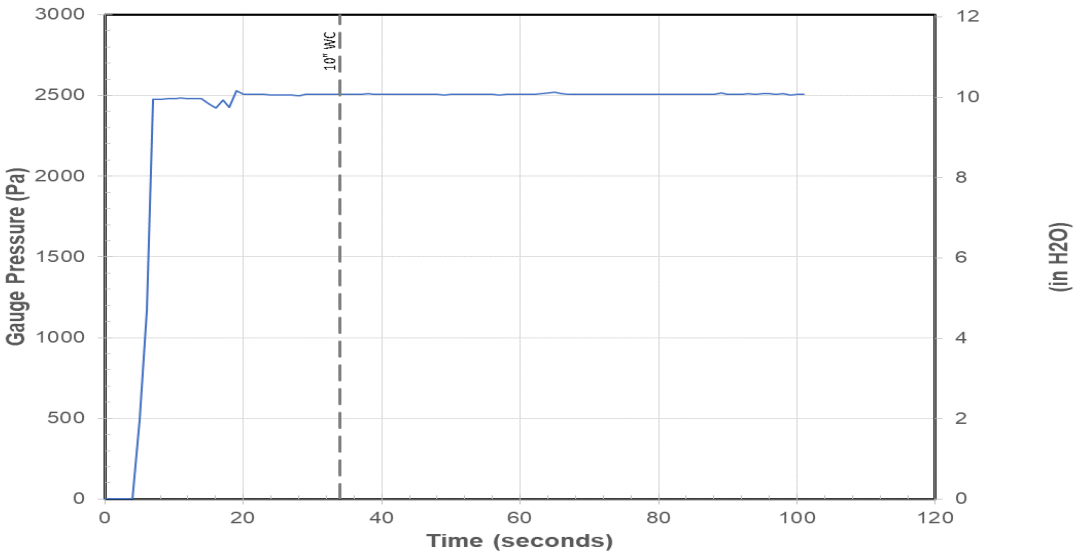

Figure 301. Gauge Pressure Data - Inlet

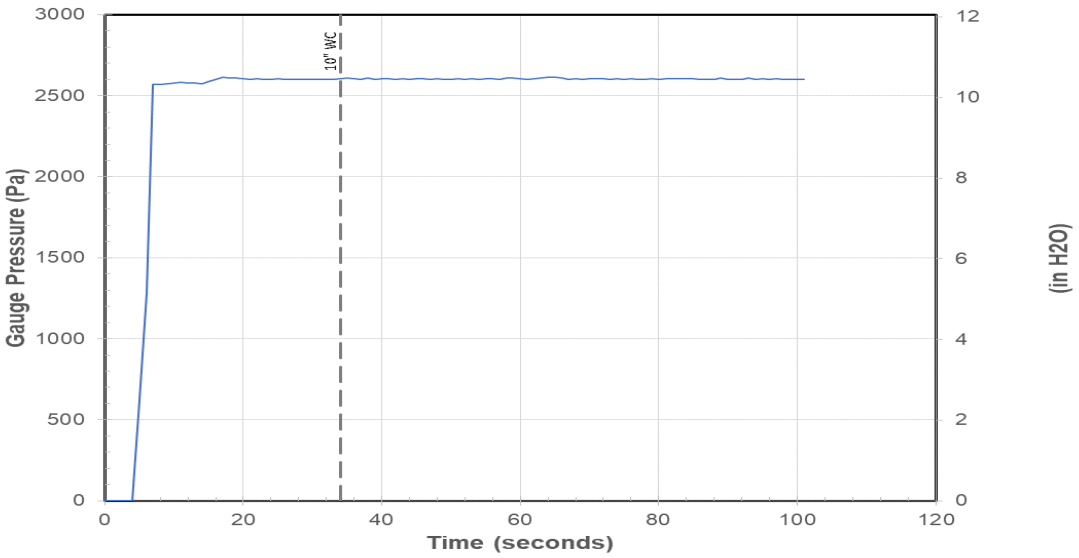

Figure 302. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

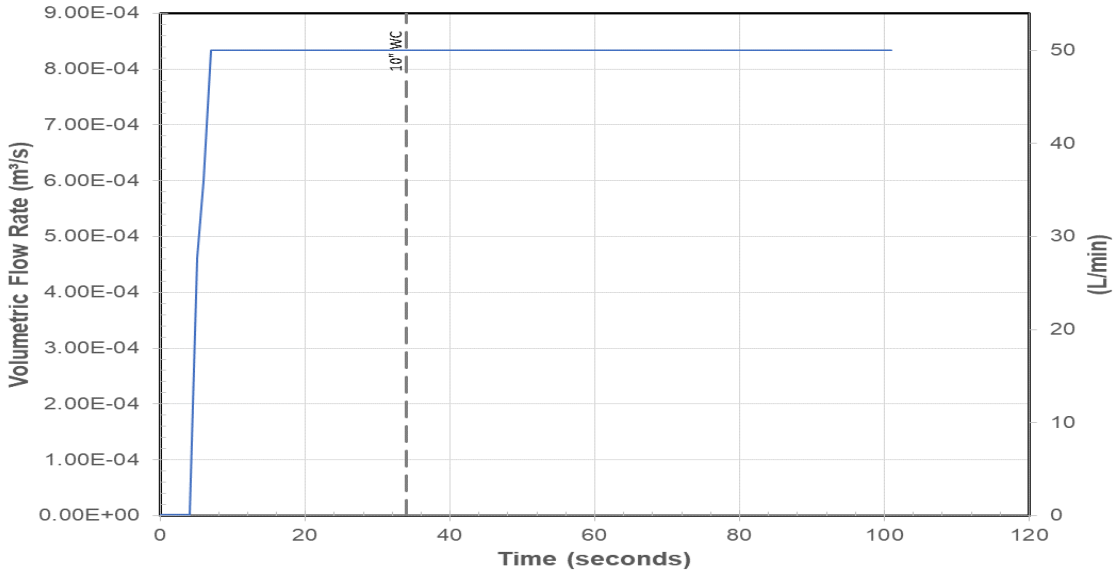

Figure 303. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 112. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	04:24:05	168	348104_20210623_162405_22A.mov
Close up	04:24:12	174	348104_20210623_162413_23A.mov
Overall	04:24:20	177	348104_20210623_162420_24A.mov
FLIR	04:24:34	179	348104_20210623_162434_6.mov
CLOSE UP	04:24:35	179	348104_20210623_162435_9.mov
OVERALL	04:24:36	179	348104_20210623_162436_10.mov
MASTER			348104_1246487.mov

Results for Test 54 (ID 348105)

The following table lists selected events that occurred during the experiment.

Table 113. Experiment Events

Description	Time (s)
10" WC	24

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

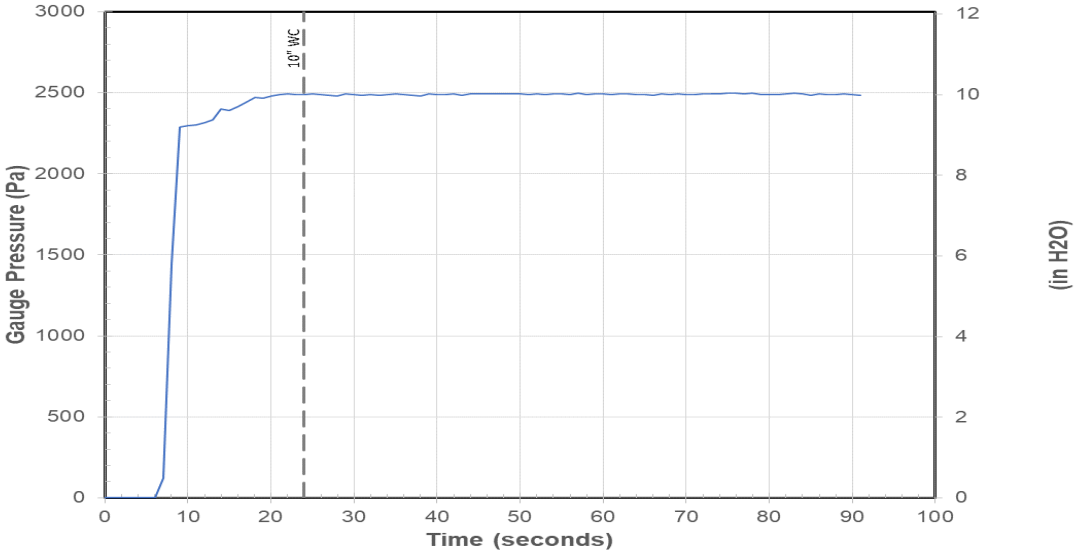

Figure 304. Gauge Pressure Data - Inlet

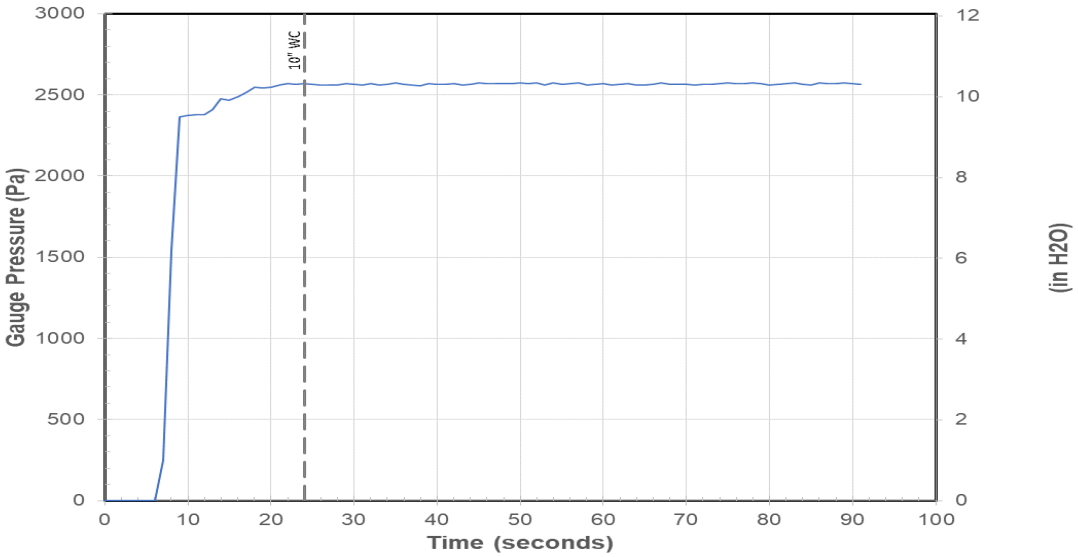

Figure 305. Gauge Pressure Data - Outlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

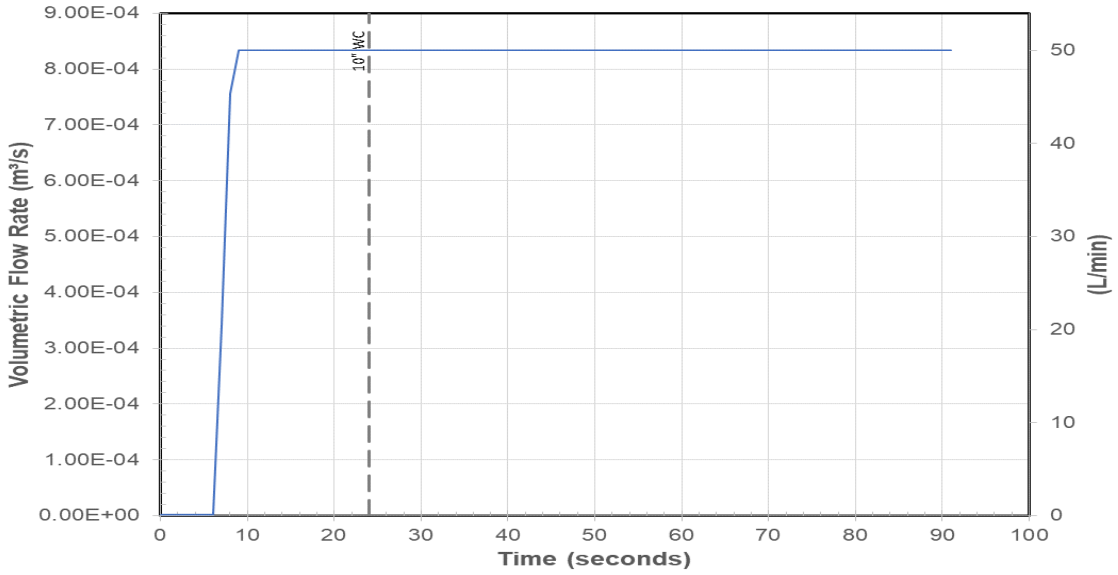

Figure 306. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 114. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	04:29:10	142	348105_20210623_162910_22A.mov
Close up	04:29:17	150	348105_20210623_162918_23A.mov
Overall	04:29:25	153	348105_20210623_162925_24A.mov
FLIR	04:29:40	154	348105_20210623_162940_6.mov
CLOSE UP	04:29:41	154	348105_20210623_162941_9.mov
OVERALL	04:29:42	154	348105_20210623_162942_10.mov
CUSTOM 10			348105_1211091.mov
MASTER			348105_1246488.mov

Results for Test 55 (ID 348111)

The following table lists selected events that occurred during the experiment.

Table 115. Experiment Events

Description	Time (s)
10" WC	42
14" WC	120

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

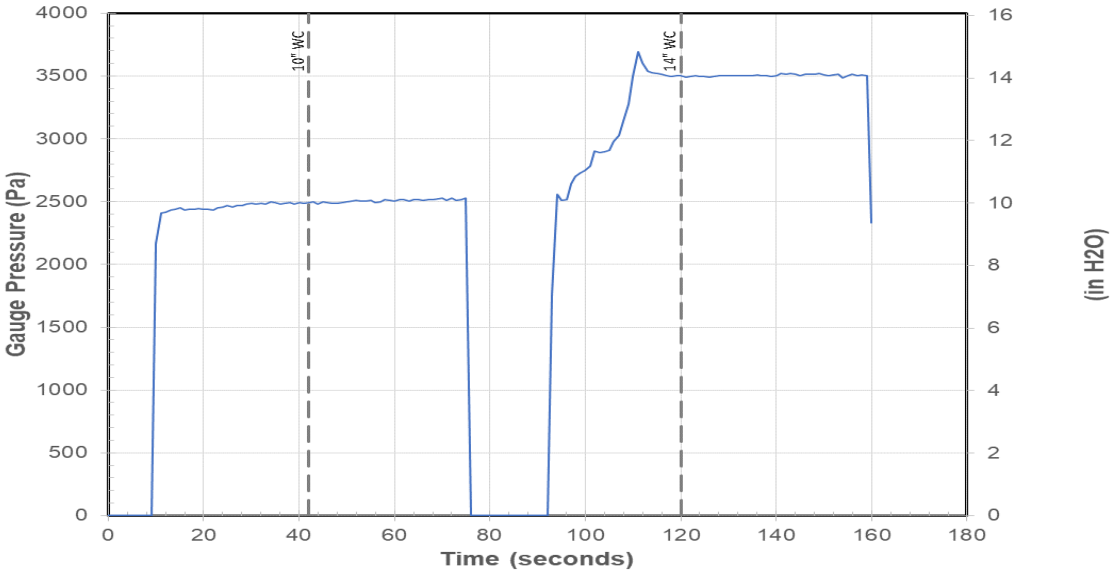

Figure 307. Gauge Pressure Data - Inlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

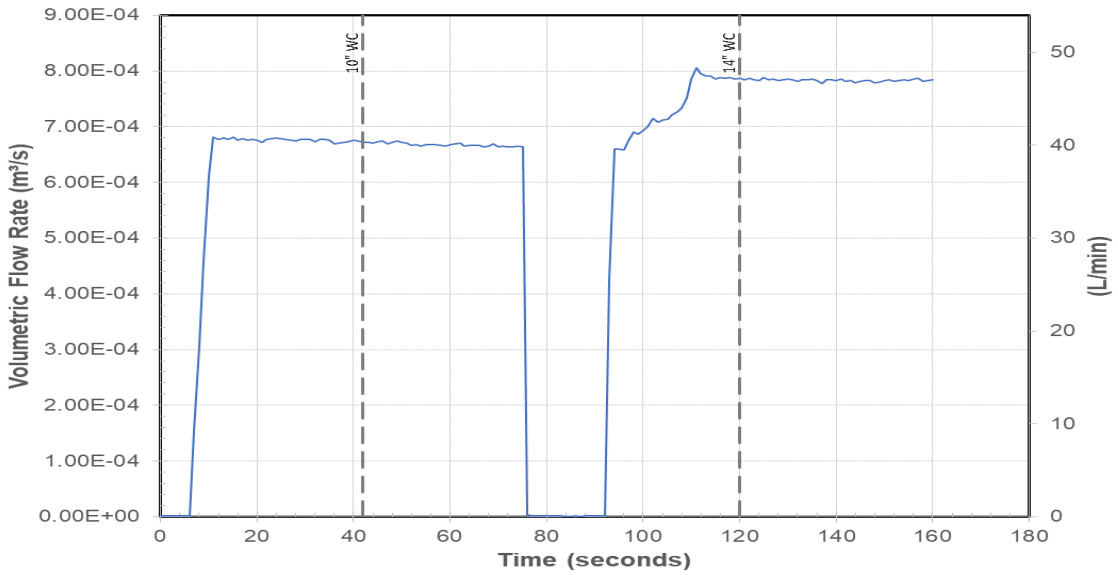

Figure 308. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 116. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	09:19:52	208	348111_20210624_091952_22A.mov
Close up	09:19:59	213	348111_20210624_092000_23A.mov
Overall	09:20:07	217	348111_20210624_092007_24A.mov
FLIR	09:20:24	215	348111_20210624_092024_6.mov
CLOSE UP	09:20:26	213	348111_20210624_092026_9.mov
OVERALL	09:20:26	219	348111_20210624_092026_10.mov
MASTER			348111_1253059.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 309. Pre test 1:21 hr:min, 348111_1193229

Figure 310. Pre test 1:21 hr:min, 348111_1193230

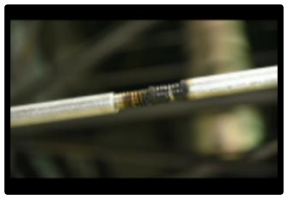

Figure 311. Pre test 1:21 hr:min, 348111_1193231

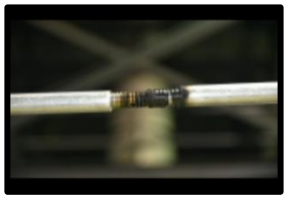

Figure 312. Pre test 1:20 hr:min, 348111_1193232

Figure 313. 20 seconds, 348111_1193233

Figure 314. 30 seconds, 348111_1193234

Results for Test 56 (ID 348112)

The following table lists selected events that occurred during the experiment.

Table 117. Experiment Events

Description	Time (s)
14" WC	41
10" WC	98

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

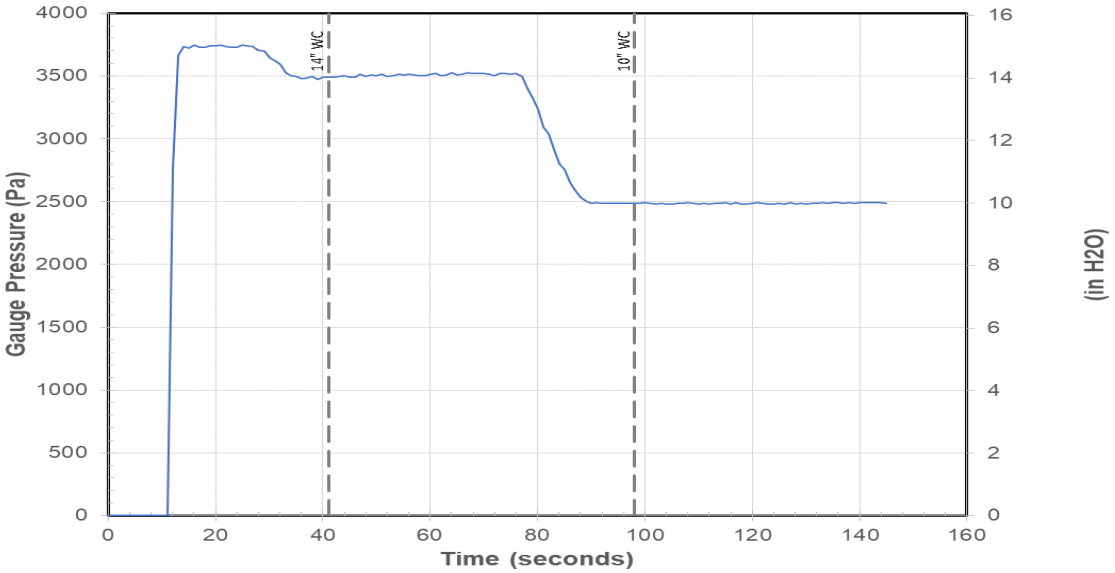

Figure 315. Gauge Pressure Data - Inlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

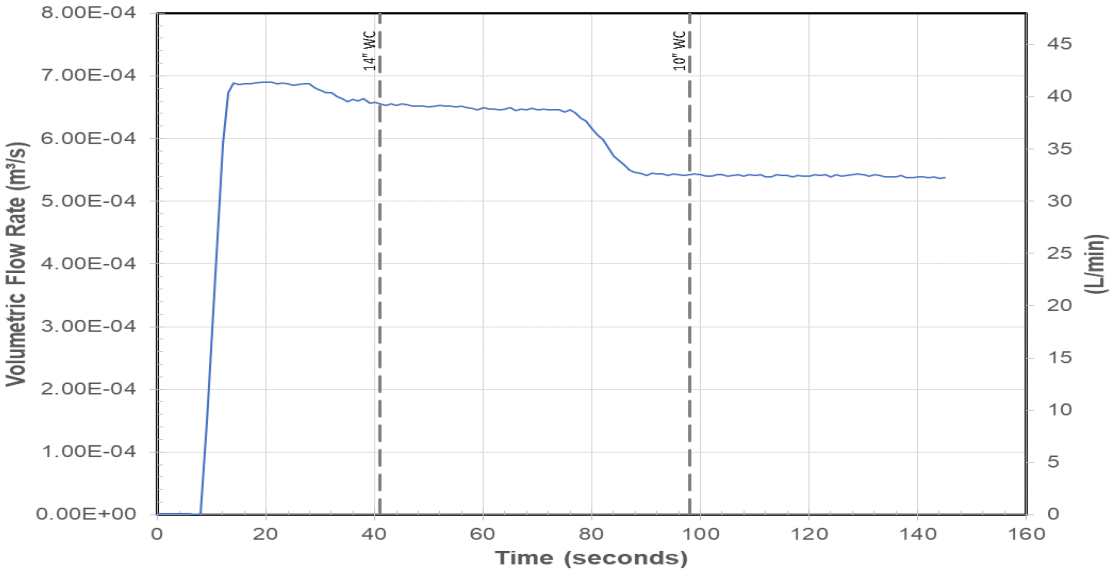

Figure 316. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 118. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	09:28:35	193	348112_20210624_092835_22A.mov
Close up	09:28:42	198	348112_20210624_092843_23A.mov
Overall	09:28:50	201	348112_20210624_092850_24A.mov
FLIR	09:29:05	200	348112_20210624_092905_6.mov
CLOSE UP	09:29:07	204	348112_20210624_092907_9.mov
OVERALL	09:29:08	203	348112_20210624_092908_10.mov
MASTER			348112_1253060.mov

Results for Test 57 (ID 348115)

The following table lists selected events that occurred during the experiment.

Table 119. Experiment Events

Description	Time (s)
14" WC	41
10" WC	138

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

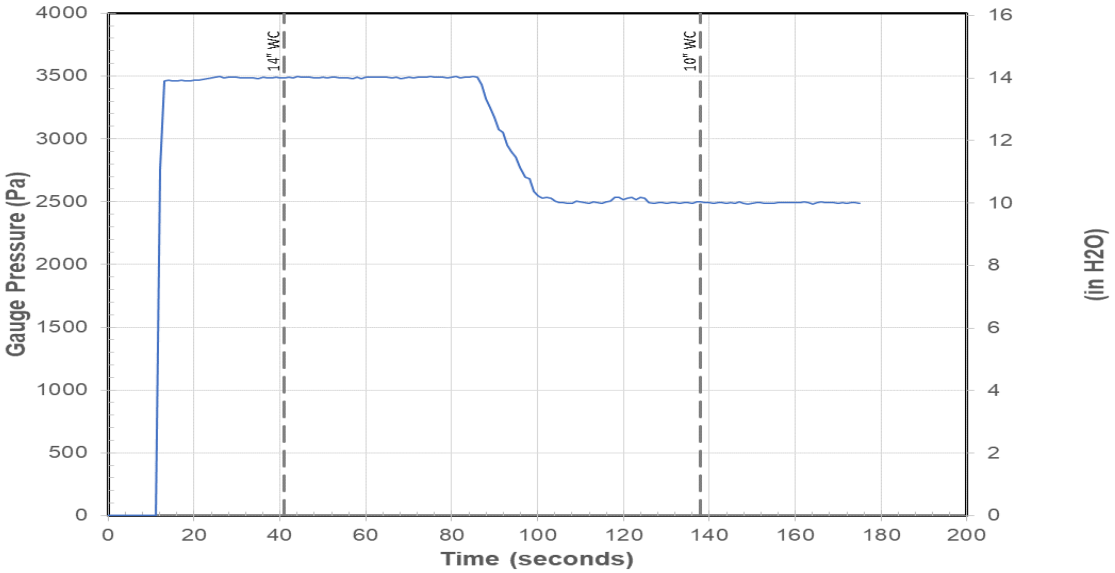

Figure 317. Gauge Pressure Data - Inlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

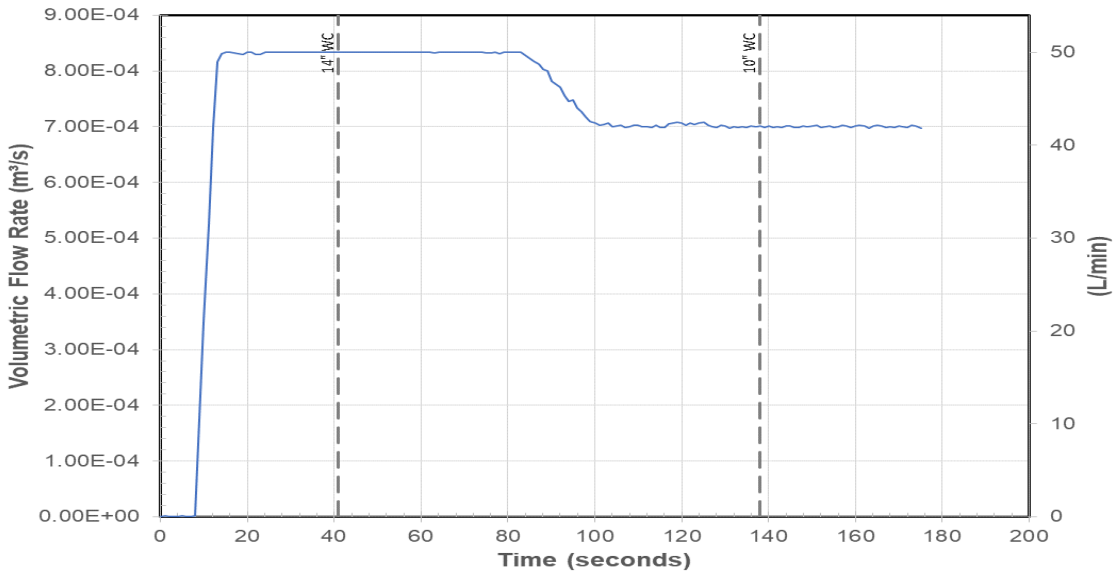

Figure 318. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 120. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	10:18:49	222	348115_20210624_101850_22A.mov
Close up	10:18:57	233	348115_20210624_101857_23A.mov
Overall	10:19:04	237	348115_20210624_101905_24A.mov
FLIR	10:19:20	235	348115_20210624_101920_6.mov
CLOSE UP	10:19:22	239	348115_20210624_101922_9.mov
OVERALL	10:19:22	240	348115_20210624_101922_10.mov
MASTER			348115_1246489.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 319. Pre test 11 minutes, 348115_1193321

Figure 320. Pre test 11 minutes, 348115_1193322

Figure 321. Pre test 11 minutes, 348115_1193323

Results for Test 58 (ID 348116)

The following table lists selected events that occurred during the experiment.

Table 121. Experiment Events

Description	Time (s)
10" WC	59
14" WC	144

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

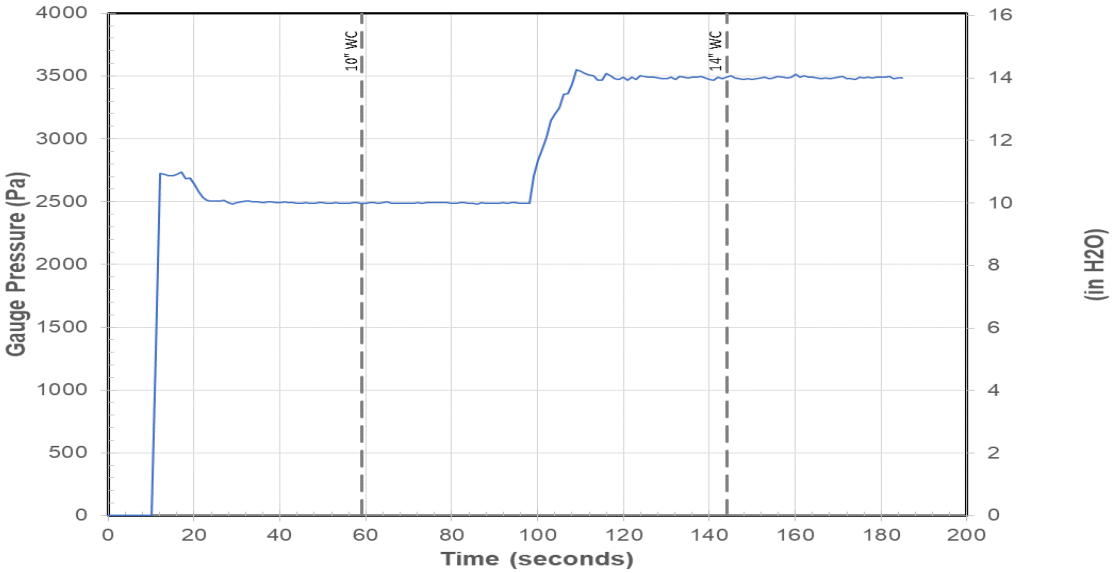

Figure 322. Gauge Pressure Data – Inlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

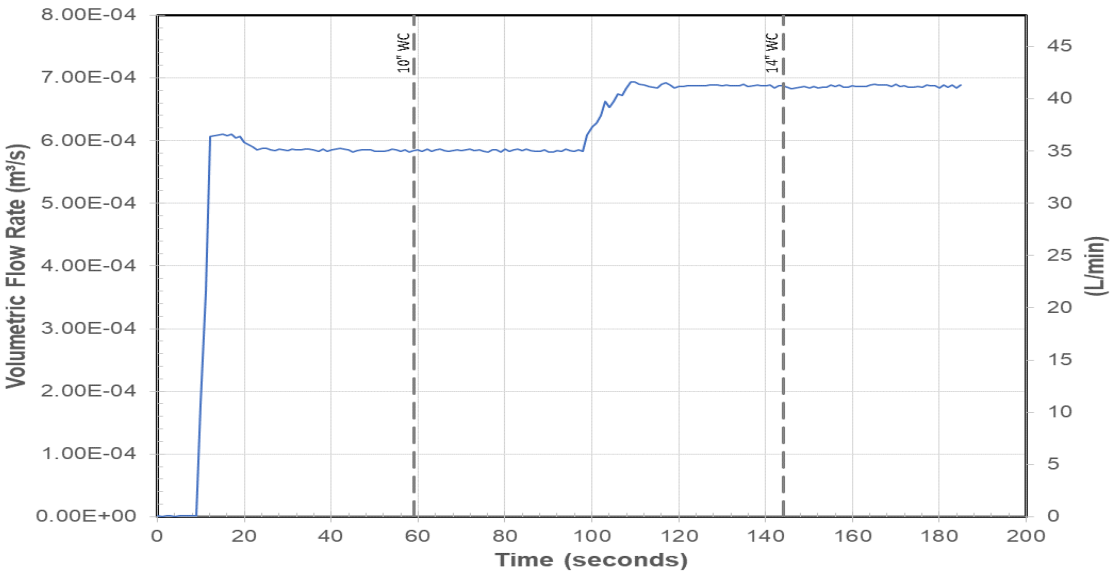

Figure 323. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 122. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	10:25:32	12	348116_20210624_102532_22A.mov
Close up	10:25:58	28	348116_20210624_102558_23A.mov
Overall	10:26:05	21	348116_20210624_102606_24A.mov
FLIR	10:26:22	375	348116_20210624_102622_6.mov
CLOSE UP	10:26:24	379	348116_20210624_102624_9.mov
OVERALL	10:26:24	379	348116_20210624_102624_10.mov
Close up	10:26:39		
FLIR	10:26:41	295	348116_20210624_102641_22A.mov
Overall	10:26:59		
Close up	10:27:33	256	348116_20210624_102734_23A.mov
Overall	10:27:43	281	348116_20210624_102743_24A.mov
MASTER			348116_1246490.mov

Results for Test 59 (ID 348117)

The following table lists selected events that occurred during the experiment.

Table 123. Experiment Events

Description	Time (s)
14" WC	102
10" WC	198

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

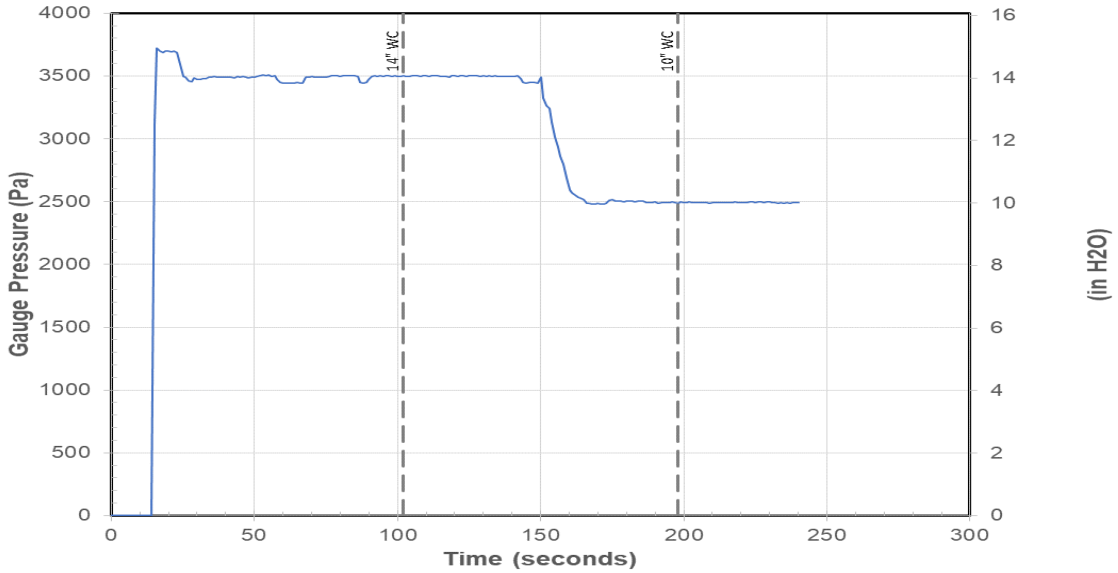

Figure 324. Gauge Pressure Data - Inlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

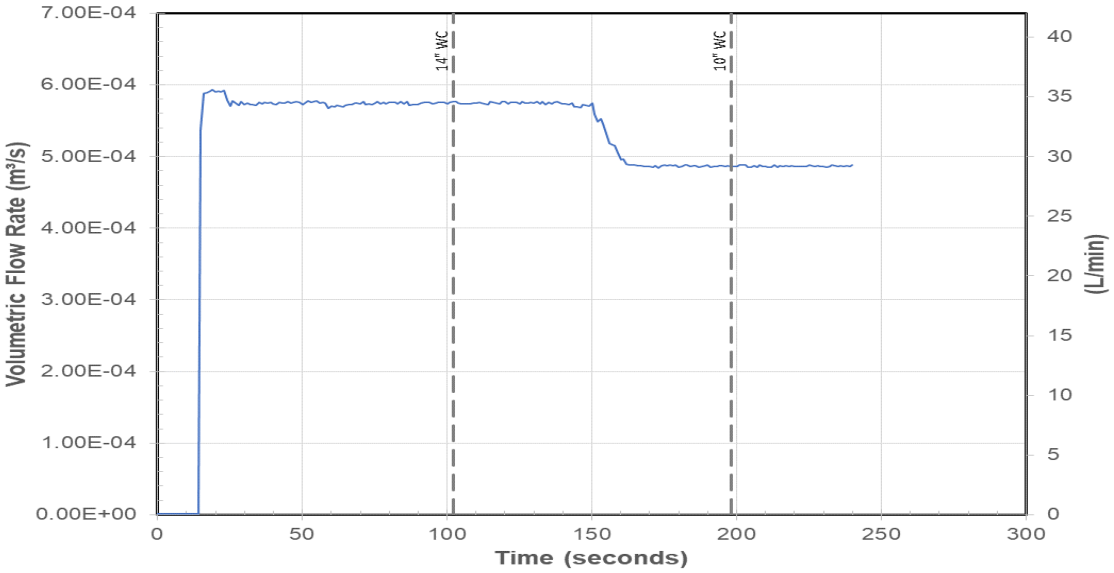

Figure 325. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 124. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	10:34:53	290	348117_20210624_103453_22A.mov
Close up	10:35:00	293	348117_20210624_103501_23A.mov
Overall	10:35:08	296	348117_20210624_103508_24A.mov
FLIR	10:35:24	294	348117_20210624_103524_6.mov
CLOSE UP	10:35:25	299	348117_20210624_103525_9.mov
OVERALL	10:35:26	299	348117_20210624_103526_10.mov
MASTER			348117_1246491.mov

Results for Test 60 (ID 348118)

The following table lists selected events that occurred during the experiment.

Table 125. Experiment Events

Description	Time (s)
10" WC	38
14" WC	126

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

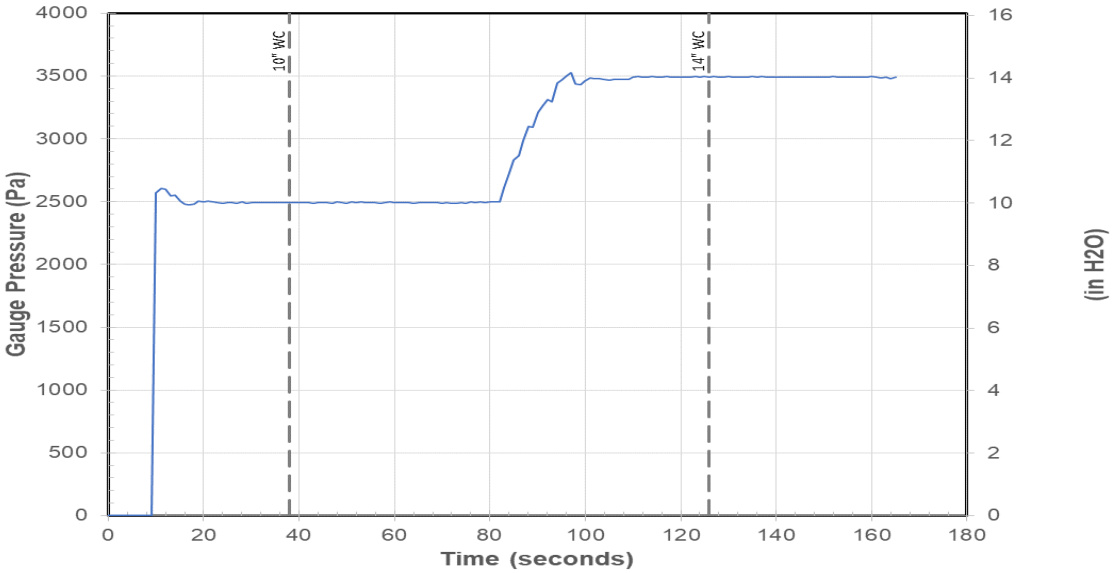

Figure 326. Gauge Pressure Data - Inlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

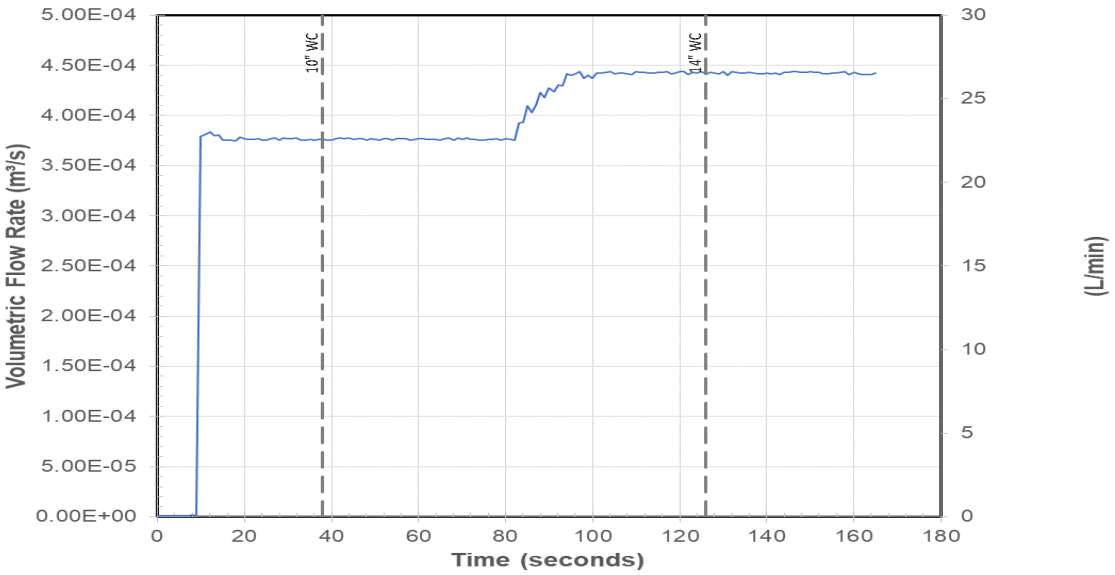

Figure 327. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 126. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	10:44:41	211	348118_20210624_104442_22A.mov
Close up	10:44:49	217	348118_20210624_104449_23A.mov
Overall	10:44:56	221	348118_20210624_104457_24A.mov
FLIR	10:45:10	225	348118_20210624_104510_6.mov
CLOSE UP	10:45:12	224	348118_20210624_104512_9.mov
OVERALL	10:45:13	224	348118_20210624_104513_10.mov
MASTER			348118_1246492.mov

Results for Test 61 (ID 348119)

The following table lists selected events that occurred during the experiment.

Table 127. Experiment Events

Description	Time (s)
14" WC	66
10" WC	186

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

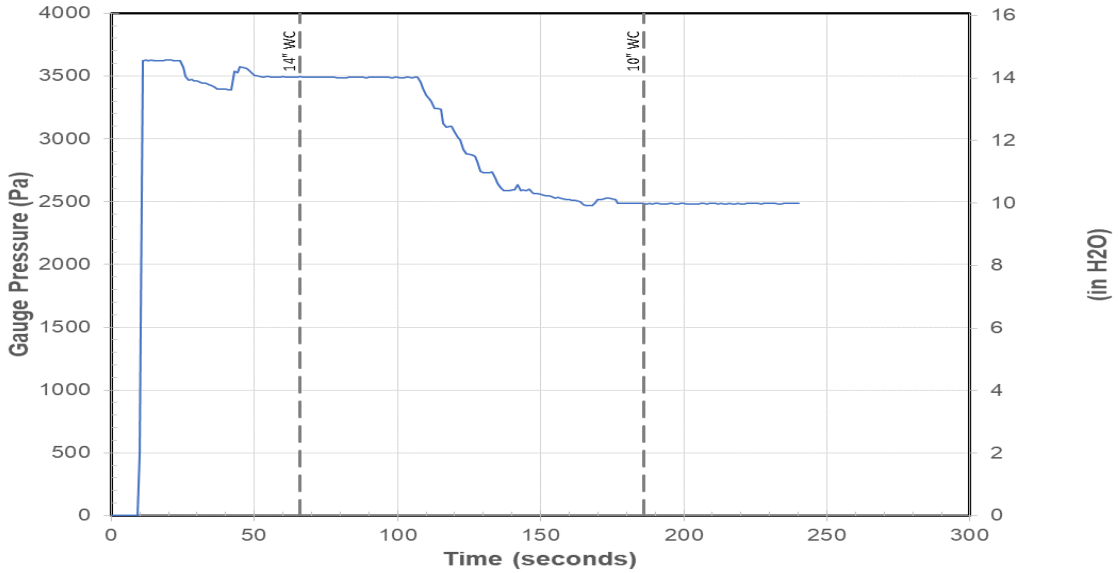

Figure 328. Gauge Pressure Data - Inlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

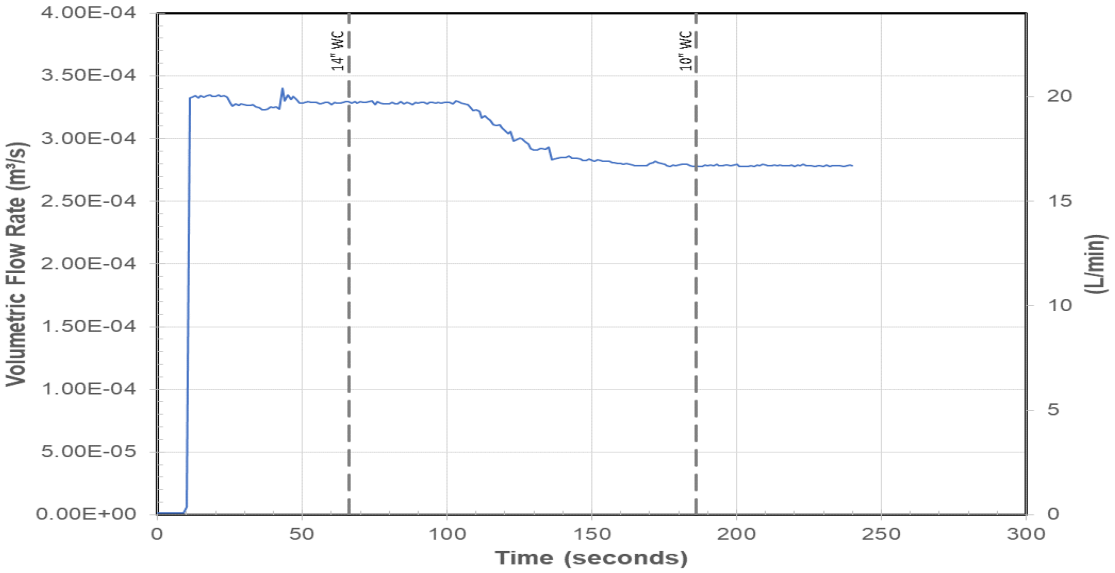

Figure 329. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 128. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	10:51:02	289	348119_20210624_105102_22A.mov
Close up	10:51:09	293	348119_20210624_105110_23A.mov
Overall	10:51:17	297	348119_20210624_105117_24A.mov
FLIR	10:51:32	300	348119_20210624_105132_6.mov
CLOSE UP	10:51:34	298	348119_20210624_105134_9.mov
OVERALL	10:51:34	299	348119_20210624_105134_10.mov
MASTER			348119_1246493.mov

Results for Test 62 (ID 348120)

The following table lists selected events that occurred during the experiment.

Table 129. Experiment Events

Description	Time (s)
10" WC	42
11" WC	114
14" WC	176

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

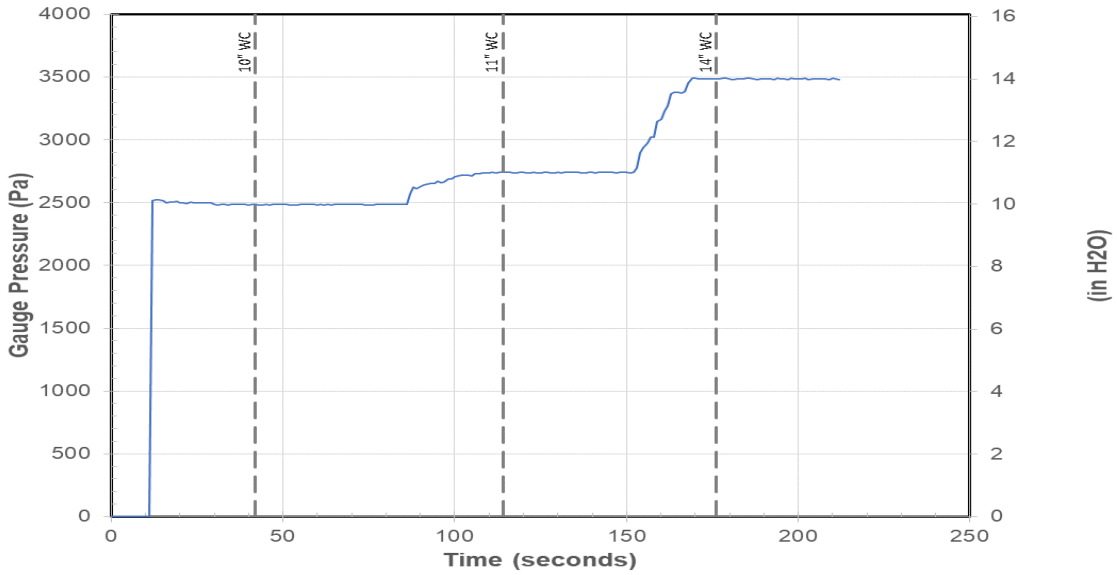

Figure 330. Gauge Pressure Data - Inlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

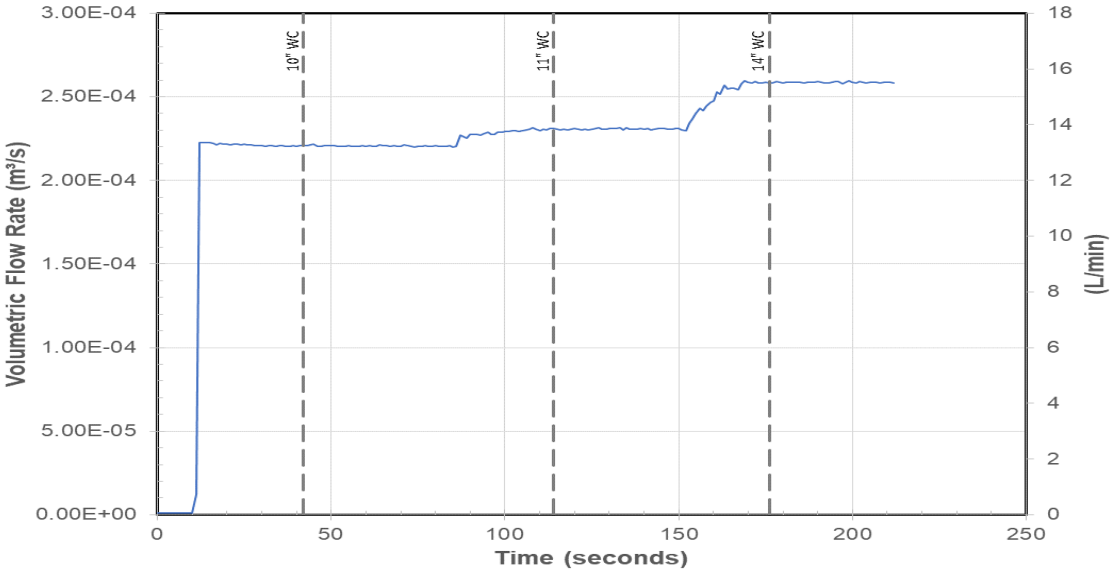

Figure 331. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 130. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	11:05:09	335	348120_20210624_110509_6.mov
CLOSE UP	11:05:36	309	348120_20210624_110536_9.mov
OVERALL	11:05:46	305	348120_20210624_110546_10.mov
MASTER			348120_1246494.mov

Results for Test 63 (ID 348124)

The following table lists selected events that occurred during the experiment.

Table 131. Experiment Events

Description	Time (s)
11" WC	17

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

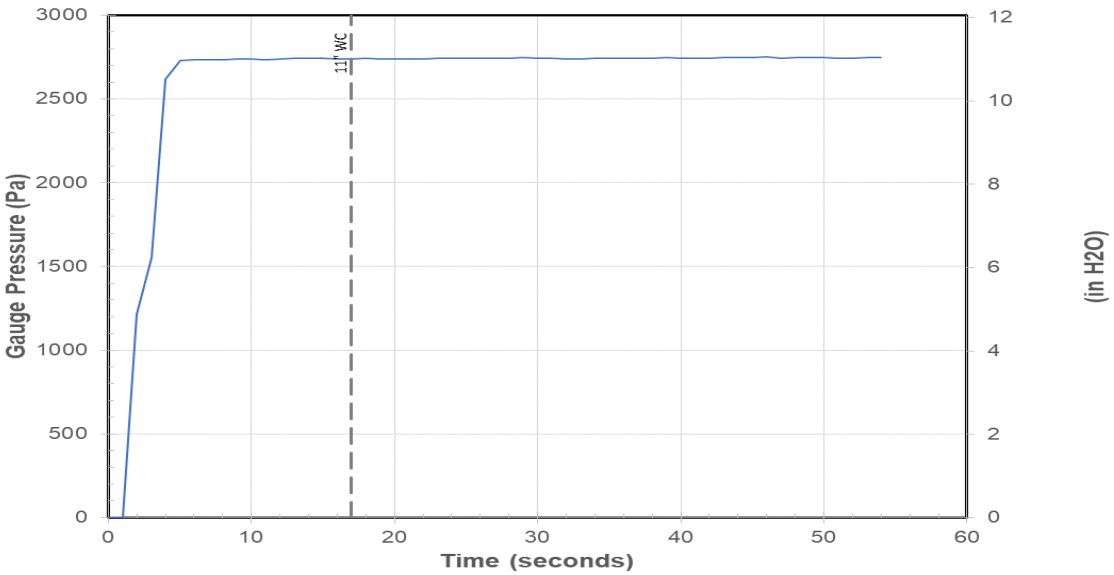

Figure 332. Gauge Pressure Data - Inlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

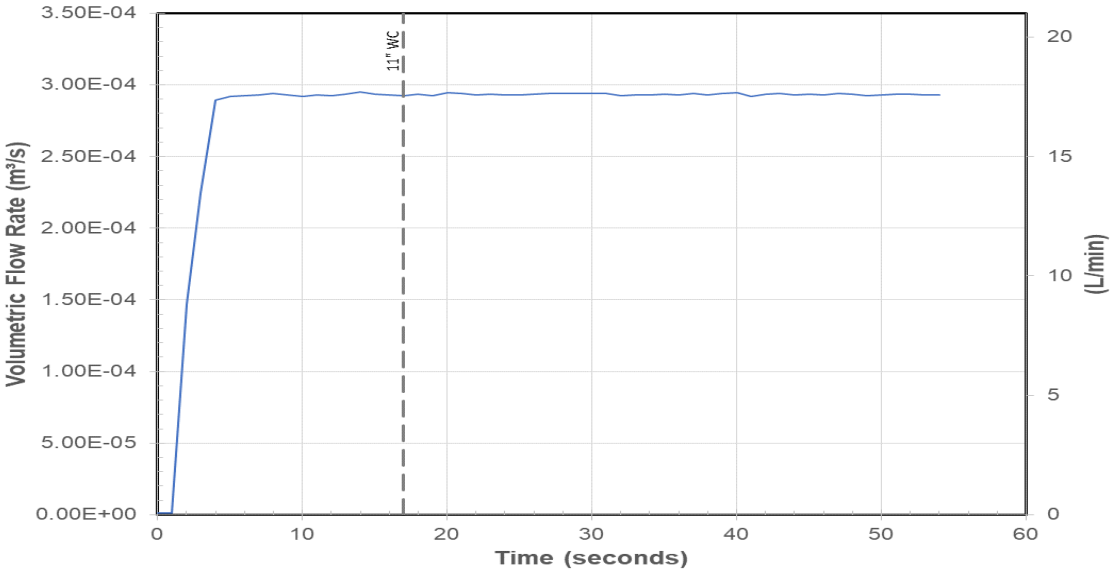

Figure 333. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 132. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	12:48:34	112	348124_20210624_124835_22A.mov
Close up	12:48:42	116	348124_20210624_124845_23A.mov
Overall	12:48:52	116	348124_20210624_124853_24A.mov
FLIR	12:49:09	114	348124_20210624_124909_6.mov
CLOSE UP	12:49:10	119	348124_20210624_124910_9.mov
OVERALL	12:49:11	119	348124_20210624_124911_10.mov
MASTER			348124_1246495.mov

Results for Test 64 (ID 348126)

The following table lists selected events that occurred during the experiment.

Table 133. Experiment Events

Description	Time (s)
11" WC	36

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

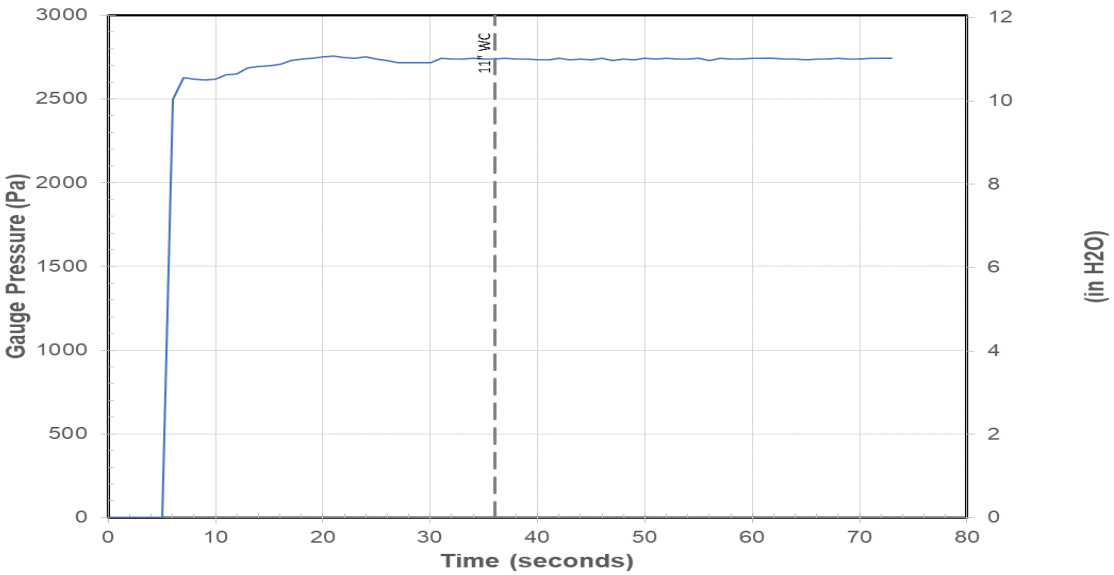

Figure 334. Gauge Pressure Data - Inlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

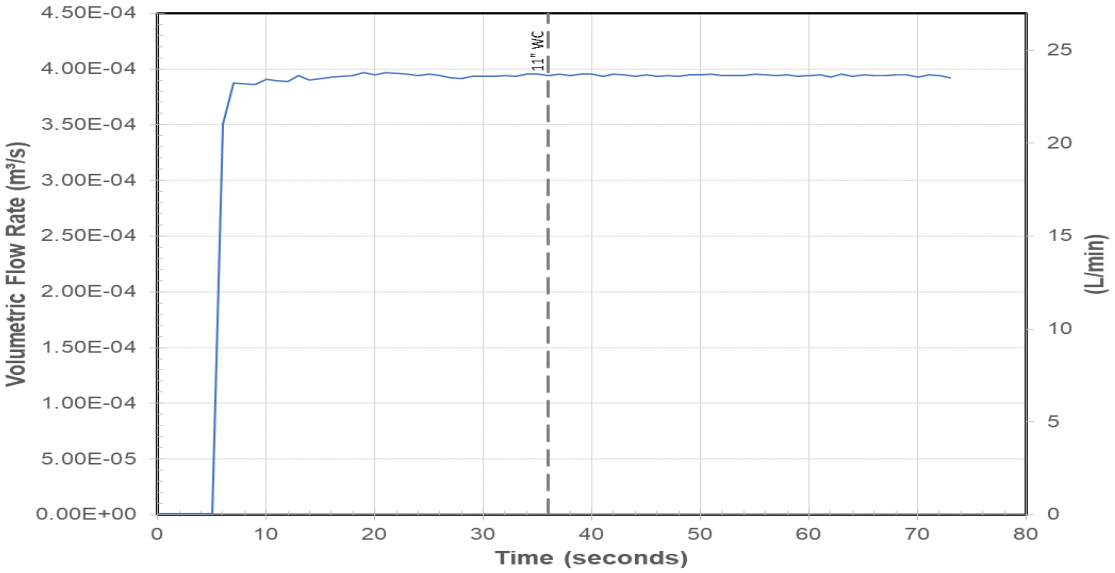

Figure 335. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 134. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	12:52:44	134	348126_20210624_125246_22A.mov
Close up	12:52:53	136	348126_20210624_125256_23A.mov
Overall	12:53:03	136	348126_20210624_125305_24A.mov
FLIR	12:53:20	134	348126_20210624_125320_6.mov
CLOSE UP	12:53:22	133	348126_20210624_125322_9.mov
OVERALL	12:53:22	134	348126_20210624_125322_10.mov
MASTER			348126_1246496.mov

Results for Test 65 (ID 348127)

The following table lists selected events that occurred during the experiment.

Table 135. Experiment Events

Description	Time (s)
11" WC	31

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

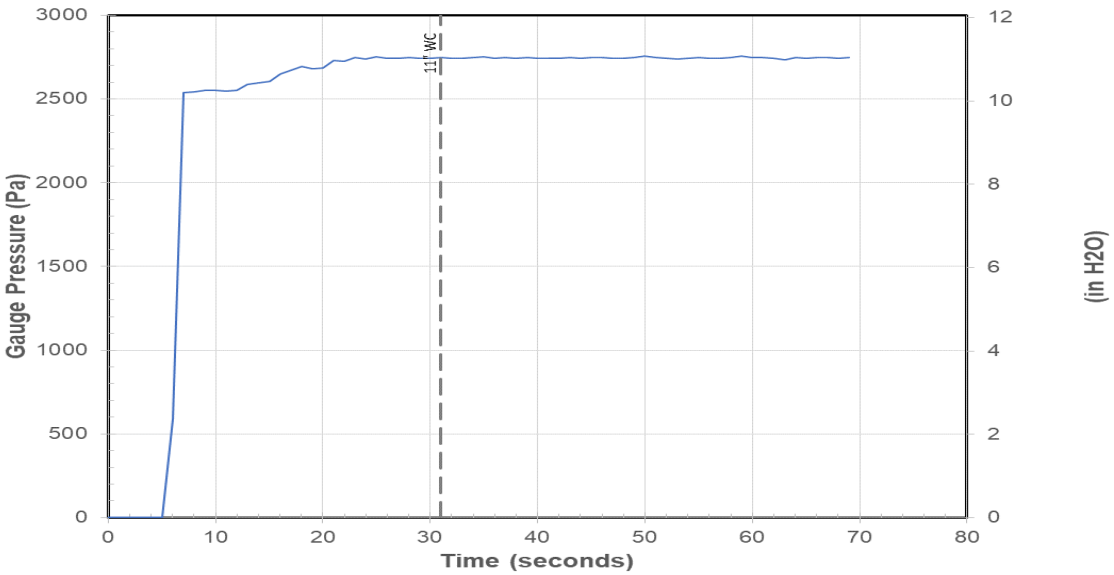

Figure 336. Gauge Pressure Data - Inlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

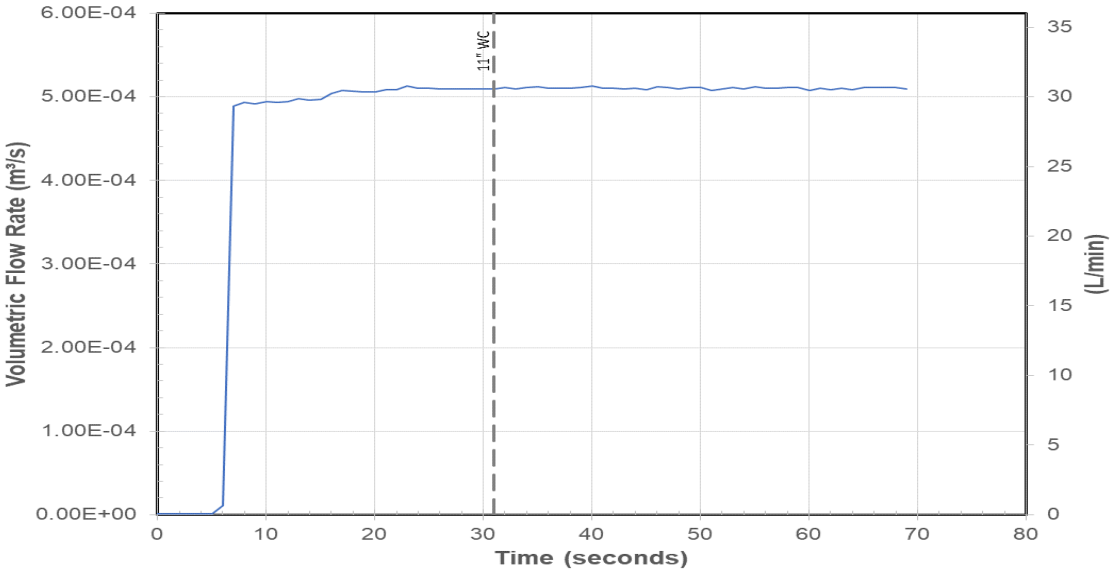

Figure 337. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 136. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	12:56:36	127	348127_20210624_125642_22A.mov
Close up	12:56:49	128	348127_20210624_125650_23A.mov
Overall	12:56:57	132	348127_20210624_125658_24A.mov
FLIR	12:57:16	129	348127_20210624_125716_6.mov
CLOSE UP	12:57:17	129	348127_20210624_125717_9.mov
OVERALL	12:57:18	134	348127_20210624_125718_10.mov
MASTER			348127_1246497.mov

Results for Test 66 (ID 348128)

The following table lists selected events that occurred during the experiment.

Table 137. Experiment Events

Description	Time (s)
11" WC	56

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

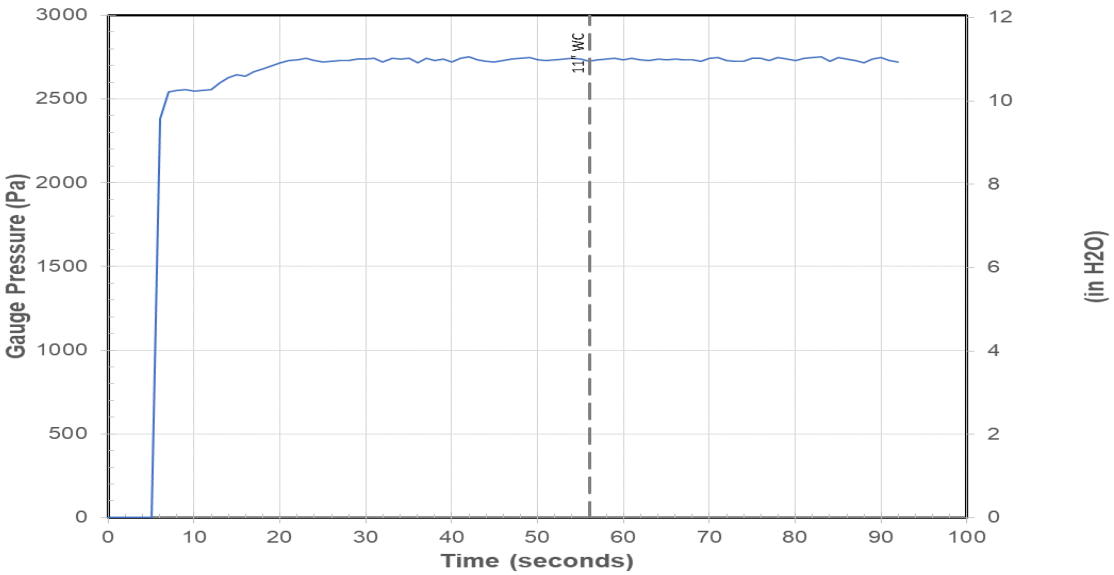

Figure 338. Gauge Pressure Data - Inlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

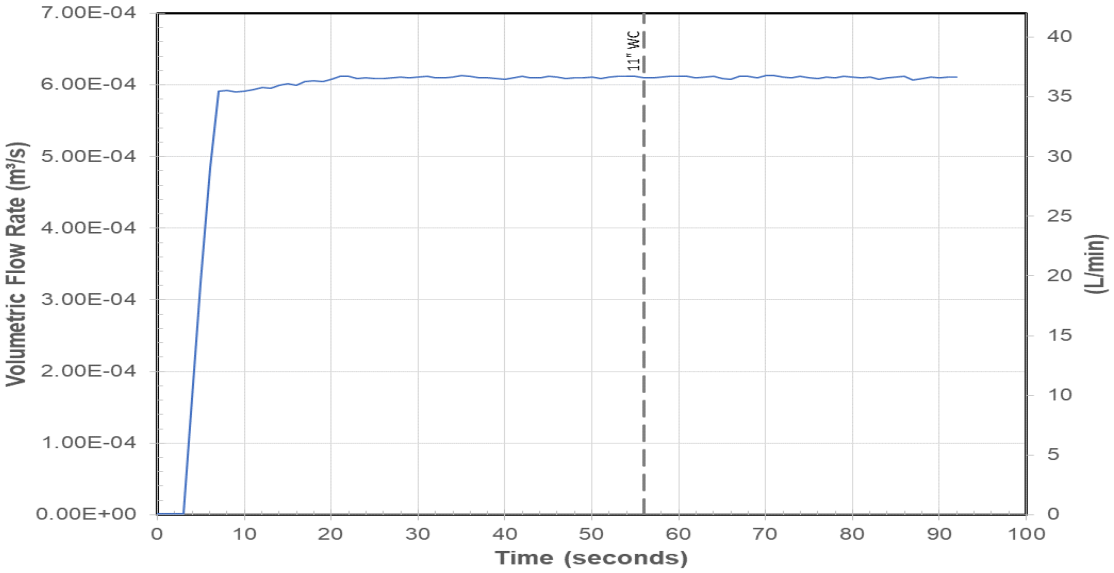

Figure 339. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 138. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	01:00:26	146	348128_20210624_130029_22A.mov
Close up	01:00:36	147	348128_20210624_130037_23A.mov
Overall	01:00:44	152	348128_20210624_130045_24A.mov
FLIR	01:01:02	144	348128_20210624_130102_6.mov
CLOSE UP	01:01:04	148	348128_20210624_130104_9.mov
OVERALL	01:01:04	149	348128_20210624_130104_10.mov
MASTER			348128_1246498.mov

Results for Test 67 (ID 348129)

The following table lists selected events that occurred during the experiment.

Table 139. Experiment Events

Description	Time (s)
11" WC	85

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

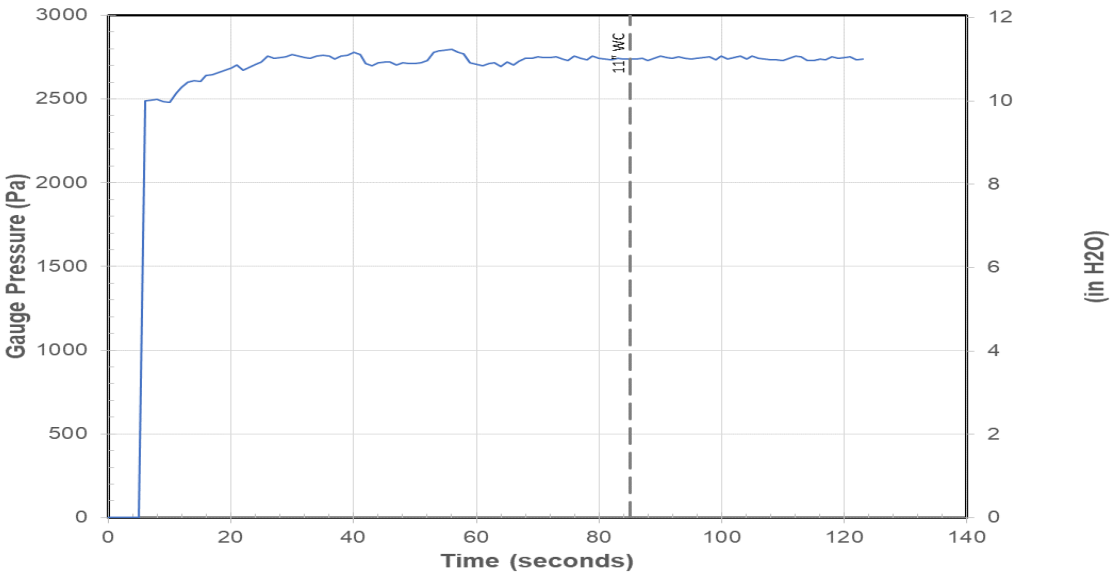

Figure 340. Gauge Pressure Data - Inlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

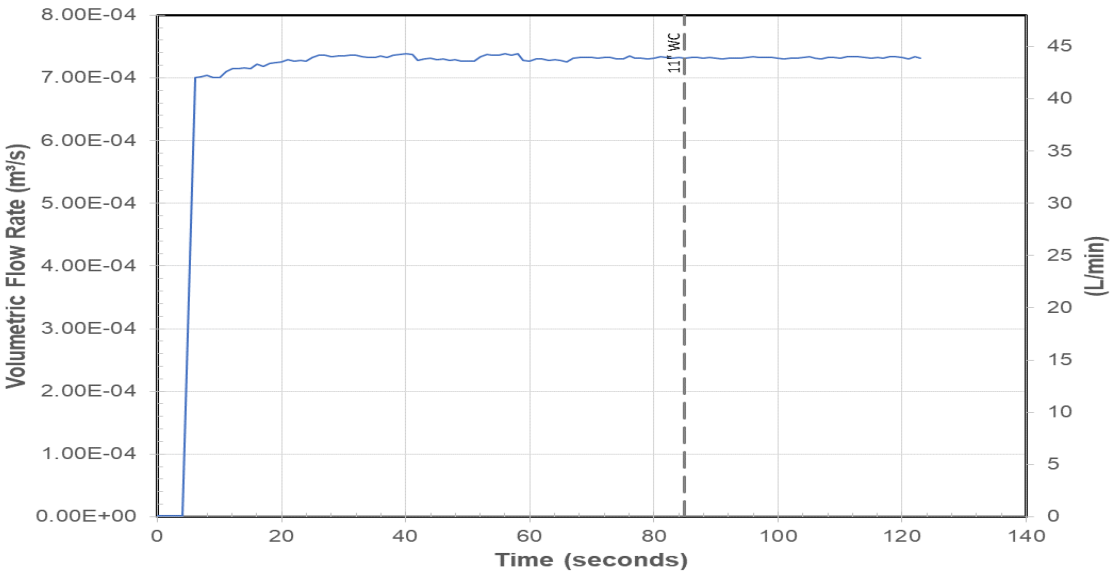

Figure 341. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 140. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	01:04:24	175	348129_20210624_130427_22A.mov
Close up	01:04:34	176	348129_20210624_130435_23A.mov
Overall	01:04:42	180	348129_20210624_130444_24A.mov
FLIR	01:04:58	179	348129_20210624_130458_6.mov
CLOSE UP	01:05:00	178	348129_20210624_130500_9.mov
OVERALL	01:05:00	179	348129_20210624_130500_10.mov
MASTER			348129_1246499.mov

The following figures show all of the still photographs uploaded into the FireTOSS system. The caption below each figure provides the picture's filename as well as any description and elapsed test time associated with the picture.

Figure 342. Post test 1 minutes, 348129_1193397

Results for Test 68 (ID 348130)

The following table lists selected events that occurred during the experiment.

Table 141. Experiment Events

Description	Time (s)
7" WC	16

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

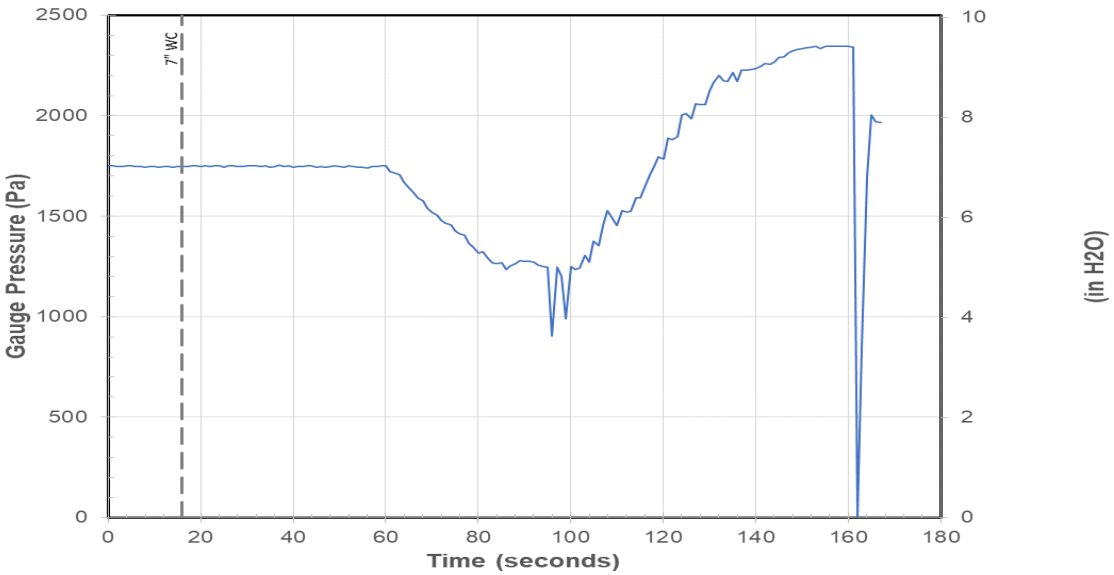

Figure 343. Gauge Pressure Data - Inlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

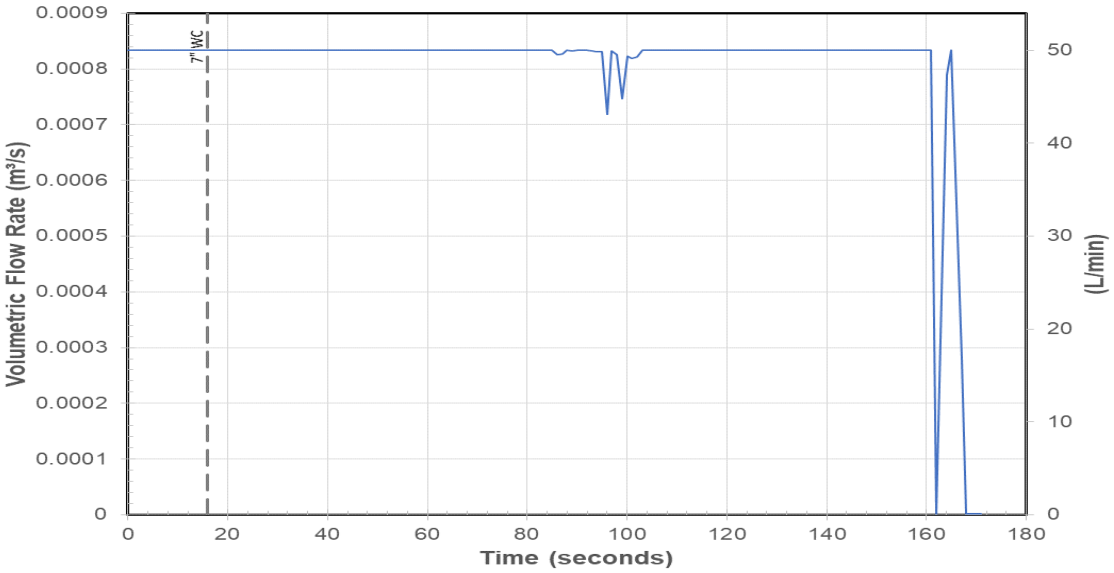

Figure 344. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 142. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	01:12:52	247	348130_20210624_131253_22A.mov
Close up	01:13:00	252	348130_20210624_131301_23A.mov
Overall	01:13:08	256	348130_20210624_131308_24A.mov
FLIR	01:13:25	254	348130_20210624_131325_6.mov
CLOSE UP	01:13:26	254	348130_20210624_131326_9.mov
OVERALL	01:13:27	259	348130_20210624_131327_10.mov
MASTER			348130_1246500.mov

Results for Test 69 (ID 348132)

The following table lists selected events that occurred during the experiment.

Table 143. Experiment Events

Description	Time (s)
7" WC	3
4" WC	96

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

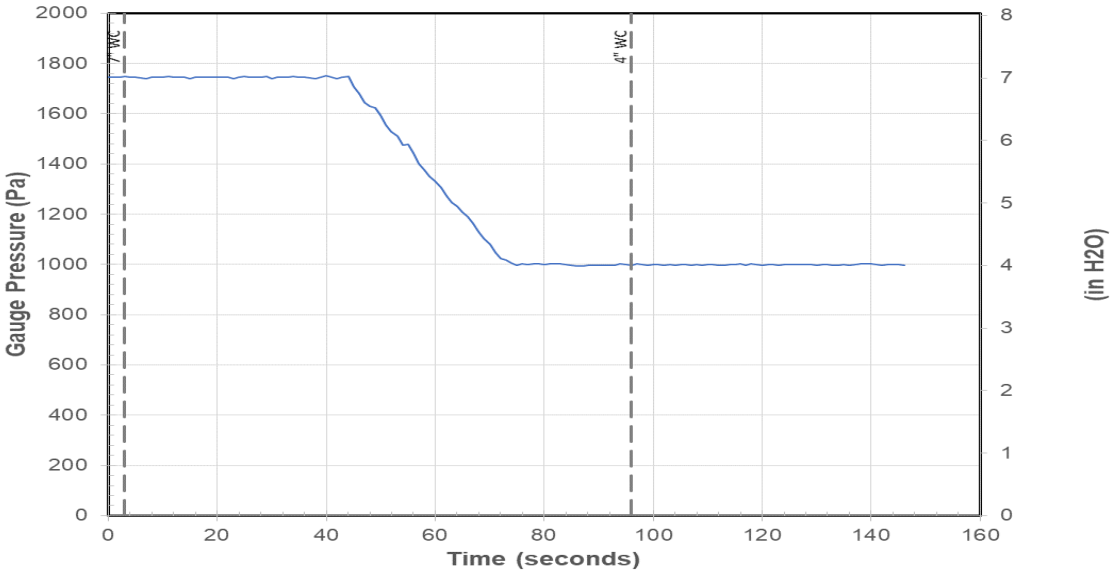

Figure 345. Gauge Pressure Data - Inlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

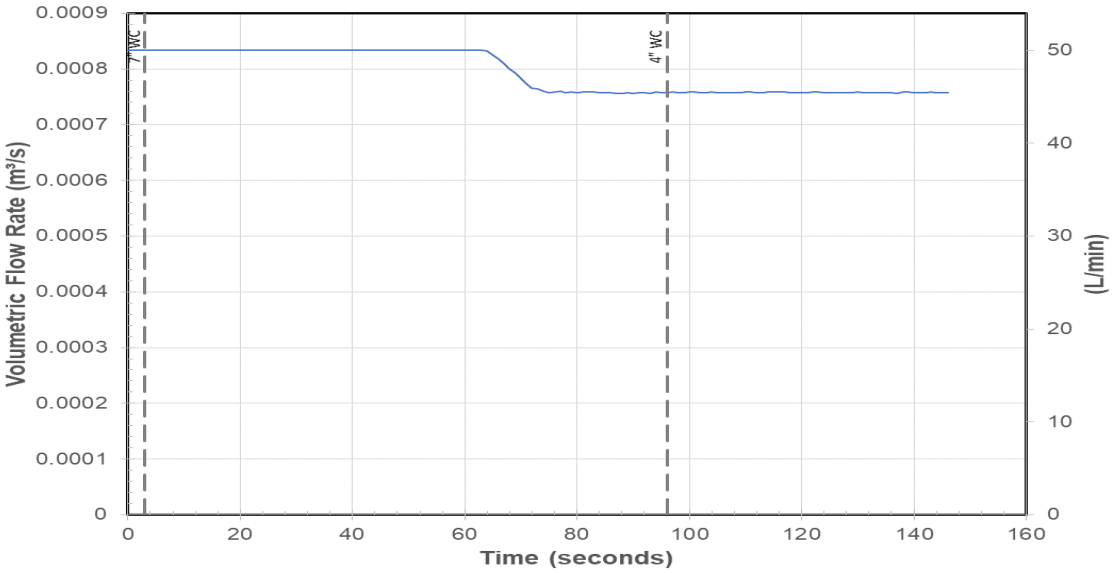

Figure 346. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 144. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	01:21:25	216	348132_20210624_132126_22A.mov
Close up	01:21:33	226	348132_20210624_132133_23A.mov
Overall	01:21:40	233	348132_20210624_132141_24A.mov
FLIR	01:21:56	230	348132_20210624_132156_6.mov
CLOSE UP	01:21:58	234	348132_20210624_132158_9.mov
OVERALL	01:21:59	234	348132_20210624_132159_10.mov
MASTR			348132_1246501.mov

Results for Test 70 (ID 348133)

The following table lists selected events that occurred during the experiment.

Table 145. Experiment Events

Description	Time (s)
4" WC	60
7" WC	170

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

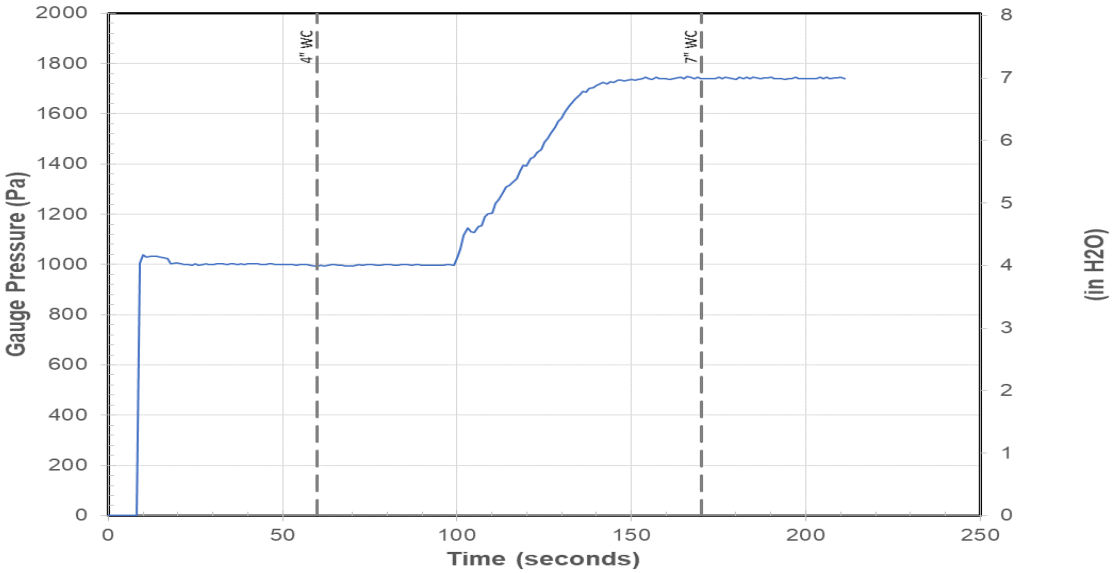

Figure 347. Gauge Pressure Data - Inlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

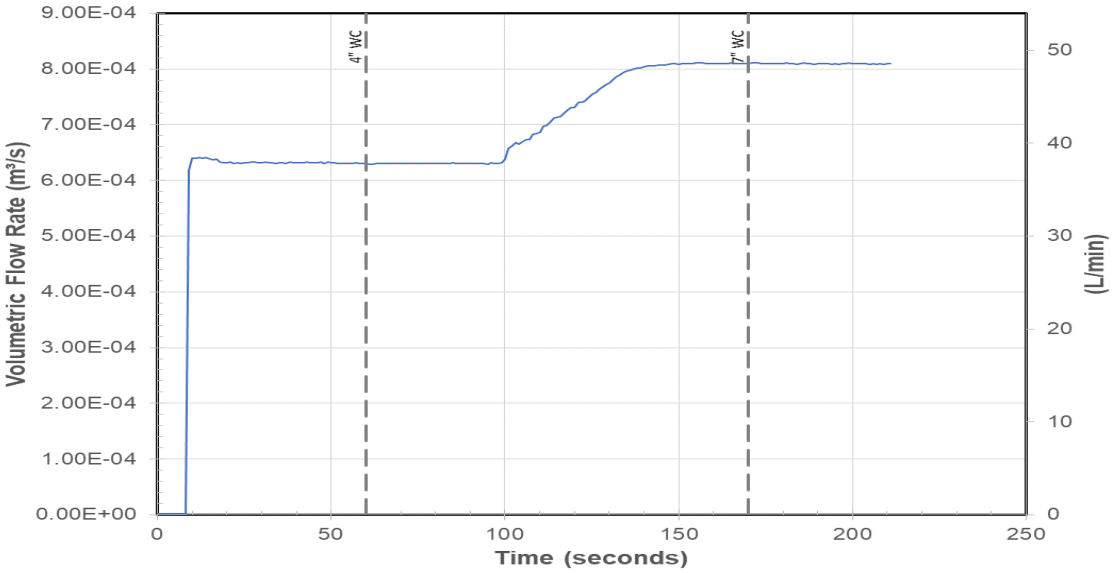

Figure 348. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 146. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	01:28:02	260	348133_20210624_132802_22A.mov
Close up	01:28:10	264	348133_20210624_132810_23A.mov
Overall	01:28:17	268	348133_20210624_132818_24A.mov
FLIR	01:28:33	270	348133_20210624_132833_6.mov
CLOSE UP	01:28:35	269	348133_20210624_132835_9.mov
OVERALL	01:28:36	268	348133_20210624_132836_10.mov
MASTER			348133_1246502.mov

Results for Test 71 (ID 348134)

The following table lists selected events that occurred during the experiment.

Table 147. Experiment Events

Description	Time (s)
7" WC	45
4" WC	136

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

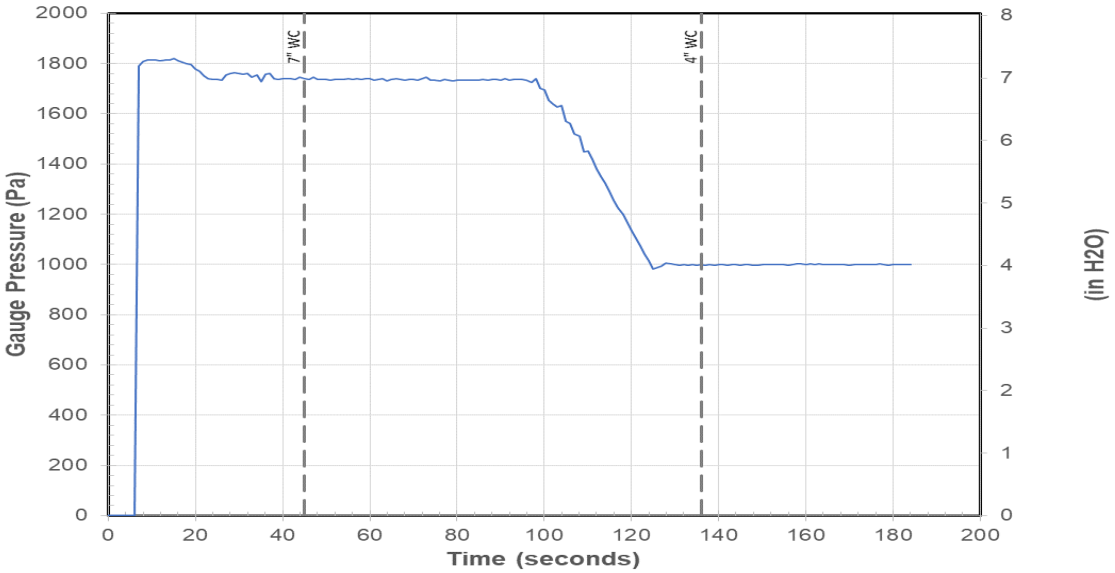

Figure 349. Gauge Pressure Data - Inlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

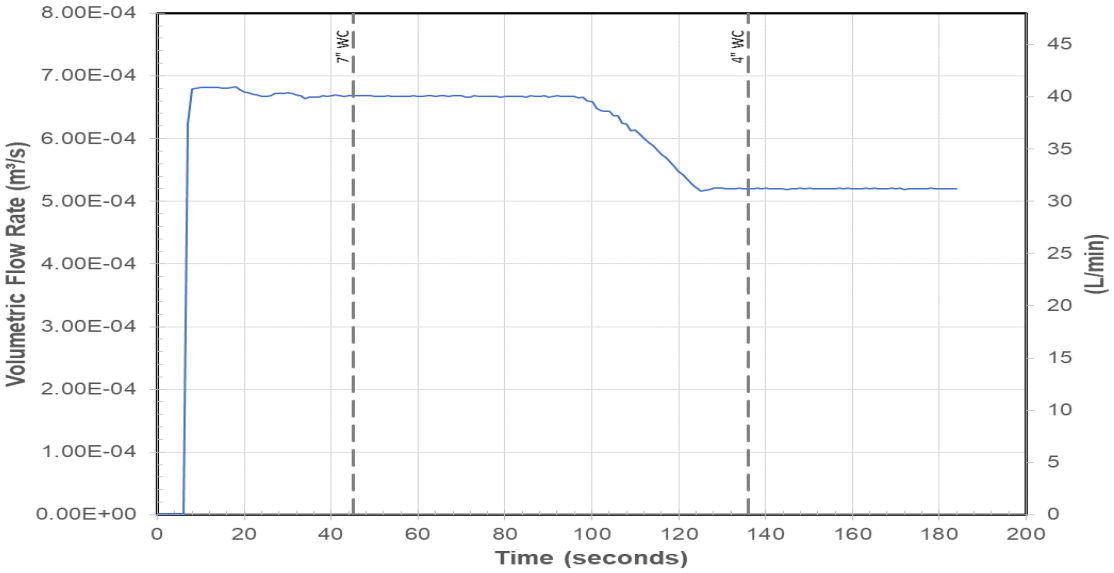

Figure 350. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 148. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	01:34:22	237	348134_20210624_133423_22A.mov
Close up	01:34:30	240	348134_20210624_133430_23A.mov
Overall	01:34:38	243	348134_20210624_133438_24A.mov
FLIR	01:34:54	245	348134_20210624_133454_6.mov
CLOSE UP	01:34:56	244	348134_20210624_133456_9.mov
OVERALL	01:34:57	243	348134_20210624_133457_10.mov
MASTER			348134_1246503.mov

Results for Test 72 (ID 348135)

The following table lists selected events that occurred during the experiment.

Table 149. Experiment Events

Description	Time (s)
10" WC	3

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

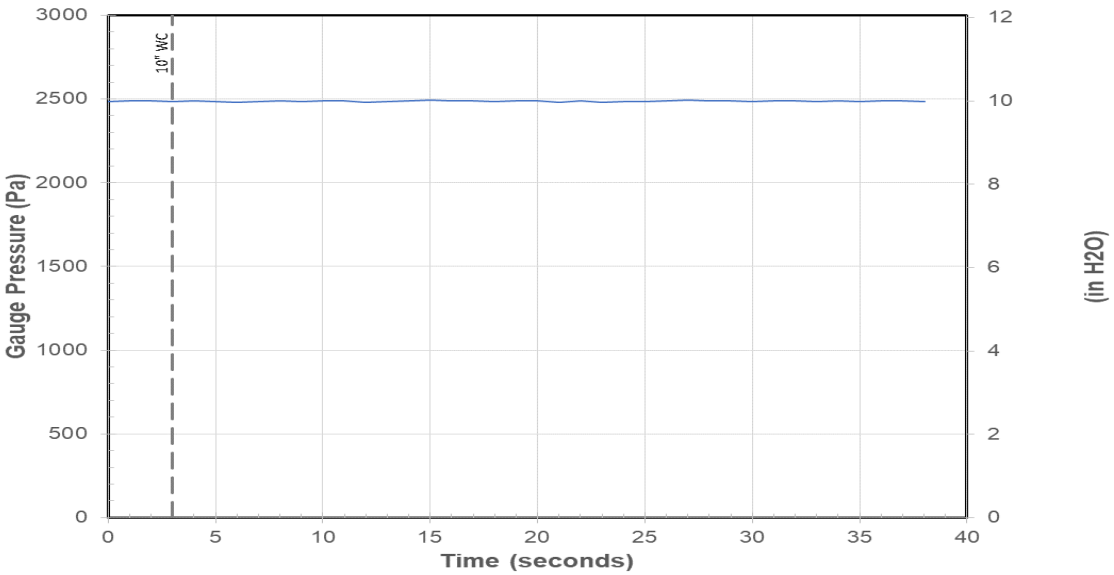

Figure 351. Gauge Pressure Data - Inlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

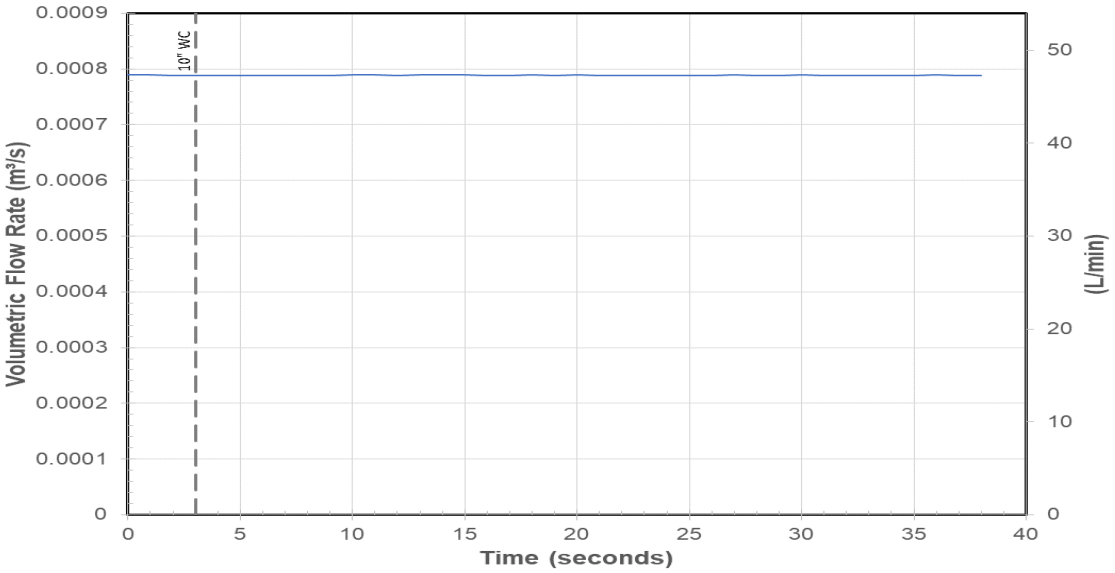

Figure 352. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 150. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	01:40:45	87	348135_20210624_134046_22A.mov
Close up	01:40:53	92	348135_20210624_134053_23A.mov
Overall	01:41:00	97	348135_20210624_134101_24A.mov
FLIR	01:41:15	95	348135_20210624_134115_6.mov
CLOSE UP	01:41:17	99	348135_20210624_134117_9.mov
OVERALL	01:41:18	98	348135_20210624_134118_10.mov
MASTER			348135_1246504.mov

Results for Test 73 (ID 348136)

The following table lists selected events that occurred during the experiment.

Table 151. Experiment Events

Description	Time (s)
10" WC	71
7" WC	241
4" WC	330

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

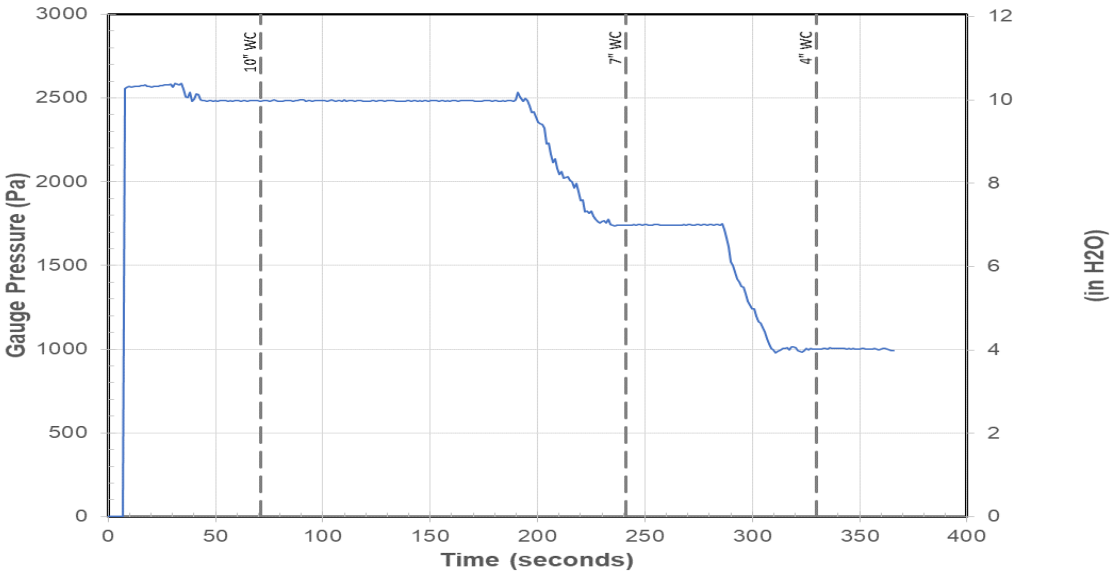

Figure 353. Gauge Pressure Data - Inlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

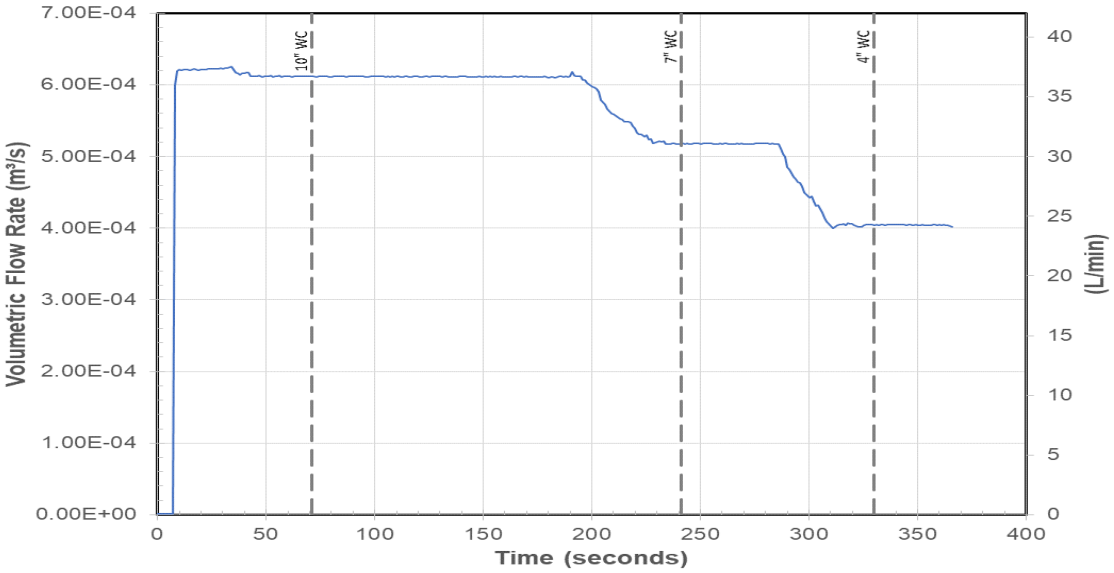

Figure 354. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 152. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	01:45:13	418	348136_20210624_134514_22A.mov
Close up	01:45:21	468	348136_20210624_134521_23A.mov
Overall	01:45:29	471	348136_20210624_134529_24A.mov
FLIR	01:45:47	467	348136_20210624_134547_6.mov
CLOSE UP	01:45:49	471	348136_20210624_134549_9.mov
OVERALL	01:45:49	472	348136_20210624_134549_10.mov
MASTER			348136_1246505.mov

Results for Test 74 (ID 348137)

The following table lists selected events that occurred during the experiment.

Table 153. Experiment Events

Description	Time (s)
4" WC	41

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

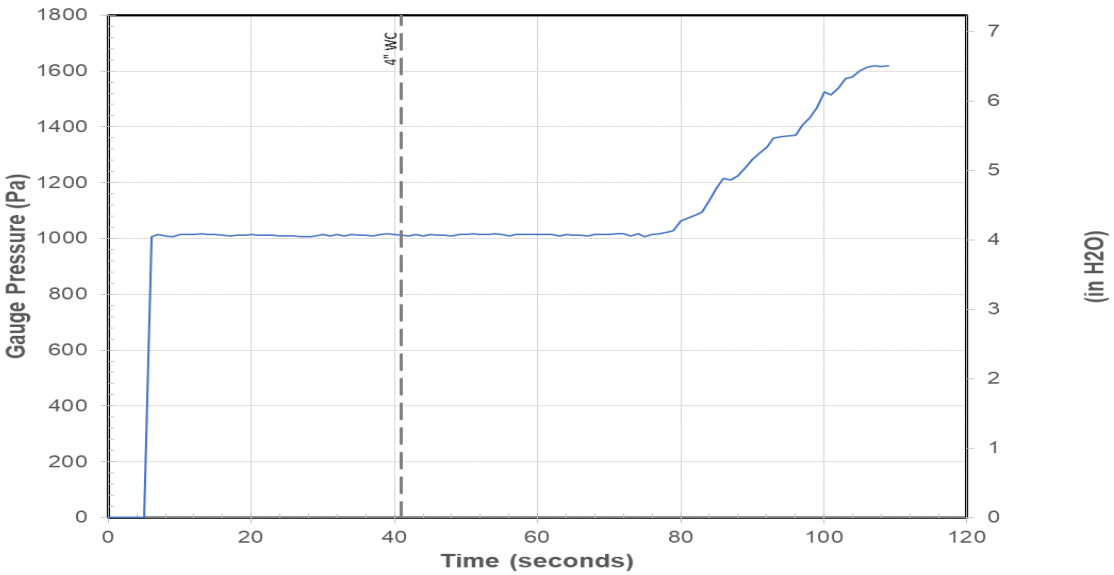

Figure 355. Gauge Pressure Data - Inlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

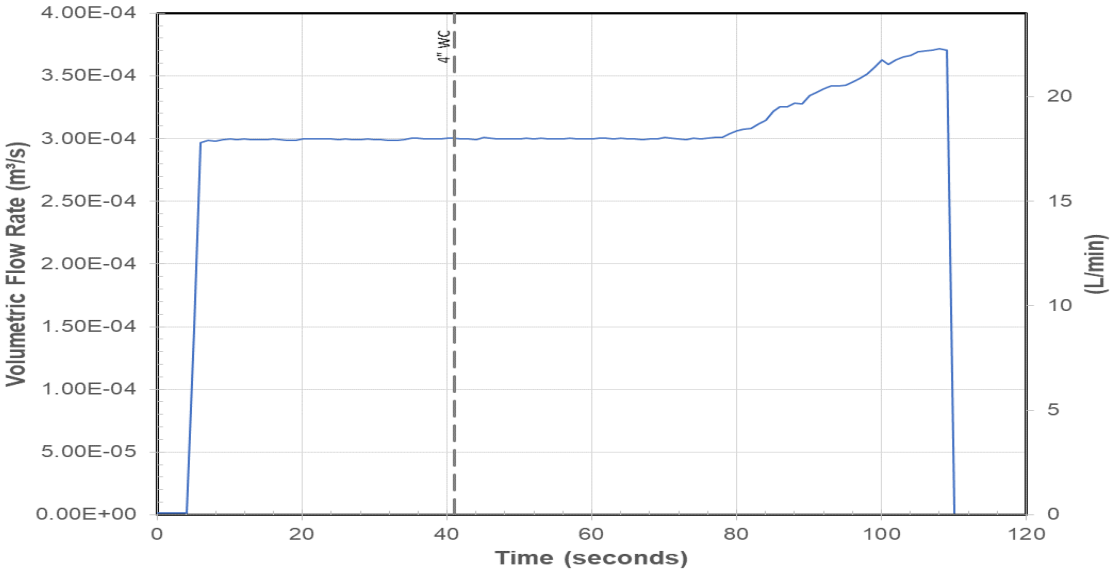

Figure 356. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 154. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	01:54:58	166	348137_20210624_135459_22A.mov
Close up	01:55:06	172	348137_20210624_135506_23A.mov
Overall	01:55:13	177	348137_20210624_135514_24A.mov
FLIR	01:55:31	176	348137_20210624_135531_6.mov
CLOSE UP	01:55:33	175	348137_20210624_135533_9.mov
OVERALL	01:55:34	175	348137_20210624_135534_10.mov
MASTER			348137_1246506.mov

Results for Test 75 (ID 348138)

The following table lists selected events that occurred during the experiment.

Table 155. Experiment Events

Description	Time (s)
10" WC	23

The following chart shows a time dependent representation of the instantaneous gauge pressure measured during the experiment.

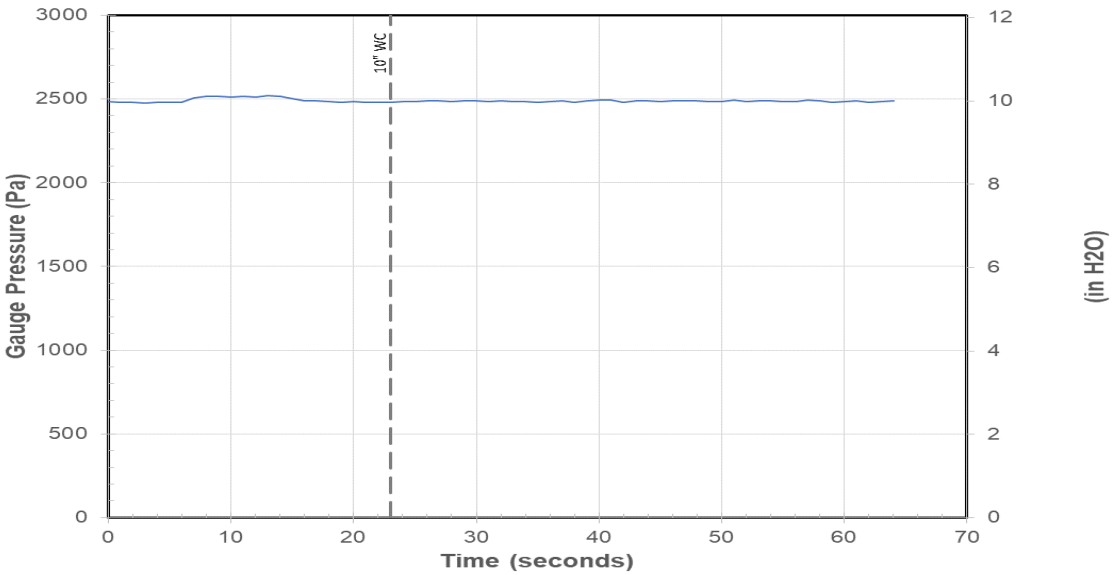

Figure 357. Gauge Pressure Data - Inlet

The following chart(s) present a time-dependent representation of the instantaneous volumetric flow rate measured during the experiment.

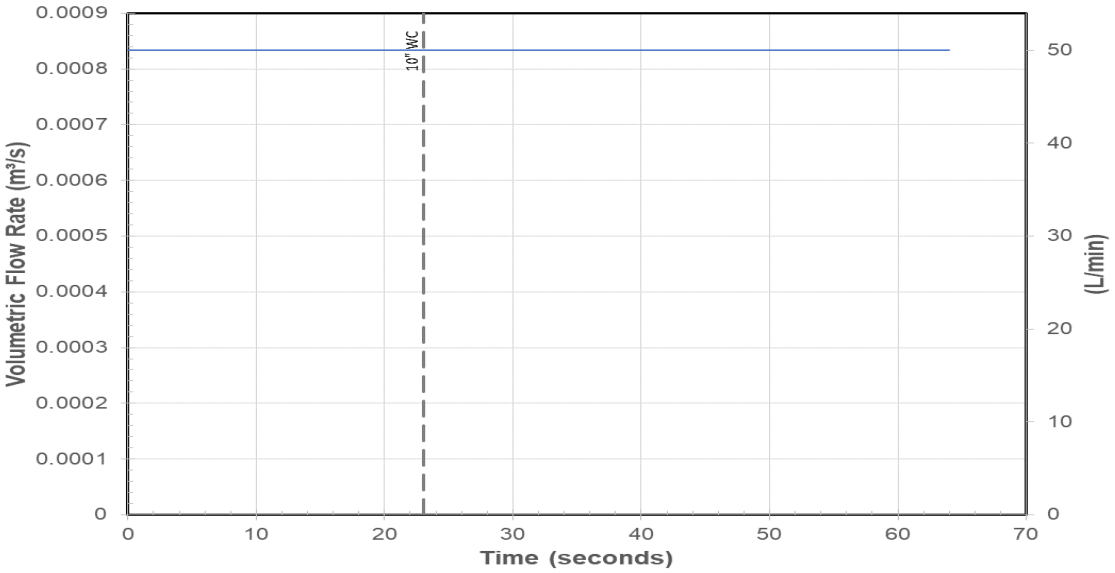

Figure 358. Volumetric Flow Rate

The following table provides a description of the video(s) taken during this experiment.

Table 156. Video Log

Description	Start Time	Duration (s)	Filename
FLIR	02:00:21	124	348138_20210624_140022_22A.mov
Close up	02:00:29	128	348138_20210624_140029_23A.mov
Overall	02:00:36	132	348138_20210624_140037_24A.mov
FLIR	02:00:50	136	348138_20210624_140050_6.mov
CLOSE UP	02:00:52	135	348138_20210624_140052_9.mov
OVERALL	02:00:53	134	348138_20210624_140053_10.mov
MASTER			348138_1246507.mov

Results Summary

The following table summarize the results for each experiment. The flow rate data and pressure data were averaged over a time interval of approximately 30-60 seconds. Flow rates greater than 50 lpm (106 cfh) were obtained from a signal photograph of the flow meter's display. For several experiments, the flow rate is listed as "Not Recorded", because the flow rate exceeded 50 lpm (106 cfh) and no photograph was taken.

Table 157. Summary of Experiments

Test #	Exp ID	Gas Type	Nominal Hole Size	Hole Orientation	Measured Gas Pressure	Measured Flow Rate	Stable Flame or Obstruction Required
1	348035	Propane	3.5 mm (0.138 inch)	Up	2740 Pa (11.0 inch H_2O)	23.3 lpm (49.4 cfh)	Stable Flame
					3238 Pa (13.0 inch H_2O)	25.3 lpm (53.6 cfh)	Stable Flame
2	348038	Propane	4.0 mm (0.157 inch)	Up	2740 Pa (11.0 inch H_2O)	30.1 lpm (63.8 cfh)	Stable Flame
					2989 Pa (12.0 inch H_2O)	31.4 lpm (66.5 cfh)	Stable Flame
3	348039	Propane	4.0 mm (0.157 inch)	Up	2740 Pa (11.0 inch H_2O)	30.1 lpm (63.8 cfh)	Stable Flame
					3537 Pa (14.2 inch H2O)	33.9 lpm (71.8 cfh)	Stable Flame
4	348041	Propane	4.5 mm (0.177 inch)	Up	2740 Pa (11 inch H_2O)	36.5 lpm (77.3 cfh)	Stable Flame
					3487 Pa (14.2 inch H_2O)	40.9 lpm (86.7 cfh)	Stable Flame
5	348042	Propane	5.0 mm (0.197 inch)	Up	2740 Pa (11.0 inch H_2O)	43.5 lpm (92.2 cfh)	Stable Flame
					3487 Pa (14.0 inch H_2O)	49.4 lpm (105 cfh)	Stable Flame
6	348044	Propane	3.5 mm (0.138 inch)	Up	2740 Pa (11 inch H_2O)	23.5 lpm (49.8 cfh)	Stable Flame
					3487 Pa (14.0 inch H_2O)	26.4 lpm (55.9 cfh)	Stable Flame
7	348045	Propane	2.5 mm (0.0984 inch)	Up	2740 Pa (11 inch H_2O)	13.7 lpm (29.0 cfh)	Stable Flame
					3487 Pa (14.0inch H_2O)	15.4 lpm (32.6 cfh)	Stable Flame
8	348046	Propane	3.0 mm (0.118 inch)	Up	2740 Pa (11.0 inch H_2O)	17.6 lpm (37.3 cfh)	Stable Flame
					3487 Pa (14.0 inch H_2O)	19.8 lpm (42.0 cfh)	Stable Flame
9	348047	Propane	2.0 mm (0.0787 inch)	Up	2740 Pa (11.0 inch H_2O)	8.9 lpm (18.9 cfh)	Obstruction Req
					3462 Pa (13.9 inch H_2O)	10.0 lpm (21.2 cfh)	Obstruction Req
10	348048	Propane	2.0 mm (0.0787 inch)	Up	2765 Pa (11.1 inch H_2O)	8.9 lpm (18.9 cfh)	Stable Flame
11	348049	Propane	1.5 mm (0.0591 inch)	Up	2740 Pa (11.0 inch H_2O)	4.4 lpm (9.3 cfh)	Obstruction Req
					3487 Pa (14.0 inch H_2O)	4.9 lpm (10.4 cfh)	Obstruction Req

Test #	Exp ID	Gas Type	Nominal Hole Size	Hole Orientation	Measured Gas Pressure	Measured Flow Rate	Stable Flame or Obstruction Required
12	348051	Propane	1.0 mm (0.0394 inch)	Up	2740 Pa (11.0 inch H_2O)	1.7 lpm (3.6 cfh)	Obstruction Req
					3487 Pa (14.0 inch H_2O)	2.0 lpm (4.2 cfh)	Obstruction Req
13	348052	Propane	0.5 mm (0.0197 inch)	Up	2740 Pa (11.0 inch H_2O)	0.6 lpm (1.3 cfh)	Obstruction Req
					3487 Pa (14.0 inch H_2O)	0.6 lpm (1.3 cfh)	Obstruction Req
14	348053	Natural Gas	5.0 mm (0.197 inch)	Up	996 Pa (4.0 inch H_2O)	44.7 lpm (94.7 cfh)	Stable Flame
					1743 Pa (7.0 inch H_2O)	57.1 lpm (121 cfh)	Stable Flame
15	348055	Natural Gas	5.0 mm (0.197 inch)	Up	996 Pa (4.0 inch H_2O)	44.2 lpm (93.7 cfh)	Stable Flame
					1768 Pa (7.1 inch H_2O)	56.6 lpm (120 cfh)	Stable Flame
16	348056	Natural Gas	4.5 mm (0.177 inch)	Up	996 Pa (4.0 inch H_2O)	36.3 lpm (76.9 cfh)	Stable Flame
					1768 Pa (7.1 inch H_2O)	46.9 lpm (99.4 cfh)	Stable Flame
17	348057	Natural Gas	4.0 mm (0.157 inch)	Up	1021 Pa (4.1 inch H_2O)	29.9 lpm (63.4 cfh)	Stable Flame
					1743 Pa (7.0 inch H_2O)	38.3 lpm (81.2 cfh)	Stable Flame
18	348058	Natural Gas	3.5 mm (0.138 inch)	Up	996 Pa (4.0 inch H_2O)	23.5 lpm (49.8 cfh)	Stable Flame
					1768 Pa (7.1 inch H_2O)	30.3 lpm (64.2 cfh)	Stable Flame
19	348059	Natural Gas	3.0 mm (0.118 inch)	Up	996 Pa (4.0 inch H_2O)	17.3 lpm (36.7 cfh)	Stable Flame
20	348061	Natural Gas	2.5 mm (0.0984 inch)	Up	996 Pa (4.0 inch H_2O)	14.3 lpm (30.3 cfh)	Obstruction Req
					1743 Pa (7.0 inch H_2O)	18.4 lpm (39.0 cfh)	Obstruction Req
21	348063	Natural Gas	2.0 mm (0.0787 inch)	Up	996 Pa (4.0 inch H_2O)	9.4 lpm (19.9 cfh)	Obstruction Req
					1743 Pa (7.0 inch H_2O)	12.1 lpm (25.6 cfh)	Obstruction Req
					2491 Pa (10.0 inch H_2O)	14.4 lpm (30.5 cfh)	Obstruction Req
22	348064	Natural Gas	1.5 mm (0.0591 inch)	Up	996 Pa (4.0 inch H_2O)	4.9 lpm (10.4 cfh)	Obstruction Req
					1743 Pa (7.0 inch H_2O)	6.3 lpm (13.3 cfh)	Obstruction Req
					2491 Pa (10.0 inch H_2O)	7.41 lpm (15.7 cfh)	Obstruction Req
23	348066	Natural Gas	1.0 mm (0.0394 inch)	Up	996 Pa (4.0 inch H_2O)	2.1 lpm (4.4 cfh)	Obstruction Req
					1743 Pa (7.0 inch H_2O)	2.7 lpm (5.7 cfh)	Obstruction Req
					2491 Pa (10.0 inch H_2O)	3.2 lpm (6.8 cfh)	Obstruction Req

Test #	Exp ID	Gas Type	Nominal Hole Size	Hole Orientation	Measured Gas Pressure	Measured Flow Rate	Stable Flame or Obstruction Required
24	348068	Natural Gas	0.5 mm (0.0197 inch)	Up	996 Pa (4.0 inch H_2O)	0.7 lpm (1.5 cfh)	Obstruction Req
					1743 Pa (7.0 inch H_2O)	0.9 lpm (1.9 cfh)	Obstruction Req
					2491 Pa (10.0 inch H_2O)	1.1 lpm (2.3 cfh)	Obstruction Req
25	348070	Natural Gas	2.5 mm (0.0984 inch)	Up	2491 Pa (10.0 inch H_2O)	21.7 lpm (46.0 cfh)	Obstruction Req
26	348071	Natural Gas	3.0 mm (0.118 inch)	Up	2491 Pa (10.0 inch H_2O)	27.6 lpm (58.5 cfh)	Obstruction Req
27	348072	Natural Gas	3.5 mm (0.138 inch)	Up	2491 Pa (10.0 inch H_2O)	36.7 lpm (21.2 cfh)	Stable Flame
28	348073	Natural Gas	4.0 mm (0.157 inch)	Up	2491 Pa (10.0 inch H_2O)	46.4 lpm (98.3 cfh)	Stable Flame
29	348074	Natural Gas	4.5 mm (0.177 inch)	Up	2491 Pa (10.0 inch H_2O)	56.8 lpm (120 cfh)	Stable Flame
30	348075	Natural Gas	2.5 mm (0.0984 inch)	Up	996 Pa (4.0 inch H_2O)	14.0 lpm (29.7 cfh)	Stable Flame
31	348080	Propane	5.0 mm (0.197 inch)	Side	2765 Pa (11.1 inch H_2O)	43.0 lpm (91.1 cfh)	Stable Flame
					3487 Pa (14.0 inch H_2O)	48.7 lpm (103 cfh)	Stable Flame
32	348082	Propane	5.0 mm (0.197 inch)	Side	2740 Pa (11.0 inch H_2O)	42.8 lpm (90.7 cfh)	Stable Flame
					3487 Pa (14.0 inch H_2O)	48.3 lpm (102 cfh)	Stable Flame
33	348084	Propane	4.5 mm (0.177 inch)	Side	2740 Pa (11.0 inch H_2O)	35.3 lpm (74.8 cfh)	Stable Flame
					3487 Pa (14.0 inch H_2O)	39.7 lpm (84.1 cfh)	Stable Flame
34	348085	Propane	4.0 mm (0.157 inch)	Side	2740 Pa (11.0 inch H_2O)	29.8 lpm (63.1 cfh)	Stable Flame
					3512 Pa (14.1 inch H_2O)	33.4 lpm (70.8 cfh)	Stable Flame
35	348086	Propane	3.5 mm (0.138 inch)	Side	2740 Pa (11.0 inch H_2O)	23.2 lpm (49.2 cfh)	Stable Flame
					3487 Pa (14.0 inch H_2O)	26.1 lpm (55.3 cfh)	Stable Flame
36	348087	Propane	3.0 mm (0.118 inch)	Side	2740 Pa (11.0 inch H_2O)	16.9 lpm (35.8 cfh)	Stable Flame
					3487 Pa (14.0 inch H_2O)	19.1 lpm (40.5 cfh)	Stable Flame
37	348088	Propane	2.5 mm (0.0984 inch)	Side	2740 Pa (11.0 inch H_2O)	13.6 lpm (28.8 cfh)	Stable Flame
					3487 Pa (14.0 inch H_2O)	15.2 lpm (32.2 cfh)	Stable Flame
38	348089	Propane	2.0 mm (0.0787 inch)	Side	3487 Pa (14.0 inch H_2O)	9.9 lpm (21.0 cfh)	Stable Flame

Test #	Exp ID	Gas Type	Nominal Hole Size	Hole Orientation	Measured Gas Pressure	Measured Flow Rate	Stable Flame or Obstruction Required
39	348090	Propane	2.0 mm (0.0787 inch)	Side	2740 Pa (11.0 inch H_2O)	8.8 lpm (18.6 cfh)	Stable Flame
					3512 Pa (14.1 inch H_2O)	9.9 lpm (21.0 cfh)	Stable Flame
40	348091	Propane	1.5 mm (0.0591 inch)	Side	3487 Pa (14.0 inch H_2O)	4.9 lpm (10.4 cfh)	Obstruction Req
41	348092	Propane	1.0 mm (0.0394 inch)	Side	2740 Pa (11.0 inch H_2O)	1.8 lpm (3.8 cfh)	Obstruction Req
					3487 Pa (14.0 inch H_2O)	2.0 lpm (4.2 cfh)	Obstruction Req
42	348093	Propane	0.5 mm (0.0197 inch)	Side	2765 Pa (11.1 inch H_2O)	0.6 lpm (1.3 cfh)	Obstruction Req
					3487 Pa (14.0 inch H_2O)	0.7 lpm (1.5 cfh)	Obstruction Req
43	348094	Natural Gas	5.0 mm (0.197 inch)	Side	996 Pa (4.0 inch H_2O)	44.4 lpm (94.1 cfh)	Stable Flame
					1719 Pa (6.9 inch H_2O)	56.5 lpm (120 cfh)	Stable Flame
44	348095	Natural Gas	4.5 mm (0.177 inch)	Side	996 Pa (4.0 inch H_2O)	36.8 lpm (78.0 cfh)	Stable Flame
					1768 Pa (7.1 inch H_2O)	47.9 lpm (102 cfh)	Stable Flame
45	348096	Natural Gas	4.0 mm (0.157 inch)	Side	996 Pa (4 inch H_2O)	30.4 lpm (64.4 cfh)	Stable Flame
					1743 Pa (7.0 inch H_2O)	39.1 lpm (82.2 cfh)	Stable Flame
					2541 Pa (10.2 inch H_2O)	46.6 lpm (98.7 cfh)	Stable Flame
46	348097	Natural Gas	3.5 mm (0.138 inch)	Side	996 Pa (4.0 inch H_2O)	24.0 lpm (50.9 cfh)	Stable Flame
					1743 Pa (7.0 inch H_2O)	30.7 lpm (65.0 cfh)	Stable Flame
					2491 Pa (10.0 inch H_2O)	36.5 lpm (77.3 cfh)	Stable Flame
47	348098	Natural Gas	3.0 mm (0.118 inch)	Side	1021 Pa (4.1 inch H_2O)	17.8 lpm (37.7 cfh)	Obstruction Req
					1743 Pa (7.0 inch H_2O)	22.9 lpm (48.5 cfh)	Obstruction Req
					2491 Pa (10 inch H_2O)	27.1 lpm (57.4 cfh)	Obstruction Req
48	348099	Natural Gas	2.5 mm (0.0984 inch)	Side	996 Pa (4.0 inch H_2O)	13.8 lpm (29.2 cfh)	Stable Flame
					1719 Pa (6.9 inch H_2O)	17.7 lpm (37.5 cfh)	Obstruction Req
					2491 Pa (10.0 inch H_2O)	21.1 lpm (44.7 cfh)	Obstruction Req
49	348100	Natural Gas	2.0 mm (0.0787 inch)	Side	996 Pa (4.0 inch H_2O)	9.0 lpm (19.1 cfh)	Obstruction Req
					1743 Pa (7.0 inch H_2O)	11.5 lpm (24.4 cfh)	Obstruction Req
					2491 Pa (10.0 inch H_2O)	13.6 lpm (28.8 cfh)	Obstruction Req

Test #	Exp ID	Gas Type	Nominal Hole Size	Hole Orientation	Measured Gas Pressure	Measured Flow Rate	Stable Flame or Obstruction Required
50	348101	Natural Gas	1.5 mm (0.0591 inch)	Side	996 Pa (4.0 inch H_2O)	4.5 lpm (9.5 cfh)	Obstruction Req
					1743 Pa (7.0 inch H_2O)	5.8 lpm (12.3 cfh)	Obstruction Req
					2491 Pa (10.0 inch H_2O)	6.9 lpm (14.6 cfh)	Obstruction Req
51	348102	Natural Gas	1.0 mm (0.0394 inch)	Side	971 Pa (3.9 inch H_2O)	1.8 lpm (3.8 cfh)	Obstruction Req
					1743 Pa (7.0 inch H_2O)	2.4 lpm (5.1 cfh)	Obstruction Req
					2491 Pa (10.0 inch H_2O)	2.8 lpm (5.9 cfh)	Obstruction Req
52	348103	Natural Gas	0.5 mm (0.0197 inch)	Side	996 Pa (4.0 inch H_2O)	0.6 lpm (1.3 cfh)	Obstruction Req
					1743 Pa (7.0 inch H_2O)	0.8 lpm (1.7 cfh)	Obstruction Req
					2491 Pa (10.0 inch H_2O)	0.9 lpm (1.9 cfh)	Obstruction Req
53	348104	Natural Gas	4.5 mm (0.177 inch)	Side	2491 Pa (10.0 inch H_2O)	Not Recorded	Stable Flame
54	348105	Natural Gas	5.0 mm (0.197 inch)	Side	2491 Pa (10.0 inch H_2O)	Not Recorded	Stable Flame
55	348111	Propane	5.0 mm (0.197 inch)	Down	2516 Pa (10.1 inch H_2O)	40.1 lpm (85.0 cfh)	Stable Flame
					3512 Pa (14.1 inch H_2O)	47.0 lpm (99.6 cfh)	Stable Flame
56	348112	Propane	4.5 mm (0.177 inch)	Down	2491 Pa (10.0 inch H_2O)	32.5 lpm (68.9 cfh)	Stable Flame
					3512 Pa (14.1 inch H_2O)	39.0 lpm (82.6 cfh)	Stable Flame
57	348115	Propane	5.0 mm (0.197 inch)	Up	2491 Pa (10.0 inch H_2O)	42.0 lpm (89.0 cfh)	Stable Flame
					3487 Pa (14.0 inch H_2O)	Not Recorded	Stable Flame
58	348116	Propane	4.5 mm (0.177 inch)	Up	2491 Pa (10.0 inch H_2O)	35.1 lpm (74.4 cfh)	Stable Flame
					3487 Pa (14.0 inch H_2O)	41.2 lpm (87.3 cfh)	Stable Flame
59	348117	Propane	4.0 mm (0.157 inch)	Up	2491 Pa (10.0 inch H_2O)	29.2 lpm (61.9 cfh)	Stable Flame
					3512 Pa (14.1 inch H_2O)	34.5 lpm (73.1 cfh)	Stable Flame
60	348118	Propane	3.5 mm (0.138 inch)	Up	2491 Pa (10.0 inch H_2O)	22.6 lpm (47.9 cfh)	Stable Flame
					3487 Pa (14.0 inch H_2O)	26.6 lpm (56.4 cfh)	Stable Flame
61	348119	Propane	3.0 mm (0.118 inch)	Up	2491 Pa (10.0 inch H_2O)	16.7 lpm (35.4 cfh)	Stable Flame
					3487 Pa (14.0 inch H_2O)	19.7 lpm (41.7 cfh)	Stable Flame

Test #	Exp ID	Gas Type	Nominal Hole Size	Hole Orientation	Measured Gas Pressure	Measured Flow Rate	Stable Flame or Obstruction Required
62	348120	Propane	2.5 mm (0.0984 inch)	Up	2491 Pa (10.0 inch H_2O)	13.2 lpm (28.0 cfh)	Stable Flame
					2740 Pa (11.0 inch H_2O)	13.8 lpm (29.2 cfh)	Stable Flame
					3487 Pa (14.0 inch H_2O)	15.5 lpm (32.8 cfh)	Stable Flame
63	348124	Propane	3.0 mm (0.118 inch)	Up	2740 Pa (11.0 inch H_2O)	17.6 lpm (37.3 cfh)	Stable Flame
64	348126	Propane	3.5 mm (0.138 inch)	Up	2740 Pa (11.0 inch H_2O)	23.7 lpm (50.2 cfh)	Stable Flame
65	348127	Propane	4.0 mm (0.157 inch)	Up	2740 Pa (11.0 inch H_2O)	30.6 lpm (64.8 cfh)	Stable Flame
66	348128	Propane	4.5 mm (0.177 inch)	Up	2740 Pa (11.0 inch H_2O)	36.6 lpm (77.6 cfh)	Stable Flame
67	348129	Propane	5.0 mm (0.197 inch)	Up	2740 Pa (11.0 inch H_2O)	43.9 lpm (93.0 cfh)	Stable Flame
68	348130	Natural Gas	5.0 mm (0.197 inch)	Up	1743 Pa (7.0 inch H_2O)	Not Recorded	Stable Flame
69	348132	Natural Gas	5.0 mm (0.197 inch)	Up	996 Pa (4.0 inch H_2O)	45.5 lpm (96.4 cfh)	Stable Flame
					1743 Pa (7.0 inch H_2O)	Not Recorded	Stable Flame
70	348133	Natural Gas	4.5 mm (0.177 inch)	Up	996 Pa (4.0 inch H_2O)	37.8 lpm (80.1 cfh)	Stable Flame
					1743 Pa (7 inch H_2O)	48.6 lpm (103 cfh)	Stable Flame
71	348134	Natural Gas	4.0 mm (0.157 inch)	Up	996 Pa (4.0 inch H_2O)	31.2 lpm (66.1 cfh)	Stable Flame
					1743 Pa (7.0 inch H_2O)	40.1 lpm (85.0 cfh)	Stable Flame
72	348135	Natural Gas	4.0 mm (0.157 inch)	Up	2491 Pa (10.0 inch H_2O)	47.3 lpm (100 cfh)	Stable Flame
73	348136	Natural Gas	3.5 mm (0.138 inch)	Up	996 Pa (4.0 inch H_2O)	24.3 lpm (51.5 cfh)	Stable Flame
					1743 Pa (7.0 inch H_2O)	31.1 lpm (65.9 cfh)	Stable Flame
					2491 Pa (10.0 inch H_2O)	36.7 lpm (77.8 cfh)	Stable Flame
74	348137	Natural Gas	3.0 mm (0.118 inch)	Up	1021 Pa (4.1 inch H_2O)	18.0 lpm (38.1 cfh)	Stable Flame
75	348138	Natural Gas	4.5 mm (0.177 inch)	Up	2491 Pa (10.0 inch H_2O)	Not Recorded	Stable Flame

The following figures illustrate how the flow rate of the gas varied with the holes size as a function of the gas pressure. The data for the different hole orientations (up, side, down) are combined into one data set at each gas pressure.

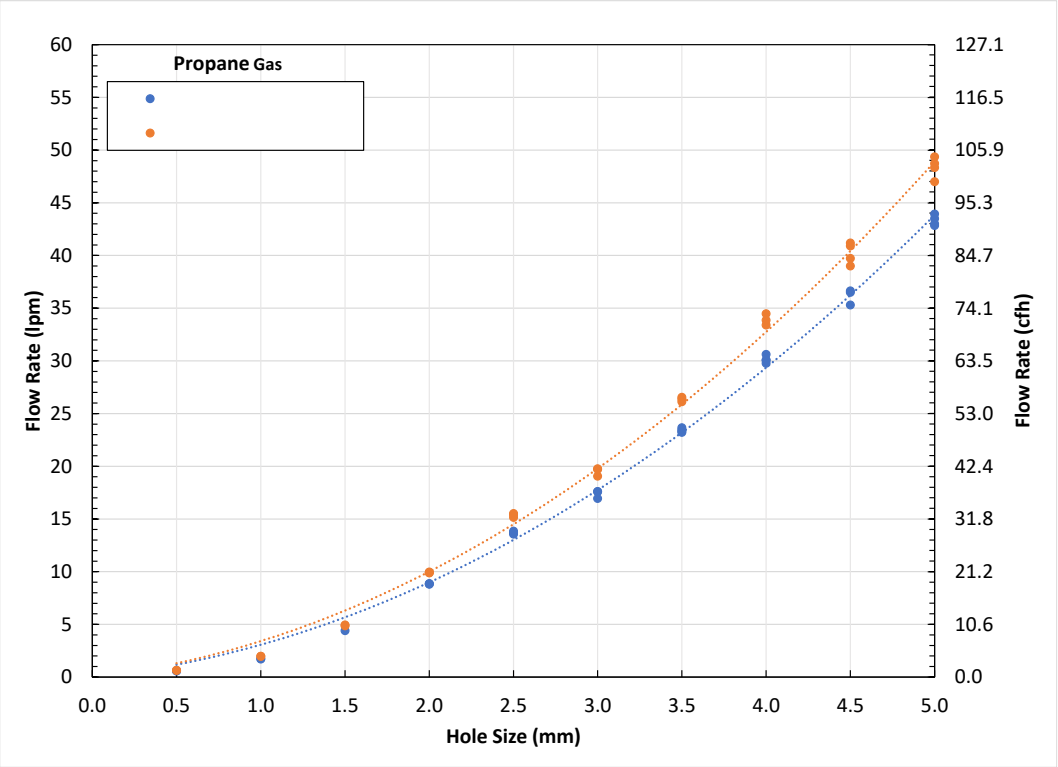

Figure 359. Flow Rate of Propane Gas versus Hole Size for all Hole Orientations

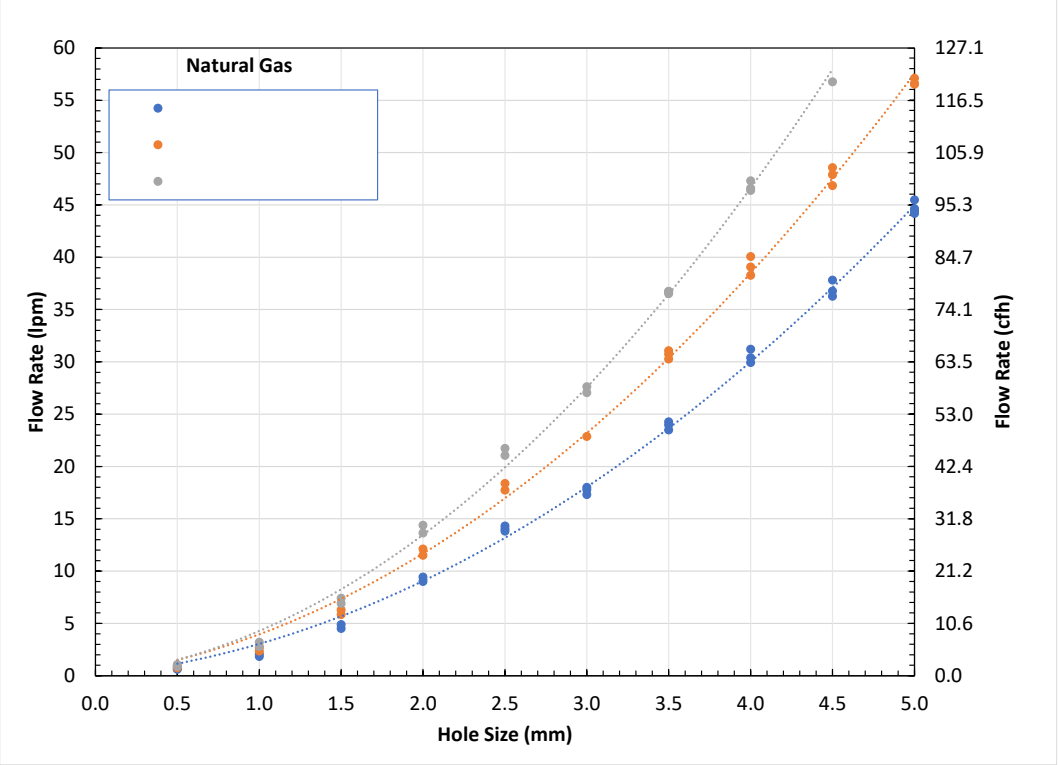

Figure 360. Flow Rate of Natural Gas versus Hole Size for all Hole Orientations

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