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PNNL-39085, Rev. 0
SWARM-RPT-002, Rev. 0

Filtration Performance of Simulated 200 West Area Waste Feeds

April 2026

PP Schonewill
J Gacutan
H Jensen
LG El Khoury
CA Burns
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U.S. DEPARTMENT of ENERGY

Prepared for the U.S. Department of Energy
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Revision History

Revision Number	Date Issued	Description of Change
0	04.10.2026	Initial issue.

Summary

Nuclear waste stored at Hanford's 200 West Area (200W) tank farm resides in both double-shell tanks (DSTs) and single-shell tanks (SSTs) and must be retrieved and treated to support the long-term Hanford mission. Current planning for 200W (referred to as the West Area Risk Management project, or WARM) is to add local operational capabilities to enable near-term retrievals, treat tank waste, and manage DST space. The WARM scope (also referred to as the West Area Tank Treatment program) includes installing process modules adjacent to the SY Tank Farm that will remove solids and Cs-137. The process modules will pretreat qualified waste delivered from tank SY-101, beginning with the resident material in SY Tank Farm and followed by a sequence of retrieved SST wastes.

Because the 200W tank system has a significantly smaller DST system than the 200 East Area (200E) tank farm, obtaining additional data related to the operation of the filtration and ion exchange process modules in 200W is important. The physical isolation of 200W from 200E requires that the SY tanks receive retrievals from SSTs, qualify waste for pretreatment, and feed the local process modules within their volumetric constraints. In addition, the pace of retrievals from 200W SSTs is planned to be rapid compared to historical retrieval rates: approximately two SSTs retrieved per calendar year. Consequently, the 200W flowsheet anticipates qualifying and pretreating recently retrieved SST waste with shorter settling times, leading to waste feeds with solids loadings that are observable (>100 ppm, or 0.1 g L^{-1}). The (likely) observable solids loadings in the waste feeds create uncertainty in the projection of dead-end filtration performance during pretreatment processing, and it was determined that the waste chemistry, physical properties, and solids composition in 200W wastes are unique enough to warrant additional testing to provide data for design and/or operation of the dead-end filter (DEF) process module. Since not all testing can be conducted with actual waste, waste simulants were recently formulated to represent chronological groups of anticipated retrieved waste feeds (see Schonewill et al. 2024).

This report describes the scaled experimental system and approach used to examine dead-end filtration performance of representative 200W waste feeds. The scaled system, which was originally designed and assembled to test Tank Side Cesium Removal (TSCR) system performance with higher-than-expected solid loadings in 2021 (Schonewill et al. 2021), was repurposed to conduct the current experiments at ~1/145 of full scale (based on throughput). Six experimental runs were conducted with five different 200W waste feed simulants: three using a DEF module scaled for TSCR and three using a DEF module scaled for the 200W process modules (based on the current design for the Advanced Modular Pretreatment System). Each experiment was run continuously for multiple days with an operating approach prototypic of the full-scale system. Staff performing the experimental runs monitored performance, obtained data from calibrated process instruments, and collected samples for observation and analysis. The measured data are presented with a focus on assessing DEF performance – specifically, the filters' differential pressure response to the five waste simulants, frequency and efficacy of backwashing, and baseline recovery between experimental runs; data related to ion exchange column performance are also discussed in cases where the opportunity arose.

The experimental campaign demonstrated that the DEFs satisfied their primary function of protecting the ion exchange column from solid intrusion for all the representative simulants used. The filters readily handled solids loadings of ≤500 ppm (and even greater), especially the modules scaled to the 200W process modules. Adjustments to the processing flow rate and reductions in feed temperature were observed to affect the rate of differential pressure increase on the filters, but neither adversely affected the ability of the DEFs to perform their primary function. Backflushing reliably recovered filter performance in all runs, although it did not prevent irreversible fouling for one simulant. The run that exhibited irreversible fouling established that both the quantity and the nature of the solids being filtered need to be considered when projecting filter performance.

Acknowledgments

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Acronyms and Abbreviations

200E	Hanford 200 East Area
200W	Hanford 200 West Area
AMPS	Advanced Modular Pretreatment System
BV	bed volume
CST	crystalline silicotitanate
DEF	dead-end filter
DFLAW	Direct Feed Low-Activity Waste
DI	deionized
DOE	U.S. Department of Energy
DST	double-shell tank
EOR	end of run
FIO	For Information Only
H2C	Hanford Tank Waste Operations & Closure
HFO	Hanford Field Office
IBC	intermediate bulk container
IC	ion chromatography
ICP	inductively coupled plasma
IX	ion exchange
IXC	ion exchange column
LS1	laboratory scale 1 [TSCR-scaled DEFs]
LS2	laboratory scale 2 [200W process module-scaled DEFs]
MOR	midpoint of run
MS	mass spectroscopy
NQAP	Nuclear Quality Assurance Program
OES	optical emission spectroscopy
PDLE	Process Development Laboratory East
PM	process module
PNNL	Pacific Northwest National Laboratory
PSD	particle size distribution
RPD	relative percent difference
RTD	resistance temperature detector
SOR	start of run
SOW	statement of work
SST	single-shell tank
SWARM	Support to West Area Risk Management
TC	total carbon

TOC	total organic carbon
TSCR	Tank Side Cesium Removal
WARM	West Area Risk Management
WRPS	Washington River Protection Solutions, LLC
WWF	West Waste Feed
XRD	X-ray diffraction

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1.0 Introduction

The process of retrieving Hanford waste from a tank and transferring it to another tank, by its very nature, entrains solids into a carrier liquid phase. Most of the entrained solids will settle via gravity once they are discharged into the receipt tank and no longer actively mobilized. If it is desirable to minimize the solid inventory that is carried forward in a subsequent transfer, the settling time must be of sufficient length (typically on the order of weeks to months). For conditions where sufficient settling time is not possible, a fraction of the solid particles will remain entrained and would have to be removed if downstream operations are intolerant of solid particles. Pretreatment systems using ion exchange columns (IXCs) are one such processing operation where solids removal is needed to protect the packed beds of the columns; dead-end filtration is the technology used to perform the solids removal. This section describes a new dead-end filtration application on the Hanford site, its similarities and differences with a currently deployed pretreatment system on the site, and research program objectives devised to provide performance data in support of its design and operation.

1.1 West Area Flowsheet and Process Modules

Approximately 56 million gallons of radioactive and chemical waste currently resides in the Hanford tank farms, split between two areas: the 200 East Area (200E, or East Area) Tank Farm and the 200 West Area (200W, or West Area) Tank Farm. The mission of the U.S. Department of Energy (DOE) Hanford Field Office (HFO) River Protection Project is to retrieve and treat Hanford tank waste and close the tank farms to protect the nearby Columbia River. The portion of the Direct Feed Low-Activity Waste (DFLAW) mission being executed by Hanford Tank Waste Operations & Closure (H2C)[1] is focused on the supernate fraction of the radioactive waste in 200E. Liquid waste in 200E is being retrieved into the AP Tank Farm and pretreated in the Tank Side Cesium Removal (TSCR) system to remove solids and cesium-137 (Cs-137). For an overview of the TSCR system, refer to Barker et al. (2019 and 2020).

Based on the successful operation of the TSCR system since 2022, HFO initiated the design of the Advanced Modular Pretreatment System (AMPS). The AMPS project will provide the additional waste pretreatment capacity needed to support the long-term operation of the Low-Activity Waste Facility at the Hanford Waste Treatment and Immobilization Plant, located in 200E. Both TSCR and AMPS use sintered stainless steel dead-end filter (DEF) modules and IXCs filled with crystalline silicotitanate (CST) media to remove solids and Cs-137, respectively. In either case, the systems are designed to handle decanted waste that has been retrieved into AP Tank Farm, given sufficient time to settle, and qualified by sample analysis before it is pretreated.

Waste in 200W, which currently resides in both double-shell tanks (DSTs) and single-shell tanks (SSTs), must also be retrieved and treated to support the long-term Hanford mission. The present focus of the 200W effort (referred to as the West Area Risk Management project, or WARM) is to mitigate risks and add local operational capabilities to enable near-term retrievals, treat tank waste, and manage DST space.[2] The scope of the 200W effort includes the installation of process modules (PMs) that will perform solids and Cs-137 removal, which is expected to be similar to the operation of TSCR and AMPS. A general diagram of the currently devised flowsheet is shown in Figure 1.1 (adapted from Nguyen et al. 2025).

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[1] Hanford Tank Waste Operations & Closure, LLC, is the current organization with the Hanford tank farm operating contract.

[2] The WARM project is also referred to as the West Area Tank Treatment (WATT for short) program, which is focused on the flowsheet and pretreatment parts of the overall WARM mission. For consistency with the initial PNNL project acronym, the term WARM will be used in this document.

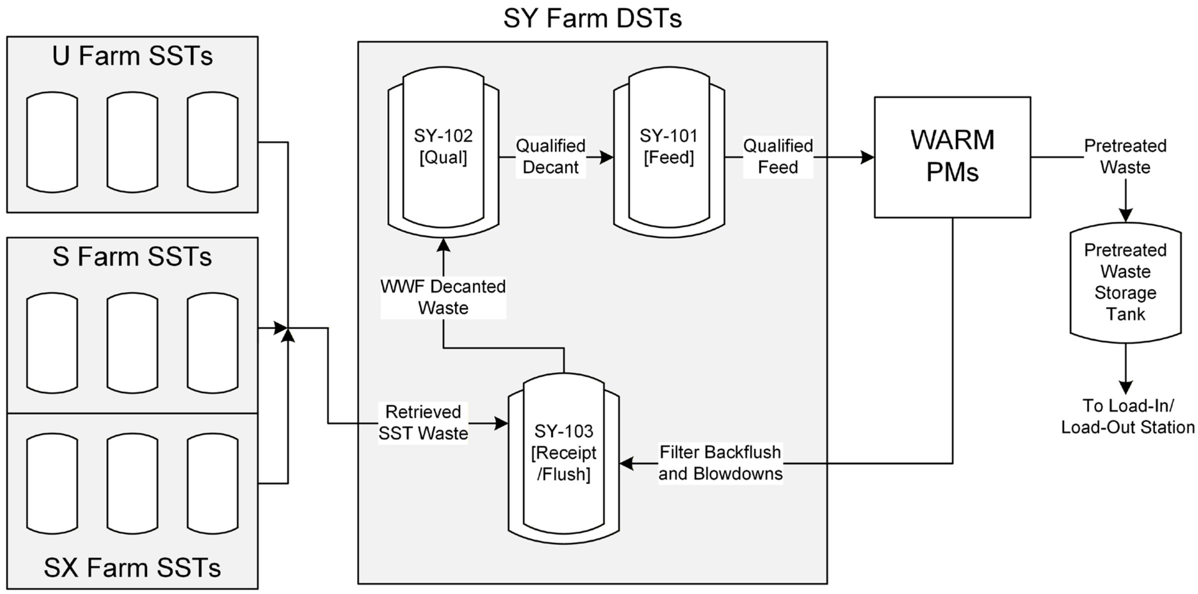

Figure 1.1. Current 200W flowsheet diagram. The SST Farm graphics are representative and do not show the actual number of SSTs in each of the farms. The primary function of each SY Farm DST is given in brackets under the tank label (adapted from Figure 3-1 in Nguyen et al. 2025). Note: WWF = West Waste Feed and PM = process module.

The 200E and 200W waste compositions, in general, are distinct, and there are only three DSTs in 200W (SY-101, SY-102, and SY-103). The physical isolation of 200W from 200E requires that the SY tanks receive retrievals from SSTs, qualify waste for pretreatment, and feed the local PMs within their volumetric constraints. Unlike 200E, where the AP Tank Farm has eight DSTs, there are no other DSTs in proximity to the SY tanks in 200W that can handle process overflow or provide additional support to the WARM mission.

Consequently, the approach in 200W will likely have differences compared with the existing process in 200E; for instance, retrieved SST waste will have shorter settling times in the SY Tank Farm, leading to waste feeds with higher solids loadings than currently experienced in 200E by TSCR[1] (and in the future, AMPS). The impact of higher-than-expected solids loading in TSCR has been investigated at scale (Schonewill et al. 2021), but the testing was specific for the chemistry of initial 200E feeds with postulated precipitated solids. There are notable differences in waste chemistry, physical properties, and solids loading in the expected 200W waste feed compared to the 200E feeds. These differences are significant enough that prediction of their impact on 200W PM performance is highly uncertain.

Therefore, it was determined that additional testing would be valuable to support 200W PM design and operating strategy. However, the similarity in operations between TSCR, AMPS, and 200W allowed a prior experimental system (Schonewill et al. 2021) to be repurposed to measure performance in a prototypic system. The prior system's scale necessitates the use of simulants, specifically, the recent 200W simulants developed at Pacific Northwest National Laboratory (PNNL) (Schonewill et al. 2024). The next section describes the objectives of the experimental program to examine filtration performance.

[1] As of this writing, the solids loading in the waste fed to TSCR has largely been negligible over the campaigns performed to-date. The amount present cannot be quantified by traditional gravimetric methods. This is consistent with (and probably less than) the nominal solids loading expected for 200E waste feed, which is ~160 to 200 ppm (see Ard 2019; Stubb and Chamberlain 2021).

1.2 Objectives

The unifying purpose of the experiments described in this report was to examine filtration performance under a range of conditions using a prototypic filtration system when 200W representative waste simulants were being processed. In prior work (e.g. Schonewill et al. 2021), PNNL designed and assembled a scaled filtration system capable of conducting operations prototypic of the TSCR system. The same system was used for the current examination with select modifications as described in Section 3.0. The use of a scaled TSCR system was deemed to be appropriate because the 200W PMs are functionally equivalent and operate at the same nominal flow rate (5 gpm). Despite the similarity, the 200W PM is expected to incorporate the same design as the DEF modules planned for AMPS (Nguyen et al. 2025); the primary differences from the TSCR filters are increased surface area and an expanded range of flow rates (3.5 to 7.5 gpm). These differences were implemented for some of the experiments so that the anticipated full-scale filter flux could be matched. (This is reflected in a few of the specific objectives listed below.) The resulting changes in the experimental system design to adjust for the different filter design are described in Section 3.1.3.

The specific objectives requested to be assessed by H2C in the experiments were to:

- Determine the expected operational time to backwash using the prototypic process filter flux of 0.065 gpm ft^{-2} (TSCR 5 gpm equivalent) and 0.038 gpm ft^{-2} (AMPS/200W PM 5 gpm equivalent) at a differential pressure limit of 2 psi for a range of solids concentrations (see target solids concentrations listed further on in this section).
- Determine the impact of increasing filter differential pressure to accommodate longer operation between backflushes.
- Determine the impact of decreasing the filter flux to 0.045 and 0.027 gpm ft^{-2} and increasing the filter flux to 0.098 and 0.057 gpm ft^{-2}. (These flux values align with a processing range of 3.5 to 7.5 gpm for TSCR and AMPS/200W PM, respectively.)
- Determine the efficacy of filter backwash operations.
- Determine the impact of changing feed temperature and assess any impacts observed beyond viscosity changes. Although both increased and decreased feed temperature impact viscosity, the focus was only on decreasing feed temperature because of the heightened precipitation risk.

More than one objective was addressed during each experimental run by designing an evolution of operations for each simulant material, which is discussed in detail in Section 5.0.

The representative simulants planned for use in the experiments – including their basis and development process – are outlined in Schonewill et al. (2024). The statement of work (SOW)[1] provided by H2C envisioned the use of the five simulants of Schonewill et al. 2024 as shown in Table 1.1. Note that the SOW simulant descriptions listed in the Table 1.1 use SWARM document numbers. These documents refer to letters transmitted to H2C that provided preliminary simulant recipes. However, these recipes were revised (particularly the solid phase composition) after transmittal of the letters, so the final recipes in Schonewill et al. (2024) were the ones used to perform the experiments. The simulant recipe

[1] The original SOW governing the work (entitled *West Area Simulant Development)* was Requisition #367698, Rev. 2, June 12, 2024. This SOW was issued by Washington River Protection Solutions, LLC (WRPS). The SOW was later replaced by Requisition #379178, Rev. 0, January 16, 2025, when the tank farm contractor changed from WRPS to H2C. A later revision of this SOW (Requisition #379178, Rev. 1, June 9, 2025) also expanded the flux ranges that were to be considered in the experimental scope.

designations from Schonewill et al. (2024) and the experimental run identifiers are provided to cross-reference between the SOW and the identifiers used in the remainder of this report.

Table 1.1. Representative Simulants to be Used in Experiments and Relevant Cross-Referenced Identifiers.

Statement of Work Simulant Description	Solids Loading Target(s) (ppm)	Simulant IDs from Schonewill et al. 2024	Associated Run ID(s) from experiments described in this document
SWARM-LTR-005 DST Feed	130 / 30	S1	W-01, W-06
SWARM-LTR-006 SST Feed #1	50	S2	W-02
SWARM-LTR-006 SST Feed #2	100	S3	W-03
SWARM-LTR-007 SST Feed #3	20	S4	W-04
SWARM-LTR-007 SST Feed #4	500 / 100	S5	W-05

The simulants in Schonewill et al. 2024 were developed with the best and most up-to-date information that H2C had regarding its planned flowsheet for 200W at the time (as presented in Templeton and Nyugen 2024). The flowsheet was subsequently updated as described in Nguyen et al. (2025). PNNL is evaluating the impact of these changes to the planned flow sheet on the simulants described in Schonewill et al. 2024, but they are not discussed further in this report.

1.3 Report Structure

The report contains a detailed description of the quality assurance governing the work (Section 2.0), the experimental systems and its modifications (Section 3.0), and makeup information and properties of the large simulants batches used (Section 4.0). Section 5.0 describes the experimental methodology and Section 6.0 presents the key data collected during each experimental run. Section 7.0 summarizes the outcomes of the experimental program, with supporting references found in Section 8.0. Five appendices are included that capture comparisons between analytical and expected simulant concentration data (Appendix A), experimental run timelines (Appendix B), tabulated process data (Appendix C), graphical time series data (Appendix D), and comparisons of miscellaneous parameters between experimental runs (Appendix E).

2.0 Quality Assurance

The work described in this report was conducted with funding from the tank farm operations contractor; when the project began the contractor was Washington River Protection Solutions, LLC (WRPS). The initial supporting work was conducted under Contract 77529-049, "West Area Simulant Development," and was defined as the Support to West Area Risk Management (SWARM) Project at PNNL. Subsequently, the contractor changed to H2C and follow-on contracts were put in place. The SWARM project initially existed under PNNL project number 82653 and, subsequently, project numbers 85435 and 86440 due to the change in contractor and fiscal years. However, all the work was united under the SWARM banner for continuity of data and record-keeping. Table 2.1 summarizes the various project numbers associated with the SWARM project; this is provided to establish a linkage between all relevant contracts/project numbers, but it does not have any bearing on the execution of the quality-affecting work.

Table 2.1. Project Numbers Associated with the SWARM Project at PNNL.

PNNL Project Number	Sponsor	Sponsor Contract Number	Description of Project Objective as Listed in the Statement of Work
82653	WRPS	77529-049	*West Area Simulant Development*: WRPS Requisition #367698, Rev. 0, dated 18 Jul 2023: "The support includes the development of simulant waste recipes for use in testing and performance of small-scale tests to resolve challenging issues for WARM." SOW was later updated in Requisition #367698, Rev. 2, dated 12 Jun 2024 to add scope as summarized below: "This support includes the development of simulant waste recipes for use in testing, procuring simulant, and performance of scaled filtration tests to evaluate expected operational performance for WARM."
85435	H2C	90685-026	*West Area Simulant Development (formally 77529-049)*; H2C Requisition #379178, Rev. 0, dated 16 Jan 2025. Same scope as in Requisition #367698, Rev. 2. A change in the sponsoring company resulted in a new PNNL project number but the project scope, description, schedule, and deliverables were unchanged. Requisition #379178, Rev. 1, dated 09 Jun 2025 adjusted the testing parameters and the deliverables needed in fiscal year 2025.
86440	H2C	90685-039	*West Area Simulant and Filtration Evaluation (formerly 90685-026)*; H2C Requisition #383202, Rev. 0, dated 25 Jun 2025: "This support includes evaluation of simulant recipes and scaled filtration tests to inform the expected operational performance for WARM."

This work was performed in accordance with the PNNL Nuclear Quality Assurance Program (NQAP). The NQAP[1] complies with DOE Order 414.1D, *Quality Assurance*, and 10 CFR 830, Subpart A, *Quality Assurance Requirements*. The NQAP uses NQA-1-2012, *Quality Assurance Requirements for Nuclear Facility Applications*, as its consensus standard and NQA-1-2012, Subpart 4.2.1, as the basis for its graded approach to quality (ASME 2012).

The NQAP works in conjunction with PNNL's laboratory-level Quality Management Program, which is based on the requirements as defined in the DOE Order 414.1D and 10 CFR 830, Subpart A.

All the work described in this report was collectively assigned a technology readiness level of 5. Any PNNL staff member contributing to the work received the appropriate technical and quality assurance training prior to performing quality-affecting work.

[1] The program is described in the *Nuclear Quality Assurance Program Manual – Quality Assurance Manual*, which is an internally controlled PNNL document. The current version is Rev. 6.0.

3.0 Experimental Approach

This section describes the experimental methodology used to address the objectives in Section 1.2. First, the scaling basis of the system (with respect to both TSCR and 200W) is discussed. This is followed by a high-level overview of the system components and key instruments. Finally, the data collection processes and analysis approaches are summarized.

3.1 Applicability of Prior Scaling Basis

The laboratory-scale (LS) system used in these experiments was originally constructed to assess the performance of the DEFs (and, to a less extent, the IXCs) in the presence of higher-than-expected solids loading in the feed stream to TSCR. To differentiate between the original, TSCR-scaled system and the modified, 200W-scaled system, they will be referred to as LS1 and LS2, respectively. The differences between LS1 and LS2 are centered around the DEFs; most of the components and their configurations remained the same between the two systems.

Schonewill et al. (2021) provide an in-depth discussion of how the filtration test skid was originally scaled to properly reflect the relevant physical phenomena expected in the full-scale TSCR system. Since the 200W PMs are only conceptual at this stage, the applicability of the scaling is limited to the similarities between TSCR and the 200W PMs (once they are design and built). The 200W PMs are expected to have the same DEF design as AMPS (Nguyen et al. 2025), so they were assumed to be equivalent when making judgments on the appropriate scaling.

3.1.1 TSCR-Scaled (LS1) Configuration

The LS1 configuration was previously used in the experiments reported in Schonewill et al. 2021. Therein, the scaling basis for the TSCR-scaled system is described extensively.[1] The experiments conducted in that system were concerned with performance at solids loadings greater than 500 ppm, which required careful scaling of the recirculation and feed lines in the system. TSCR operates at a fixed flow rate, so once an IXC size was selected, the DEF parameters were defined in proportion to the IXC scale. A DEF module was designed to satisfy the parameters required to preserve the defined scale. The important scaled parameters are shown in Table 3.1 and compared to the companion values from the full-scale system (TSCR in this case). The table is very similar to Table 3.1 in Schonewill et al. 2021, with an adjustment to the concentration range of solids allowed in the feed; the recommendation to limit the concentration to 500 ppm was an outcome of the original PNNL test program.

The 200W PMs are planned to be operated in a similar manner to TSCR, but there are some differences – particularly in the DEF surface area and the operating flow rate range. If DEF fouling rate scaled linearly with changes in filter surface area, flow rate, and solids concentration in the feed, the impact of these changes would be invariant to the scale used to measure the performance. Although it is a plausible assumption, it would remain an unquantified uncertainty and complicate correlation of the data with expected full-scale performance. Thus, the experimental system also used a DEF module that reflects the updated design for the AMPS/200W PM as discussed in the following section.

[1] The interested reader would find the pertinent TSCR scaling discussion in Sections 3.2, 3.3, and 3.4 in Schonewill et al. 2021.

Table 3.1. Summary of Scaled Parameters for the Initial Laboratory-Scale System (LS1) Compared to TSCR Parameters. Note that most of the parameters are unchanged from the system originally operated as described in Schonewill et al. 2021.

System Parameter	Laboratory-Scale (LS1) Value	TSCR (Full-Scale) Value	Scaling Basis
Column bed height	92 in.	92 in.	Full-height CST bed for characteristic hydraulic performance
Column inner diameter	1.87 in.	23 in. (with ~4.5-in. annulus)	Existing full-height column size that is large enough to keep wall effects small
Bed volume (BV)	1.09 gal	159.1 gal	Defined by column size parameters, ignoring excluded volume
Planned BVs to process	≥ 250	n/a – TSCR has a carousel and switches columns based on breakthrough, not BVs processed	Originally selected based on PNNL test data to characterize initial cesium breakthrough (> 0.1% of the feed concentration) at an elevated feed concentration
Volume of simulant needed to process to BV target	273 gal	n/a – See note above	Minimum volume representing the BV target selected
Scaled process flow rate	0.0344 gpm (130.1 mL min^{-1})	5 gpm (18,927 mL min^{-1})	Flow rate that matches full-scale BV hr^{-1} processing rate based on bed cross-sectional area, with a filter flux of 0.065 gpm ft^{-2}
Filter length needed to achieve flow rate	1 tube of 24.5 in.	98 tubes of 36 in.	Ratio of full-scale filter to scaled filter area needed to achieve the scaled flow rate
Operating time to process BV target	132.6 h	n/a	Defined by the BV and scaled process flow rate
Scaled filter housing volume	0.14 gal (1.5-in. diameter shell)	49.5 gal (18-in. diameter shell)	Maintain same superficial velocity between the shell and tube as the full-scale filter
Volume of air accumulator	0.13 gal (0.5 L)	20 gal (75.7 L)	Maintain same ratio of filter area to air volume as full-scale filter system. (The initial pressure in the air accumulator will match full-scale system, so using same ratio of filter area to air volume should result in the same average flow rate through the filter in both the laboratory- and full-scale systems.)
Criteria for switching filter unit	2 psig increase in pressure drop or at 24 h	2 psig increase in pressure drop or at 24 h	Criteria for switching filters is the same in both the laboratory- and full-scale systems
Solution for soaking filter not in use	0.1 M NaOH	0.1 M NaOH	Solution for soaking the filter not in use is the same for both laboratory- and full-scale systems
Range of solids concentration in feed	≤ 500 ppm	0 – 15,000 ppm	Based on the results of Schonewill et al. 2021, the 200W PMs restrict the solids loading compared to the range allowed by the TSCR specification

3.1.2 200W-Scaled (LS2) Configuration

Scaling a system for the 200W PMs is analogous to scaling a system for AMPS since they are planned to have the same design and similar operation. The LS2 system takes advantage of that by basing its configuration on the AMPS design (Nguyen et al. 2025; Garrett 2025), which was farther along in its design process than 200W PMs when the experiments were conducted.[1] However, they are expected to be equivalent unless something changes in the future, so the LS2 configuration will be referred to as a 200W-scaled system.

Table 3.2 presents important changes or updates to scaled parameters for the LS2 configuration (compared now to the 200W PM as the full-scale system). Parameters appearing in Table 3.1 that are not shown in Table 3.2 were unchanged from the prior LS1 value. For the experiments described in this document, the focus was on measuring DEF performance (see Section 1.2), and IXC performance was only assessed opportunistically. (For a detailed study of ion exchange (IX) performance at smaller scale using the same simulant material, see Westesen et al. 2026.) The IXC scaling parameters are listed in Table 3.1 because they were a key scaling element of the work in Schonewill et al. 2021, but since IX performance is not an area of focus for the current filtration testing, no changes were made to the IXC in the LS2 system. Note that this changes the residence time of simulant in the IX bed[2] from the scaled value whenever the system is operated at flow rates different than the nominal process flow rate of 130 mL min^{-1} (equivalent to 5 gpm at full scale).

The DEF design used in the LS2 configuration is described in detail in Section 3.1.3. The most significant differences are an increase in surface area of the filter media and a larger air accumulator capacity. The increased surface area results in filter fluxes that are matched with the full-scale 200W PMs, whereas the LS1 DEFs have filter fluxes that are approximately 70% greater.[3] Operation of the system was essentially the same regardless of configuration.

[1] As evidenced by the existence of engineering design documents for AMPS, i.e., filter fabrication drawings transmitted under EDT-885954 to H2C.
[2] Nominally 32 min – a BV of 1.09 gal with a flow rate of 2.064 gal h^{-1}.
[3] At 5 gpm, the TSCR filter flux is ~0.065 gpm ft^{-2} and 200W PM filter flux is ~0.038 gpm ft^{-2}. This is approximately a factor of 1.7; this factor is also reflected in the ratio of the number of filter tubes contained in the DEF modules for the two systems: 98 vs. 168.

Table 3.2. Summary of Scaled Parameters for the Modified Laboratory-Scale System (LS2) Compared to Preliminary 200W PM Design Parameters. Only updated parameters are captured; all other parameters remain unchanged from Table 3.1.

System Parameter	Laboratory-Scale (LS2) Value	200W PM (Full-Scale) Value	Scaling Basis
Scaled nominal process flow rate	0.0344 gpm (130.1 mL min^{-1})	5 gpm (18,927 mL min^{-1})	Flow rate that matches full-scale DEF filter flux of 0.038 gpm ft^{-2} based on filter surface area
Scaled minimum and maximum process flow rates	0.0240 gpm (91.1 mL min^{-1}) 0.0515 gpm (195.2 mL min^{-1})	3.5 gpm (13,249 mL min^{-1}) 7.5 gpm (28,391 mL min^{-1})	Flow rate that matches full-scale filter flux at the minimum (0.027 gpm ft^{-2}) and maximum (0.057 gpm ft^{-2}) flow rates
Filter length needed to achieve flow rate	3 tubes of 13.8 in.	168 tubes of 36 in.	Ratio of full-scale filter to scaled filter area needed to match the filter flux rates
Scaled filter housing volume	0.36 gal (2.5-in. diameter shell)	114 gal (24-in. diameter shell)	Maintain approximately the same superficial velocity between the shell and tube as the full-scale filter
Volume of air accumulator	0.40 gal (1.5 L)	60 gal (227 L)	Increases the air accumulator volume by the same factor that the full-scale accumulator increased, maintaining the same air volume to filter surface area as the full-scale system
Criteria for switching filter unit	2 psig increase in pressure drop or at 24 h	2 psig increase in pressure drop or at 48 h	Pressure criteria for switching filters are the same in both the laboratory- and full-scale systems, but 48 h was not firmly established prior to PNNL runs
Range of solids concentration in feed	≤ 500 ppm	≤ 500 ppm	Maximum solids concentration is the same for both systems. Based on the results of Schonewill et al. 2021, the 200W PMs restrict the solids loading compared to the range allowed by the TSCR specification

3.1.3 Description of 200W-Scaled Filter Design

The change to 200W-scaled filter units for the LS2 configuration was made halfway through the experimental program. The first three runs (W-01, W-02, and W-03) were conducted with the TSCR-scaled DEFs originally designed, fabricated, and used in the 2021 system, i.e., the LS1 configuration. Subsequently, it was determined that collecting data at filter flux rates matched to the expected full-scale values (rather than matching the scaled throughput as determined by IXC BV h^{-1}) was valuable for informing ongoing 200W PM design and operation planning. The filter flux rates can be matched by one of two methods: (1) adjust the operating flow rate of the experimental system, or (2) change the filter surface area while continuing to operate at the same flow rate.

The first method was strongly considered because it would not have required any modifications to the system. As Table 3.1 and Table 3.2 show, the reduction in flux is expected to be approximately a factor of 1.7, which would require a flow rate ~40% less than the 130 mL min^{-1} used in the LS1 configuration to achieve a 5-gpm equivalent flow (for TSCR). An operating flow rate of ~76 mL min^{-1}, which is achievable using the system equipment, would be approximately the 5-gpm equivalent flow for the 200W PMs, which would match the filter flux of 0.038 gpm ft^{-2}. There was concern about running for long periods at this flow rate; even the 130 mL min^{-1} flow rate was firmly in the laminar regime, and the 2021 tests had experienced line plugging (assumed to be due to settling of solids) on occasion. The risk of this occurring at even lower flow rates was deemed to be significant and the decision was made to change the filter surface area of the DEF modules in the system.

The design of the new DEF modules was undertaken with the following constraints:

- Base the design on the same scaling principles as the TSCR-scaled filters.
- Use Mott Grade 5 sintered stainless steel media.
- Maintain the use of 1-in. (outer diameter) filter elements.
- Do not exceed the length of the full-scale filter elements (which is nominally 36 in.).
- Minimize the modifications that must be made to the rest of the experimental system to accommodate the new DEFs.

The conceptual design that satisfies these constraints is represented in Figure 3.1 (cross-sectional view) and Figure 3.2 (side view). Recalling that the TSCR-scaled DEF had 1-in. outer diameter filter elements of 24.5 in., increasing the filter area by a factor of 1.7 would result in a total filter length of ~42 in. This exceeded the full-scale filter length, so the filter elements were split into a group of three in the arrangement shown in Figure 3.1. To achieve the needed length of 42 in., each of the three elements had ~14 in. of filter media. The shell diameter and separation distances between the three elements were selected to have a superficial velocity approximately similar to the full-scale 200W PM design.

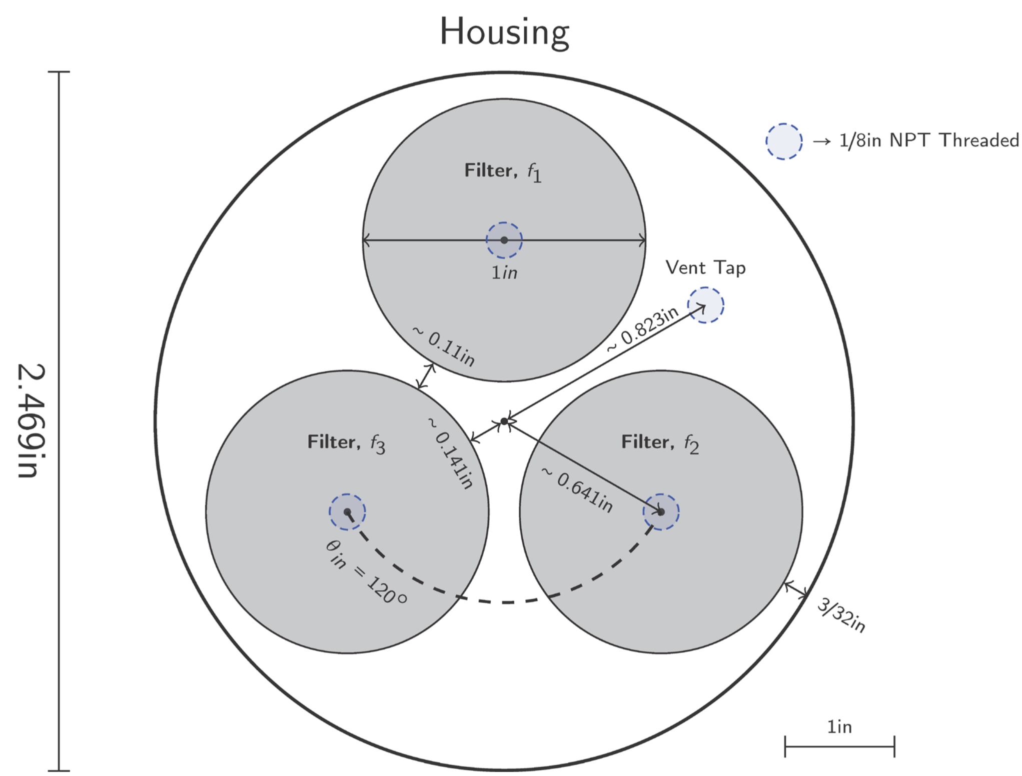

Figure 3.1. Top (cross-sectional) view diagram of the 200W-Scaled DEF module. The listed dimensions were design targets for the separation distances between the various reference points shown.

For convenience, a similar approach was adopted for the 200W-scaled DEF modules as the TSCR-scaled DEF modules. The porous elements were ordered in custom lengths from the Mott Corporation and then built to PNNL specifications on site using other commercial parts. They were welded to a 300# 2.5-in. NPT flange with three 1/8-in. fittings tapped into it and a fourth 1/8-in. fitting to serve as the shell-side vent. The filter shell was constructed of a Schedule 40 2.5-in. pipe of 18 in. in length and threaded on both ends. One end was capped with a 2.5-in. NPT pipe cap with a 1/4-in. fitting tapped into it. On the other end, a threaded 300# 2.5-in. NPT flange was added. The filter became a completed module by slipping the flange with the attached Mott filter elements into the shell and bolting their flanges together on the top (with a Teflon gasket sandwiched in between them).

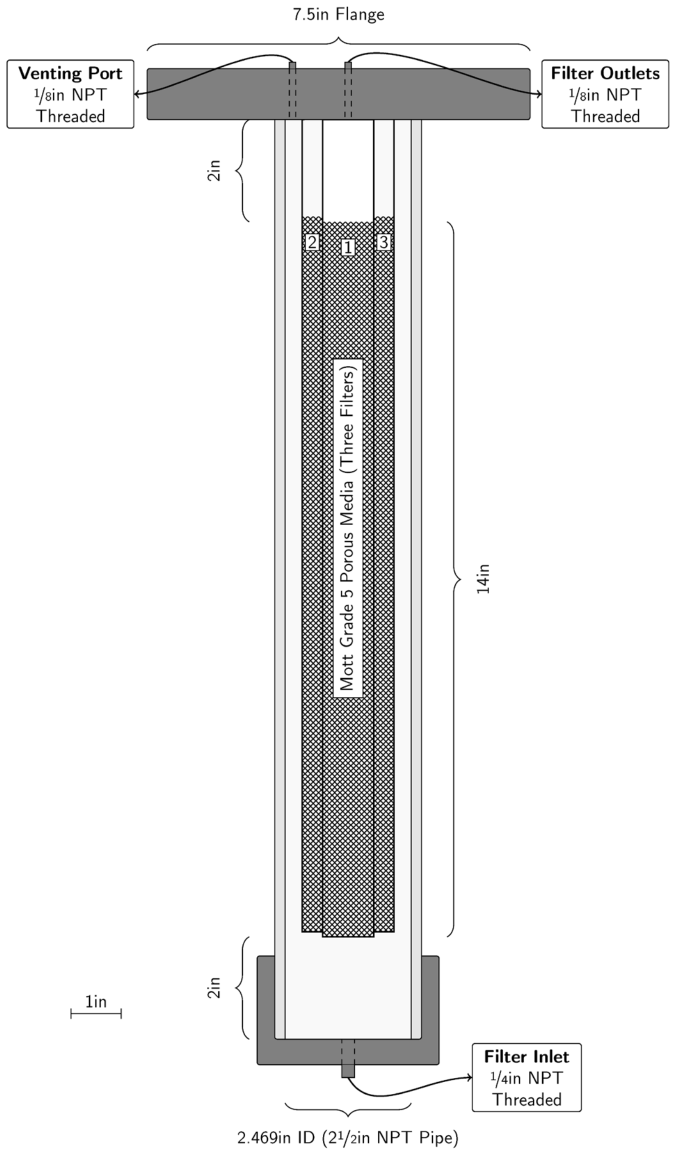

Figure 3.2. Side view diagram of the 200W-scaled DEF module. Dimensions indicated on the diagram were the design targets for the fully assembled module.

As Figure 3.2 illustrates, once an assembly was complete, there was approximately 2 in. of non-porous length at the top of the DEF and 2 in. of open cross-section in the bottom where the processing fluid entered (and backwashed fluid was expelled). As-built images of the DEF modules are shown in Figure

3.3. To keep the three filter elements rigid and equally spaced, small metal tie bars were welded at the bottom of the elements as shown in the top two images. Each filter element had an independent fitting for the filtrate to leave the module; they were plumbed together external to the DEF module (see bottom left image in Figure 3.3) before the upper differential pressure port that defines the DP-01 and DP-02 measurements.

Figure 3.3. Images detailing the 200W-scaled DEF fabrication. Clockwise from the top left: Side view of the filter elements with welded spacers, top view of the filter elements welded to the flange, full DEF assembly, and top view of the filtrate discharge ports and vent port.

The full DEF assemblies as installed in the LS2 configuration are pictured in Figure 3.4. The installation required minor realignment of some process lines but the general arrangement and orientation of valves and instruments surrounding the filter modules was preserved. The operation of the experimental system once the DEFs were installed was also unaffected, except for a few extra steps that were required when backflushing because two air tanks were used instead of one. The 200W-scaled DEF shells did require more time to fill with fluid due to their larger volume compared to the TSCR-scaled filters, but this did not result in any changes in procedure.

Figure 3.4. Image of the as-assembled 200W-scaled DEFs installed in the system (LS2 configuration). DEF-01 is on the left and DEF-02 is on the right in the image.

3.1.4 Comparison of the LS1 and LS2 DEFs

Since the differences between the LS1 and LS2 configurations are centered around the DEF modules, it is instructive to compare the two modules and their key parameters to one another. First, Table 3.3 shows the full-scale DEF parameters (operating filter flux based on the minimum, nominal, and maximum flow rates) and the corresponding laboratory-scale DEF parameters (flow rate to achieve the same flux). Based on the scaled flow rates in the laboratory-scale system and the as-built surface area of the DEF modules, the LS1 configuration has a flux that is nominally 0.3% less than the full-scale TSCR system and the LS2 configuration has a flux that is nominally 0.8% greater than the full-scale 200W PMs. Thus, all experiments were approximately within 1% of the full-scale filter flux targets while processing simulant feed (if flow was being controlled at or near its target value).

Table 3.3. Comparison Between Full-Scale and Laboratory-Scale DEF Parameters for Both TSCR and the 200W Process Modules.

System	Full-Scale System			Laboratory-Scale System		
	Flow Rate (gpm)	Surface Area (ft^2)	Filter Flux (gpm ft^{-2})	Flow Rate (mL min^{-1})	Surface Area (ft^2)	Filter Flux Compared to Target
TSCR / LS1	3.5	77.0	0.045	91.1	0.531	-0.3%
	5		0.065	130.1		
	7.5		0.097	195.2		
200W PM / LS2	3.5	131.5	0.027	91.1	0.897	0.8%
	5		0.038	130.1		
	7.5		0.057	195.2		

Table 3.4 compares the relevant dimensional and derivative parameters for the LS1 and LS2 DEFs to each other and key quantities from their full-scale counterparts. The LS2 DEF has more surface area and a shorter, larger volume shell (~80% more volume). The cross-sectional area of the LS2 DEF is considerably larger, but the percentage of open area is similar between the two modules. In both cases, the estimated superficial velocity in the shell of the DEF is comparable to the full-scale estimated value, which should preserve the hydrodynamic interactions between the fluid, solid particles, shell wall, and filter elements between scales; however, their respective superficial velocities are different from each other by approximately a factor of 2.5 (LS1 velocity ~ 2.5 LS2 velocity). The LS1 and LS2 DEFs also preserve the ratio of air accumulator volume to filter surface area of their full-scale counterparts, which was the scaling basis for the shell volume. They do not match the full-scale air accumulator volume to filter shell volume ratio, as both DEFs have a greater ratio by roughly a factor of two. Aside from these observations, the effect of having one filter element versus three in the DEF module cannot be quantified without testing module(s) which have the same filter area but a different number of filter elements. However, it is a fair assumption that DEF performance is dominated by surface area. The configuration of that surface area (if it is reasonably similar) should not have a measurable impact on DEF performance.

Table 3.4. Comparison of LS1 and LS2 DEF Module Dimensional and Derived Parameters.

Quantity [unit]	TSCR-scaled DEFs (LS1 Configuration) *Full-scale: TSCR*	200W-scaled DEFs (LS2 Configuration) *Full-scale: 200W PM*
Filter element length (in. / cm)[(a)]	24.4 / 61.84	13.7 / 34.83
Filter surface area (ft^2)	0.531	0.897
Shell inner diameter (cm)	3.81	6.27
Shell length (cm)	77.83	51.11
Shell volume, estimated (in^3 / cm^3)	48.9 / 800.8	87.5 / 1434.5
Open cross-sectional area (cm^2)	6.3	15.7
Open area of cross-section (%)	55.6	50.8
Superficial velocity in shell at nominal flow rate (cm s^{-1})[(b)]	0.342	0.138
Full-scale superficial velocity at 5 gpm (cm s^{-1})	0.364	0.153
Air accumulator volume (L / gal)	0.5 / 0.13	1.5 / 0.40
Volume to DEF surface area (ft^3 ft^{-2})	0.033	0.059
Volume to surface area for full-scale (ft^3 ft^{-2})	0.035	0.061
Ratio of air accumulator volume to shell volume (gal gal^{-1})	0.96	1.09
Ratio for the full-scale system (gal gal^{-1})	0.40	0.53

(a) This is the length per filter element. LS1 has one element per module, whereas LS2 has three.
(b) The nominal flow rate is taken to be 130.1 mL min^{-1} (5 gpm equivalent for the LS1 and LS2 systems).

3.2 System Overview

This section gives an overview of the experimental system used to collect the data in this report. For additional information, refer to Schonewill et al. 2021, which has the details of the original design and assembly. The elements of the system are briefly discussed in Section 3.2.1, with notable differences from the version used in the 2021 experimental program called out in Section 3.2.2. Section 3.2.3 presents general arrangement details of the as-operated system and updated images from its current laboratory location.

3.2.1 System Components

The system's components and instruments are shown in Table 3.5 for the system. The LS1 and LS2 configurations contained all the same components unless noted in the table. The physical configurations and as-built dimensions that are described in Schonewill et al. 2021 (in particular, Section 3.5.1 and 3.5.2) all remained valid for the LS1 configuration. The as-built dimensions for DEF-01 and DEF-02 when changing from TSCR to 200W-scaled filters (LS2 configuration) are described in Section 3.1.3. The only other substantive change between configurations was increasing the air accumulator volume. This was achieved by adding a second tank with a volume of ~1.0 L to the LS2 configuration. Expanding from one to two air accumulator tanks resulted in renaming TK-05 to TK-05A and the second tank became TK-05B.

Table 3.5. Components and Instruments Installed in the Experimental System. All components were present in both the LS1 and LS2 configurations unless noted in the table, so the same labels are used in both Figure 3.5 and Figure 3.6.

Instrument/Component	Label	Description / Location
Validyne P55 Differential Pressure Transducers	DP-01	Differential pressure across filter DEF-01
	DP-02	Differential pressure across filter DEF-02
	DP-03	Differential pressure from column inlet to exit
	DP-04	Differential pressure from column inlet to 6 in. from the top of the CST bed
	DP-05	Differential pressure from 6 in. from the top of the CST bed to the column exit
Hydra-Cell D10 Feed Pump	PMP-01	Pump for recirculating simulant with suspended solids and mixing and suspending solids in feed tote
Cole-Parmer 7521-70 Digital Gear Flush/Soak Pump	PMP-02	Pump for supplying 0.1 M NaOH to test system (up to ~300 mL min^{-1} based on installed gear drive)
Omega PR-11L-3-100-1/4-6-115-SB Resistance Temperature Detector Probes w/ DP20 Panel Meter	T-01	Temperature in simulant feed tote
	T-02	Temperature of simulant in flow line upstream of filters
	T-03	Temperature of simulant in flow line downstream of column
	T-AMB	Ambient temperature of the PDLE space
Swagelok PGI-PG160 Pressure Gauge	P-01	Gauge pressure at discharge of feed pump PMP-01 (FIO/operator aid)
Ashcroft DG25 Pressure Transducers	P-02	Gauge pressure upstream of filters
	P-03	Gauge pressure downstream of filters/upstream of column
Swagelok PGI-63B-PG100 Pressure Gauge	P-04	Gauge pressure at air tank/accumulator

Instrument/Component	Label	Description / Location
Ashcroft DG25 Pressure Transducer	P-05	Gauge pressure downstream of column
Swagelok PGI-PG100 Pressure Gauge	P-06	Gauge pressure at discharge of PMP-02 (FIO/operator aid)
Swagelok SS-4R3A Pressure Relief Valves	PRV-01, PRV-02	Simulant recirculation line and 0.1 M NaOH flush line over-pressure relief
ifm SM6001 Magnetic Flow Meter	FM-01	Flow meter on simulant recirculation line to TK-01 (FIO/operator aid)
Bronkhorst ES-FLOW Ultrasonic Liquid Flow Meter/Controller	FM-02 with V-24	Flow meter and actuated control valve for maintaining desired flow
Brooks SLAMF50S Mass Flow Controller	FM-03	Mass flow controller for supplying dry air to column inlet (FIO/operator aid)
PNNL-assembled Filter Assemblies using Mott Grade 5 Porous Tube	DEF-01, DEF-02	Duplicate DEFs that can be swapped between in-use and offline during processing: LS1 used TSCR-scaled assemblies and LS2 used 200W-scaled assemblies
Swagelok SS-4F-2 2-mm Inline Filters	FLT-01A, FLT-01B	Inline guard filters (swappable) at column exit
PNNL-assembled Sanitary Tubing CST Column	IXC-01	Full-height IXC with CST bed within column; assembled out of sections of tri-clamped sanitary tubing
275-gal IBC Tote for Feed Tank/Vessel	TK-01	Large vessel tote for mixing and feeding simulant
5-gal Poly Reagent Tank/Vessel	TK-02	Tank for holding 0.1 M NaOH or other flush fluids, i.e., water
55-gal Poly Drum Flush Tank	TK-03	Tank for receiving flushed solids and other miscellaneous waste
55-gal Poly Drum Product Tank	TK-04	Tank for receiving processed waste simulant (Cs-decontaminated)
Swagelok 316L-HDF4-500 Air Tank/Accumulator	TK-05(A)	Scaled (0.5 L) volume tank with compressed air during filter cleaning. In the LS1 configuration, this was the only tank and called TK-05. In the LS2 configuration, it was renamed TK-05A.
Swagelok 316L-HDF4-1000 Air Tank/Accumulator	TK-05B	Scaled (1.0 L) volume tank with compressed air during filter cleaning; only present in LS2 configuration
Swagelok BSN4-02-2-NNP Backpressure Regulator	BPR-01	Backpressure regulator to control pressure at inlet to filters and test system
Exergy AS-00528 Tube-in-Tube Heat Exchanger	HX-01	Heat exchanger to heat or cool simulant in recirculation line to maintain target temperature; plumbed to water bath (Fischer Scientific Isotemp 4100)
Parker DAS 3NPT Air Dryer	DRY-01	Dryer to provide low-humidity air to IXC-01 to blow out moisture at test end
Honeywell NX20200A1002 Variable Frequency Drive	VFD-01	Variable frequency drive for controlling PMP-01 speed
Swagelok SS-42GXS4 Sample Valves	SV-01, SV-02, SV-03	Sampling locations at filter inlet, filter exit/column inlet, and column exit

FIO is For Information Only; PDLE is Process Development Laboratory East.

3.2.2 System Configuration and Comparison to 2021 System

Figure 3.5 and Figure 3.6 show diagrams of the two configurations used in the experimental runs. The equipment and instruments in both figures can be identified by cross-referencing the identification labels in the diagrams with the corresponding labels in Table 3.5.

During experimental operations using the LS1 configuration, the system as presented in Figure 3.5 was used; the diagram reflects a few minor changes made to implement improvements recommended during prior operations discussed in Schonewill et al. 2021, which was referred to as the TSCR High Solids Performance Testing project. The minor configuration changes were:

- Replacing the three-way sampling valves SV-01, SV-02, and SV-03 with a tee junction and two-way plug or ball valve at each location. The use of three-way valves, which completely diverts the system flow, caused noticeable disruptions to flow and pressure when samples were collected. Since samples are primarily for chemical analysis, using less-intrusive two-way valves that do not fully divert flow will be satisfactory. Note that SV-01 was replaced with a tee junction and two valves so the recirculation loop can still be isolated.
- Changing out T-01, T-02, and T-03, which were Type-K thermocouples that transmitted to a hand-held thermometer, for resistance temperature detectors (RTDs) transmitting to digital displays. The thermocouples were found to be adversely affected by VFD-01 when PMP-01 was operating (which was nearly all the time) and their readings were more unstable ("nosier") than preferred. Using RTDs and digital displays stabilized the temperature readings during testing and provided better feedback for temperature control in the system. A standalone RTD was also used to monitor the ambient temperature in the laboratory space.
- Reconfiguring the process lines entering DEF-01 and DEF-02 to minimize the possibility of plugging during filter backwashing/flushing operations. The flush lines from DEF-01 (via V-09) and DEF-02 (via V-07) made 90° turns shortly after the simulant leaves the filter. These sudden turns were prone to accumulate solids during prior testing and occasionally needed to be manually cleaned out. The flow path beneath DEF-01/DEF-02 was widened from 1/8 in. to 1/4 in. and routed so that the backflush path was vertically down. To make this work in physical space, this also required swapping the locations of V-04 and V-09 for DEF-01 and V-05 and V-07 for DEF-02.

Aside from these three minor configuration changes,[1] all the existing equipment as described in Schonewill et al (2021) was used. Note that DP-05 was found to be damaged before the start of Run W-01 and was not replaced with a calibrated spare until Run W-04. This did not impact the LS1 configuration but did result in an absence of data for the DP-05 measurement of CST bed differential pressure for Runs W-01, W-02, and W-03.

When the experimental system was modified to the LS2 configuration, the 200W-scaled filter modules were installed in place of the TSCR-scaled filter modules. As mentioned earlier, the air accumulator volume was also increased by a factor of three (by adding a second air tank). The diagram in Figure 3.6 reflects the configuration change needed to implement the additional air accumulator tankage, but installing the new DEF-01 and DEF-02 modules – although resulting in a different spatial arrangement – did not impact the valve or instrument configuration around them.

[1] A fourth change is that the system was moved from one PNNL laboratory location to another after it was last used in 2021. This was not expected to impact the experiments other than different ambient conditions in the new laboratory space.

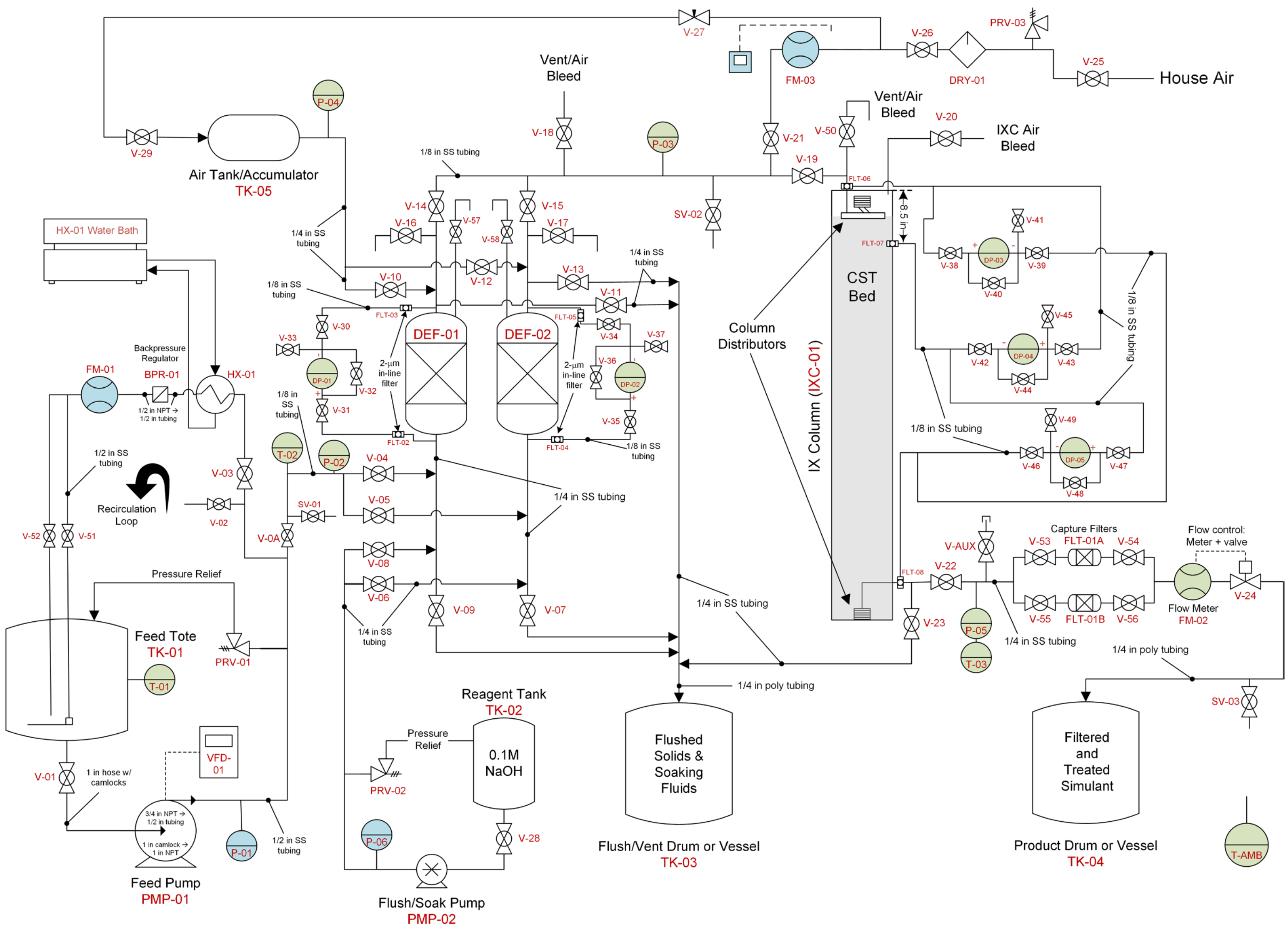

Figure 3.5. Detailed schematic for the LS1 configuration of the experimental system. Green instruments are quality-affecting and blue instruments are FIO.

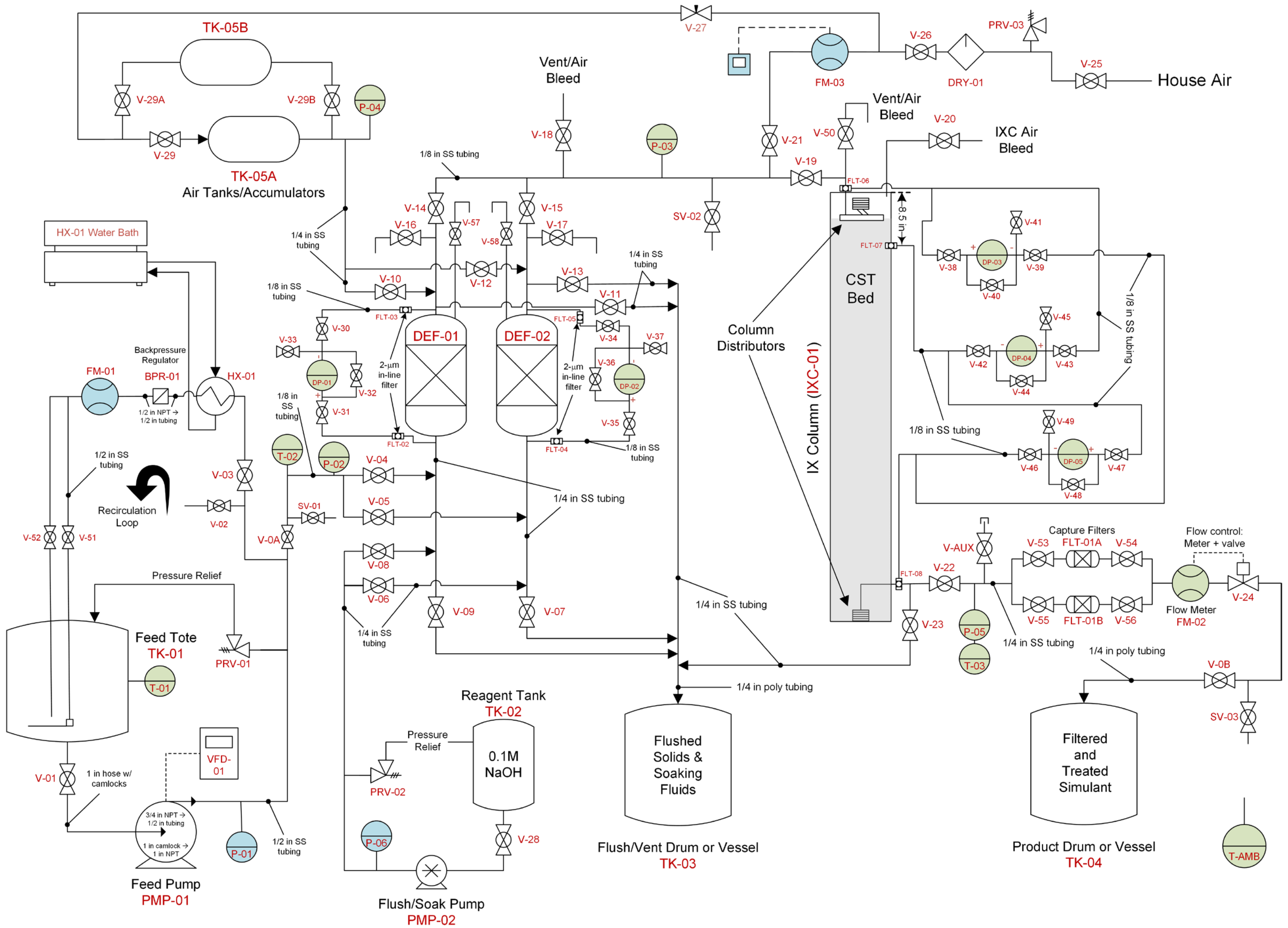

Figure 3.6. Detailed schematic for the LS2 configuration of the experimental system. Green instruments are quality-affecting and blue instruments are FIO.

3.2.3 System As-Operated for Experimental Runs

The experimental system for the 200W filtration testing was initially re-assembled from its configuration used in the prior campaign in 2021 after the equipment was moved from the Applied Process Engineering Laboratory to its current location, PDLE. PDLE is an engineering high-bay facility on the south end of the PNNL Richland campus. Figure 3.7 and Figure 3.8 provide an overview of the laboratory area in PDLE where the system was installed and operated.

As before, the system contains mounted elements on a frame (Bosch strut was used for this purpose) since many instruments, valves, and tubing runs needed to be at heights of more than 8 ft. The entire system was contained in a 10×10-ft collapsible secondary containment with an elevated work platform situated to provide access to valves and instruments that were at elevated heights. As-assembled images of the 200W filtration test system, which is also referred to as the “experimental system” for the remainder of the report, are provided in Figure 3.7, Figure 3.9, and Figure 3.10.

The views of the system in Figure 3.7 and Figure 3.8 provide a sense of the experimental system’s scale, ambient location, and supporting elements like intermediate bulk container (IBC) mediated management of feed, process, and waste material. Figure 3.9 shows most of the critical equipment and instruments, which were mounted on or near a Bosch strut frame, seen in the foreground of that image. Behind the frame is an elevated work platform that operators use to access valves and instruments and to load the IXC with CST. Behind the platform on the right side are the feed system, the flow controller FM-02/V-24, and the effluent collection tank TK-04. TK-02 and TK-03 are in the foreground on the right and left, respectively. The DEFs are installed in the middle of the frame just to the left of the instrument panel, and the IXC rises above and below the instrument panel on the right side of the frame.

The feed and recirculation system used to deliver simulant to the DEFs and IXC are pictured in Figure 3.10. This part of the system was unchanged across the LS1 and LS2 configurations. TK-01 is the feed tank that received all the simulant material during the experiments. The rest of the pictured system recirculated the simulant at flow rates much greater than the processing rate (typically ~4 gpm) and provided the driving pressure for operation, kept solids suspended off the bottom,[1] controlled feed temperature, and enabled feed samples to be collected.

[1] Approaching the end of a run, simulant levels in the feed tank were too low to use the pivot nozzle mixer, and simulant was mixed by the return loop only (an open 1/2-in stainless steel line). This may not have suspended all remaining solids adequately to provide a homogenous feed to the system.

Figure 3.7. Experimental system workspace in PDLE facing north. Feed simulant IBC totes shipped from the vendor are in the foreground, with the experimental system (in the LS1 configuration) immediately behind. The IBC totes on the left edge of the image were used for capturing process and effluent solutions as each experimental run progressed.

Figure 3.8. Experimental system workspace in PDLE facing west. This is later in the experimental program when the system was in the LS2 configuration and multiple feed simulant shipments had been received (left foreground).

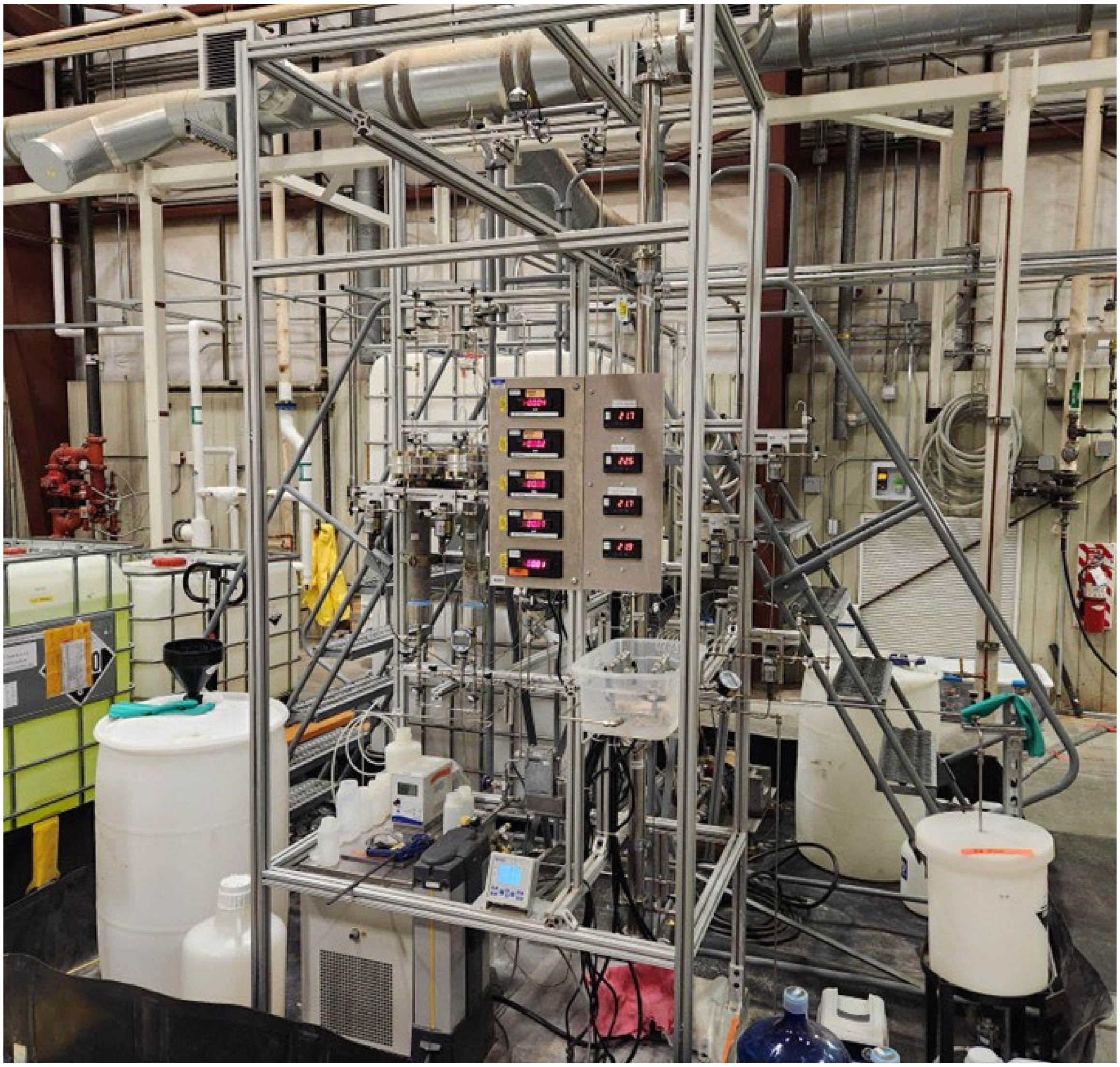

Figure 3.9. Front face of the experimental system in the LS2 configuration facing west. TK-02 is in the right foreground, TK-03 is in the left foreground, and TK-04 is behind the stairway on the right.

Figure 3.10. Feed vessel (TK-01) and recirculation loop of the experimental system facing south. On the ground in front of the stacked totes is PMP-01, with TK-01 being the upper tote (partially filled with simulant). The elements of this part of the system were unchanged across the LS1 and LS2 configurations.

3.3 Discussion of Experimental Data

Every experimental run was conducted at a set of target conditions and then monitored over time. The instruments listed in Table 3.5 (and shown in Figure 3.5 and Figure 3.6) were the primary source of performance data, in conjunction with some samples and downstream data analysis. The remainder of this section describes the data collection and analysis processes employed to measure filtration performance during the experimental runs.

3.3.1 Data and Sample Collection

During each experimental run, data was recorded manually by the operators from all system instruments on a periodic basis – nominally every 0.5 h – as well as select other times at the operator's discretion. Special attention (data collected at 2, 4, 6, 8, and 10 min) was paid to the initial increase in differential pressure when a previously inactive DEF was brought into service. The time stamps of each filter backflushing evolution step were also recorded as it was executed. As a backup, critical data was recorded via Brinno Inc. TLC200 time-lapse cameras every 20 s (the cameras recorded images of the instrument readouts). For these tests, the data considered critical were the DEF differential pressure instruments (DP-01 and DP-02) and the system flow rate (as measured and controlled by FM-02). The temperature instruments (T-01, T-02, T-03, T-AMB) and other differential pressure instruments (DP-03, DP-04, DP-05) were all displayed on the same panel, so they were also recorded.

Samples were collected throughout each experimental run, falling into one of four general categories:

1. Samples taken for analysis of the feed simulant. These were either taken from the as-received material from the vendor or after initial loading of the simulant into TK-01 from either SV-01 or V-02. These samples were used in a comprehensive suite of analyses, including chemical composition, density, viscosity, particle size, and solids content. Samples of this type were occasionally taken later in the test when there was a change in the test simulant (for example, the solids concentration was diluted) or there was a need to confirm a previous value.
2. Samples taken periodically for visual observation. An initial feed sample was collected as a visual reference and then post-DEF samples were taken from SV-02 approximately every 12 h during testing. The samples had a volume of ~20 mL, were collected in glass vials, and were not analyzed.
3. Samples taken periodically from SV-03 for cesium analysis. Effluent samples were collected approximately every 8 h for the entire experimental run. The samples were usually ~20 mL in volume and a select group of them were analyzed.
4. Samples taken at the end of test/post-test for observation. This catch-all category includes a final simulant archive sample, an end-of-test effluent sample, and post-test CST samples for visual observation. Most of these were taken directly from totes, tanks, or columns.

Samples that fall in the first category are described in more detail in Section 4.2.3 and 4.2.4 since they are relevant to the as-tested simulant properties. Samples in the second and fourth categories were not analyzed by any quantitative techniques; they were collected for the purpose of making visual observations and looking for anomalous system behavior. Samples in the third category were analyzed for cesium in solution by inductively coupled plasma mass spectrometry (ICP-MS).

3.3.2 Direct Data Observations

The performance of the experimental system in response to processing planned 200W waste feed simulants was directly observed during operations via the following quantities:

- The response of the flow controller as it adjusted the system flow rate to achieve a target value
- The rate of increase in the pressure differential across DEFs when active
- The frequency of backflushing needed to maintain the target flow rate without the DP exceeding its maximum allowable value (referred to as the "trigger point").
- Filter recovery, e.g., the ΔP at t = 10 min on the active DEF after swapping filters

- Pressure differentials measured across the IXC
- Examining post-DEF samples for evidence of solid particles

These quantities are available directly from the recorded data collected during the tests. Only simple post-test analyses, such as removing known low-quality data points and statistical calculations (averages, standard deviations), were performed on most of the observed data. Specific performance analyses for filtration provide additional valuable information; methodologies used to conduct that analysis are described in the next subsection. In contrast to the work performed in Schonewill et al. 2021, the IXC data was not a primary objective and the full permeability analysis was not employed; however, a reference permeability calculation was still performed between experimental runs to confirm the CST bed returned to a similar state each time.

3.3.3 Filtration Data Analysis

A common method used to analyze filtration data is to place it within the framework of Darcy's law (Darcy 1856), which is valid when the Reynolds number < 10 (Bear 1972). For the filters considered in the test system, the Reynolds number is defined as

$$Re_F = \frac{\rho_s \left(\frac{Q_o}{A_F}\right) d_F}{\mu_S} \tag{3.1}$$

where ρ_s is the simulant density, μ_s is the simulant viscosity, Q_o is the nominal flow rate, A_F is the surface area of the filter, and d_F is the characteristic length-scale. The length-scale d_F is usually defined as the mean grain size to represent the nominal pore size; in this case, it is approximated based on the grade of the Mott filter, i.e., $d_F = 5$ microns. The quantity (Q_o/A_F) is called the filter flux and has the same units as velocity.

The viscosity of the simulants is a function of temperature which, following Daniel et al. (2018) and Schonewill et al. (2021), could be written as

$$\mu_S = \mu_{S,o} \exp\left[\lambda\left(\frac{1}{T} - \frac{1}{T_o}\right)\right] \tag{3.2}$$

where $\mu_{S,o}$ and λ are measured parameters, T is the temperature of interest (in Kelvins), and T_o is the reference temperature of 298.15 K (25 °C). Data to compute the parameters $\mu_{S,o}$ and λ were measured (see Section 4.2.3.3, Table 4.6) but the viscosity expression in Eq. (3.2)was not used in any filtration calculations. For the purposes of Reynolds number calculations, the lowest measured viscosity was used ($\mu_s \sim 1.5$ mPa·s). The density is also a weak function of temperature, but to estimate the Reynolds number only a density that bounds all simulants was used ($\rho_s = 1270$ kg m^{-3}). Both parameter values will maximize the Re_F value. For the range of conditions in these experiments, $Re_F \ll 1$ and the Darcy's law approximation is valid.[1]

[1] Assuming that the DEFs are processing liquids, because the filter pores are a very small length scale ($d_F \sim 5 \times 10^{-6}$ m) and the density that cannot be reasonably much greater than 1300 kg m^{-3}, it would require flow rates several orders of magnitude higher than the ones used in the experiments to approach $Re_F \sim 10$. The Reynolds numbers are approximately on the order of the 10^{-4}.

Since Darcy's law is valid, the relationship between the pressure differential across a filter ΔP_F and the filter flux J_o is defined as

$$\left(\frac{Q_o}{A_F}\right) = J_o = \frac{\Delta P_F}{\mu_S R} \tag{3.3}$$

where R is the total resistance of the filter media. DEFs of the type used in TSCR (and the test system) operate at constant flux (Q_o and J_o are target parameters to which the system is controlled) and allow the driving pressure to change, so performance is described in terms of changes in resistance over time. The filter resistance is often represented as

$$R = R_{m,o} + R^*(t) = \frac{\Delta P_F}{\mu_S J_o} \tag{3.4}$$

where $R_{m,o}$ is the initial resistance of the membrane only and $R^*(t)$ is the component that changes with time ($t > 0$), which is some combination of membrane fouling, cake development, cake maturation, and other particle-filter attractive interactions. The initial resistance can be calculated from manufacturer's data but is best measured when the filter is "clean" in its operating configuration, which serves as a baseline for gauging performance. A baseline measurement was performed prior to each run with 0.1 M NaOH at flow rate Q_o to determine $R_{m,o}$ using Eq. (3.3) and a few substitutions:

$$R_{m,o} = \frac{\Delta P_{F,o}}{\mu_o J_o} \tag{3.5}$$

where μ_o is the viscosity of 0.1 M NaOH (0.97 mPa·s at 22°C) and $\Delta P_{F,o}$ is the pressure drop across a filter measured with 0.1 M NaOH solution. Eq. (3.5) was generated assuming that the filter is a flat geometry, but the DEFs have a tubular geometry; thus, a curvature correction is employed to appropriately compare the resistance across geometries:

$$R_{m,o}^{+} = -\left(\frac{\Delta P_{F,o}}{\mu_o J_o}\right)\left[\frac{D_{F,o}}{2\theta_F}\ln\left(1 - \frac{2\theta_F}{D_{F,o}}\right)\right] = \gamma_c\left(\frac{\Delta P_{F,o}}{\mu_o J_o}\right) \tag{3.6}$$

where θ_F is the filter tube thickness, $D_{F,o}$ is the outer diameter of the filter tube, and the correction factor is called γ_c for convenience. For the DEF geometry in the test system, γ_c is ~1.07. Finally, a simple normalization of Eq. (3.4) with $R^+_{m,o}$ (and using $R^+_{m,o}$ in place of $R_{m,o}$) yields

$$\omega = \frac{R}{R_{m,o}^{+}} = 1 + \frac{R^*(t)}{R_{m,o}^{+}} \tag{3.7}$$

where ω is the normalized resistance, which is equal to unity when the filter resistance is the same as the "clean" membrane and greater than unity when any resistance, i.e., fouling, above the baseline level is present. Normalized resistance is a useful comparison tool when the initial filter resistance $R_{m,o}$ (or $R^+_{m,o}$) is substantially different between data sets.

During the experimental runs, filter data was collected as a function of time, which for constant-flux filtration is identical to collecting data as a function of volume filtered. To facilitate comparison of the data across different scales, different process fluids, and different media grades, the specific volume filtered is used. The dimensionless specific volume filtered is defined as

$$v^{+} = \frac{\int_0^t Q\,dt}{l_c A_F} \tag{3.8}$$

where the integration of the measured flow rate Q was accomplished by discrete numerical integration of the measured values of flow rate (from the instrument FM-02) and associated time increments. The specific volume filtered (also referred to as normalized volume) is often made dimensionless by an appropriate length-scale (l_c), where a typical selection is an estimate of the cake thickness. For consistency with other work, the inner radius of the filter tube ($D_{F,i}/2$) was selected as the length-scale.

3.3.4 Ion Exchange Column Analysis

Darcy's law is also appropriate for assessing the CST bed in the IXC if the Reynolds number criterion is met. For the IXC, the Reynolds number is defined as

$$Re_{IX} = \frac{\rho_s \left(\frac{Q_o}{A_{IX}}\right) d_{CST}}{\mu_S} \tag{3.9}$$

where A_{IX} is the cross-sectional area of the IXC and d_{CST} is the average grain diameter of the CST (taken to be 709 microns as reported by Gauglitz et al. 2019). Note that the ratio of the two Reynolds numbers [combining Eq. (3.1) and Eq. (3.9)] for the unit operations reduces to

$$\frac{Re_F}{Re_{IX}} = \left(\frac{d_F}{d_{CST}}\right)\left(\frac{A_{IX}}{A_F}\right) \tag{3.10}$$

because they share the same fluid and flow rate during operation. Using Eq. (3.10), the ratios for the LS1 and LS2 configurations are approximately 2.5×10^{-4} and 1.5×10^{-4}, respectively; the IXC Reynolds number is ~4 orders of magnitude greater than Re_F. During the baseline flow tests prior to operation, Re_{IX} was determined to have a value of order 1, depending on the flow rate used. Because test operations used a more viscous fluid than 0.1 M NaOH, the baseline flow test value of Re_{IX} is bounding. Since, as Eq. (3.10) demonstrates, Re_F is orders of magnitude less, the proposed Darcy's law approximations are valid for both unit operations.

For the IXC, the pressure differential expression is constructed a bit differently than for the filters, but otherwise is functionally the same:

$$\left(\frac{Q_o}{A_{IX}}\right) = \beta \frac{\Delta P_{IX}}{\mu_S h_{bed}} \tag{3.11}$$

where β is called the permeability of the CST bed and h_{bed} is the bed height. To obtain reference values of permeability for the CST bed only, Eq.(3.11) can be rearranged as follows:

$$\beta_{IX,o} = \left(\frac{Q_o}{A_{IX}}\right)\frac{\mu_o h_{bed}}{\Delta P^*_{IX,o}} \tag{3.12}$$

where $\beta_{IX,o}$ is the permeability of the CST bed only (a reference value) and $\Delta P^*_{IX,o}$ is the pressure drop defined by

$$\Delta P^*_{IX,o} = \Delta P_{IX,o} - \Delta P_{nb,w} \tag{3.13}$$

The $\Delta P_{IX,o}$ term is the measured pressure drop with CST present and $\Delta P_{nb,w}$ is the measured pressure drop with no CST present (subtracts out the impact of column piping, fittings, and the inlet/outlet distributors). Note that a small error is introduced in $\beta_{IX,o}$ because the $\Delta P_{IX,o}$ measurement was collected with 0.1 M NaOH but $\Delta P_{nb,w}$ was measured with water. At the same temperature this error is approximately 2%.

The $\Delta P_{nb,w}$ measurement was not repeated in this experimental program (data from prior work was used because the column configuration was not changed); note that this introduced an additional error in cases when the flow rate was not 130 mL min^{-1}. The error arises because $\Delta P_{nb,w}$ should change at different flow rates, such as 91 or 195 mL min^{-1}, but is being treated as constant. In previous testing (Schonewill et al. 2021), the permeability of the IXC was normalized and computed with elapsed time, but this analysis was not performed for the experimental runs discussed in this report.[1] Thus, reference permeabilities calculated using Eq. (3.13)should only be compared at the same flow rate across different measurements so that the discrepancy in the $\Delta P_{nb,w}$ value does not impact the interpretation of the data.

Note that an analog to Eq. (3.12) can be generated from the filter data as well starting with Eqs. (3.5) and (3.6), which is

$$\beta_{F,o} = \frac{\theta_F}{R^+_{m,o}} = \left(\frac{Q_o}{A_F}\right)\frac{\mu_o \theta_F}{\gamma_c \Delta P_{F,o}} \tag{3.14}$$

Eq. (3.14) demonstrates mathematically that permeability is the inverse of the resistance per unit thickness (or depth) of a porous media. Thus, an increase in resistance would manifest as a decrease in media permeability, and vice versa.

Opportunistic IX Breakthrough Curve

The cesium concentration was measured from effluent samples to assess the progression of the cesium breakthrough curve. The cesium concentrations measured in the sample were normalized by the relevant feed concentration and tracked against the approximate total BVs processed. This was a unique measurement since the CST media was not “refreshed” during each experimental run; therefore, the combined duration of the experimental program was sufficient to generate an entire breakthrough curve; this was not possible in the testing conducted in Schonewill et al. (2021). However, the breakthrough curve was not collected at a fixed group of parameters: The simulant material and flow rate were varied in accordance with each run’s target parameters and the CST remained in the column between each run. The data is collected and provided as information on the impact of varying parameters on the CST media; this should be considered a qualitative assessment of the cesium loading behavior. For a more detailed study of the performance of the simulated feeds used in this study, refer to Westesen et al. 2026.

[1] The differential pressure data collected by the instruments on the IXC, which are the direct indicator of changes in bed pressure drop/permeability over time, will convey if there were significant changes in the CST packed bed over the course of an experimental run. These data are collected in Appendix D. The normalization “smooths” out the impact of small changes in other parameters and permits appropriate comparison across different run conditions. Because prior work has demonstrated the packed bed does not experience appreciable changes in permeability over the course of an experimental run with the system, it was not considered critical to compile permeability data for the entire data set.

4.0 Simulated Waste Feeds

The experiments discussed in this document were conducted using simulant batches of nominally 300 gal. The 300-gal batch size follows the convention of prior testing (Schonewill et al. 2021) and is a convenient volume for production and shipment because the batch fills a standard 330-gal IBC tote. The development of the simulant recipes had already been completed and reported elsewhere (see Schonewill et al. 2024). Consequently, this section summarizes the formulations that were used in Section 4.1 but does not discuss in detail their bases or development processes. The interested reader should refer to Schonewill et al. (2024) for those supporting details. Section 4.2 describes how the liquid batches were prepared, handled, and characterized for the simulants used – this includes the as-received and as-experimented properties. Section 4.2.4 briefly discusses how the solid components, i.e., trim solids, were added during operations and relevant properties [particle size distribution (PSD), solid concentration, and solid phase chemistry] of the material that was fed to the experimental system.

4.1 Description of Formulations

The simulants used in the experimental runs are composed of two parts: (1) a liquid salt solution that was produced by an external vendor following PNNL recipes and (2) solid components added just before the experimental run. Both the liquid and solid parts were developed to reflect specific groupings of 200W waste feeds to the PMs. The formulation (recipe) for each liquid salt solution is presented in Table 4.1. The recipes are given in both mass of each component salt per mass and volume of the total liquid solution. The two quantities suggest an estimated liquid density for the solution, which was used as a proxy acceptance criterion for each batch (see Section 4.2.1). The corresponding concentrations of the major dissolved species are summarized in Section 4.2.3.1 and compared to analytical measurements of samples collected during the experiments.

The solid components were added to the liquid solution to achieve a specific solid phase composition for each simulant. The mass fractions of the specified components are presented in Table 4.2. The total mass of solids loaded in each experimental run was defined by target parameters estimated by H2C in their flowsheet calculations and provided in the SOW (see Table 1.1). Note that the solid components are a mixture of commercially available salts (sodium oxalate, iron phosphate), minerals from a specific manufacturer and lot (gibbsite, boehmite, kyanite), and synthesized species (natrophosphate, cancrinite). The metric used for verifying that solid components were added as intended was comparison with a baseline PSD curve. In each experiment, feed samples were collected and the PSD was measured; comparisons of these measurements with the expected distributions are discussed in Section 4.2.4.

Table 4.1. Charge Balanced Simulant Recipes for the Liquid Solutions Used in Filtration Experiments. The estimated density for each simulant can be used to convert between a simulant solution's mass and volume basis. Each liquid solution (S1, S2, etc.) is paired with a specific solid composition given in Table 4.2.

		S1 ρ ~ 1.25 kg L^{-1}		S2 ρ ~ 1.25 kg L^{-1}		S3 ρ ~ 1.09 kg L^{-1}		S4 ρ ~ 1.17 kg L^{-1}		S5 ρ ~ 1.20 kg L^{-1}	
Salt or Species	Molecular Weight (g mol^{-1})	Mass Salt / Mass Liquid (g kg^{-1})	Mass Salt / Volume Liquid (g L^{-1})	Mass Salt / Mass Liquid (g kg^{-1})	Mass Salt / Volume Liquid (g L^{-1})	Mass Salt / Mass Liquid (g kg^{-1})	Mass Salt / Volume Liquid (g L^{-1})	Mass Salt / Mass Liquid (g kg^{-1})	Mass Salt / Volume Liquid (g L^{-1})	Mass Salt / Mass Liquid (g kg^{-1})	Mass Salt / Volume Liquid (g L^{-1})
$Al(NO_3)_3 \cdot 9H_2O$	375.13	50.30	62.83	14.18	17.69	8.69	9.5	22.72	26.56	22.84	27.31
$CsNO_3$	194.91	0.0043	0.0054	0.0010	0.0012	0.0009	0.0010	0.0015	0.0018	0.0014	0.0017
$Sr(NO_3)_2$	211.63	0.00056	0.00070	0.00064	0.00080	0.00064	0.00070	0.00068	0.00080	0.00142	0.00170
$Na_2Cr_2O_7 \cdot 2H_2O$	298.00	0.44	0.55	0.57	0.71	0.25	0.28	0.52	0.61	1.99	2.38
50% NaOH (w/w)	40.00	134.67	168.20	42.66	53.21	30.11	32.93	73.63	86.08	72.83	87.09
$Na_3PO_4 \cdot 12H_2O$	380.12	13.96	17.44	14.70	18.33	14.55	15.91	20.72	24.22	13.25	15.85
KNO_3	101.10	2.90	3.62	0.79	0.98	0.63	0.69	1.30	1.52	0.84	1.00
NaCl	58.44	5.22	6.52	1.34	1.67	1.15	1.26	1.87	2.19	2.02	2.42
$CaCl_2 \cdot 2H_2O$	147.01	0.083	0.10	0.075	0.093	0.092	0.10	0.267	0.312	0.026	0.031
NaF	41.99	0.39	0.49	0.34	0.42	0.82	0.90	0.64	0.74	0.75	0.90
Na_2SO_4	142.04	4.68	5.84	4.27	5.32	2.71	2.96	5.14	6.01	5.56	6.65
$NaCH_3CO_2$	82.03	2.06	2.57	0.08	0.11	0.84	0.92	0.73	0.86	n/a	n/a
$NaCHO_2$	68.01	1.71	2.13	0.07	0.09	0.70	0.76	0.61	0.71	n/a	n/a
$Na_2C_2O_4$	134.00	1.09	1.36	1.67	2.08	1.67	1.83	2.05	2.40	2.20	2.63
$NaNO_2$	69.00	62.32	77.84	13.80	17.21	14.12	15.44	24.11	28.18	21.04	25.16
$NaNO_3$	84.99	73.32	91.58	237.48	296.2	58.32	63.79	94.01	109.90	132.80	158.80
$Na_2CO_3 \cdot H_2O$	124.00	44.04	55.01	16.94	21.13	14.12	15.44	20.75	24.26	23.16	27.69
H_2O	18.02	602.80	752.90	651.04	812.00	851.23	931.00	730.93	854.50	700.70	837.90

Table 4.2. Specific Solid Phase Compositions for the Simulants Used in Filtration Experiments. Each solids composition is paired with a corresponding liquid solution recipe given in Table 4.1.

		Mass Fraction in the Solid Phase for Simulant ID				
Solid Component Name [Formula]	Additional Specification(s)	S1	S2	S3	S4	S5
Gibbsite [$Al(OH)_3$]	Noah Technologies R6011	0.493	0.365	0.658	0.490	0.397
Boehmite [AlO(OH)]	APRYAL AOH20	--	--	0.203	0.379	--
Boehmite [AlO(OH)]	APRYAL AOH180E	--	0.311	--	--	0.464
Natrophosphate [$Na_7FP_2O_8 \cdot 19H_2O$]	PNNL-developed synthesis	0.277	0.214	--	--	--
Sodium oxalate [$Na_2C_2O_4$]	Commercial vendor, reagent grade	0.231	0.017	0.029	0.049	0.041
Grimaldiite [CrO(OH)]	PNNL-developed synthesis	--	0.066	0.032	0.063	0.083
Iron phosphate [$FePO_4 \cdot 4H_2O$]	Commercial vendor, reagent grade Adjust mass added by a factor of 1.48 to account for the tetrahydrate	--	0.028	0.014	0.019	0.014
Kyanite [Al_2SiO_5]	Kyanite Mineral Corporation Sieved to 400 mesh	--	--	0.064	--	--

4.2 Simulant Batch Preparation and As-Delivered Properties

This section discusses the simulant preparation process, which was performed by an external vendor, and vendor-specific instructions for preparing the 300-gal batches of the liquid simulant used in the experimental runs. Likewise, it discusses the delivery and receipt of the simulant batches and observations regarding the material before it was added to the system. Finally, the methods and resultant data from chemical and physical properties of the tested simulants are discussed. This includes a brief description of how trim solids were added to the system for each experimental run.

4.2.1 Simulant Batch Preparation Methodology

The vendor selected by PNNL to perform the simulant batch preparation was NOAH Technology Corporation (referred to as NOAH hereafter), located in San Antonio, Texas. NOAH had experience with similar batch production from prior filtration testing (Schonewill et al. 2021) and full-height IXC testing (Fiskum et al. 2019). PNNL provided the liquid composition and recommended recipes for each of the five simulant materials in a SOW.

The following is a general outline of steps communicated to NOAH for preparation of the five simulants, based on previous liter-scale preparations conducted as described in Schonewill et al. 2024. The preparation of each full-scale (300-gal) batch was based on the per liter component quantities given in Table 4.1. It was determined that a double batch (two duplicate 300-gal quantities) would be procured for the S1 simulant to provide additional flexibility in the experimental program.

1. Select an appropriately sized makeup vessel (300-gal batch target).
2. Add the required water to the vessel. Note: Deionized (DI) water should be used.
3. Measure the mass of each constituent and add constituents to the vessel one at a time while being stirred or mixed.[1] Allow each constituent to completely dissolve (heating may be required) into solution before the next constituent is added. Add the constituents in the order listed below (referring to Table 4.1):
    a. Deionized water [H_2O]
    b. Aluminum nitrate nonahydrate [$Al(NO_3)_3 \cdot 9H_2O$]
    c. Cesium nitrate [$CsNO_3$]
    d. Strontium nitrate [$Sr(NO_3)_2$]
    e. Sodium dichromate dihydrate [$Na_2Cr_2O_7 \cdot 2H_2O$]
    f. 50% sodium hydroxide solution [NaOH (50% w/w)]
    g. Sodium phosphate dodecahydrate [$Na_3PO_4 \cdot 12H_2O$]
    h. Potassium nitrate [KNO_3]
    i. Sodium chloride [NaCl]
    j. Calcium chloride dihydrate [$CaCl_2 \cdot 2H_2O$]
    k. Sodium fluoride [NaF]
    l. Sodium sulfate [Na_2SO_4]

[1] All components were required to be added to a tolerance of ±1% for simulant components present at >0.1 g kg^{-1} or ±5% for simulant components present at ≤0.1 g kg-1.

m. Sodium acetate [$NaCH_3CO_2$] (Note: not present in S5)
n. Sodium formate [$NaCHO_2$] (Note: not present in S5)
o. Sodium oxalate [$Na_2C_2O_4$]
p. Sodium nitrite [$NaNO_2$]
q. Sodium nitrate [$NaNO_3$]
r. Sodium carbonate monohydrate [$Na_2CO_3 \cdot H_2O$]

4. Heat the solutions to 60±5 °C and hold at that temperature for 0.5 to 1.0 h while continuing to mix.
5. Cool the solution to ambient temperature over approximately 8 h and hold (while still mixing) for at least 16 additional hours; care should be taken to minimize evaporation.
6. If necessary, add DI water to return the final solution to its target mass / volume (e.g., to make up for water loss due to evaporation).

NOAH had discretion on the equipment used to execute the simulant preparation procedure. PNNL had the following requirements and acceptance criteria for the simulant batch production process:

1. Prepare six 300-gal batches of 200W simulant supernatants:
   a. Batch #1A: 300 gal of Group 1 Simulant (S1 in Table 4.1)
   b. Batch #1B: 300 gal of Group 1 Simulant (S1 in Table 4.1)
   c. Batch #2: 300 gal of Group 2 Simulant (S2 in Table 4.1)
   d. Batch #3: 300 gal of Group 3 Simulant (S3 in Table 4.1)
   e. Batch #4: 300 gal of Group 4 Simulant (S4 in Table 4.1)
   f. Batch #5: 300 gal of Group 5 Simulant (S5 in Table 4.1)
2. Perform all preparation in vessels that have been rinsed with DI water and well-drained/dried prior to simulant makeup. Where possible, glass vessels shall be avoided during simulant preparation as the high pH of the simulant attacks and dissolves glass.
3. Measure the prepared simulant density at 20 °C and verify it falls within:
   - 1.23 to 1.27 kg L^{-1} for Batches #1A, #1B, and #2 (S1 and S2)
   - 1.07 to 1.11 kg L^{-1} for Batch #3 (S3)
   - 1.15 to 1.19 kg L^{-1} for Batch #4 (S4)
   - 1.18 to 1.22 kg L^{-1} for Batch #5 (S5)

   NOAH was directed to contact PNNL if prepared simulant fell outside this range to determine corrective actions.
4. Ship each batch of prepared simulant to PNNL in a new, clean, and dry 330-gal IBC tote[1] with bottom drain.
5. Use DI water with a resistivity greater than 10 MΩ cm for preparations. Water used as a rinse for equipment and transport containers (truck tanks and/or totes) need not meet this requirement.

[1] For example, see https://www.protank.com/330gallon-caged-ibc-tote-p8443458

6. Where possible, use ACS reagent grade chemicals (or equivalent) for preparations. Note: DI water is exempted from this requirement.
7. Provide a summary report on the production process that includes:
    - Reagent materials used, manufacturer, lot number, description (inclusive of impurities as listed by the manufacturer), and a Chemical Analytical Report (or Certificate of Analysis) for each of the chemicals used in preparing the simulant solution, containing the actual results of chemical analyses performed on the specific chemicals used
    - Measured as-prepared simulant density
    - Process steps applied and associated bench sheets
    - Identification/description of equipment
    - Observations and issues
    - Dated signature (including typed or printed name) of the scientist in charge of the operation with position title
    - Dated signature (including typed or printed name) of the technical reviewer with position title

NOAH provided batch preparation reports for all six 300-gal batches with calculated (theoretical) and measured solution density values that met the criteria specified in item 3 above. The density criterion is in place as a proxy for the correct total loading of dissolved salts in the liquid simulant. Due to the scale of preparation (and the time that elapsed between preparation and receipt at PNNL), the liquid composition was not confirmed via analytical samples before it was used in the experimental runs. Each simulant batch was sampled for chemical composition once it arrived at PNNL as described in Section 4.2.3.1.

4.2.2 Batch Delivery and Receipt

Procurement for the simulants was placed in a single contract with NOAH. The delivery was planned to occur sequentially as each batch was produced. The actual production, receipt, and experimental schedule for each batch is given in Table 4.3. Delays in simulant production at NOAH required some batches – notably S1 (Batch 1A), S2, and S3 – to be used less than a week after being received at PNNL.[1] The S2 batch was used immediately upon receipt because it had experienced significant delays in production at the NOAH facility. In each case, the simulant batch (or two batches for S1) was received in a 330-gal IBC tote. A ~125-mL sample was collected from each tote for chemical analysis and observation – the chemical analysis results are described in Section 4.2.3.1 and captured in Appendix A. Each batch arrived with a makeup report provided by NOAH with a final measured density. The density measurements are discussed in more detail in Section 4.2.3.2.

[1] There are no major concerns with the timeline, but it did not permit a quick turnaround chemical analysis of these batches. Since this was not done for the first three simulants, it was not performed for any as-received material. Subsequent analysis of the as-received tote samples indicated that the chemical composition was as expected (see Table 4.4), but this data was not available until after the experimental program had been completed.

Table 4.3. As-Executed Simulant Batch Production, Receipt, and Experiment Schedule.

Batch	NOAH Production Completion Date	Batch Received at PNNL on	Experimental Run Start Date	Used in Experimental Run
S1 (Batch #1A)	February 10, 2025	February 27, 2025	March 6, 2025	W-01(A/B)
S1 (Batch #1B)	February 10, 2025	February 27, 2025	September 22, 2025	W-06
S2 (Batch #2)	April 3, 2025	April 10, 2025	April 10, 2025	W-02
S3 (Batch #3)	May 16, 2025	May 23, 2025	May 28, 2025	W-03
S4 (Batch #4)	June 16, 2025	June 20, 2025	August 7, 2025	W-04
S5 (Batch #5)	July 14, 2025	July 17, 2025	September 2, 2025	W-05(A/B)

The as-received totes all arrived in good condition with nominally 300 gal (~1136 L) in volume. Every tote contained at least a small layer of solids on the tote floor, with the S1 batches containing the most significant layer (~1 to 2 in. in depth). The observed solids in the IBC totes could have precipitated out during transport,[1] may represent minor amounts of solid components that were quasi-stable (or not completely soluble), or possibly originated from impurities in the feedstock chemicals used at NOAH. No matter the source, since the objective was to add known amounts of specific solid species to mirror the compositions developed in Schonewill et al. 2021, the liquid was decanted out of the totes to minimize carryover of the solid material found in the as-received solutions. Decanting was performed with an air-operated double diaphragm pump, and in some cases (W-01 and W-03), this appeared to introduce additional solids into TK-01 when makeup material was added part-way through the run. The impacts of this are discussed in Sections 5.2 and 6.0.

The S2 simulant batch was a unique case because it arrived with only a small solids layer on the IBC tote floor, but it had a distinct color (brownish, whereas the solids found in the other as-received material was closer to white or beige) and the liquid itself was cloudy. NOAH observed solids in their preparation vessel during makeup of S2. PNNL directed NOAH to pump the simulant through a filter while they were packaging the liquid for shipment, but NOAH reported that there were negligible solids collected in their filter when they did so. Thus, the S2 solids were anticipated to be quite small; the cloudy liquid also indicated that to be the case. When preparing the S2 material for the W-02 experimental run, the liquid was decanted and pumped in through a filter, but that appeared to have little or no effect and the material in TK-01 was cloudy even before the trim solids were added (see Figure 4.1 for an example of the contrast between unprocessed and processed material). Refer to Section 6.3 for additional details on the handling and impact of the S2 material on DEF performance.

[1] The material was shipped from San Antonio, Texas, to Richland, Washington, via overland freight. The shipments were not temperature controlled, so batches travelling in colder months (notably S1) may have experienced temperatures less than ~25 °C.

Figure 4.1. Close-up of S2 simulant in TK-01 during experimental W-02. Contrast the color and opaqueness of the solution in the foreground to the material in the IBC tote in the background, which is filtered S2 liquid.

4.2.3 Batch Properties (Liquid Phase)

The current section outlines the chemical and physical properties measured for the liquid simulant materials (S1, S2, S3, S4, and S5) used in the experimental runs. In particular, the physical properties presented below and on the pages that follow are ordered as:

- Liquid and chemistry by ICP, ion chromatography (IC), and total carbon (TC) / total organic carbon (TOC) (as applicable)
- Dissolved solid content by gravimetric analysis
- Liquid phase density by glass pycnometry
- Liquid phase viscosity as measured by concentric cylinder rheometer

4.2.3.1 Liquid Phase Chemistry

The liquid phase chemistry (namely the speciation of different analytes in solution) was quantified by a combination of ICP optical emission spectroscopy (OES), ICP-MS, IC, TC, and TOC analyses, and free OH^- analysis. Total inorganic carbon is not directly provided by these analyses but may be calculated as the difference between TC and TOC (which are both reported in grams of carbon per unit mass/volume of sample). Characterization was performed of the as-received simulant, the initial feed material (i.e., the material supplied to the DEF/IX operations from TK-01) for each run, and typically one or two additional feed samples at later points during the run. The as-received samples were dip samples directly from the IBC totes, whereas any TK-01 feed samples were taken upstream of the filters at either SV-01 or V-02.

Here, ICP-OES was used to quantify simulant loadings of Al, Cr, Ca, Na, and K. ICP-MS was used to measure the Cs and Sr content of the simulant (including the post-IXC effluent samples). Simulant anion loadings (Cl^-, F^-, NO_3^-, NO_2^-, PO_4^{3-}, and SO_4^{2-}) were quantified by using IC. Organic carbon and inorganic carbon were quantified using TC/TOC. For simplicity, the TC values were compared to the sum of the major carbon-bearing constituents in the liquid phase, which were CO_3^{2-}, $C_2O_4^-$, $C_2H_3O_2^-$, and CHO_2^-. Finally, the free hydroxide was quantified by acid titration. The primary function of liquid phase chemistry testing was to validate simulant contents and opportunistically assess Cs loading on the IXC. All liquid phase chemical analyses were performed by PNNL's Environmental Sciences Laboratory, except for free OH analysis, which was done by the Analytical Support Operations laboratory operating out of PNNL's Radiochemical Processing Laboratory.

The target composition was compared to the measured composition for all simulants used in the experiments; the result of the comparison is presented in Table 4.4. Each measured composition (called "Mean" in Table 4.4) is an average of three or four individual measurements from different samples. The sample-by-sample comparison is provided in Appendix A for all the analytes. The absolute relative percent difference (RPD) is defined as

$$RPD = \frac{|Target - Mean|}{Target} \times 100 \tag{4.1}$$

and provided for each analyte and experimental run. RPD values greater than 30% are considered significant and are indicated by red text in Table 4.4. The significant RPD values are limited to potassium (which appears to be a systematic error of unknown origin), cesium (difficult to measure small concentrations in a matrix with higher concentrations of other salts), and a few other individual analytes with no obvious trend within a particular simulant. The elevated RPDs predominantly arise when the measured concentration is smaller than the target, implying that precipitation may have occurred (Al in W-04, W-05; PO_4 in W-01; free OH in W-03; and NO_2 in W-05). Only the Cl values in W-02 and W-04 represent RPDs > 30% where the concentration is (slightly) elevated above the target.

Table 4.4. Comparison of Target and Mean Concentrations from Analyzed Samples for the Experimental Runs. RPDs greater than 30% are indicated using red text.

Analyte	W-01[(a)] (S1)			W-02 (S2)			W-03 (S3)			W-04 (S4)			W-05 (S5)		
	Target	Mean	RPD	Target	Mean	RPD	Target	Mean	RPD	Target	Mean	RPD	Target	Mean	RPD
Al	1.6×10^{-1}	1.3×10^{-1}	22.4	4.7×10^{-2}	4.3×10^{-2}	9.5	2.6×10^{-2}	2.3×10^{-2}	11.7	7.3×10^{-2}	3.0×10^{-2}	59.4	7.4×10^{-2}	2.8×10^{-2}	61.7
Cl	1.1×10^{-1}	1.1×10^{-1}	3.6	3.0×10^{-2}	4.0×10^{-2}	34.6	2.3×10^{-2}	2.8×10^{-2}	17.9	4.3×10^{-2}	5.7×10^{-2}	33.1	4.2×10^{-2}	5.0×10^{-2}	18.9
F	1.1×10^{-2}	1.1×10^{-2}	7.9	1.0×10^{-2}	1.1×10^{-2}	10.2	2.2×10^{-2}	2.0×10^{-2}	8.6	1.8×10^{-2}	1.4×10^{-2}	22.3	2.2×10^{-2}	1.8×10^{-2}	17.3
Free OH	1.4×10^{0}	1.5×10^{0}	7.6	4.7×10^{-1}	3.6×10^{-1}	23.6	3.1×10^{-1}	5.8×10^{-2}	81.6	8.1×10^{-1}	8.5×10^{-1}	4.6	7.9×10^{-1}	7.4×10^{-1}	6.8
Na	5.7×10^{0}	5.1×10^{0}	10.7	5.0×10^{0}	4.9×10^{0}	3.1	1.9×10^{0}	1.7×10^{0}	6.2	3.5×10^{0}	4.2×10^{0}	20.5	4.0×10^{0}	3.8×10^{0}	7.0
NO_2	1.1×10^{0}	1.2×10^{0}	3.9	2.5×10^{-1}	2.2×10^{-1}	12.0	2.3×10^{-1}	2.3×10^{-1}	0.5	4.2×10^{-1}	4.1×10^{-1}	1.7	3.7×10^{-1}	1.6×10^{-1}	56.0
NO_3	1.6×10^{0}	1.6×10^{0}	2.6	3.6×10^{0}	3.4×10^{0}	6.9	8.5×10^{-1}	8.0×10^{-1}	5.6	1.6×10^{0}	1.5×10^{0}	5.0	2.1×10^{0}	2.0×10^{0}	6.3
PO_4	4.3×10^{-2}	1.9×10^{-2}	56.5	4.8×10^{-2}	4.7×10^{-2}	3.2	4.4×10^{-2}	3.9×10^{-2}	10.9	7.0×10^{-2}	5.7×10^{-2}	17.5	4.4×10^{-2}	3.8×10^{-2}	13.2
SO_4	4.0×10^{-2}	4.0×10^{-2}	0.0	3.8×10^{-2}	4.4×10^{-2}	16.3	2.2×10^{-2}	2.2×10^{-2}	0.6	4.5×10^{-2}	4.3×10^{-2}	4.1	4.8×10^{-2}	4.9×10^{-2}	1.3
Ca	7.4×10^{-4}	ND	n/a	6.3×10^{-4}	ND	n/a[(b)]	6.6×10^{-4}	ND	n/a	2.0×10^{-3}	ND	n/a	2.0×10^{-4}	ND	n/a
Cr	3.6×10^{-3}	3.7×10^{-3}	2.7	4.7×10^{-3}	4.3×10^{-3}	10.5	1.9×10^{-3}	1.7×10^{-3}	10.6	4.3×10^{-3}	4.4×10^{-3}	1.1	1.6×10^{-2}	1.5×10^{-2}	6.6
K	3.6×10^{-2}	9.0×10^{-2}	>100	9.7×10^{-3}	1.7×10^{-1}	>100	6.7×10^{-3}	4.0×10^{-2}	>100	1.5×10^{-2}	8.6×10^{-2}	>100	9.8×10^{-3}	8.9×10^{-2}	>100
Sr	3.3×10^{-6}	ND	n/a	3.6×10^{-6}	ND	n/a	3.4×10^{-6}	ND	n/a	3.4×10^{-6}	ND	n/a	7.8×10^{-6}	ND	n/a
Cs	2.8×10^{-5}	3.1×10^{-5}	10.0	6.0×10^{-6}	8.7×10^{-6}	45.9	5.2×10^{-6}	1.1×10^{-5}	>100	9.1×10^{-6}	1.5×10^{-5}	66.8	8.8×10^{-6}	7.6×10^{-6}	13.6
Carbon	5.4×10^{-1}	3.8×10^{-1}	29.2	2.1×10^{-1}	1.8×10^{-1}	13.9	1.9×10^{-1}	1.7×10^{-1}	10.4	2.8×10^{-1}	2.5×10^{-1}	10.9	2.7×10^{-1}	2.5×10^{-1}	9.2

ND = not detected, n/a = cannot be calculated.
(a) Even though the opportunistic Run W-06 does not appear in this table, it used the same material as W-01.
(b) One calcium analysis for W-02 (S2) was above the detection limit, but the other samples were all below detection. Thus, this was assigned a value of ND.

4.2.3.2 Liquid Density

Liquid phase density was determined at 16, 20, 22, and 25 °C by use of 25-to-50-mL glass pycnometers. First, the liquid and pycnometers were thermostatted to the target temperature by immersion in a recirculating water bath (whose temperature was verified using a calibrated thermocouple with ± 2.2 °C accuracy). Next, liquid was quickly added to a pre-weighed, certified pycnometer and the pycnometer was capped, dried, and weighed. The net mass of liquid in the pycnometer was then divided by the certified pycnometer volume to determine liquid density. The nominally solids-free liquids provided for density measurement were derived from dead-end filtration of 2-L simulant feed samples or feed tote grab samples (see "Total Solids Content" method in Section 4.2.4.1). The liquid density measurements are shown in Table 4.5 and compared to the previously reported values in Schonewill et al. 2024.

Table 4.5. Liquid Density of Simulants Measured from Samples Collected from the Experimental System. The densities are compared to the measurements made on 1-L batches during the development process (Schonewill et al. 2024) and the density reported by NOAH after production.

	Density (g mL^{-1}) from Simulant Development Process (1-L batches)			Density (g mL^{-1}) from Simulants Used in Experiments (samples from TK-01)				
Simulant ID	Estimated Target	Measured at 20 °C	Measured at 25°C	Reported by NOAH	Measured at 16°C	Measured at 20°C	Measured at 22°C	Measured at 25°C
S1	1.25	1.2517	1.2480	1.261	1.2395	1.2391	1.2373	1.2354
S2	1.25	1.2506	1.2466	1.235	1.2428	1.2403	1.2392	1.2379
S3	1.09	1.0930	1.0923	1.084	1.0938	1.0935	1.0918	1.0905
S4	1.17	1.1701	1.1692	1.170	1.1728	1.1705	1.1700	1.1685
S5	1.20	1.1976	1.1945	1.192	1.1868	1.1845	1.1836	1.1821

The densities measured from the experiment samples are ±1% of the data from the prior simulant development batches (at the same temperature) and the value reported by NOAH (assumed to be at 20 °C for comparison). The S1 data are the possible exception, as the sample densities are more than 1% less than the prior measurements at 20 and 25 °C. There is also significant difference between the density reported by NOAH and the sample data for S1; however, it is reasonable to conclude that the difference (sample data is ~2% less than the NOAH density) was mostly due to the significant amount of precipitation observed in the S1 as-received IBC totes. Precipitated solids which were in solution at the NOAH facility and settled out during transit would result in a reduced density when samples were taken from TK-01 during the W-01 experimental run. This may also partially explain the slightly smaller density for the experimental samples compared to the prior measurements from the 1-L batches.

4.2.3.3 Liquid Viscosity

Liquid phase viscosity was measured at 16, 20, 22, and 25 °C using a high-precision, air-bearing rheometer with a concentric cylinder single gap geometry. Temperature control was achieved by connecting the rheometer to a recirculating water bath whose temperature was verified by a calibrated thermocouple (accurate to ± 2.2 °C). The stress response of the liquid feed simulants (collected from material in TK-01 and dead-end filtered) was characterized as a function of shear rate (spanning 0 to 1000 s^{-1}). The viscosity of the liquid was quantified by linear regression of the slope of the stress response against shear rate (in accordance with the Newtonian constitutive equation and with care taken to eliminate shear rate regions impacted by second flows such as Taylor vortices). Table 4.6 compares the viscosity measurements measured from samples to the prior measurements made during the simulant development process, e.g., Schonewill et al. 2024.

Table 4.6. Liquid Viscosity Measured from Samples Collected from the Experimental System. The viscosities are compared to the measurements made on 1-L batches during the development process (Schonewill et al. 2024).

	Viscosity (mPa·s) from Simulant Development Process (1-L batches)			Viscosity (mPa·s) from Simulants Used in Experiments (samples from TK-01)			
Simulant ID	Measured at 15 °C	Measured at 20°C	Measured at 25°C	Measured at 16°C	Measured at 20°C	Measured at 22°C	Measured at 25°C
S1	4.70	4.02	3.50	3.87	3.44	3.29	3.04
S2	2.90	2.58	2.33	2.76	2.50	2.39	2.19
S3	1.89	1.79	1.47	1.77	1.64	1.59	1.49
S4	2.84	2.42	2.17	2.49	2.27	2.17	2.02
S5	2.85	2.51	2.22	2.54	2.34	2.18	2.07

The viscosities measured from experimental samples are within 10% of the viscosities originally measured during the simulant development process (except S1, which differs by about ~15%). In all cases, the data from the samples is lower than those measured in the 1-L batches. This is reasonable due to the difference in the simulant formulation environment between small batches using reagent-grade chemicals (at PNNL, 1 L) and larger batches using technical-grade chemicals (at NOAH, 300 gal). Another factor contributing to the reduced viscosities in the experimental samples is the various levels of precipitation observed in the as-received simulant batches (recall again that S1 had the greatest amount, and the largest difference in viscosity in Table 4.6), whereas the development batches had negligible precipitation. It is also expected that viscosity will decrease as the dissolved solids content decreases; examination of the data presented in Section 4.2.3.4 shows that the effects are correlated as anticipated.

4.2.3.4 Liquid Dissolved Solids Content

The dissolved solids content of nominally solids-free liquids (derived from dead-end filtration – see Section 4.2.4.1 for the total solids content method) was determined by placing a 5- to 15-g sample of liquid into a pre-weighed dish and oven-drying at 105 °C until a stable mass was reached (after more than 24 h of drying). The dissolved solids content of the liquid was determined as the ratio of the dried sample mass to original liquid sample mass.

Table 4.7. Dissolved Solids Measured from Samples Collected from the Experimental System. The dissolved solids data are compared to value estimated from the recipes and the measurements made on 1-L batches during the development process (Schonewill et al. 2024).

Simulant ID	Estimated Dissolved Solids (wt%) (from recipe)	Measured (wt%) from Simulant Development Process (1-L batches)	Measured (wt%) from Simulant Used in Experiments (samples from TK-01)[(a)]
S1	29.4	29.0	28.2
S2	31.1	32.2	30.5
S3	12.0	12.1	11.9 / 11.9
S4	20.7	20.8	20.6 / 21.1
S5	24.2	24.1	22.7

(a) Simulants with two measurements were conducted on a sample from the beginning and end of the associated experimental run. All other measurements were performed on initial feed samples.

The measured dissolved solids content from the samples is ~5% lower (or better) than those measured during the simulant development process. As discussed in the previous section, the slightly lower dissolved solids content in the experimental samples probably stems from the precipitation observed in the as-received simulant batches, which left a smaller amount of dissolved species in the liquid phase. The dissolved content data reported in Table 4.7 correlates well with observed viscosities, which were also slightly less than the previously measured values.

4.2.4 Addition of Trim Solids

For each experimental run, the solid composition presented in Table 4.2 was added to TK-01 after the liquid simulant was loaded to achieve target solid loadings. The solids were weighed out separately and then combined with a few liters of liquid simulant material sub-sampled from the IBC tote in a large poly container. The solids were added by swirling the content to mix and pouring them into TK-01 (via the top port) while the recirculation system was active. Residual solids were rinsed with additional liquid simulant to achieve quantitative addition to TK-01. The basis and source (manufacturer, lot number) for the solids are discussed in detail in Schonewill et al. 2024. However, the synthesis processes for natrophosphate and grimaldiite are summarized below. The natrophosphate synthesis was conducted three times and the grimaldiite synthesis was repeated several dozen times to produce the required mass of solids required for different runs.

Natrophosphate Synthesis

The natrophosphate batches were prepared in 4-L Erlenmeyer flasks, starting with ~1900 mL of DI water (holding back ~200 mL of DI water for rinsing) and adding 164 g of sodium phosphate tribasic dodecahydrate ($Na_3PO_4 \cdot 12H_2O$). Approximately 50 mL of the set aside DI water was used to rinse down residual solids. Then, 84 g of sodium fluoride was added 900 mL of DI water in a separate 2-L flask (again rinsing solids down with ~50 mL of DI water).

Both solutions were heated to 60 °C and stirred until all solids were dissolved. The hot NaF solution was added to the hot $Na_3PO_4 \cdot 12H_2O$ solution, and the remaining ~100 mL of the set aside DI water was rinsed down the NaF vessel into the $Na_3PO_4 \cdot 12H_2O$ solution. The combined solution was stirred for 5 min while continuing to heat, then allowed to cool slowly to room temperature. After cooling, the stir bar was removed, and the solution was left undisturbed for 24 h for crystallization to occur. Vacuum filtration was used on the solution to filter and isolate the crystals. The crystals were size-reduced using a mortar and pestle and passed through a 400-mesh sieve (<37 microns) before use in experimental runs.

Grimaldiite synthesis

Grimaldiite was synthesized using two feedstock chemicals: chromium nitrate ($Cr(NO_3)_3 \cdot 9H_2O$) and 10 vol% ammonium hydroxide solution (NH_4OH), both of which were used as-received from commercial sources. Then:

- 3 g of $Cr(NO_3)_3 \cdot 9H_2O$ was dissolved in 15 or 30 mL of DI water.
- 15 or 30 mL of 10 vol% of NH_4OH solution were added to the chromium nitrate solution (matching the volume of DI water used in the prior step) while stirring at room temperature. The pH value of the solution was confirmed to be between 5 and 8.
- The mixture was stirred for 30 min at room temperature.
- Approximately 30 or 60 mL of the mixture was removed and placed into a 125-mL Teflon vessel of a hydrothermal reactor.

- The hydrothermal reactor was sealed and heated in an oven at 170 °C for 1 to 4 days.
- After heating, the resulting product was washed with DI water and centrifuged at 4000 G for 5 min. The washing process was repeated two more times.
- The solid product was dried at 65 °C overnight to drive off residual moisture.

The remainder of this section presents the analyses performed on samples from the system that contained the trim solids, including:

- Total solids content by filtration-assisted gravimetric analysis
- PSD by laser diffraction
- Precipitated solid mineral phase identification by X-ray diffraction (XRD)

4.2.4.1 Total Solids Content

The total undissolved solids content in the simulant feed samples was characterized by dead-end filtration of nominally 2-L grab samples taken from the feed vessel during each experimental run. The dead-end-filter assembly used to separate precipitated simulant solids from the high-salt aqueous suspending phase consisted of a 1-L cylindrical suspension reservoir joined by C-clamps to a 70-mm Mott Grade 0.2 DEF (and was similar to the assembly used for dead-filtration studies in Geeting et al. 2018a,b). Liquid flow through the Mott disk was driven by 20-30 psig N_2 overpressure and continued until the entire contents of the suspension reservoir had been filtered and N_2 breakthrough through the filter was audibly noted. Immediately following breakthrough, the system was dissembled, and the “wet” solids scraped off the filter surface (to the best extent practicable) using a razor blade. These solids were also rinsed with appropriate solvents to wash out as much residual supernatant as possible. The process removes the vast majority of solids collected (except for solids that may have penetrated the tortuous network formed of pores with a hydrodynamic diameter on the order of 1-3 µm – see Daniel et al. 2011). This approach was also used to obtain solids content during the TSCR high solids testing described in Schonewill et al. 2021.

The solids-free filtrate from each 2-L sample was collected and segregated from the solids; sub-samples from the filtrate material were used to measure many of the liquid physical properties, such as density (Section 4.2.3.2), viscosity (Section 4.2.3.3), and dissolved solids (Section 4.2.3.4). The collected solids were weighed, dried at 105 °C for at least 24 h, and reweighed until a stable mass was reached. The final mass was then corrected to remove the mass of dried solids that derived from supernate hold-up in the solids (based on moisture loss during drying) and ratioed to the mass of the original 2-L sample to determine total solids content. The estimated solids content for the 2-L samples measured from the experimental runs are given in Table 4.8. Given the uncertainty in the method, the measurements are rounded to the nearest 10 ppm. There is an inherent challenge in drying the collected solids without salting out species from the supernatant; thus, though care is taken to rinse out the residual supernatant liquid, the data will tend to be biased high.

Table 4.8. Total Solids Content Measured by Dead-End Filtration for Simulants with Trim Solids Added. The measured values are compared to the target values for each experimental run.

Simulant ID	Sample ID	Description	Target/Expected (ppm)	Measured (ppm)
S1	W01A-S1-05	W-01A SOR feed sample	130	180
	W01B-S1-01	W-01B SOR feed sample (diluted)	30	300
	W01B-S1-18	W-01B EOR feed sample	30	120
	W06-S1B2-1	W-06 SOR feed sample	130	210
S2	W02-S2-01	W-02 SOR feed sample	50	400
	W02-S2-28	W-02 MOR feed sample	50	100
S3	W03-S3-02	W-03 SOR feed sample	100	140
	W03-S3-26	W-03 MOR feed sample	100	150
S4	W04-S4-02	W-04 SOR feed sample	20	80
	W04-S4-21	W-04 MOR feed sample	20	90
S5	W05A-S5-02	W-05A SOR feed sample	500	960
	W05A-S5-15	W-05A MOR feed sample	500	690
	W05B-S5-1	W-05B SOR feed sample (diluted)	100	270

SOR is start of run; MOR is midpoint of run (typically after adding remainder of trim solids and simulant to TK-01); EOR is end of run.

Examination of the data in Table 4.8 reveals the following key features about the experimental runs that are worth mentioning, as they factor into the interpretation of the filter performance data presented in Section 6.0:

- The initial trim solids (SOR samples) added in W-01 and W-06 were similar to one another and were within ~50% of the target loading.
- Subsequent W-01 solids content data show that more solids were introduced to the system than expected. This occurred between the W-01A SOR and W-01B SOR sample values when the remainder of the S1 liquid was added to TK-01:
  - Therefore, a portion of W-01A contained feed with a solids content exceeding 500 ppm. The intention was to dilute from 130 to 30 ppm using processed liquid. Using the W-01B EOR value of 120 ppm indicates that at least 520 ppm[1] was likely present. The W-01B SOR sample suggests it could have been even greater, but the sample may not represent a well-mixed state of TK-01 since its contents had been diluted shortly before the sample was taken.
  - The entire W-01B was performed at factor of at least 4 greater than the target of 30 ppm.
- W-02 had more solids than anticipated at the start of the run by about a factor of 8. The solids were observed in the S2 as-received IBC tote and could not be filtered out as they were loaded into the system. Once this was observed, the second trim solids addition was not made when the remainder of the S2 materials was pumped into TK-01. This contributed to the reduction in solids loading observed in the W-02 MOR sample.

[1] Estimated using the dilution ratio, which is computed using the nominal target loadings: 130 ppm/30 ppm = 4.33. The dilution ratio is then multiplied by the W-01B EOR data, i.e., 120 ppm × 4.33 ~ 520 ppm. If the W-01B SOR sample is used, the number increases to 300 ppm × 4.33 ~ 1300 ppm.

- W-03 and W-04 were conducted at consistent solid loadings for their entirety. The measured solids contents were approximately ~50% and a factor of 4 greater than the W-03 and W-04 targets, respectively.
- W-05 was initially nearly a factor of two above the target solids loading; in part this was caused by an erroneous amount of sodium oxalate added with the trim solids. The error was discovered later, and the second trim solids addition was corrected to account for it. This explains the reduction in solids loading measured in the W-05A MOR sample.
- Dilution from W-05A to W-05B was planned to reduce the solids loading by a factor of 5 (500 to 100 ppm). Data from the W-05A MOR and W-05B SOR samples indicates it may have been closer to a factor of 3. However, the SOR samples were likely impacted by the same effect present in W-01B and it likely would have been measured at a lower value later in the run.

For runs W-01, W-02, and W-05, it is possible that the reduction in solids loading observed in samples collected later in the evolution of the experiment was caused by preferential feeding of solids to the system because the solid particles in those simulants were segregated closer to the bottom of TK-01 (where the recirculation suction is located). However, it is difficult to ascertain the magnitude of this effect without additional samples from the end of runs W-03 and W-04 (which appeared more "stable") and a better understanding of the uncertainty in the method used to measure total solids content.

4.2.4.2 Particle Size Distribution

The PSD of a representative feed sample of the simulant after trim solids were added was measured using laser diffraction. To avoid any agglomerating and recrystallization effects from drying, all size measurements were made using solids that were sampled directly from the suspending phase and diluted (when necessary) using solids-free filtrates from the DEF system (see the description of the total solids content method in Section 4.2.4.1). During size analysis, samples were mixed and dispersed using an in-cell recirculator and sonicator. Beyond continuous recirculation and periodic sonication during measurements, no additional means of dispersing the solids, such as the use of surface-active agents, were undertaken. Therefore, particle size measurements reflect the state of solids agglomeration that occurs under conditions of active shear that can be measured with laser diffraction technology[1] rather than the true, primary particle size of the solids themselves.

The PSDs measured for the feed samples were compared to the measurements made during the simulant development process. Each PSD was formulated to approximate a reference PSD derived from actual waste data based on different tank farms in 200W – for additional discussion on this topic refer to Schonewill et al. 2024. Figure 4.2 shows the PSDs measured for experimental runs using S1 simulant with trim solids (W-01, W-06). The two measurements are quite similar to one another, but they are considerably larger than the S1 data from the development process (which is also slightly larger than the SY tank farm benchmark). The solid phase includes natrophosphate and sodium oxalate, both of which are partially soluble and more likely to experience changes in particle size in contact with a caustic, aqueous solution. The discrepancy could also arise from representativeness of the feed sample, which is collected from the recirculation line at a single point in time.

[1] The instrument used for the reported measurements (a Malvern Mastersizer 2000) has a lower limit of 20 nm under the best conditions. Measurement of typical tank waste simulant dispersions, which comprise broad mixtures of solids containing agglomerates > 1000 nm in size, is limited to sizes > 200 nm.

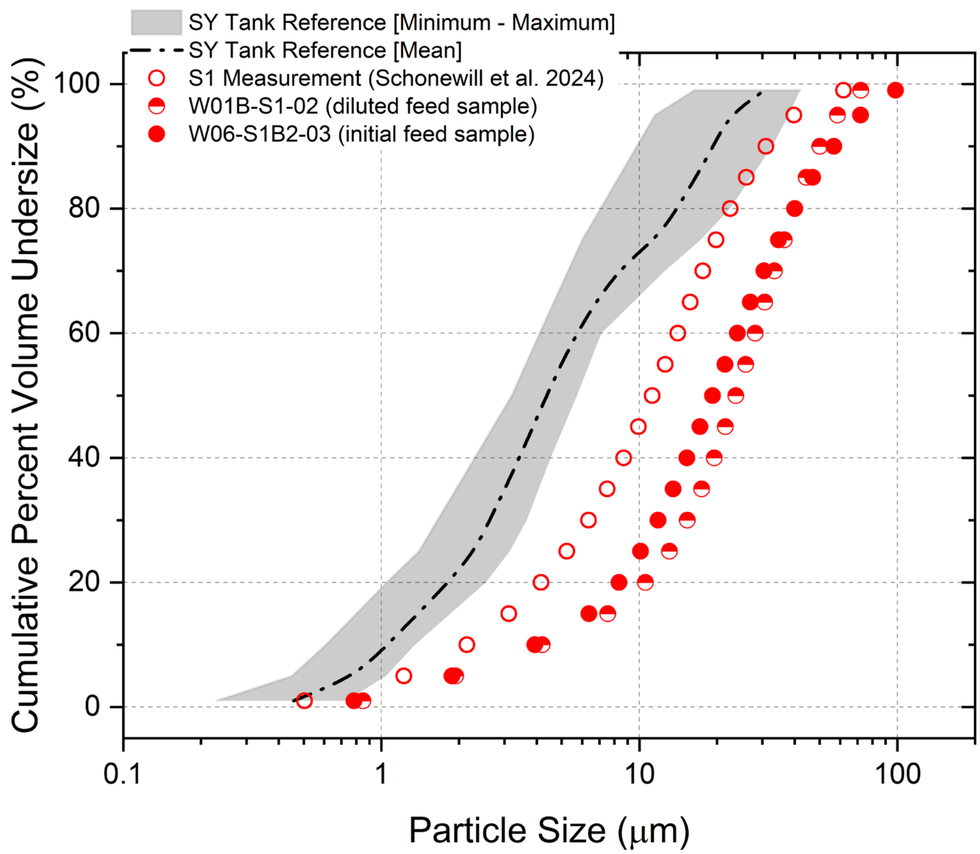

Figure 4.2. Particle size distribution of W-01B and W-06 samples compared to the measurement of S1 during simulant development. The shaded region represents the SY Tank Farm reference curve that was the metric for the S1 solid particle size.

Figure 4.3 compares the simulants based on S Tank Farm (S2 and S5) with their feed sample measurements during runs W-02 (S2) and W-05 (S5). PSD data for both feed samples differ from the targets for different reasons. W-02 used S2 simulant, which had some native precipitated solids that arrived with the as-received IBC tote. These solids were colloidal and passed through a 10-micron cloth filter when being loaded into TK-01 (see Section 4.2.2). The inclusion of these solids likely shifted the PSD to considerably smaller sizes compared to the expected S2 simulant. Notably, the W-02 PSD puts it predominantly (between ~20 and 80 percentiles) within the reference PSD for S Tank Farm. The W-05 sample PSD data simulant is larger across all percentiles than the expected S5 material. The cause of this is likely the addition of too much sodium oxalate – which is one of the large solid components – skewing the PSD toward that of sodium oxalate itself. The unintentional addition of excess sodium oxalate is discussed further in Section 5.1.2 and was not discovered until the trim solids had already been added. (Run W-05A had processed for several hours.)

Figure 4.4 shows the feed samples for S3 (W-03) and S4 (W-04) compared to the data measured during their formulation. The S3 PSDs from W-03 and Schonewill et al. 2024 are nearly indistinguishable, particularly at percentiles >50%. The W-04 trim solids, which were present at a solids loading target of 20 ppm, were not present in a sufficient quantity to be measured via laser diffraction and cannot be reported. Without any measurable data, the similarity of W-04 to W-03 and the original S4 measurement cannot be confirmed; regardless, the feed samples for the U Tank Farm simulants appeared to be the most consistent with their formulations.

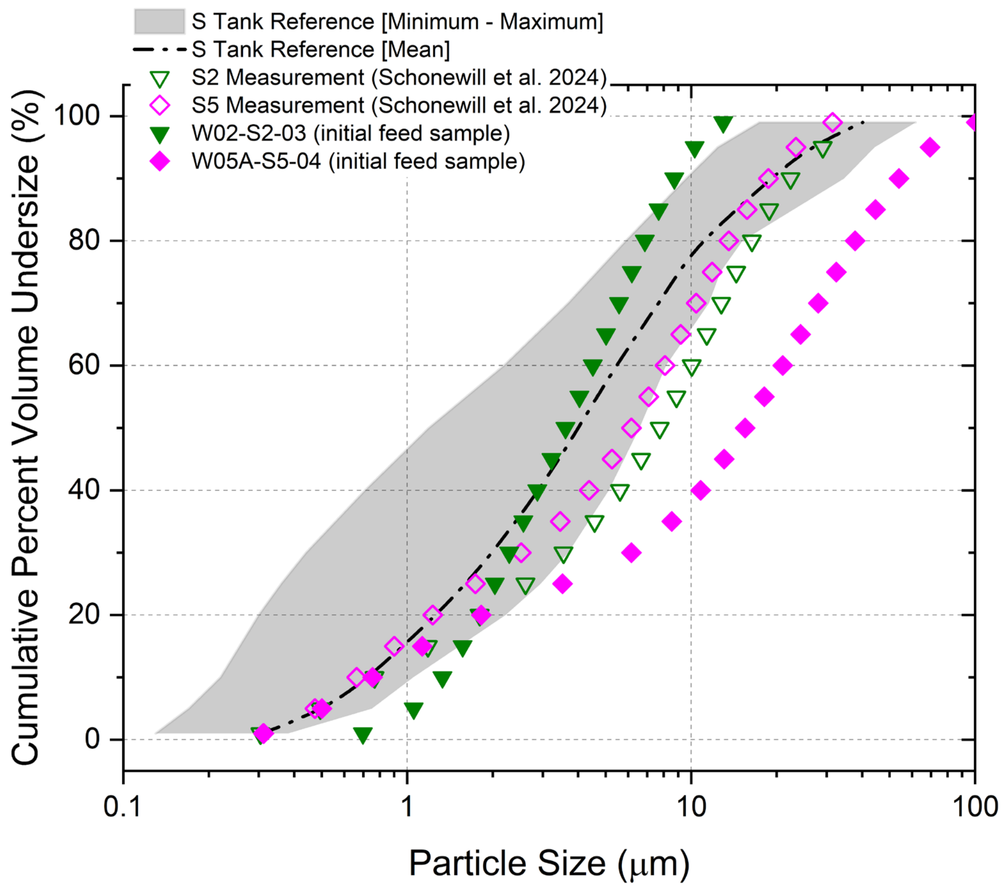

Figure 4.3. Particle size distribution of W-02 and W-05 samples compared to the measurement of S2 and S5 during simulant development. The shaded region represents the S Tank Farm reference curve that was the metric for the S2 and S5 solid particle size.

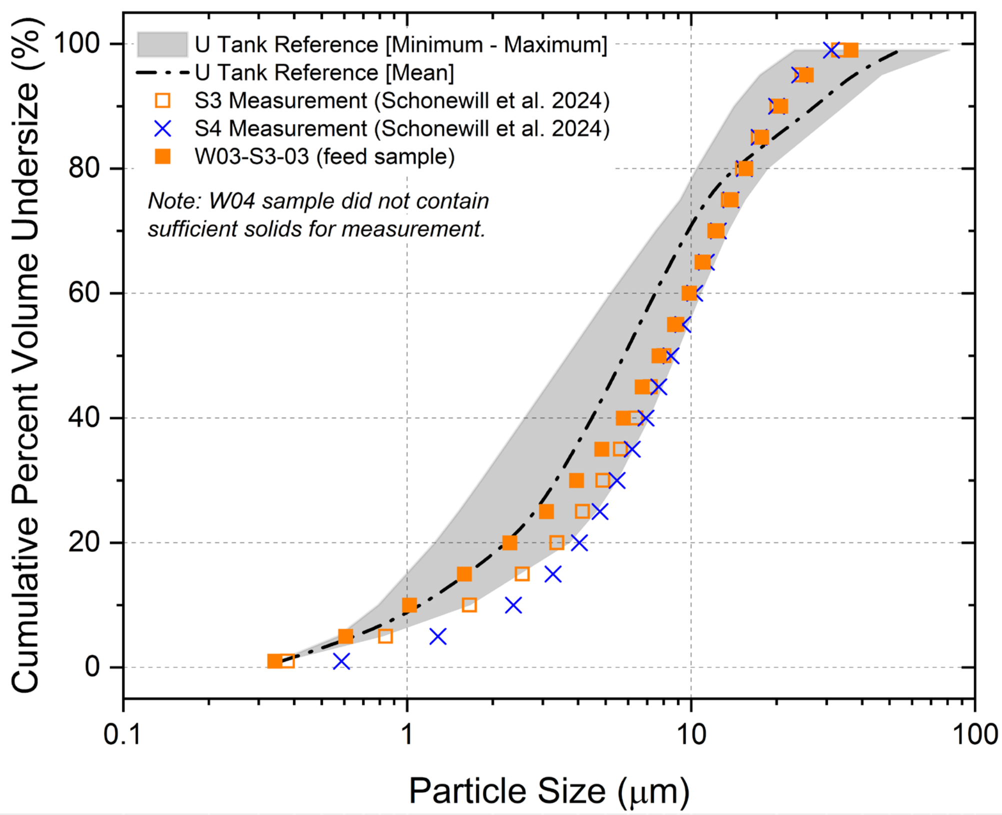

Figure 4.4. Particle size distribution of W-03 and W-04 samples compared to the measurement of S3 during simulant development. The shaded region represents the U Tank Farm reference curve that was the metric for the S3 and S4 solid particle size. The W-04 sample did not contain enough solids to perform the particle size measurement.

Figure 4.5 presents the change in PSD over the course of an experimental run by examining multiple samples from Run W-05. The first sample (solid diamonds) is the same data previously shown in Figure 4.3 and was collected within the first hour of operation. The second sample (half-solid diamonds) was taken after ~114 h[1] of processing and TK-01 contents were diluted to a reduced solids concentration (target of 500 to 100 ppm). This occurred approximately halfway through the run. The third sample (crossed diamonds) was collected after the TK-01 contents were cooled to 16 °C and held there for 24 h. Processing was then restarted at 16 °C and a feed sample was collected (almost the end of the run). The data indicate that the solids distribution gradually increased its population of larger particles over time, although the particles with the largest sizes didn't increase noticeably. This is consistent with the processes of either aggregation and/or precipitation occurring in the TK-01 material over time. Because the drop in temperature (represented in the cooled feed samples) did not occur immediately after the diluted feed samples were collected, it is difficult to ascertain which operation had a more pronounced effect on the S5 material (from comparing the PSDs of the diluted and cooled samples). These evolutions were not assessed for any other runs, so the data is illustrative but not necessarily indicative of all simulant wastes.

[1] At 114 h of processing time and assuming the flow rate was nominally 130 mL min^{-1}, this is ~890 L (~235 gal) of simulant fed and filtered through the experimental system.

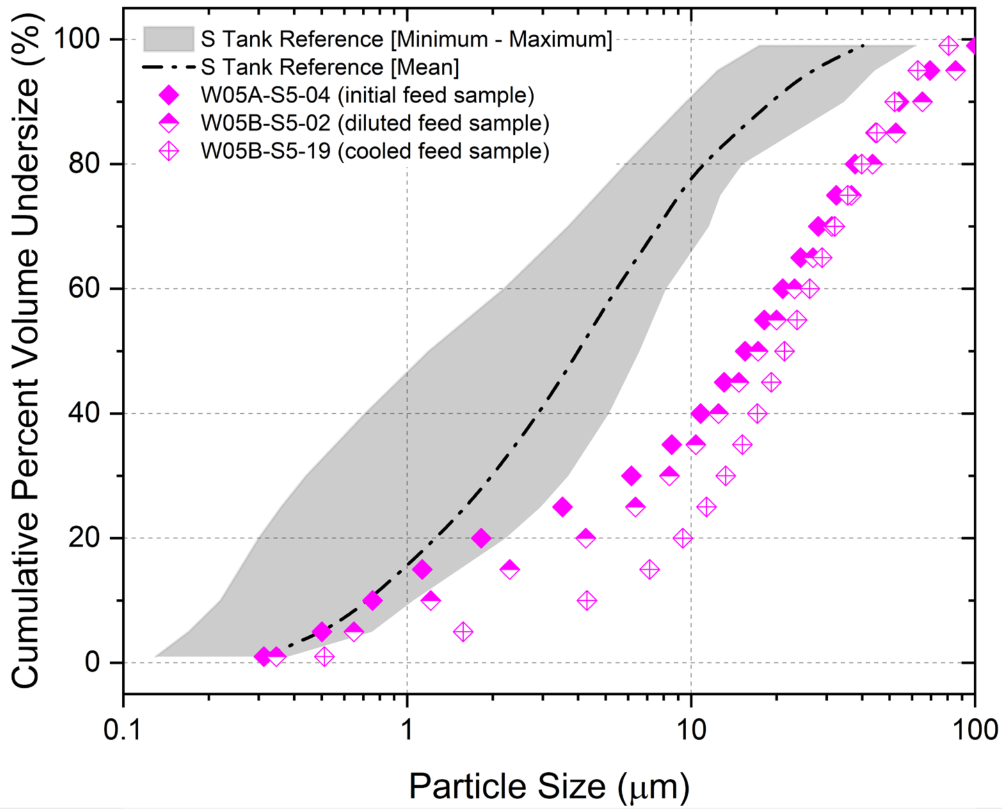

Figure 4.5. Evolution of particle size distribution over the W-05 run. The data is listed chronologically in the legend (solid diamonds, half-solid diamonds, crossed diamonds).

4.2.4.3 Solid Phase Chemistry

Identification of crystalline mineral phases in the simulant solid phase was accomplished by XRD. Solids were collected by dead-end filtration as described in Section 4.2.4.1 on to a Mott Grade 0.2 filter disk (with filtration driven by 20-30 psig N_2 overpressure), dried, and subsampled for analysis. The makeup chemistry of the simulant liquid and added trim solids were used to optimize software-assisted mineral phase identification by specifying key analytes expected to comprise the solids.

For XRD analysis, the samples were placed on zero-background quartz holders (MTI Corporation, Richmond, CA) and scanned with a Bruker D8 ADVANCE X-ray diffractometer (Bruker AXS Inc., Madison, WI) with Cu Kα source. The scan parameters were 5–75° 2θ with a step of 0.015° and 2 s dwell. For the phase identification and quantification, Bruker AXS DIFFRAC^{plus} EVA (v4.1) and TOPAS (v5) software programs were used, respectively, using crystallographic information files from PDF-5 (International Centre for Diffraction Data). For the XRD standard, TiO_2 with ~91% crystallinity was used, and ~10 wt% of TiO_2 standard was mixed with samples using a mortar and pestle. For one sample (W04-S4-02), ~24 wt% of TiO_2 was used due to the small amount (0.0055 g) of available sample.

By inspection, the majority of the “expected” solid phases – based on the trim solids added to the simulant for each run as described in Table 4.2 – were detected. Almost every XRD scan showed a measurable amount of nitratine (crystalline $NaNO_3$). Sodium nitrate was present in large amounts in the liquid phase (it is the single most abundant sodium salt), so this could indicate supernatant that salted out during drying. If that was the cause – and because it happened consistently – the total solids content reported in Table 4.8 may be ~10% to 20% greater than it should be. This is difficult to confirm, but it illustrates the challenge of an accurate total solids content measurement.

In Table 4.9, the solid phases that were supposed to be present (the "expected" phases) are cross-walked against the XRD scan results given in Table 4.10. An "X" in the table means the solid should be present in the samples associated with the simulant/experimental run, whereas "—" indicates it should not be present. If the cell is green, then the XRD scan agrees with expectation. Red cells call out solids that should have been present but were not identified by XRD analysis. Yellow cells indicate when solids were identified in the XRD analysis, but in small amounts (S2 gibbsite, S1 natrophosphate), or solids were not detected in the XRD pattern but they are only present in small amounts and may have been obscured by more abundant solids (grimaldiite, iron phosphate, and kyanite) or were part of the amorphous/unidentified fraction. That fraction comprised at least 10% of every sample. Despite these limitations, the expected solid phases – in particular, the phases that were present in the most significant amounts – were identified by XRD analysis for all simulants.

There were two exceptions, and both had to do with identifying solids that constituted an appreciable fraction of the solid phase but should not have been present: (1) W-01 samples that identified thermonatrite and sodium phosphate, and (2) the nearly 50% of the W-02 solids identified as brushite.

The thermonatrite ($Na_2(CO_3)\cdot H_2O$) in sample W01B-S1-01 (and probably the higher mass fraction of nitratine) is likely from the precipitated solids in the as-received S1 IBC tote. Approximately halfway through W-01A the remainder of the S1 liquid was transferred to TK-01; during this transfer, it is suspected that some of the settled, precipitated solids were entrained into the simulant during pumping. The "extra" solids show up in the total solids content data and are correlated with a sudden change in DEF performance (see Section 6.2). Interestingly, when those settled solids were sampled, dried, and analyzed by XRD (sample W01B-S1-20), thermonatrite was not found. Other common precipitated sodium salts were identified: sodium phosphate, natrophosphate, and sodium oxalate. Those settled solids were a slushy mass of salts, difficult to filter and dry, and more than half of the solid phase was not identified by XRD. Either way, this W01B sample demonstrates the presence of multiple sodium salts that were in the S1 dissolved phase recipe that would be probable precipitate compounds.

The brushite ($Ca(PO_3)(OH)\cdot 2H_2O$) found in all the W-02 samples in ~50% mass percent was mildly surprising. Given the observed behavior during run W-02 (see Section 6.3) and the fine, colloidal solids that arrived in the IBC tote with the S2 simulant from NOAH, it was not surprising that a relatively large amount of an unexpected solid was detected. It was also not surprising that the contributing elements were calcium and phosphate, because the presence of a calcium phosphate compound is reasonable given the simulant chemistry. In fact, Disselkamp (2010) identifies a few Hanford tanks with calcium phosphate (C-103, C-108) and other calcium mineral solids (S-112, SY-101); calcium solids were also recently observed in AP-101 and AP-107 samples analyzed at PNNL (Allred et al. 2024).[1] Calcium was present in the five simulant liquids at ~10^{-3} mol L^{-1} and S2 specifically at 6×10^{-4} mol L^{-1}.

What is surprising is that the compound identified by XRD in multiple samples was brushite (and only brushite – no other notable solid was detected). Brushite is only stable in aqueous solutions of acidic to neutral pH (Tas 2016) or as high as pH of 9.8 (Montes-Hernandez and Renard 2020); it also is readily soluble in water compared to other calcium phases (Miller et al. 2012; Tas 2016). Brushite easily hydrolyzes (within minutes) to other calcium phases as the pH becomes more basic (Miller et al. 2012). The S2 simulant was caustic (pH ≥ 14), aqueous, and had several days to equilibrate before use in the

[1] To be clear, the calcium solids in these samples were only identified by their elemental composition and classified as calcite, which would be $CaCO_3$. It is reasonable to assume that not all the calcium-bearing solids are calcite and other phases containing calcium are present, but this cannot be verified.

system. Thus, it seems highly likely that the solids present during Run W-02 were hydroxyapatites[1] ($Ca_5OH(PO_4)_3$) because brushite is a common precursor (Miller et al. 2012; Chahal et al. 2023). Hydroxyapatites are stable in basic solutions and are noted for their ability to form a variety of gel/hydrogels (Svarca et al. 2022; Tan et al. 2021) that remain Newtonian with low viscosities if the solids loading is not high (Abbas et al. 2025). The W-02 solids had a gel-like, colloidal behavior, settled slowly, and the measured PSD was smaller than the target for the S2 sample. These observations are all consistent with the presence of hydroxyapatite. In principle, hydroxyapatite can convert back to brushite if the pH shifts toward the neutral range, which may have occurred when the samples were filtered and then washed to remove residual salts; perhaps this is what led to the detection of brushite as the only Ca-bearing phase.

Regardless, the XRD analysis quantifies a portion of the W-02 solids as something that was not added with the trim solids. These solids, referred to as brushite for convenience, were created during the simulant makeup process at NOAH's facility or in transit to the PDLE facility where the experiments were conducted. The detection of brushite suggests a solid that contained both calcium and phosphate, a combination for which there is precedent in the Hanford tank waste. Some of these examples were already mentioned, but data contained in Wells et al. 2011 (Appendix C) estimates that the solid phase in the 200W tanks contains around 0.05 to 0.35 wt% (S, SX tanks), 0.1 to 0.75 wt% (U tanks), or ~1% (SY tanks) of hydroxyapatite. This is also reflected in Table 3.9 of Schonewill et al. 2024, where hydroxyapatite is around 1% for two of the five groupings that formed the basis of the five simulants used in the current experimental campaign. These estimates represent a low probability that significant amounts of hydroxyapatite (or other apatites) are present in 200W tank waste, but its presence is difficult to rule out completely. Because the W-02 filtration behavior was unique, confirming the cause of the irreversible fouling would mitigate future risk in the 200W process modules. However, additional analysis to supplement the XRD data would be needed to better assess the possibility of apatite phases in 200W-relevant chemistry.

[1] Other apatites are possible, such as fluorapatite (F replaces OH) or chlorapatite (Cl replace OH).

Table 4.9. Results of XRD Scan Collected for Solid Samples Collected from TK-01 Feed Samples During Runs. Raw scans and peak information are collected in Appendix A.

	Solid Composition per Quantitative XRD (wt% of solid phase in sample)									
Sample ID / Description	Gibbsite	Boehmite	Natroxalate	Grimaldiite	Nitratine	Thermo-natrite	Sodium Phosphate	Natro-phosphate	Brushite	Amorphous[a]
W01A-S1-05 Initial feed	33.6	nd	29.0	nd	1.0	nd	nd	nd	nd	36.4
W01B-S1-01 Diluted feed	18.5	nd	17.7	nd	27.9	22.1	nd	nd	nd	13.8
W01B-S1-18 Feed at end of run	26.4	nd	33.7	nd	14.7	nd	nd	nd	nd	25.1
W01B-S1-20 S1 tote sample (settled solids)	nd	nd	15.4	nd	4.2	nd	19.9	0.7	nd	59.8
W02-S2-01 (FIO)[b] Initial feed	X	X	nd	nd	X	nd	nd	nd	X	n/a
W02-S2-28 Feed at midpoint of run	0.6	nd	9.8	nd	24.0	nd	nd	nd	46.4	19.3
W02-S2-31 S2 tote sample (settled solids)	nd	nd	8.6	nd	20.3	nd	nd	nd	47.3	23.8
W03-S3-02 Initial feed	60.1	15.0	nd	nd	10.4	nd	nd	nd	nd	14.5
W03-S3-02-1 Initial feed duplicate	70.0	15.8	nd	nd	nd	nd	nd	nd	nd	14.2
W04-S4-02 Initial feed	3.3	11.4	nd	16.3	8.1	nd	nd	nd	nd	60.8
W05A-S5-02 Initial feed	7.9	17.3	58.8	1.2	4.8	nd	nd	nd	nd	9.9

nd = not detected in the sample, n/a = cannot be estimated, X = detected in the sample
(a) Amorphous is a catch-all for both non-crystalline solids in the sample and solids that could not be identified in the database.
(b) This sample was only assessed using a preliminary, qualitative analysis. The solid composition is not quantitative and is For Information Only.

Table 4.10. Crosswalk Between Simulant Trim Solids Expected (see Table 4.2) and XRD Analysis Results. An entry of "X" indicates the phase is expected, whereas a "—" indicates it should not be present. Green = XRD result matches; Yellow = XRD result is ambiguous; Red = XRD result does not match.

Solid Components	S1 (W-01)	S2 (W-02)	S3 (W-03)	S4 (W-04)	S5 (W-05)
Gibbsite [$Al(OH)_3$]	X	X	X	X	X
Boehmite [AlO(OH)]	—	X	X	X	X
Natrophosphate [$Na_7FP_2O_8 \cdot 19H_2O$]	X	X	—	—	—
Sodium oxalate [$Na_2C_2O_4$]	X	X	X	X	X
Grimaldiite [CrO(OH)]	—	X	X	X	X
Iron phosphate [$FePO_4 \cdot 4H_2O$]	—	X	X	X	X
Kyanite [Al_2SiO_5]	—	—	X	—	—

5.0 Experimental Methodology

This section presents an overview of test operations used to collect the performance data for the DEFs. The experimental program used five distinct liquid simulants and trim solid compositions at various solids loadings. In general, the experiments were run at a fixed flow rate and temperature, although both parameters were changed in some instances. This section includes a discussion of the target and actual run conditions (Section 5.1), the general steps used to perform the runs (Section 5.2), and notable differences in simulant and configuration changes in the system (Section 5.3).

5.1 Run Matrix

As described in Section 1.2, satisfying the test objectives required performing tests across a range of 200W representative simulants with solids loading ranging from 20 to 500 ppm. To meet this requirement, five runs were planned. The target and actual conditions of each experimental run are summarized in this section; for context, the runs as they were originally planned at the outset of the test program are discussed first, followed by the conditions of the tests as they were conducted.

5.1.1 Target Run Matrix

A total of five runs were planned – each with a unique liquid simulant – and various solid additions to achieve solids loadings between 20 and 500 ppm, flow rates ranging between 76 and 195 mL min^{-1} with 130 mL min^{-1} as baseline, and temperature either set at 22 °C (as baseline) or 16 °C (to assess precipitation risk) as described in Table 5.1. Simulants S1 through S5 represent the DST Feed and SST Feeds #1 through #4 as described in Section 4.0. The original system configuration was LS1 as described in Section 3.1.1. Since the adjustment of flow rate, temperature, and simulant conditions were not commonly performed in the last test program, e.g., Schonewill et al. 2021, whenever changes to flow rate, temperature, or feed simulant were made, a new filter period was initiated (except when operating with gradient flow in W-04).

The baseline run, W-01, was planned to be conducted in two parts. The first part, W-01A, was intended to use simulant S1 (DST Feed Simulant) with solid additions of gibbsite, natrophosphate, and sodium oxalate to achieve a solids loading of 130 ppm. This run was referred to as the baseline simply because it represents the first 200W feed that will be processed. For some portion of W-01A, operating at a flow rate of 76 mL min^{-1} was proposed to observe filtration behavior at lower flux (to match the expected flux of the 200W PM). Immediately after W-01A was completed, the second part, W-01B, was planned to take residual simulant from Run W-01A in TK-01 and dilute it with processed S1 liquid to achieve a solids loading of 30 ppm. At the beginning of Run W-01B, the planned flow rate and temperature were selected to mimic W-01A conditions; following this, the feed temperature was to be lowered to 16 °C and held for roughly 24 h to assess the precipitation risk and then resumed processing for at least 24 h (one DEF cycle). The approximate operating times for W-01A and W-01B were anticipated as 112 and 132 h, respectively – combined, these comprise the continuous W-01 run of ~250 h.

The performance impact of varying flowrate with simulant S2 (SST Feed #1) was planned for Run W-02 with solid additions of gibbsite, boehmite, natrophosphate, grimaldiite, iron phosphate, and sodium oxalate to achieve a solids loading of 50 ppm. To determine the impact of flow rate on filtration performance, it was planned to flow at 130 mL min^{-1} for the first 48 h, then 91 mL min^{-1} for the next 48 h, and finally 195 mL min^{-1} until TK-01 was at its minimum operating level. To accomplish Run W-02, operation was anticipated to occur for ~130 h.

Run W-03 was designed to determine the performance impact of varied flow rate and assess precipitation risk at reduced temperature with simulant S3 (SST Feed #2). The trim solids to be added were gibbsite, boehmite, kyanite, grimaldiite, sodium oxalate, and iron phosphate to achieve a loading of 100 ppm. For the first 48 h of the test, the system would be operated at the baseline flow rate, 130 mL min^{-1}, and temperature, 22 °C. For the next 48 h of the test, the flow rate was planned to be lowered to 91 mL min^{-1}. After the test had eclipsed 96 h of operation, the flow rate was planned to be increased to 195 mL min^{-1} for 24 h or until TK-01 had enough volume remaining to flow at 130 mL min^{-1} for 8 h; whichever occurred first. For the final 24 h of Run W-03, the temperature of the feed was planned to be lowered from 22 to 16 °C to assess the precipitation risk (in the same way as was performed in Run W-01).

Run W-04 was proposed to determine the impact of a flow rate gradient on simulant S4 (SST Feed #3) with solids additions of gibbsite, boehmite, grimaldiite, sodium oxalate, and iron phosphate to achieve a solids loading of 20 ppm. For the first 48 h, the flow rate would be set to the baseline of 130 mL min^{-1}. After 48 h of operation, the flow rate would be lowered to 91 mL min^{-1} for the next 48 h. After a total of 96 h of operation, the flow rate would be returned to baseline for 4 h. Finally, after a total of ~100 h of operation, the gradient flow evaluation would start by increasing or decreasing the flow rate every 2 h (without swapping filters unless necessary based on the differential pressure requirements). The proposed flow rates in the gradient included 91, 110, 130, 150, 170, and 195 mL min^{-1}. Run W-04 would end whenever TK-01 reached its minimum operating level.

Run W-05 was planned to take place in two parts like W-01. The first portion,W-05A, was designated to measure filter performance at the highest solids loading of any run. W-05A would be conducted using simulant S5 (SST Feed #4) with trim solid additions of boehmite, gibbsite, grimaldiite, sodium oxalate, and iron phosphate to achieve a solids loading of 500 ppm. The flow rate for W-05A would remain constant at the baseline of 130 mL min^{-1} for roughly 114 h. After W-05A was complete, the remaining liquid in the tank would be diluted with processed S5 to achieve a solids loading of 100 ppm for W-05B. For the first ~110 h of W-05B, the conditions were intended to be fixed at a flow rate of 130 mL min^{-1} and a feed temperature of 22 °C. After that point, the feed temperature was planned to be lowered to 16 °C and held for 24 h to assess precipitation risk (again, as in Runs W-01 and W-03). The remaining feed in TK-01 would be processed at the baseline flow rate with the colder feed until TK-01 was at its minimum operating level.

Table 5.1. Initial Proposed Run Conditions for 200W Filtration Experiments.

Run ID	Simulant	Solids Loading (ppm)	Target Temperature(s) (°C)	Target Flow Rate(s) (mL min^{-1})	Approximate Operating Time (h)	Objective
W-01A	S1	130	22	130 / 76[(a)]	112[(a)]	Baseline performance
W-01B	S1	30	22, then 16 (last ~24 h)	130 / 76[(a)]	132[(a)]	Performance with diluted solids; precipitation check
W-02	S2	50	22	91 / 130 / 195	130	Performance impact of flow rate changes
W-03	S3	100	22, then 16 (last ~24 h)	91 / 130 / 195	130	Performance impact of flow rate changes; precipitation check
W-04	S4	20	22	91 / 130 / 195 (or gradient)	130	Performance impact of flow rate changes
W-05A	S5	500	22	130	116	Baseline performance at highest solids loading
W-05B	S5	100	22, then 16 (last ~24 h)	130	136	Performance with diluted solids; precipitation check

(a) Some portion of these runs (perhaps two or three filter cycles) were proposed to be conducted at 76 mL min^{-1}. The operating time represents a minimum approximate operating time based on running at 130 mL min^{-1} for the entire run. However, some fraction of this run, if performed at ~76 mL min^{-1}, would increase the operating time above this value.

5.1.2 As-Executed Run Matrix

Ultimately, six runs were executed as shown in Table 5.2. Compared to the target run conditions presented in Table 5.1, the experimental runs deviated in the as-added trim solids loadings (which does not account for any solids introduced to the system from the simulant totes, precipitation, or other mechanisms) and their approximate operating time (primarily resulting from how flow rate varied). The runs that had notable deviations in solids loading were W-02, W-05A, and W-05B.

For W-02, operations at the beginning of the run occurred with a trim solids addition of 50 ppm, but once the working volume was depleted, additional solids were not introduced during the second spike due to elevated differential pressures around the DEFs. This resulted in the nominal solids loading during the second part of W-02 to be lower than the desired concentration at 19 ppm compared to 50 ppm.

For W-05A, a calculation error for the initial spike resulted in a sodium oxalate concentration 10 times larger than desired. The error in the initial spike was corrected in the second spike to achieve a solids loading of 501 ppm. Although the initial solids loading was greater than desired at the beginning of W-05A – resulting in the nominal solids loading to be roughly 150 ppm more than anticipated – the data collected during the run provided insight regarding filter performance at a more challenging simulant condition (also note also the likely impact on the solid PSD that is described in Section 4.2.4.2). The elevated as-added solids concentration in W-05A carried forward to W-05B with 133 ppm instead of 100 ppm. Although the solids concentration was greater than anticipated, this provides more robust insight into the precipitation behavior of the material at lowered temperatures.

Due to the change in the system from the LS1 to LS2 configuration as described in Section 3.0, Run W-06 was added to provide comparison data between the two DEF scales using the same S1 simulant. W-06 used a duplicate batch of S1 liquid PNNL had acquired for contingency and added the same composition and proportion of trim solids as W-01A. Run W-06 was a rerun of Run W-01A conditions, except that a second spike of trim solids was not added, which accounts for the difference in the approximate operating time.

Table 5.2. Nominal Run Conditions Executed During the FY25 Experimental Program

Run ID	Con-figuration	Simulant	Trim Solids Loading (ppm)	Actual Solids Loading (ppm)[(a)]	Actual Temperature(s) (°C)[(b)]	Actual Flow Rate(s) (mL min^{-1})[(c)]	Approximate Operating Time (h)
W-01A	LS1	S1	130	1st portion: 180 2nd portion: >500	20.9 – 22.3	120.0 - 134.1	117
W-01B	LS1	S1	30	120 - 300	15.5 – 16.0 21.1 – 22.2	129.5 – 131.3	82+
W-02	LS1	S2	50 (1st part), 19 (2nd part)	At start: 400 At end: 100	21.1 – 22.6	72.0 – 77.9 89.4 – 93.2 127.9 – 132.4	135
W-03	LS1	S3	100	140 – 150	15.9 – 16.4 21.0 – 23.2	90.8 – 91.5 129.3 – 131.0 194.6 – 196.1	128+
W-04	LS2	S4	20	80 – 90	20.9 – 22.5	90.3 – 91.3 108.9 – 111.4 129.5 – 130.2 149.9 – 150.2 167.9 – 170.2 195.0 – 195.2	144
W-05A	LS2	S5	648 (Spike 1: 684, Spike 2: 501)	690 – 960	21.2 – 22.2	128.7 – 132.6	114
W-05B	LS2	S5	133	270	15.3 – 16.7 21.3 – 22.2	128.0 – 131.7	133+
W-06	LS2	S1	130	210	20.9 – 25.2	129.1 – 132.0	102

+ Approximate operating time does not include cooling and 24-h hold.
(a) Refer to Table 4.8 for individual total solids content sample data for each run.
(b) The ranges shown are the minimum and maximum of the range measured during operation in TK-01. See Appendix D for time traces of temperature for each run.
(c) The ranges shown are the minimum and maximum of the flow rate for each target flow measured by FM-02. In general, control was more precise (well within ±1 mL min^{-1}). See Appendix D for time traces of flow rate for each run.

5.2 Run Operation

This section outlines the typical steps performed in conducting the six experimental runs outlined in Table 5.2. Each run consisted of four elements:

1. Preparation (as required) of the simulant and loading it into the test system.
2. Preparation of the experimental system and startup activities.
3. Operation and data collection at the target conditions.
4. Shutdown of operations and post-test observations

Of these four elements, the first two preparation steps sometimes occurred simultaneously in practice, but both were completed before proceeding to run operation. The following subsections provide additional details of these elements; when applicable, operational steps specific to a subset of the four tests are described.

For convenience, most equipment and instruments are referred to by their identifiers as shown in Figure 3.5 and Figure 3.6. In all significant aspects, run operations were very similar to what is described in Schonewill et al. 2021. However, because some details were refined or different, the processes are summarized in the following sections.

5.2.1 Simulant Preparation and Loading

Before a run was started, the corresponding batch of simulant that was prepared by NOAH Technologies had to be received, sampled, and loaded into the test system. These steps often occurred at the same time as other preparation activities, such as CST washing and loading (prior to Run W-01) and filling/de-gassing the DEF and IXC with 0.1M NaOH, since different parts of the system were involved; the simulant loading primarily involved the TK-01 and recirculation loop. The general steps involved with simulant preparation and loading were:

- Receive the simulant batch from NOAH Technologies into PDLE and examine for abnormalities. The batches were shipped in IBC totes of 330-gal maximum capacity.
- Collect as-received samples from the simulant tote for future analysis. The chemical analyses are described in Section 4.2.3.1.
- Prepare the tote contents for transfer into TK-01; if time permitted, the tote was allowed to settle undisturbed for several days to minimize suspended solids in the supernatant. As noted in Section 4.2.2, upon arrival at PDLE, every tote had some observable solids that fell out of solution during shipping.
- TK-01 is a 275-gal IBC tote and could not accept the entire volume contained in the simulant totes (which were 330-gal IBC totes with 300 gal of simulant). Once the shipped tote was ready for transfer, it was pumped into TK-01 using a 1-in. air-operated diaphragm pump. The inlet to the pump ended in a polyvinyl chloride lance that was used to extract simulant through the 6-in. port on the top of the tote. Pumping was performed with care to avoid sending settled salts into TK-01; in practice, this was not always accomplished (see W-01 and W-02 in Table 5.2).
  – TK-01 was usually filled with simulant to approximately 75% full initially (~200 gal), and the system was put into recirculation mode. In the standard recirculation mode, the return line to TK-01 terminates in a pivot nozzle mixer to prevent particles from becoming stationary on the TK-01 bottom.

- While in recirculation, the appropriate trim solids were added and mixed for 30 min (Table 4.2). This was done with the valve going to the DEF feed line closed (recirculation system was isolated from the rest of the system).
- The volume limitations in TK-01 meant that during each run, the remaining volume of simulant (usually 75 to 80 gal) had to be added to it partway through the run. This was done with the system in recirculation mode. The remainder of the simulant was pumped to TK-01 using the air-operated diaphragm pump and a lance. Once the material was transferred, the mass of simulant added to TK-01 was used to compute the trim solids needed to bring the TK-01 contents back to the target solids loading for that run.
- Tests W-01 and W-05 were two-phased (parts "A" and "B"), with different solids loading targets. Upon completion of the first phase (W-01A, W-05A), processed simulant was pumped back into the system to dilute the solids content to a new, lower target value and trim solids were adjusted accordingly. The processed volumes were selected to achieve the targets listed in Table 5.2.

- Once TK-01 was loaded, the recirculation loop continued to run, bringing feed material to the target temperature of 22 ± 1 °C using HX-01. This took a couple of hours, depending on the starting temperature of the simulant.
- Feed verification samples were collected from the recirculation system – usually at V-02 – after loading was completed and contents had been recirculating for at least 30 min. These samples were used to estimate solids loading, PSD, density, viscosity, and chemical composition of simulant as discussed in Sections 4.2.3 and 4.2.4.

Once these steps were completed, the simulant in TK-01 was ready for processing in the run. The recirculation loop was run continuously to agitate the contents and provide thermal control until the system was ready to commence with normal operations. Generally, the system was prepared for operation prior to the loading and preparation of simulant.

5.2.2 System Preparation and Startup

Prior to beginning the experimental campaign, the system was filled with water without CST in the IXC and operated to evaluate system readiness (no leaks, instrumentation was working, target pressure could be achieved, etc.). The column was loaded with CST before Run W-01 after it was conditioned with 0.1 M NaOH. Additional details on these preparation steps are provided in Section 5.2.2.1. Note that the CST bed was left in place for the entire experimental program; other than confirming that the bed was resettled to the correct level, no other CST handling was performed. After loading the column with CST, the column was flushed with 0.1 M NaOH solution using PMP-02 with the column effluent directed to tank TK-03. Flushing was conducted until the effluent was visually clear with no fines. After flushing, flow was redirected through a capture filter (FLT-01A or FLT-01B) to the flow controller (FM-02/V-24) and the system was ready for normal operations.

5.2.2.1 CST Preparation and Loading

Dry "as-received" CST media, IONSIV R9140-B (UOP LLC, Lot No. 805602-999), was provided by WRPS[1] and is from the same CST lot used in the previous CST drying study (Gauglitz et al. 2019) and TSCR high solids testing (Schonewill et al. 2021). Before Run W-01, the CST was conditioned and washed using 0.1 M NaOH solution prepared from 50 wt% NaOH stock solution (Sigma-Aldrich, Product No. 415413, Batch No. MKCL3081) and distilled water; conditioning was conducted to mimic the conditions expected for CST used in the planned full-scale column following the approach used by

[1] Now Hanford Tank Waste Operations & Closure (H2C).

Gauglitz et al. (2019). For initial contacting, a volume of 0.1 M NaOH that was approximately twice the bulk volume of CST was added to a container with the CST. The slurry was gently mixed and then the supernatant liquid with suspended fines was removed by decanting. This washing and decanting was conducted three times, then the wet CST was soaked in 0.1 M NaOH for at least 24 h.

Prior to W-01, the washed, wet CST was slowly added to the column, which was filled with 0.1 M NaOH, using a small scoop. The CST particles were allowed to gravity-settle through the column of liquid to form a settled bed. This slow addition of small quantities of CST allowed any entrained gas bubbles in the CST to be released. Periodically, the column was tapped on the side with a rubber mallet to help settle the bed. Once the column was loaded with CST to a bed height of ~92 in., the inlet distribution ring and screen were inserted so that the VEE-WIRE was at a target height of 92.75 in.

5.2.2.2 Flow Test with 0.1M NaOH

Typically, the system was also re-evaluated with water before each subsequent individual run (W-02, W-03, etc.) to confirm system cleanliness (e.g., no fines leaving the column, differential pressure data was as expected), resettle the CST bed, and evaluate the DEF recovery from post-run operations that occurred in the run prior. After the system was evaluated with water, it was drained and then filled and flushed with 0.1 M NaOH, including flushing the lines to the differential pressure transducers. At this point, the system pressure was increased to the nominal operating pressure of ~60 psig and the zeros on the differential pressure transducers were checked and adjusted if needed.

The next step was to conduct a flow test with 0.1 M NaOH at the target flow rate of 130 mL min^{-1} and record data from the system. (The differential pressure data was of the most significant interest.) In some runs, the 0.1 M NaOH flow test was also performed with other flow rates, particularly if other flow rates were planned during the run, e.g., 91 or 195 mL min^{-1}. After conducting the baseline flow test with 0.1 M NaOH solution, the DEFs, IXC, and all associated process lines were left laid up with 0.1 M NaOH until normal operations for the run began.

5.2.3 Normal Run Operations

For each run, following the preliminary flow test, "normal" operations involved processing simulant at the target flow rate through one of the DEFs and IXC-01, monitoring their differential pressure response, and performing filter swaps/backflushes when the appropriate criteria were reached. The system was operated continuously at the target flow rate using a flow controller (FM-02/V24, a flow meter paired with an actuated valve). While the system was in a normal operating mode, instruments were monitored for signs of instability or system upsets and data was recorded by hand nominally every half hour; timelapse data (every 20 s) for temperature, differential pressure, and flow rate readings were also captured for each test. Samples were collected periodically as outlined in Appendix B without interrupting normal operations.[1]

The feed tank (TK-01) temperature was controlled by manually adjusting the setpoint temperature on the HX-01 water bath as needed to maintain it at 22 or 16 °C, depending on the run parameter. The feed pump PMP-01 was typically run at a fixed speed for the entire test period with only minor adjustments made to backpressure regulator BPR-01 to keep the pressure ≥ 55 psig and the recirculation flow rate at ≥ 4 gpm. For most of the run, the pivot nozzle mixer was in use (V-51 open, V-52 closed) until the level

[1] Sample collection was often accompanied with a spike in differential pressure (due to the short-term increase in flow rate as the sample container was filled). Most of the time this effect was transient and the values readily returned to their prior values, but in some cases a portion of the differential pressure increase from the spike remained.

in feed tank TK-01 became low. At low level, the valves were reversed (V-51 closed, V-52 open) to avoid aspiration/air entrainment into the suction of PMP-01. Visual observations of the TK-01 contents were made periodically to assess vessel mixing, although this was not reliable due to the opacity of the simulant.

The filters were swapped based on criteria during each run. When a swap occurred, the DEF that was on standby and laid up with 0.1M NaOH was brought online first, and then the DEF that had been active was isolated from the system. The target swap criterion (that mimics the TSCR and 200W PM approach) of a 2-psid increase was only applied in the beginning of run W-01A, and the swap criterion was changed to a 5-psid increase ~60 h into the run. This was reduced to a 3-psid increase ~60 h into run W-01B. The criterion was once again adjusted to account for challenges faced in run W-02. For W-02, the swap differential pressure was changed to a 25-psid increase – with a maximum absolute value of 32 psid, the highest differential pressure for which the sensors were calibrated. A differential pressure increase criterion of 2 psid was sufficient for subsequent runs W-03 through W-06. To restore DEF performance, 2-h 0.1 M NaOH soak times were performed for every run except W-02, which had an average soak time of 1.04 h.

Once the filters were swapped, the previously active filter was backflushed using nominally 0.5 L (TK-05) of 80 psig air for test runs W-01 through W-03, and nominally 1.5 L (TK-05A and TK-05B) of 80 psig air for test runs W-04 through W-06. Flushed simulant with solids was sent to TK-03 using the compressed air and then the filter was filled with 0.1 M NaOH using PMP-02 from TK-02. The fill was determined to be complete upon collection of the solution out of the shell-side and tube-side bleed-vents. Once full, the filter was soaked for nominally 2 h (except for in run W-02, where more frequent swapping decreased the soak times) and backflushed again. After being refilled with 0.1 M NaOH a second time, the backflushed filter was recharged and ready for use again. No plugging or effluent holdup to TK-03 was observed during backflushing.

Other routine activities during normal operations involved swapping the guard filter between FLT-01A and FLT-01B to maintain the target flow rate, checking tank levels, and repositioning T-01 (which measured feed tote temperature) in TK-01 as the simulant level dropped. Notable non-routine or off-normal activities are described in Section 5.3. TK-02 was periodically refilled with pre-made batches of 0.1 M NaOH from 5-gal carboys as needed. TK-03 and TK-04 contents were occasionally transferred to larger holding vessels as they became full. The system was operated in this manner until the amount of simulant remaining in TK-01 was approaching the level of the PMP-01 suction line. Once feed was no longer provided to the system, the normal operating mode was complete.

5.2.4 Test Shutdown and Post-test Activities

Following the completion of a test run, DEFs and the recirculation loop were isolated, and VFD-01 and HX-01 were turned off. All differential pressure gauges were isolated, and the previously active filter was backflushed. Whichever filter was the last to be active was backflushed using the standard protocol to put the filters into the same state at the end of the test. In the cases of runs W-01 and W-05 (which had two parts), the system was put in recirculation between part “A” and “B” instead of being shut down. Processed simulant was pumped into TK-01 and, as applicable, trim solids were added and temperature setpoints were achieved before restarting operations for part “B.”

The IXC and DEFS were drained, and if it was judged necessary, dried using house air (a column blowdown). This was done using FM-03 at a controlled rate of 5.8 standard liters per minute for approximately 1 h. Between tests, the top flange of the IXC was removed, and the bed height inspected. If the level was lower than the target 92 in., CST was added to reach the target bed height. Recall that CST media was not exchanged between runs – the same bed was used for all six runs. Following the completion of a simulant test run, TK-03 and TK-04 were emptied, and TK-01 was rinsed with process water.

If data collected during a run indicated anything unusual or unexpected, system components were examined or removed for inspection. Unexpected occurrences were observed in two runs: W-01 and W-02. These occurrences and other off-normal events are described in the next section.

5.3 Notable Non-routine or Off-Normal Occurrences

During the experimental program, some events required non-routine actions (or were notable for being off-normal/unexpected). These include the following:

1. Prior to run W-01, the recently calibrated instrument DP-05 started to behave erratically and ultimately became unresponsive. It was removed from service before W-01. After examination, it appeared to be damaged and unable to be repaired. A replacement instrument was ordered, but it was not available to be calibrated and installed in the system until run W-04. Therefore, there is no data from the DP-05 instrument for W-01, W-02, and W-03.
2. There was a shift in pressure drop response for DEF-01 and DEF-02 during W-01A after the S1 remainder was added to TK-01. Given the appreciable amount of precipitated solids in the S1 tote, it was suspected that some solids were entrained during transfer to TK-01, which increased the "effective" solids content in the feed to the system. The total solids content data reflects this suspicion (see Table 4.8 and Table 5.2). Although the DEF performance was impacted, the DEFs did not require any unusual actions during the run (or post-run cleaning).
3. Later during run W-01, entrapped air had to be removed from the system due to an erroneous backflush on the active DEF. Air had to be removed from the system because the flow meter FM-02 uses an ultrasonic technique and it could not accurately measure (and control) flow while air resided in the system. Removing air involved bleeding air from DEF-02 using V-17 and V-58 and from the system tubing using V-50, SV-02, and V-AUX. Further, V-50 was removed from the system and cleaned in an ultrasonic bath to remove CST media that plugged one of the vent lines during the backflush event. While the degassing was performed, the system was either in recirculation mode or briefly shut down. This caused a data gap in the time series for the W-01B data set and influenced one of the differential pressure curves for DEF-02.
4. As noted in Section 4.2.2, the W-02 simulant (S2) had a different visual appearance and was difficult to filter throughout the run. This occurred despite passing the material through a ~10-micron cloth filter on the discharge line of the diaphragm pump while the S2 liquid was being loaded into TK-01. Excessive pressure drop (>>2 psid) across DEF-01 and DEF-02 occurred throughout run W-02, suggesting significant fouling of the filters, and backflushing was only minimally effective in restoring performance with each cycle. Because of this, the second trim addition of solids was not performed. After W-02 was completed, the standard post-run actions were taken (Section 5.2.4), but the differential pressure of both filters was found to be elevated well above their baseline values. Additional rinsing and backflushing with 0.1M NaOH did not correct this.

   To remedy the fouling and restore the baseline differential pressure, DEF-01 and DEF-02 were acid-cleaned sequentially using 2.0 M HNO_3 and 0.5 M oxalic acid. To do this, the DEFs were drained and then rinsed with distilled water until a pH < 8 was measured with pH indicating strips. Then, the DEFs were filled with 2.0 M HNO_3 and soaked for nominally 2 h. After the acid soak, filters were backflushed with distilled water and rinsed until a pH > 6 was measured. This process was repeated using 0.5 M oxalic acid. The acid cleaning successfully restored the DEF baseline differential pressure.

5. It was found that DEF-02 in the LS2 configuration had a considerably higher measured differential pressure during the 0.1M NaOH flow test than the LS1 DEF-02 (~3 vs. ~0.5 psid at 130 mL min^{-1}); DEF-01 was nearly unchanged between LS1 and LS2 (both ~0.5 psid at 130 mL min^{-1}). Troubleshooting was performed to identify the cause (in case the elevated pressure was resulting from pinched differential pressure lines, plugged frits, etc.), but nothing substantial was identified prior to starting run W-04. Since the most critical data is the change in differential pressure over time, the discrepancy is noted here, but it was not anticipated to affect interpretation of the DEF-02 data in Runs W-04, W-05, and W-06.

Note that planned configuration updates made as part of changing from the LS1 to LS2 configuration are covered elsewhere (Section 3.1).

6.0 Performance Data and Results

This section presents and discusses the data collected from each test. First, the results from the baseline (0.1M NaOH) flow measurements for all tests are presented in Section 6.1. Then, each test is discussed separately in the same order as presented in Table 5.2: W-01A (Section 6.2.1), W-01B (Section 6.2.2), W-02 (Section 6.3), W-03 (Section 6.4), W-04 (Section 6.5), W-05A (Section 6.6.1), W-05B (Section 6.6.2), and W-06 (Section 6.7). The final section (Section 6.8) draws comparisons across all tests and summarizes overall test performance.

Narratives for each test run are not included in this section; rather, Appendix B contains a timeline of events that occurred during each run. The timelines highlight the major activities, including sample collection, that occurred during each run. Appendix C contains tables of data collected manually by the test operators that are used to perform the assessments in this section. Appendix D includes time series of operating data that are not presented (or discussed) in the subsections below. Finally, comparison data is provided in Appendix E to allow for direct comparison between runs conducted on the LS1 and LS2 configurations and with run parameters (W-01A and W-06) across the two configurations.

6.1 Baseline Flow Data

Prior to the beginning of each test, a baseline flow measurement was taken before initiating flow of simulant into the system. The flow test occurred with the IXC loaded with CST, all differential pressure measurement lines filled with 0.1 M NaOH, all system lines downstream of SV-01 filled with 0.1 M NaOH, and differential pressure instruments' zero points checked and re-zeroed (as required). Before collecting data, flow of the 0.1 M NaOH solution was established in the system to ensure the system was clear of air.

In each baseline flow test, flow measurements were captured at 130 mL min^{-1}. For some tests, other flow measurements were taken and are presented for reference in Appendix E (Table E.12 through Table E.14). Plots of the baseline resistance and permeability organized by run and flow rate are presented for reference in Appendix E (Figure E.1 through Figure E.6). Feed pressure was controlled to nominally 60 psig during the flow tests. Using DEF differential pressure data, combined with other physical parameters and constants, initial membrane resistance ($R^{+}_{m,o}$) and baseline permeability ($\beta_{x,o}$) were calculated using expressions presented in Sections 3.3.3 and 3.3.4. Table 6.1 summarizes these results for all six runs, where the "Run" indicates the run performed after the 0.1 M NaOH flow test; therefore, W-01 data provides the resistance and permeability between HS3 performed for Schonewill et al. 2021 and W-01A. Note $R^{+}_{m,o}$ is dependent on the viscosity of 0.1 M NaOH (0.97 mPa·s at 22 °C) which is different from the simulant viscosities provided in Table 4.6. The viscosity difference between 0.1M NaOH and the simulant viscosity used in the subsequent normalized resistance (ω) calculated for each run shows up in that parameter as a ratio; this (effectively) normalizes filter performance to the 0.1 M NaOH viscosity.

Table 6.1. Summary of Baseline Flow Test Results with 0.1 M NaOH Solution at 130 mL min^{-1}

		Initial Membrane Resistance ($R^{+}_{m,o}$)		Baseline Permeability ($\beta_{x,o}$)			
Run	Configuration	DEF-01 (m^{-1})	DEF-02 (m^{-1})	DEF-01 (m^{2})	DEF-02 (m^{2})	IXC-01 (m^{2})	IXC-01 (Da)
W-01	LS1	5.28E+10	5.60E+10	3.00E-14	2.83E-14	2.53E-10	256.6
W-02	LS1	7.20E+10	8.19E+10	2.07E-14	1.38E-14	2.08E-10	210.8
W-03	LS1	8.71E+09	2.25E+10	1.82E-13	7.07E-14	2.08E-10	210.8
W-04	LS2	1.56E+11	8.40E+11	2.05E-14	3.81E-15	2.16E-10	218.7
W-05	LS2	1.21E+11	7.99E+11	2.65E-14	4.00E-15	2.10E-10	212.7
W-06	LS2	1.23E+11	7.66E+11	2.61E-14	4.18E-15	1.90E-10	192.4

The initial filter resistances vary significantly between W-01, W-02, and W-03, with DEF-01 consistently having less resistance than DEF-02.[1] The large decrease in resistance for W-03 compared to W-01 and W-02 is likely due to the additional cleaning step performed after W-02 as described in Section 5.3. Compared to HS3 from Schonewill et al. 2021, W-01 $R^{+}_{m,o}$ is ~3.4 times larger for DEF-01 and ~1.3 times larger for DEF-02. The increase in resistance between usage in 2021 to 2025 and the decrease in resistance between W-02 and W-03 show that filter performance is impacted by previous use parameters and reflects the variability in the post-test cleaning process as described in Section 5.2. This also highlights the importance of comparing filter performance using normalized resistances, such as defined in Eq. (3.7).

Overall, the initial resistance determined for the filters in the LS1 configuration is of a similar order of magnitude when compared with other data: the same system in previous testing (Schonewill et al. 2021), the quoted resistance (Allred et al. 2021), and the measured resistance in another system with the same filter media (Allred et al. 2021; Daniel et al. 2020). Considering the use of distinct cleaning protocols and different filter geometries (but the same media) across the cited references, an order of magnitude agreement is reasonable. The $R^{+}_{m,o}$ values returning to approximately the same value after each test, except for between W-02 and W-03, is anecdotal evidence that the simple cleaning procedures used were effective enough to return the filters to their initial performance.

W-02 was a special case because significant irreversible fouling was observed and acid cleaning was required to restore performance. The acid cleaning was very effective and likely removed other particles that had been deposited in prior runs but had not significantly impacted the measured initial filter resistances. For more information about W-02 solids, refer to the discussion of its solid properties in Section 4.2.4 and the uniqueness of that simulant described in Section 5.3, Item 4. Appendix E presents the various flow test data collected and illustrates the necessity for the acid cleaning after W-02.

The values of $\beta_{IX,o}$ are in good agreement across all six tests, and after W-01 they are narrowly distributed. It is possible that W-01 further compacted the CST bed compared to the initial loading in the column, although the bed height was not measurably affected. This result provides some confidence that the CST bed did not change significantly between tests via channeling or CST loss. For comparison, the filters have permeabilities that are three to four orders of magnitude smaller.

[1] This was also observed in Schonewill et al. 2021: DEF-02 had a slightly higher resistance than DEF-01 in all flow tests. The filters were unchanged and had not been used since that time.

It is instructive to compare the CST bed permeability to an empirical prediction. Bear (1972) provides such an expression:

$$\beta_{emp} = 0.617 \times 10^{-11}\left(d_{gd}\right)^2 \qquad (6.1)$$

where β_{emp} is in units of cm^2 and d_{gd} is the mean grain diameter in microns. Using d_{CST} in Eq. (6.1) yields a value of 314.3 Da for β_{emp}, which is roughly 45% higher than the average value from Table 6.1. The difference between the empirical prediction and the measured data is larger than was observed in Schonewill et al. 2021; however, Eq. (6.1) has a strong dependence on grain diameter and d_{CST} approximates that quantity. If, for example, d_{CST} is only 10% smaller, the predicted permeability and the column measurements are similar.

The pressure drop of the bed that was measured during the flow test was compared to the Kozeny-Carman equation (Kozeny 1927; Carman 1937, 1956) prediction from the formula:

$$\Delta P = \left[\frac{150\mu_o\left(\frac{Q_o}{A_{IX}}\right)h_{bed}}{d_{CST}^2}\right]\left[\frac{(1-\varepsilon)^2}{\varepsilon^3}\right] \qquad (6.2)$$

where ε is the packed bed void fraction. There is significant uncertainty as to the value of ε; Hamm et al. (2002) suggest a value of 0.50, but recent measurements suggest something closer to 0.67 (Fiskum et al. 2019). Eq. (6.2) is usually restricted for use at $\varepsilon < 0.5$, but for estimation purposes, values of 0.5 and 0.67 were used, resulting in ΔP values of 0.27 and 0.05 psid, respectively. Since the average pressure differential across the column was measured to be 1.93 psid, the results from Eq. (6.2) suggest that the actual void fraction is less than 0.5. Setting ΔP to 1.93 psid and solving Eq. (6.2) numerically results in an ε of 0.32, which aligns with the value of 0.34 determined in Schonewill et al. 2021.

Aside from the parameters derived from the baseline flow measurements, the measurements also established that the system was in a similar initial state as it had been in prior tests; consequently, data comparisons across tests are meaningful because they are starting from a similar base state.

6.2 Run W-01

Run W-01 was completed using the "S1" simulant with composition discussed in Table 4.1. W-01 was a two-part test that consisted of W-01A and W-01B. W-01B was conducted immediately after the completion of W-01A using the same simulant material and processing conditions. As noted previously (Section 4.2.2 or 5.3), it was suspected some solids were entrained from the as-received S1 IBC tote when the remainder of the liquid was pumped into the system partway through W-01A. This suspicion was confirmed by total solids content analysis conducted on samples from the system (Section 4.2.4.1, Table 4.8). The impact on filtration performance data with additional solids in the simulant persisted throughout the remainder of W-01A and W-01B.

6.2.1 Run W-01A

The goal of run W-01A was to gather baseline data of the system with a simulant and solids loading representative of the first feed batches that will be processed in the 200W PMs. Supernatant was decanted from the as-received tote into TK-01 and recirculated until it reached 22 ± 1 °C as measured by T-01, and the trim solids were added (see Table 4.2) to reach the desired loading of 130 ppm. During the W-01A test, the system was operated for approximately 117 h with a flow rate tightly controlled to the target (130.0 ± 1 mL min^{-1}), except for 6 outliers out of the 213 recorded data points, which resulted in a processed volume of ~240 gal. The temperature of the feed tank was also maintained tightly around the target (22 ± 1.1 °C). For the raw data collected during W-01A, see Appendix C, Section C.1 (Table C.1 and Table C.2) and for the time traces of flow rate, temperature, and system pressures, see Appendix D, Section D.1 (Figure D.1 through Figure D.4). The feed pressure to the system from the recirculation loop (P-02) was maintained at ~55 psig (recirculation loop controlled to ~62 psig). Flow was introduced to DEF-01 first, then alternated between DEF-02 and DEF-01 for every period thereafter. For the first four filter periods, the trigger point was 2 psid, but it was increased to 5 psid from filter period 5 and the subsequent periods to allow for adequate filter regeneration time.

The initial ΔP values are shown in Figure 6.1 for each filter period of W-01A, which provides the baseline for the trigger point pressure; there is an increasing trend in ΔP for both DEFs until period 19, after which the values return to be consistent with the differential pressures measured in the first few periods. Over the 117 h of operation, each filter was used 11 times. Figure 6.2 and Figure 6.3 show the ΔP evolution for each DEF period; only the first filter period (DEF-01) was able to run for a full 24-h period, with shorter subsequent filter periods. There was an increased rate of change in differential pressure after the S1 remainder was added to TK-01 partway through W-01A; this is evidenced by the more pronounced slopes for both DEF-01 and DEF-02 in later filter periods and can be directly observed in Figure 6.2 and Figure 6.3. The slope differences before and after the S1 remainder was added are detailed in Figure D.7. The normalized resistance data for the filters is shown in Figure 6.5. The resistance increased from the baseline resistance, $R^{+}_{m,o}$, by a factor of ~4 for the first three filter periods, then by a factor of between ~6 and ~9 for the subsequent periods. The data in Figure 6.1 and Figure 6.5 demonstrates that the DEFs did return to their initial performance level (ΔP after 10 min and initial ω with time do not significantly change) after each backflush and filter swap.

The differential pressure (DP-03) observed in the IXC (IXC-01) settled just under 6 psid during normal operation in W-01A and increased (very slightly) as the run progressed. This is aligned with the observed behavior in Schonewill et al. 2021 where the DP-03 pressures established around 5 to 6 psid and rose gradually over the course of the test; for more details see Figure D.4.

During run W-01A, the DEFs exhibited increased resistance after period 3. This was apparent by the gradually increasing initial differential pressure and decrease in filter period time, which also led to the decision to increase the trigger point pressure from 2 to 5 psid. The degradation in filter performance that occurred between periods 3 and 4 can be attributed to the second spike volume added to TK-01. Although the volume of liquid simulant added during the second spike was decanted from the as-received S1 tote that the first spike came from, Figure 6.6 shows the residual solids from that tote. A small fraction of these precipitated solids were likely mixed into the liquid during pumping; the net result was that solids loadings in excess of the target 130 ppm were introduced to the feed (refer to Table 4.8). Since the IXC had minimal differential pressure increase over the run time, this is further evidence that the DEFs can adequately filter solids at ≥130 ppm despite the introduction of unknown/unplanned solids added to the system.

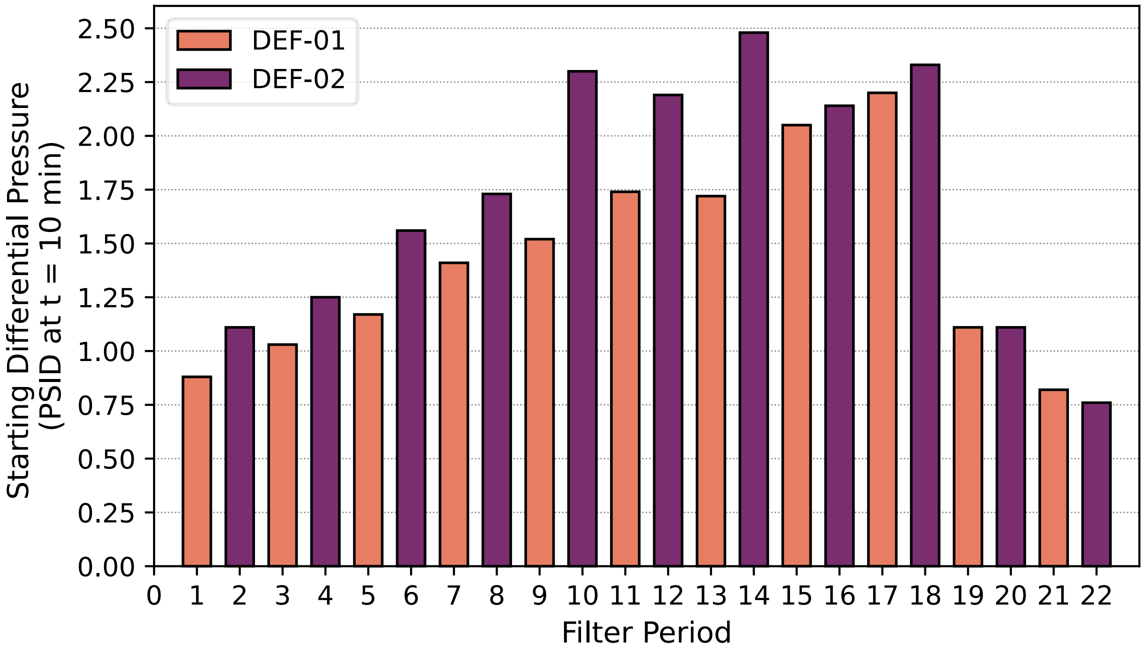

Figure 6.1. Starting differential pressure (psid at t=10 min) for each W-01A filter period.

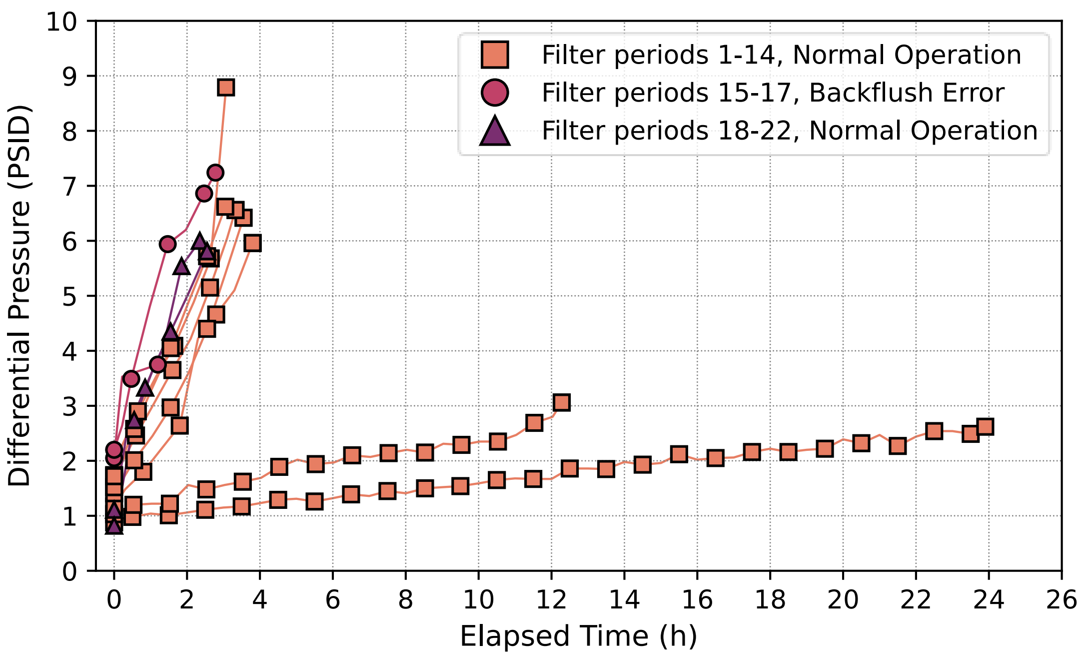

Figure 6.2. Differential pressure traces for each W-01A DEF-01 filter period.

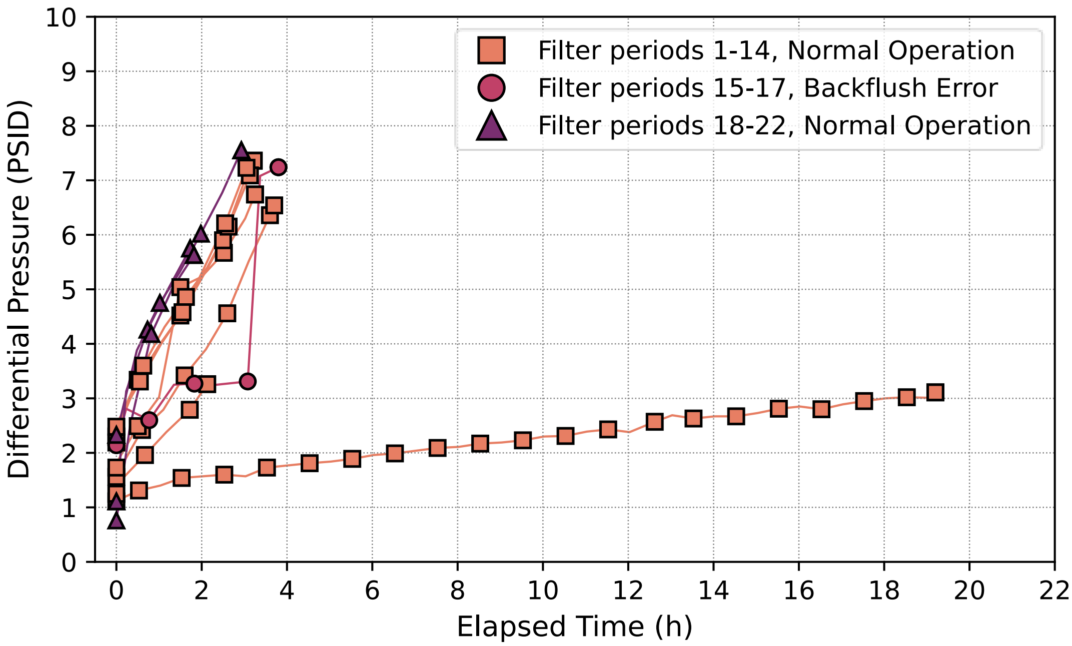

Figure 6.3. Differential pressure traces for each W-01A DEF-02 filter period.

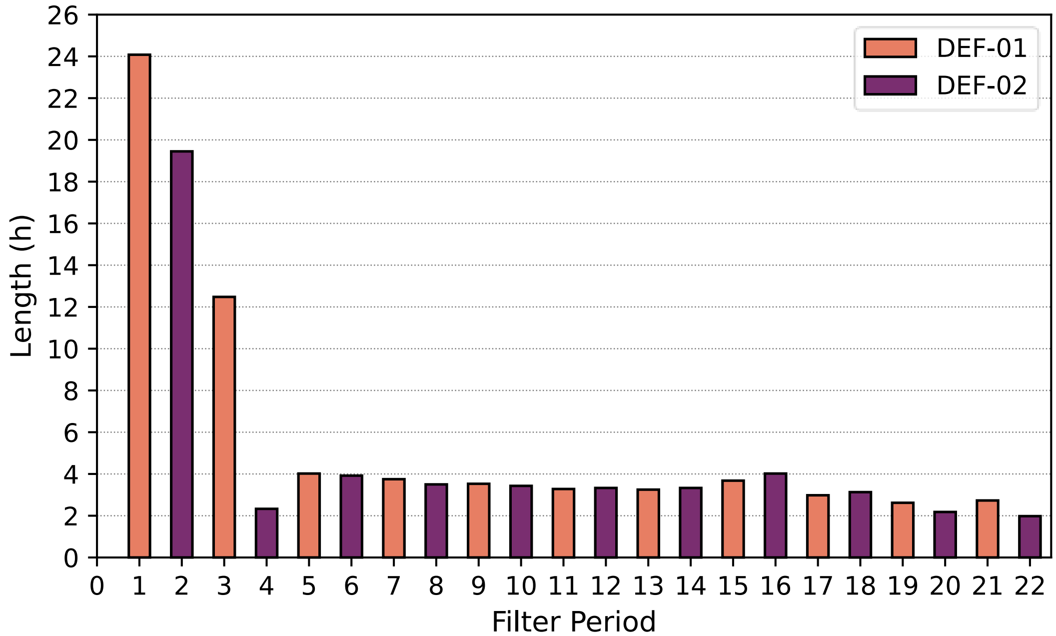

Figure 6.4. Filter period length (h) for each W-01A filter period.

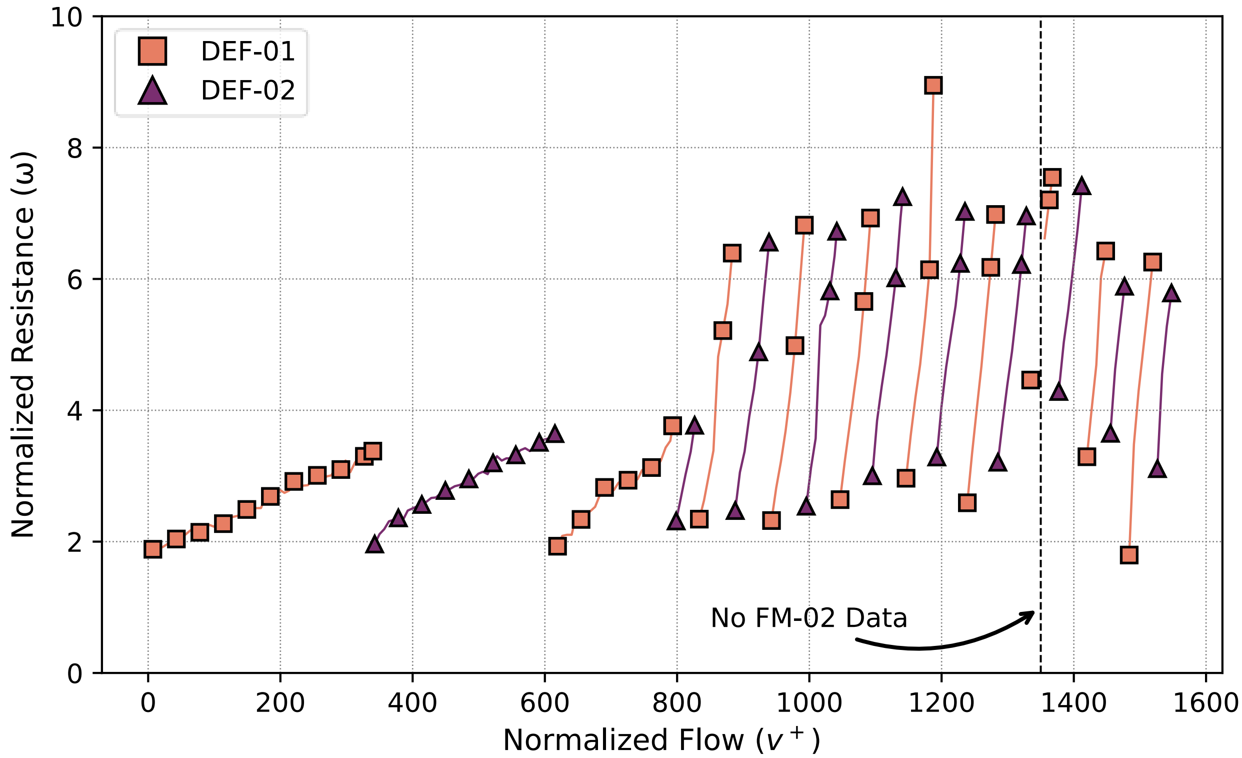

Figure 6.5. Normalized resistance (ω) over normalized flow (v^+) for each run W-01A filter period. Discontinuity during filter period 15 occurred due to a FM-02 malfunction (air bubbles were introduced into the system). Flow data for the end of filter period 15, entirety of filter period 16, and beginning of filter period 17 was not measured; discontinuity begins during filter period 15 and ends during filter period 17. No assumptions regarding flow rate during that period were made since it could not be accurately estimated. Consequently, total filtered volume was higher than indicated.

Figure 6.6. S1 IBC tote with residual solids.

6.2.2 Run W-01B

The goal of run W-01B was to determine performance at a diluted solids concentration and check for precipitation at 16 °C. Processed supernatant (filtered liquid from Run W-01A) was transferred from an effluent collection vessel into the feed tote (TK-01), which already contained ~30 gal of leftover 130-ppm simulant from W-01A, to achieve a total volume of 220 gal. The simulant was mixed and recirculated until it reached 22 ± 1 °C as measured by T-01; no trim solids were added to achieve the target concentration of 30 ppm – it was achieved by dilution. During the W-01B test, the system was operated for approximately 82 h with a flow rate tightly controlled to the target (130.0 ± 1 mL min^{-1}), except for 4 outliers out of the 151 recorded data points, which resulted in a processed volume of ~170 gal. The temperature of the feed tank was also maintained tightly around the targets; 22 ± 1.1 °C for filter periods 1-10 and 15 ± 1.0 °C for the remainder of the test. For the raw data collected during W-01B, see Appendix C (Table C.3 and Table C.4) and for the time traces of flow rate, temperature, and system pressures, see Appendix D (Figure D.8 through Figure D.10). The feed pressure to the system from the recirculation loop (P-02) was maintained at ~55 psig. Flow was introduced to DEF-01 first, then alternated between DEF-02 and DEF-01 for every period thereafter. Throughout the run, the trigger point was 5 psid, except for filter period 10, where the trigger point was lowered to 3 psid.

The initial ΔP values are shown in Figure 6.10 for each filter period of W-01B, which provides the baseline for the trigger point pressure; there is an increasing trend in ΔP for both DEFs until period 9, after which the values return to be consistent with the differential pressures measured in the first few periods. The change in trend after filter period 9 can be partially attributed to the change from 22 to 16 °C. Over the 82 h of operation, DEF-01 was used eight times and DEF-02 was used seven times. Figure 6.7 and Figure 6.8 show the ΔP evolution for each DEF period; a notable observation with Figure 6.8 is the backflush error that occurred during filter period 8 (DEF-02), where an incorrect valve configuration while cleaning DEF-01 led to a differential pressure change across the active filter.

The length of the filter periods decreased when the temperature of the feed was lowered from 22 to 16 °C, typically from ~7 to ~3.5 h (Figure 6.9). The slope differences due to temperature change are detailed in Figure D.14.

The normalized resistance data for the filters is shown in Figure 6.11. The resistance increased from the baseline resistance, $R^{+}_{m,o}$, by a factor of between ~6 and ~9 throughout the run. The data in Figure 6.10 and Figure 6.11 demonstrates that the DEFs did return to their initial performance level (ΔP after 10 min and initial ω remained ~1) after each backflush and filter swap. The backflush error is reflected in Figure 6.11 with a vertical dashed line; no assumptions regarding flow rate were made during that period.

The differential pressure (DP-03) observed in the IXC (IXC-01) settled at just under 6 psid during normal operation in W-01B. This is aligned with the observed behavior in Schonewill et al. 2021, where the DP-03 pressures established around 5 to 6 psid; for more details, see Figure D.11.

During run W-01B, the DEFs exhibited increased resistance as the run progressed, with resistance decreasing with lowered temperature but still following the same behavior. This was apparent from the gradually increasing initial differential pressure and the decrease in filter period time. The slight increase in filter ΔP rate that occurred between periods 9 and 11 can be attributed to the planned decrease in feed temperature. The IXC had minimal differential pressure increase over the run time and did not appear to be hydrodynamically impacted by the reduction in operating temperature.

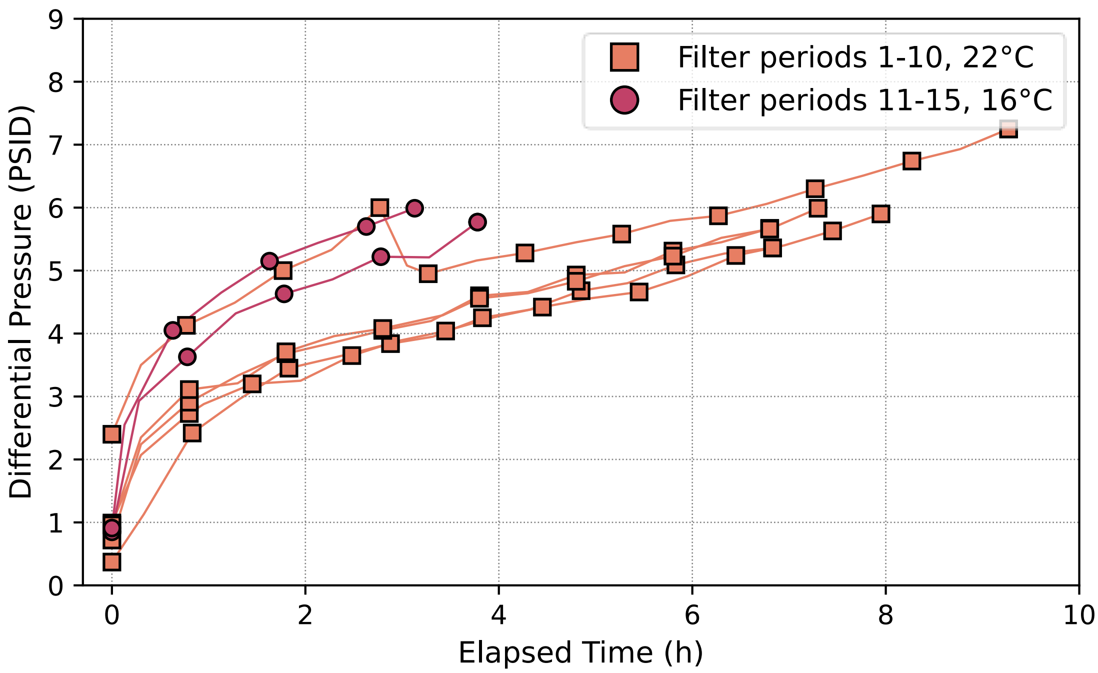

Figure 6.7. Differential pressure traces for each W-01B DEF-01 filter period.

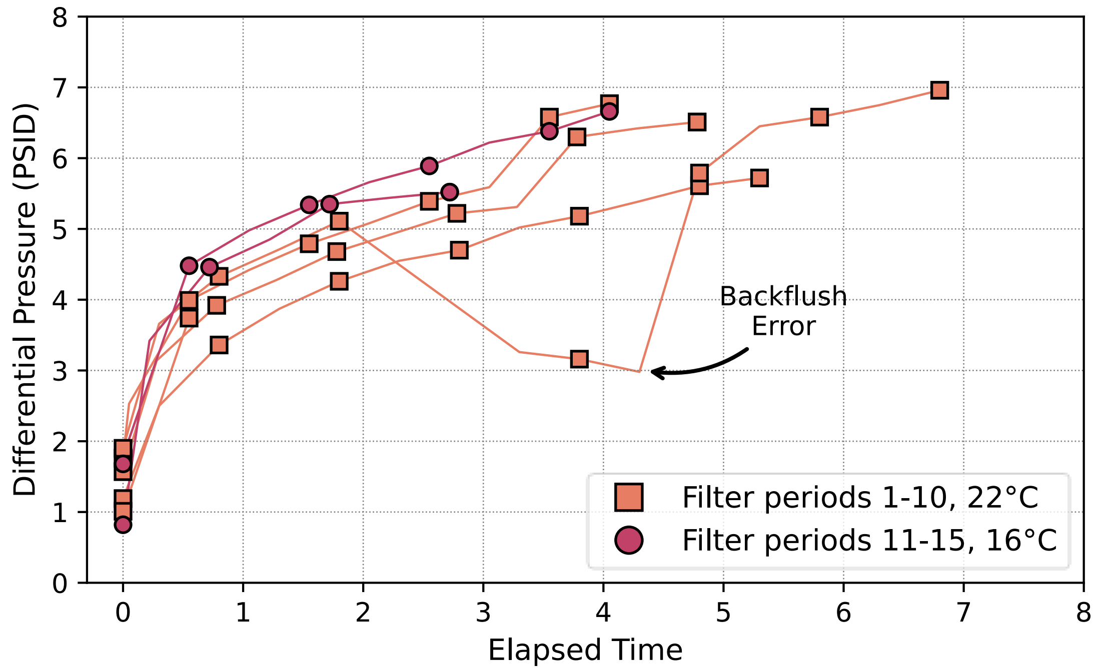

Figure 6.8. Differential pressure traces for each W-01B DEF-02 filter period.

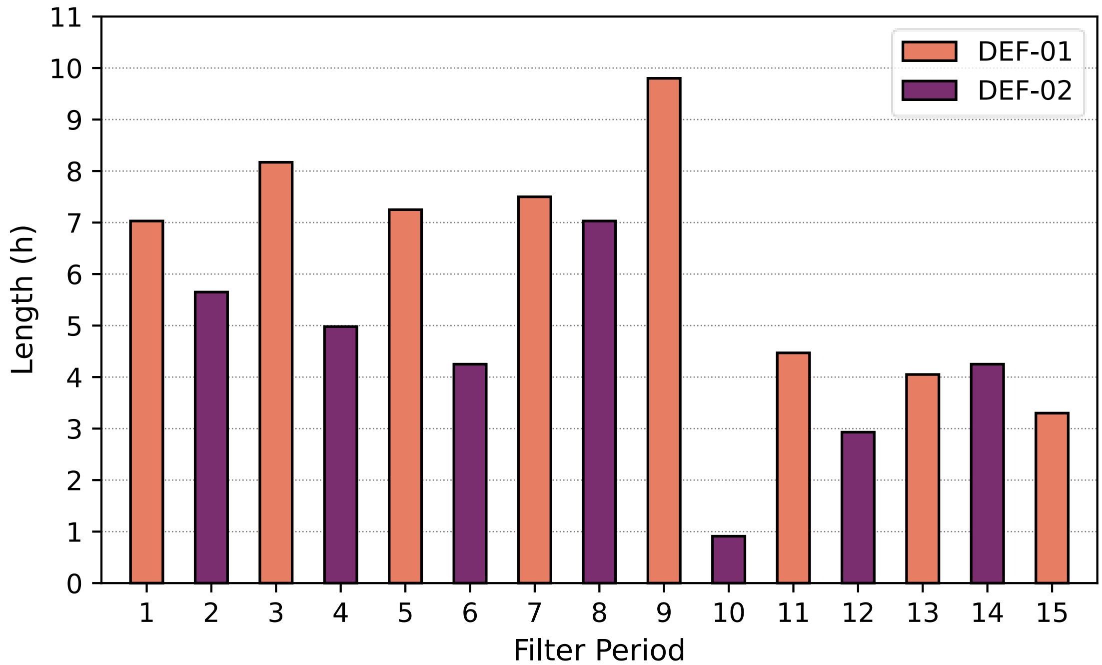

Figure 6.9. Filter period length (hours) for each W-01B filter period.

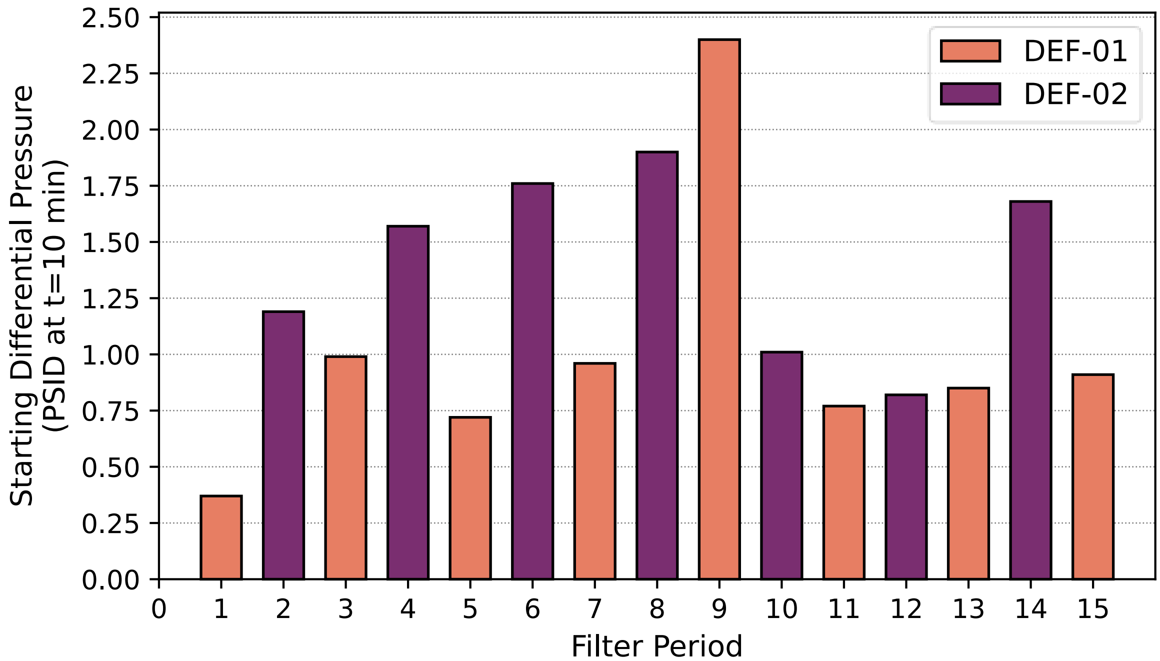

Figure 6.10. Starting differential pressure (PSID at t=10 min) for each W-01B filter period.

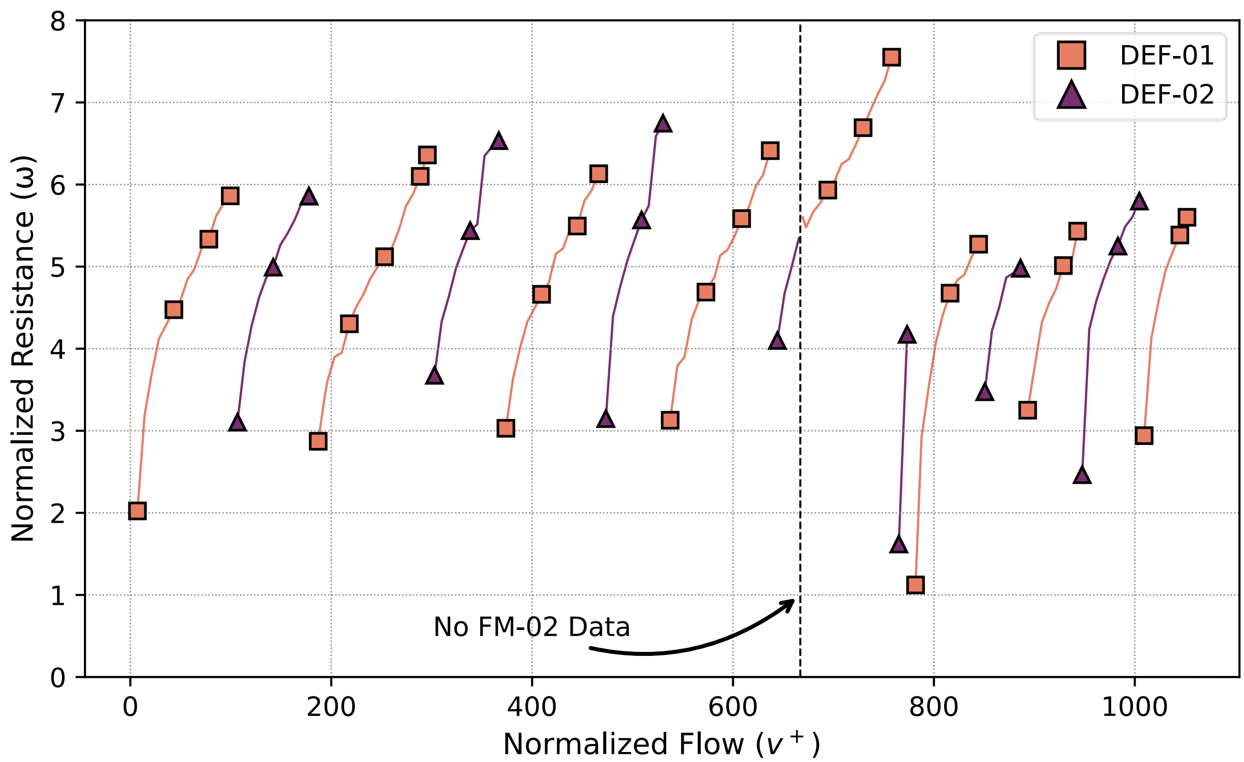

Figure 6.11. Normalized resistance (ω) over normalized flow (v^+) for each run W-01B filter period. There is no FM-02 data for a period between filter periods 8 and 9. No assumptions regarding flow rate during that period were made. Consequently, total filtered volume is likely to be higher than indicated.

6.3 Run W-02

The goal of run W-02 was to gather data on the system with varied flow rate. Supernatant was decanted from the as-received tote into TK-01 and recirculated until it reached 22 ± 1 °C as measured by T-01, and the trim solids were added (see Table 4.2) to reach the desired loading of 50 ppm. During the W-02 run, the system was operated for approximately 135 h with a flow rate tightly controlled to the targets (76.0, 90.0, and 130.0 ± 1 mL min^{-1}), except for 10 outliers out of the 347 recorded data points, which resulted in a processed volume of ~230 gal. The temperature of the feed tank was also maintained tightly around the target (22 ± 0.8 °C). For the raw data collected during W-02, see Appendix C, Section C.2 (Table C.5 and Table C.6) and for the time traces of flow rate, temperature, and system pressures, see Appendix D, Section D.3 (Figure D.15 through Figure D.17).

The feed pressure to the system from the recirculation loop (P-02) was maintained around ~55 psig (recirculation loop was controlled to ~80 psig). Flow was introduced to DEF-01 first, then alternated between DEF-02 and DEF-01 such that DEF-01 was the active filter for odd filter periods between 1 and 65, then even filter periods between 66 and 102. The change from DEF-01 as the active filter from odd to even periods at period 65 is due to a pause in the run for troubleshooting, which allowed for both filters to be cleaned at the same time. For the first two filter periods, the trigger point was 5 psid above the starting DP, then it was increased to 25 psid above the starting differential pressure for filter periods 3 through 65 and then increased to the maximum allowable absolute differential pressure of 32 psid. The change in trigger points was chosen to allow for more time between filter switches (to make operations practical while still allowing for some data collection); the secondary benefit was that it allowed more time to soak the filter in 0.1 M NaOH in between periods. Even though the trigger point was dramatically increased, a majority of the soak times and total contact time with the cleaning solution (0.1 M NaOH) remained shorter than the target soak time of 2 h (see Appendix D, Section D.3 (Figure D.19 and Figure D.20).

The initial ΔP values are shown in Figure 6.15 for each filter period of W-02, except filter period 66, where the differential pressure increased above the trigger point prior to the 10-min reading, which provides the baseline for the trigger point pressure. When flow rate is constant, there is an increasing trend in ΔP for both DEFs with an overall increase across filter periods 1 through 47 and 48 through 65; comparisons across filter periods 66 through 102 are not as apparent due to the short length of time that data was collected at constant flow rate. As expected, increased flow rate resulted in higher initial ΔP. Over the 135 h of operation, DEF-01 was used 52 times and DEF-02 was used 50 times. Figure 6.12 and Figure 6.13 show the ΔP evolution for each DEF period where, generally, lower flow rate corresponds to smaller slopes, allowing for more time to pass before triggering a filter period change. The slope differences are presented in more detail in Figure D.21.

The normalized resistance data for the filters is shown in Figure 6.16. The resistance increased from the baseline resistance, $R^{+}_{m,o}$, by a factor of ~30 to ~50, with smaller resistance increases occurring earlier within the run and at lower flow rates. The comparatively small max resistance of the first filter period was due to a 2-psid increase in trigger pressure for a backflush. This increased in subsequent periods. The data in Figure 6.15 and Figure 6.16 demonstrates that the DEFs' initial performance level (ΔP after 10 min and initial ω) gradually increased with each filter cycle after each swap and backflush at a fixed flow rate (for example, periods 1 through 47). After period 21, the amount of air used in the backflush was increased by allowing 80-psig air to continue flowing through the backflushed DEF for an additional 2 min. The increased air usage was observed to slow down (but not completely stabilize) the increase in the starting ΔP for the remainder of the run.

The differential pressure (DP-03) observed in the IXC (IXC-01) settled between ~4 and ~6 psid at 130 mL min^{-1} and decreased to ~2 to ~3 at lower flow rates. This is aligned with the observed behavior in Schonewill et al. 2021 where the DP-03 pressures established around 5 to 6 psid with flow rate of 130 mL min^{-1}; for more details see Figure D.18.

During run W-02, the DEFs exhibited increased resistance with higher flow rates and as the run progressed. This was apparent from the increase in initial ΔP over time at constant flow rate and the decision to increase the trigger point as the run time increased. The improvement in filter performance between filter periods 47 and 48 and the degradation in performance between filter periods 65 and 68 provide a clear and negative relationship between flow rate and filter performance for the type of solids present in S2. Although the volume of liquid simulant added was decanted from the as-received S2 tote, Figure 6.17 shows the residual solids from that tote. A fraction of these solids was likely mixed into the liquid during pumping (they passed right through a cloth filter); the net result was a solids loading in excess of the target 50 ppm (refer to Table 4.8). The nature of the added solids in W-02 made them particularly difficult to filter (see Section 4.2.4.3) and they were observed to be very small in size (Figure 4.3) and behave more like a colloidal gel when samples were examined. Again, the IXC had minimal differential pressure increase over the run time, so despite the challenges the DEFs experienced filtering the fine, colloidal solids in TK-01, they still performed their primary function of protecting the CST bed. As noted before, after W-02 was complete, the performance of the DEFs could only be restored with an acid cleaning protocol, which is described in Section 5.3.

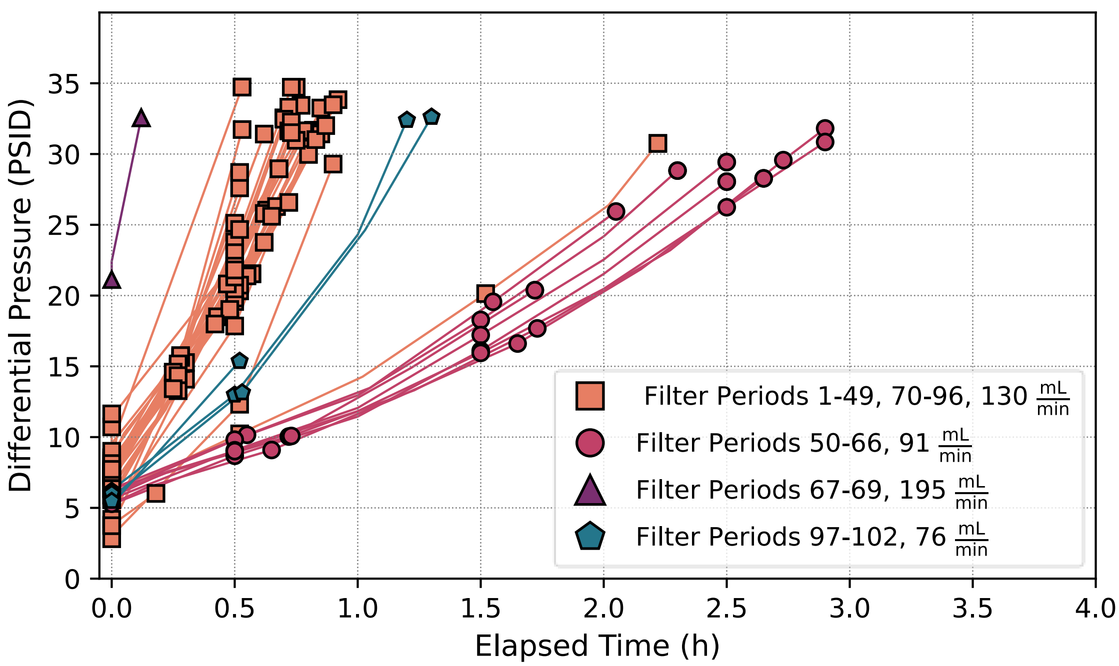

Figure 6.12. Differential pressure traces for each W-02 DEF-01 filter period.

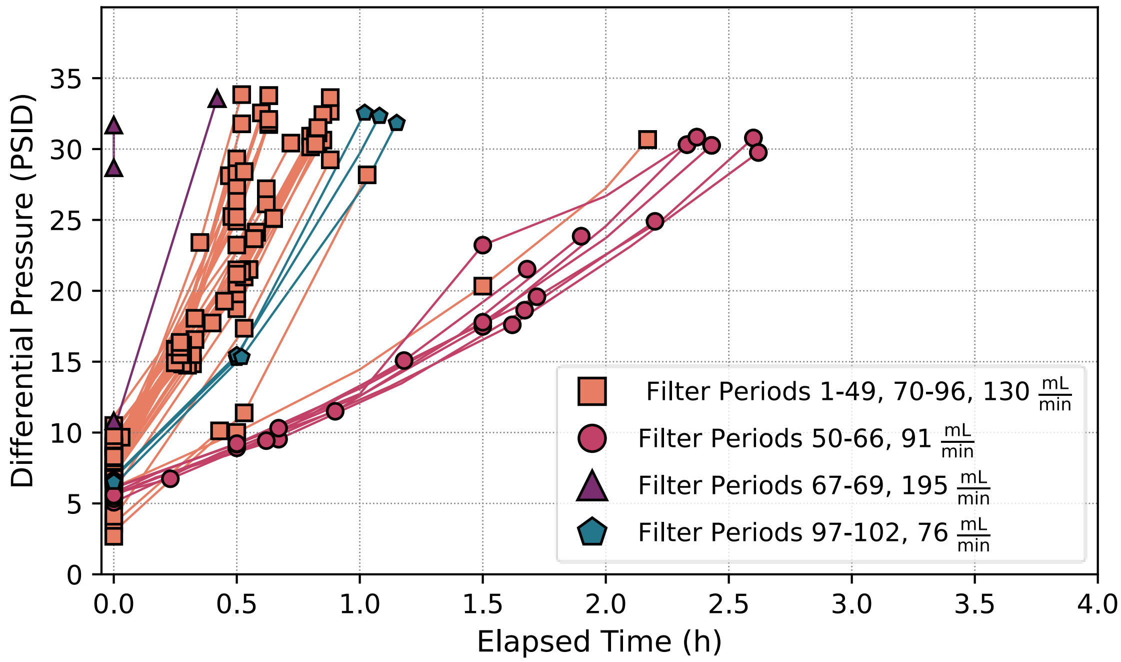

Figure 6.13. Differential pressure traces for each W-02 DEF-02 filter period.

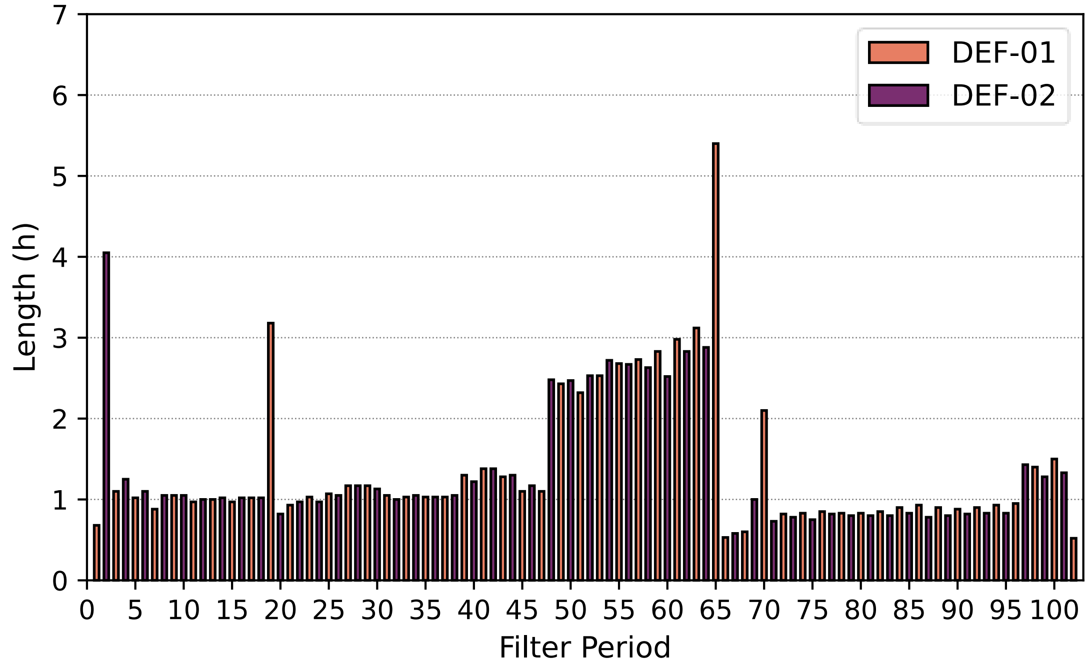

Figure 6.14. Filter period length (hours) for each W-02 filter period.

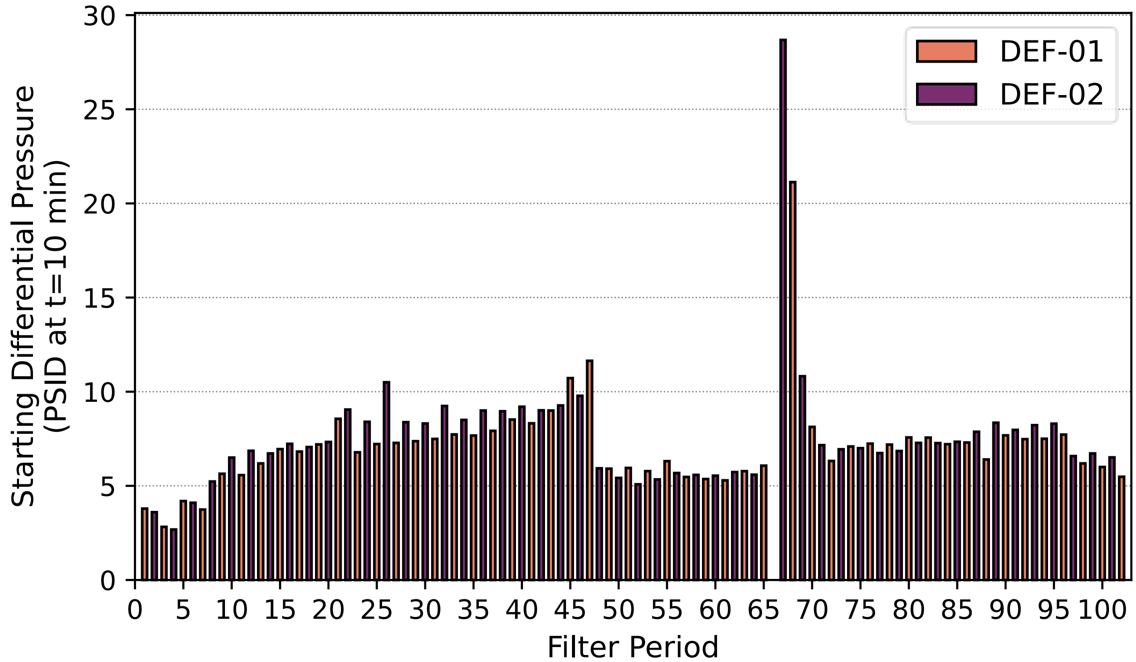

Figure 6.15. Starting differential pressure (PSID at t=10 min) for each W-02 filter period.

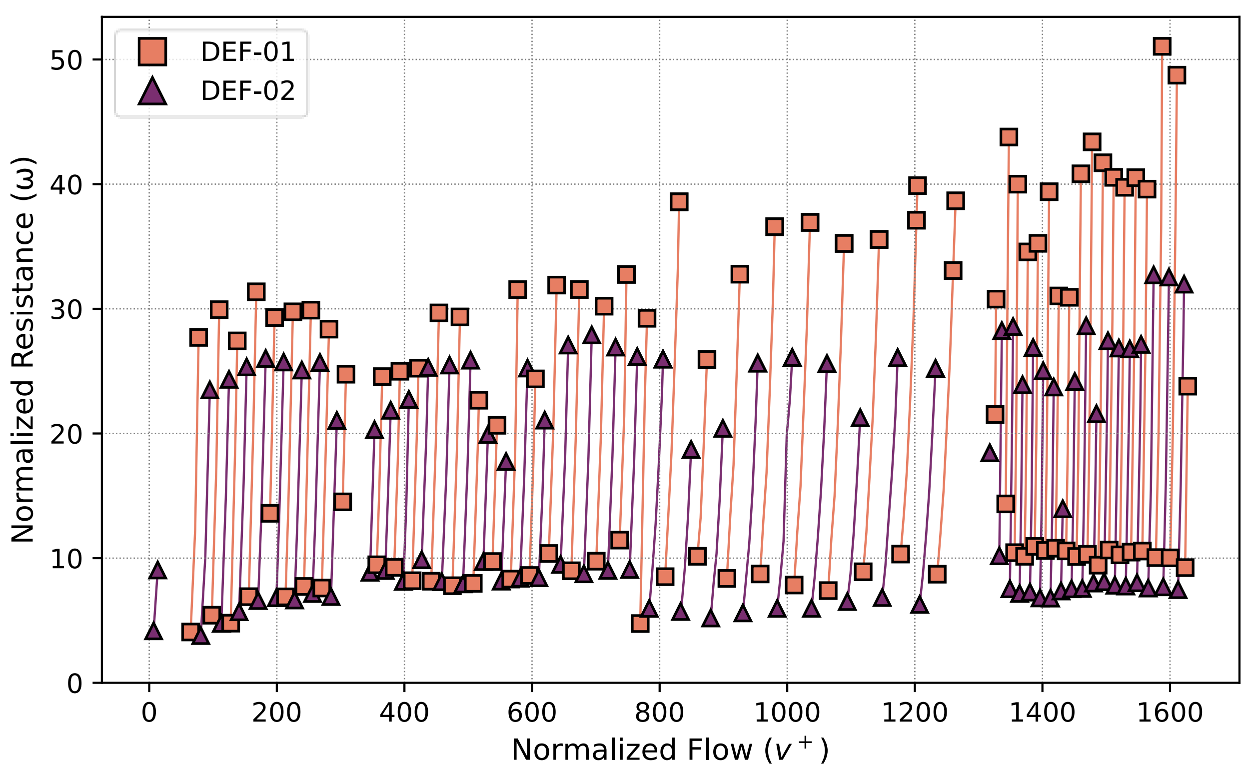

Figure 6.16. Normalized resistance (ω) over normalized flow (v^+) for each run W-02 filter period.

Figure 6.17. Simulant S2 as-received tote after transfer to TK-01.

6.4 Run W-03

The goal of run W-03 was to gather data of the system with varied flow rate. Supernatant was decanted from the as-received tote into TK-01 and recirculated until it reached 22 ± 1 °C as measured by T-01, and the trim solids were added (see Table 4.2) to reach the desired loading of 100 ppm. During the W-03 run, the system was operated for approximately 128 h with a flow rate tightly controlled to the targets (91.0, 130.0, and 195.0 ± 1 mL min^{-1}), except for 1 outlier out of the 262 recorded data points, which resulted in a processed volume of ~250 gal. The temperature of the feed tank was also maintained tightly around the targets (16 and 22 ± 1 °C). For the raw data collected during W-03, see Appendix C, Section C.3 (Table C.7 and Table C.8) and for the time traces of flow rate, temperature, and system pressures, see Appendix D, Section D.4 (Figure D.22 through Figure D.24). The feed pressure to the system from the recirculation loop (P-02) was maintained at ~55 psig. Flow was introduced to DEF-01 first, then alternated between

DEF-02 and DEF-01. Throughout the run, the trigger point pressure was set to the ideal trigger point of 2 psid.

The initial ΔP values are shown in Figure 6.21 for each filter period of W-03. As expected, increased flow rate resulted in higher initial ΔP: Filter periods 5 through 8 (195 mL min^{-1}) had an initial ΔP of ~0.6 psid and filter periods 1 through 4 (130 and 91 mL min^{-1}) had an initial ΔP of ~0.3 psid. Comparison of periods 9 and 10 (130 mL min^{-1}) to periods 1 and 2 (130 mL min^{-1}) provides evidence that the initial ΔP did not increase substantially with processing time; even though there was a difference in the rate of increase in differential pressure between these periods the DEFs started from a similar point after each backflush. Over the 128 h of operation, each DEF was used five times. Figure 6.18 and Figure 6.19 show the ΔP evolution for each DEF period, where, generally, lower flow rate corresponds to a smaller rate of change in ΔP. The slope differences are presented in more detail in Figure D.28.

The normalized resistance data for the filters is shown in Figure 6.22. The resistance increased from the baseline resistance, $R^{+}_{m,o}$, by a factor of ~33 with smaller resistance at lower flow rates. Note the decreased resistance of DEF-02 across filter periods. Initial resistance returned to a similar value across periods, indicating successful filter recovery. Interestingly, although Run W-03 had a much lower increase rate in differential pressure for the DEFs, the observed normalized resistance is not dissimilar from W-02. This demonstrates how normalization accounts for differences in viscosity (S3 is less viscous than S2) and DEF cleanliness (the filters were acid cleaned after W-02).

The data in Figure 6.21 and Figure 6.22 demonstrates that the DEFs did return to their initial performance level (ΔP after 10 min and initial ω with time do not significantly change) after each backflush and filter swap. The differential pressure (DP-03) observed in the IXC (IXC-01) settled between ~2 and ~6 psid with a positive relationship between flow rate and differential pressure. This aligns with the observed behavior in Schonewill et al. 2021, where the DP-03 pressures established around 5 to 6 psid with flow rate of 130 mL min^{-1}; for more details, see Figure D.25.

During run W-03, the DEFs exhibited increased resistance with higher flow rates and as the run progressed. Although the total solids content data (Table 4.8) indicates that the target solids loading was achieved in W-03 with the trim solids and was "constant" over the run, a very small amount may have been added when the S3 remainder was pumped into TK-01 (this occurred right before running at 195 mL min^{-1}) and contributed to a larger increase in slope at that flow rate. When the flow rate was returned to 130 mL min^{-1} in periods 9 and 10, the slope remained elevated compared to periods 1 and 2; however, it is difficult to untangle this from the effect of running at 16 °C and the possible precipitation of solids. Regardless, the W-03 simulant remained well within the capability of the DEFs, and that reliably protected the IXC over the entire run.

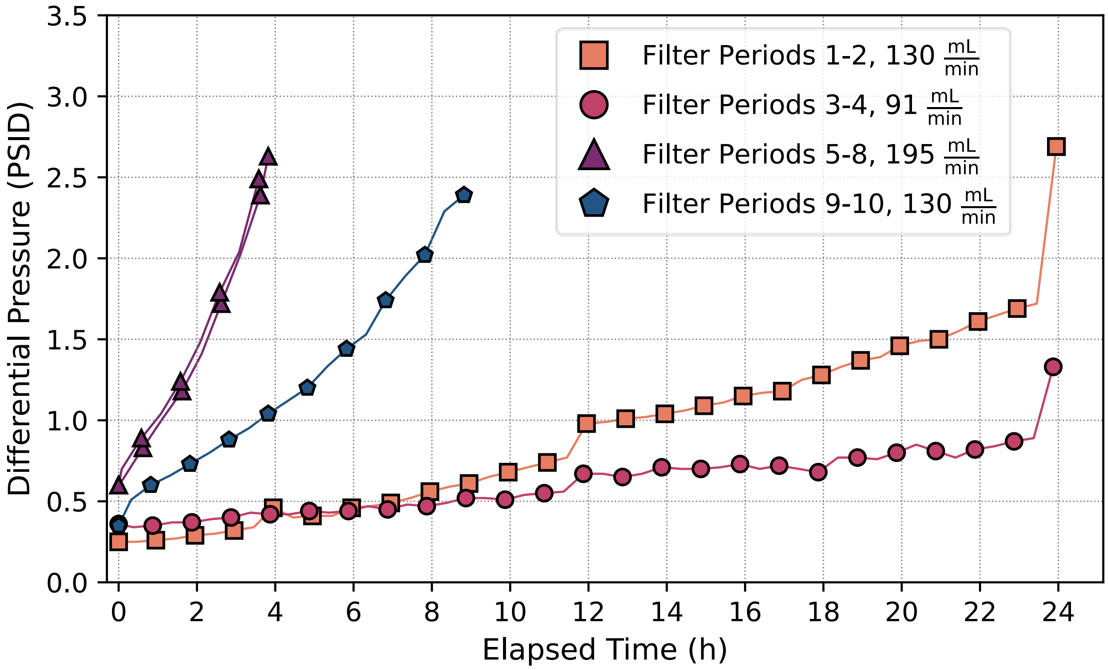

Figure 6.18. Differential pressure traces for each W-03 DEF-01 filter period.

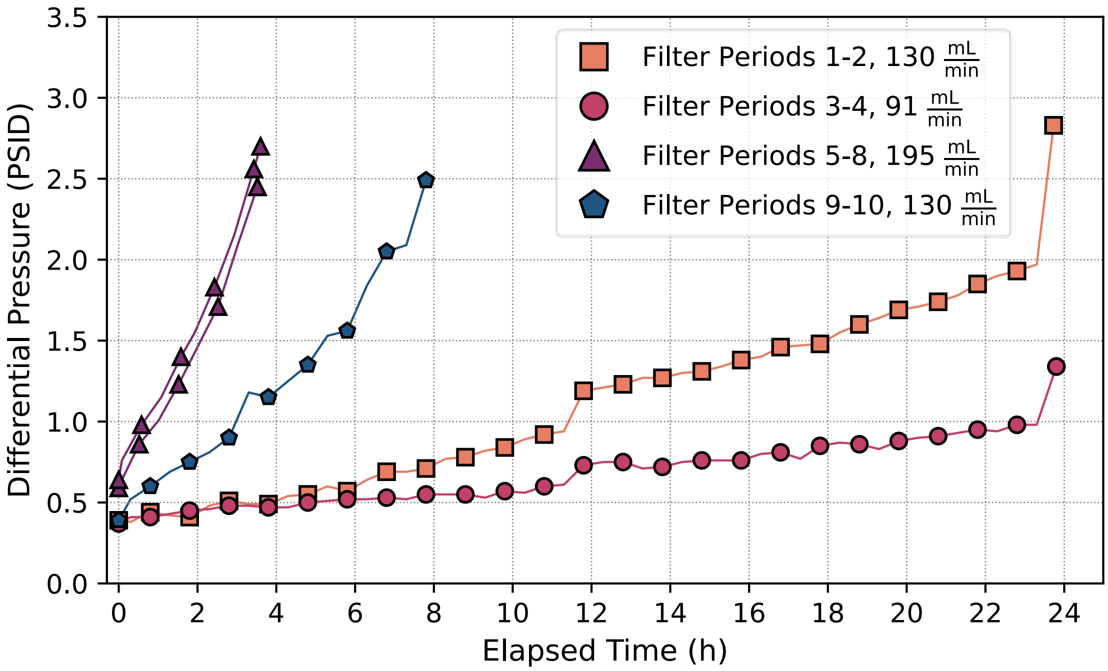

Figure 6.19. Differential pressure traces for each W-03 DEF-02 filter period.

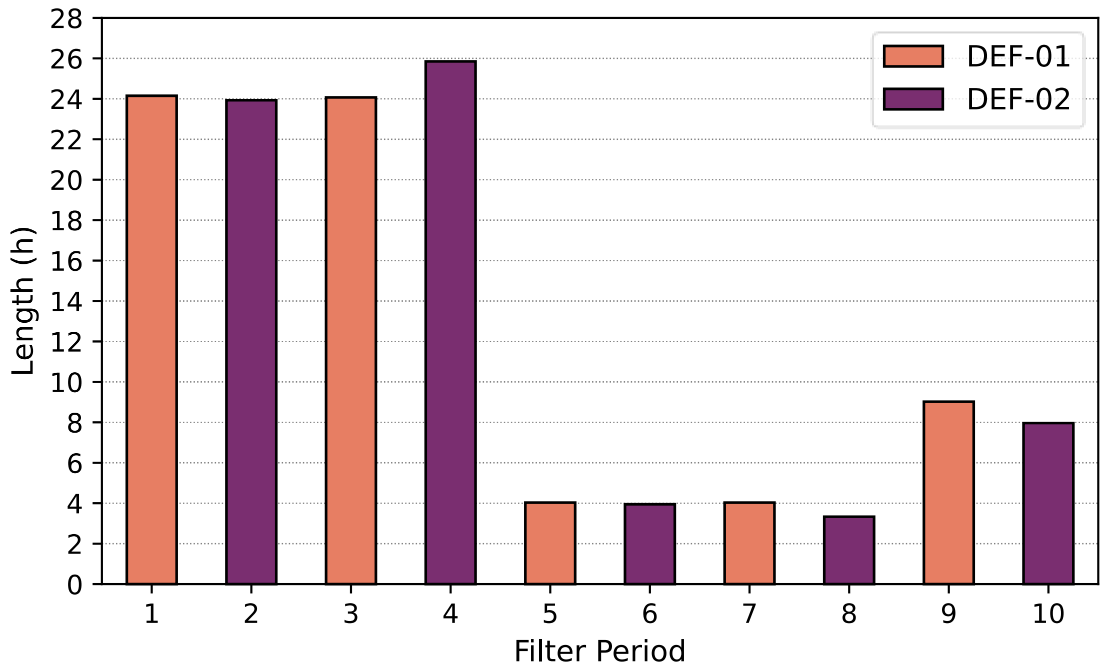

Figure 6.20. Filter period length (hours) for each W-03 filter period.

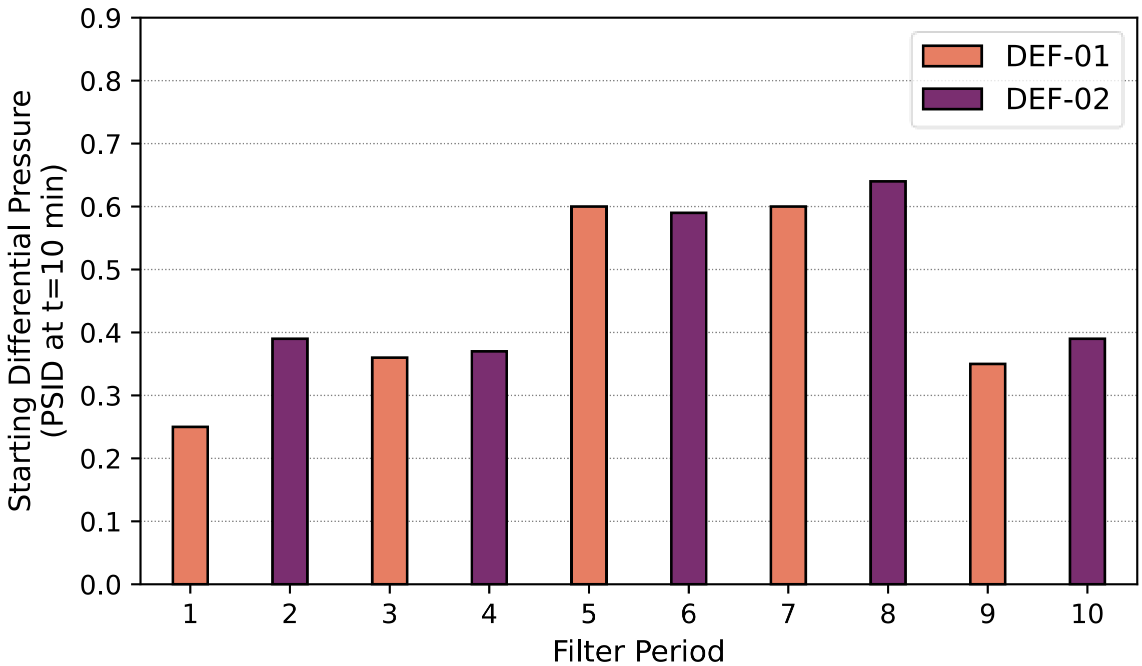

Figure 6.21. Starting differential pressure (PSID at t=10 min) for each W-03 filter period.

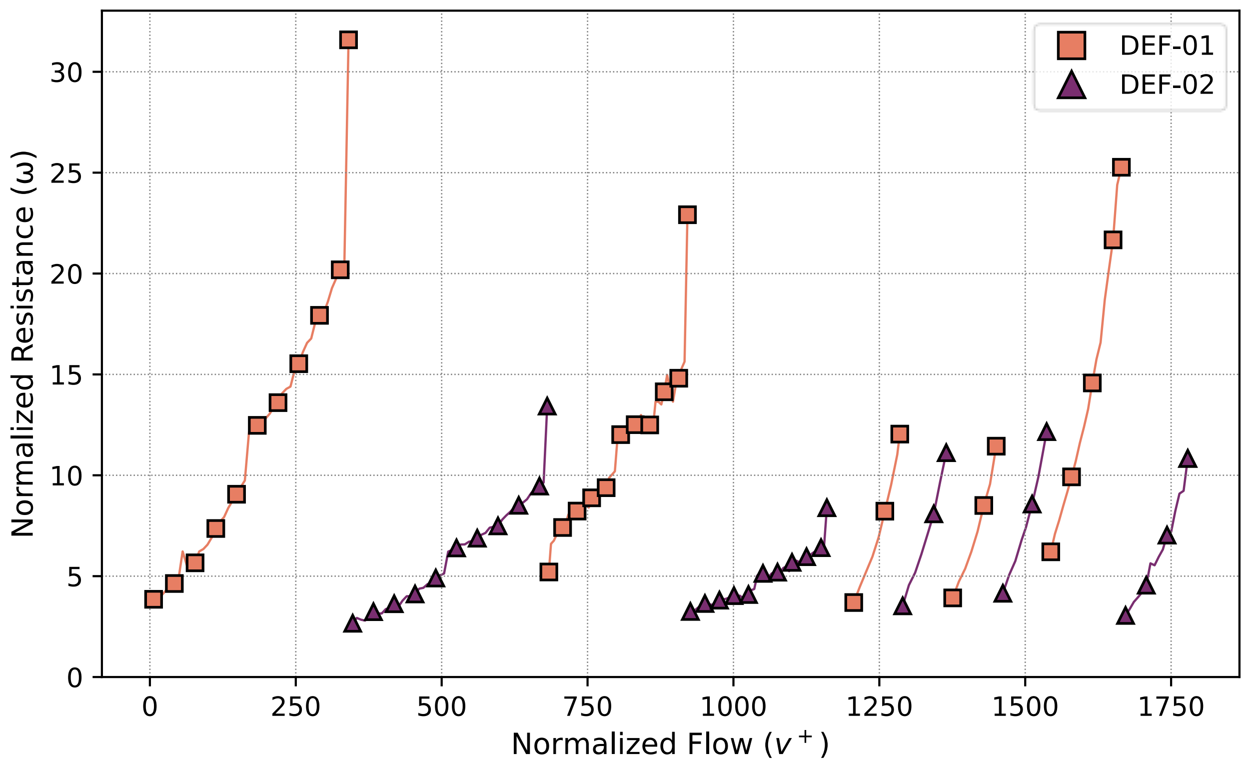

Figure 6.22. Normalized resistance (ω) over normalized flow (v^+) for each run W-03 filter period.

6.5 Run W-04

The goal of run W-04 was to gather data of the system with gradient flow. Supernatant was decanted from the as-received tote into TK-01 and recirculated until it reached 22 ± 1 °C as measured by T-01, and the trim solids were added (see Table 4.2) to reach the desired loading of 130 ppm. During the W-04 run, the system was operated for approximately 144 h with a flow rate tightly controlled to a range of targets (91.0, 110.0, 130.0, 150.0, 170.0, and 195.0 ± 1 mL min^{-1}), except for 5 outliers out of the 283 recorded data points, which resulted in a processed volume of ~270 gal. The temperature of the feed tank was also maintained tightly around the target (22 ± 1 °C). For the raw data collected during W-04, see Appendix C, Section C.4 (Table C.9 and Table C.10) and for the time traces of flow rate, temperature, and system pressures, see Appendix D, Section D.5 (Figure D.29 through Figure D.31). The feed pressure to the system from the recirculation loop (P-02) was maintained between ~55 and 65 psig[1] (driven by a recirculation pressure controlled to ~70 psig). Flow was introduced to DEF-01 first, then alternated between DEF-02 and DEF-01. Throughout the run, the trigger point pressure was set to the ideal trigger point of 2 psid.

The initial ΔP values are shown in Figure 6.26 for each filter period of W-04. As expected, increased flow rate resulted in higher initial ΔP, which is apparent when comparing filter periods 1 and 2 (130 mL min^{-1}) with initial ΔP of ~0.9 for DEF-01 and ~3.6 for DEF-02 to filter periods 3 and 4 (90 mL min^{-1}) with initial ΔP of ~0.4 psid for DEF-01 and ~1.7 for DEF-02. Throughout W-04, the initial ΔP for DEF-02 was consistently larger than that of DEF-01. Over the 144 h of operation, each DEF was used three times. Figure 6.23 and Figure 6.24 show the ΔP evolution for each DEF period, which demonstrates that the

[1] The variation was driven by changes in the flow rate. P-02 was closer to 55 psig at the lowest flow rates and 65 psig at the higher flow rates.

filters did not experience significant differences in the rate of change in ΔP across the flow rate range that was used. The (minor) slope differences are presented in more detail in Figure D.35; the filters were able to operate for full 24-h periods before swapping at all flow rates.

The normalized resistance data for the filters is shown in Figure 6.27. The resistance increased minimally from the baseline resistance, $R^{+}_{m,o}$, by a factor of ~1.9, and the impact of flow rate is not very distinct (see the resistances for periods 5 and 6, which vary flow rate across a range). Almost all the increase above baseline occurred in the first few minutes of operation. Note the slightly decreased resistance of DEF-02 across filter periods. The data in Figure 6.26 and Figure 6.27 demonstrates that the DEFs returned to their initial performance level (ΔP after 10 min and initial ω with time do not significantly change) after each backflush and filter swap.

The differential pressure (DP-03) observed in the IXC (IXC-01) settled between ~2 and ~7 psid with a positive relationship between flow rate and differential pressure. This is aligned with the observed behavior in Schonewill et al. 2021, where the DP-03 pressures established around 5 to 6 psid with flow rate of 130 mL min^{-1}; for more details, see Figure D.32.

Run W-04 exhibited little or no change in DEF resistance despite varying flow rates over the full range of 200W PM-scaled filter fluxes. The total solids content, based on feed samples, was consistent across the run and the filters handled the ~80-ppm feed without significant issues.

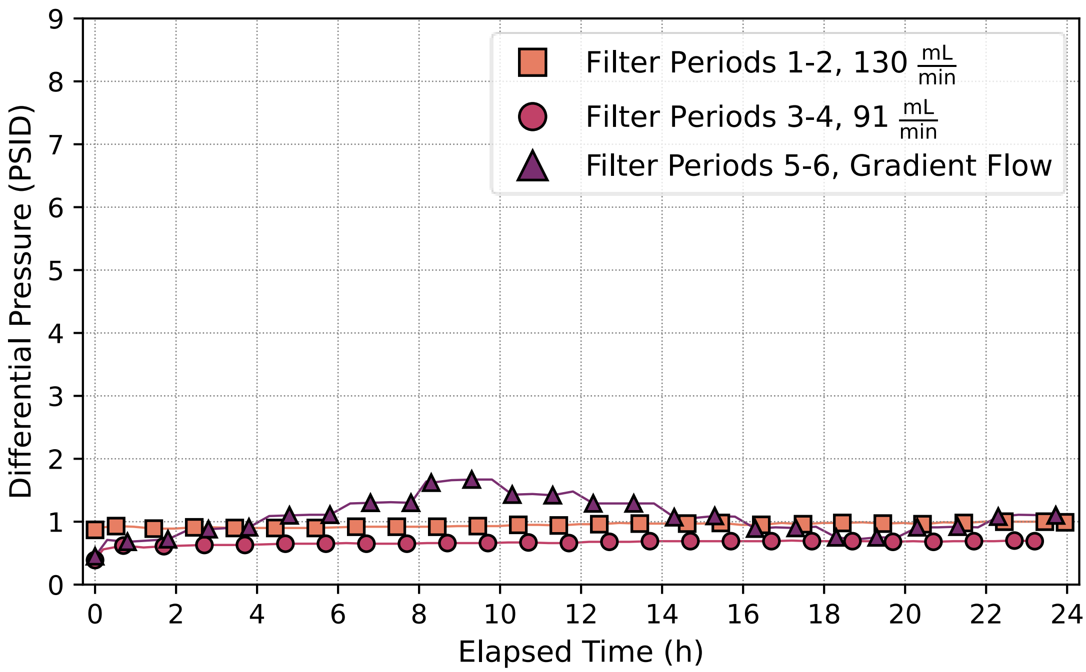

Figure 6.23. Differential pressure traces for each W-04 DEF-01 filter period.

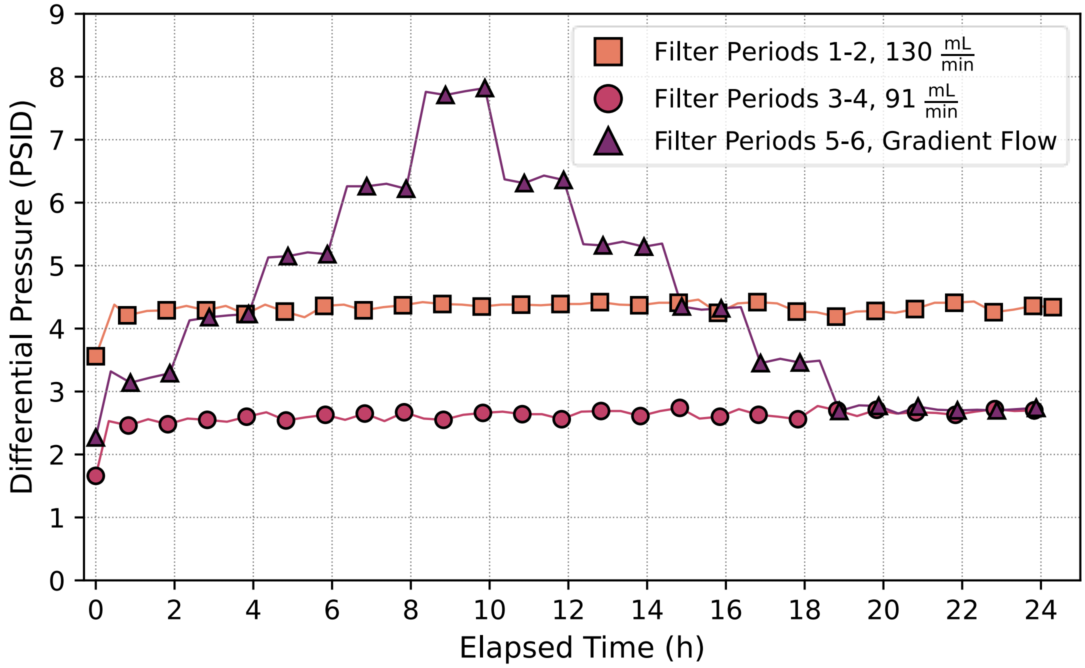

Figure 6.24. Differential pressure traces for each W-04 DEF-02 filter period.

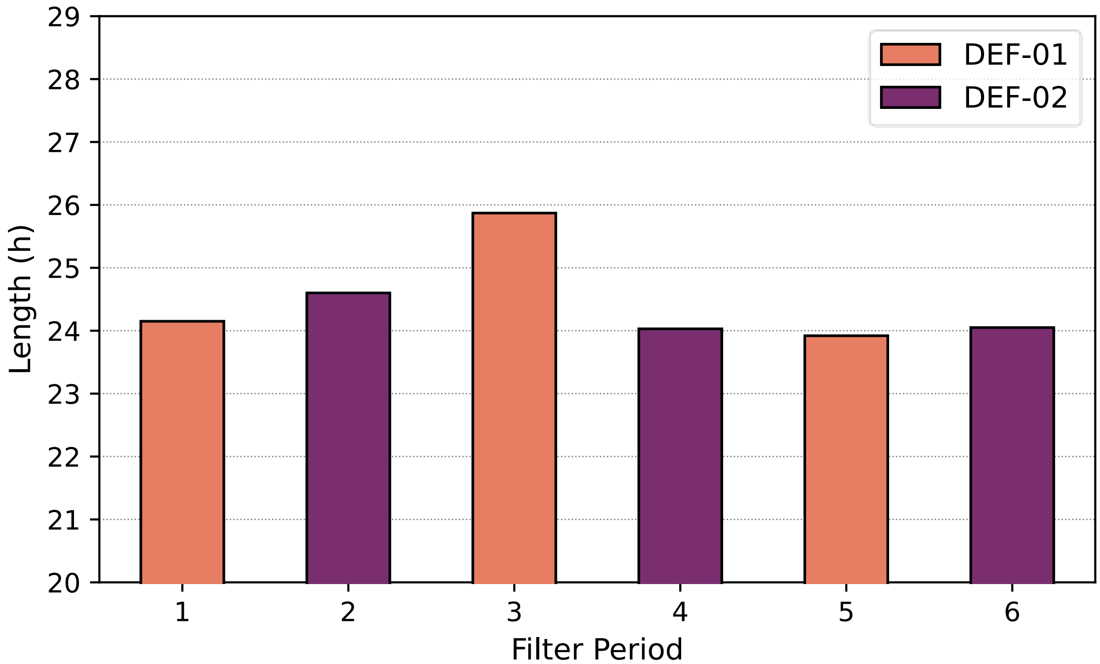

Figure 6.25. Filter period length (hours) for each W-04 filter period.

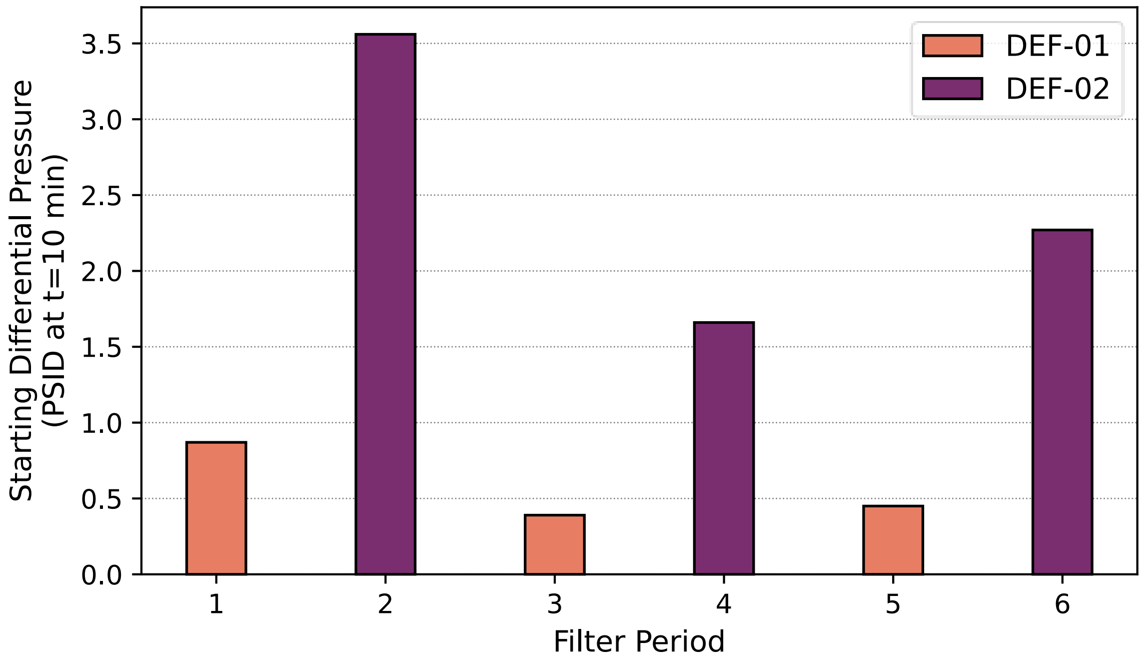

Figure 6.26. Starting differential pressure (PSID at t=10 min) for each W-04 filter period.

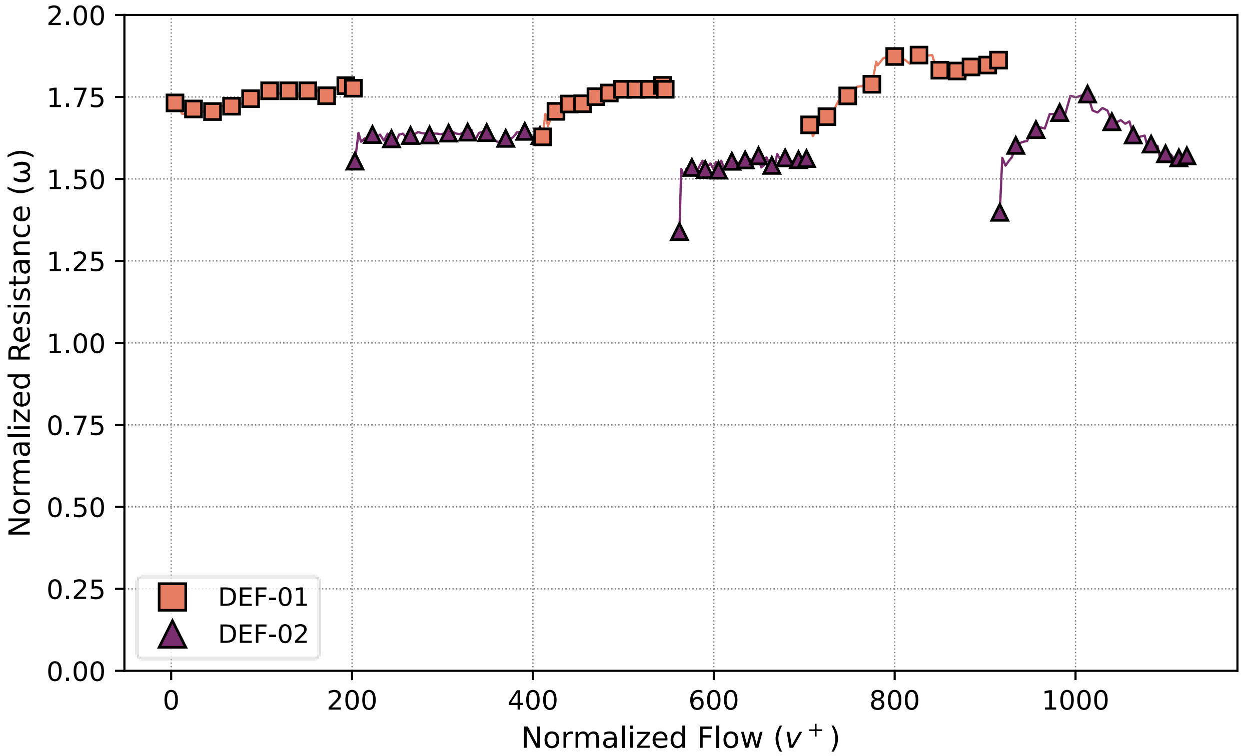

Figure 6.27. Normalized resistance (ω) over normalized flow (v^+) for each run W-04 filter period.

6.6 Run W-05

Run W-05 was completed using the "S5" simulant with composition discussed in Table 4.1. W-05 was a two-part test that consisted of W-05A and W-05B. W-05B was conducted immediately after the completion of W-05A using the same simulant material and processing conditions by adding processing simulant back into TK-01 to reduce the solid loading (referred to as dilution).

6.6.1 Run W-05A

The goal of run W-05A was to gather data from the system with the highest solids loading (500 ppm). Supernatant was decanted from the as-received tote into TK-01 and recirculated until it reached 22 ± 1 °C as measured by T-01, and the trim solids were added (see Table 4.2) to reach the desired loading of 500 ppm. During the W-05A test, the system was operated for approximately 116 h with a flow rate tightly controlled to the target (130.0 ± 1 mL min^{-1}), except for 3 outliers out of the 234 recorded data points, which resulted in a processed volume of ~180 gal. The temperature of the feed tank was also maintained tightly around the target (22 ± 1 °C). For the raw data collected during W-05A, see Appendix C, Section C.5 (Table C.11 and Table C.12) and for the time traces of flow rate, temperature, and system pressures, see Appendix D, Section D.6 (Figure D.36 through Figure D.39). The feed pressure to the system from the recirculation loop (P-02) was maintained at ~70 psig (recirculation loop was controlled to ~75 psig). Flow was introduced to DEF-01 first, then alternated between DEF-02 and DEF-01 for every period thereafter. The trigger point pressure was 2 psid and it was not increased throughout the duration of the run.

The initial ΔP values are shown in Figure 6.31 for each filter period of W-05A, which provides the baseline for the trigger point pressure; the starting ΔP for DEF-02 increased between filter periods 4 and 6, but no general trend was observed, and starting ΔP values for DEF-02 fell following filter period 6. No discernible trend was observed in starting ΔP for DEF-01. Over the 116 h of operation, DEF-01 was used seven times and DEF-02 was used six times. Figure 6.28 and Figure 6.29 show the ΔP evolution for each DEF period; no filter period lasted the full 24 h, but period lengths were consistent across runs and generally lasted between 8 and 10 h as seen in Figure 6.30. Despite operating at a higher baseline ΔP, DEF-02 had a lower (almost negligibly, perhaps 0.01 psid·h^{-1}) average psid·h^{-1} change compared to DEF-01, shown in Appendix D, Section D.6 (Figure D.42).

The normalized resistance data for the filters is shown in Figure 6.32. There is a difference in resistance between DEF-01 and DEF-02 from the baseline resistance, $R^{+}_{m,o}$, with DEF-01 increasing by a factor of ~4 and DEF-02 increasing by ~1.9, but this is likely related to the difference in initial resistances of the filters. The average increase in resistance of DEF-01 fell slightly across filter periods but rose slightly for DEF-02. The data in Figure 6.31 and Figure 6.32 demonstrates that the DEFs returned to their initial performance level (ΔP after 10 min and initial ω with time do not significantly change) after each backflush and filter swap, indicating successful filter restoration.

The differential pressure (DP-03) observed in the IXC (IXC-01) was consistent at 4 psid during normal operation in W-05A and increased (very slightly) as the run progressed. This is aligned with the observed behavior in Schonewill et al. 2021, where the DP-03 pressures established around 5 to 6 psid and rose gradually over the course of the test; for more details, see Figure D.39.

During run W-05A, the differential pressures across DEFs rose consistently across filter periods, and resistance rose repeatably across periods. No apparent degradation in filter performance was observed, and there was a very slight increase in differential pressure across the IXC, seen in Figure D.39, suggesting repeatable filtration performance without solids-breakthrough. This evidence suggests that the

200W PM-scaled DEFs can filter solids similar to those in simulant S5 at loading levels of at least 500 ppm (total solids content data indicates the level was closer to 700 – 1000 ppm, see Table 4.8) without observable degradation in filter performance.

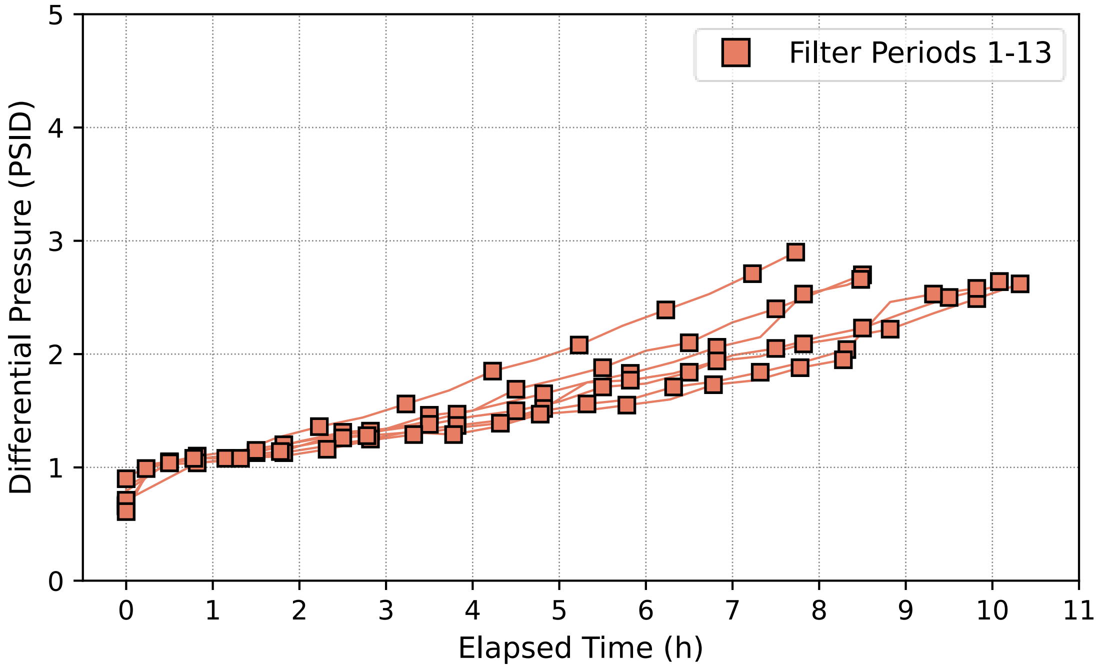

Figure 6.28. Differential pressure traces for each W-05A DEF-01 filter period.

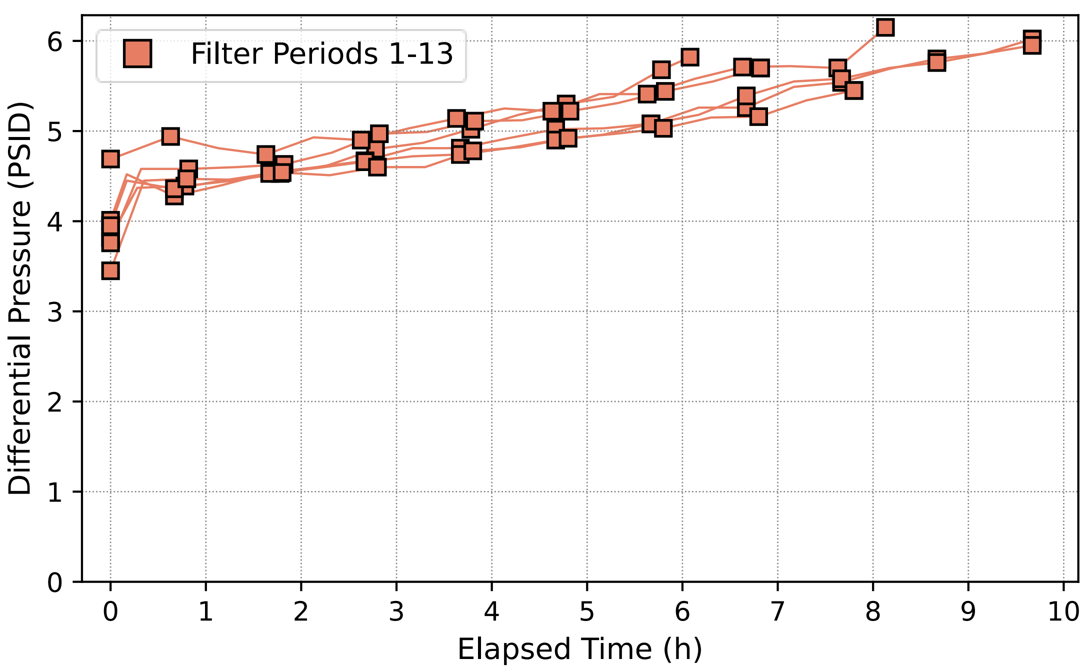

Figure 6.29. Differential pressure traces for each W-05A DEF-02 filter period.

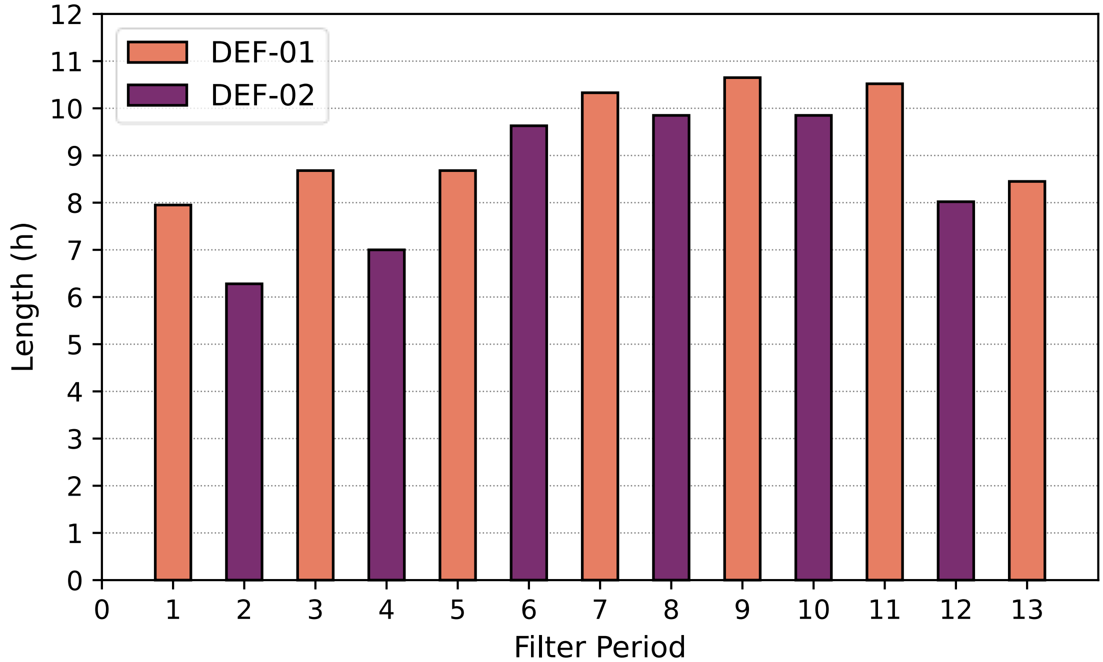

Figure 6.30. Filter period length (hours) for each W-05A filter period.

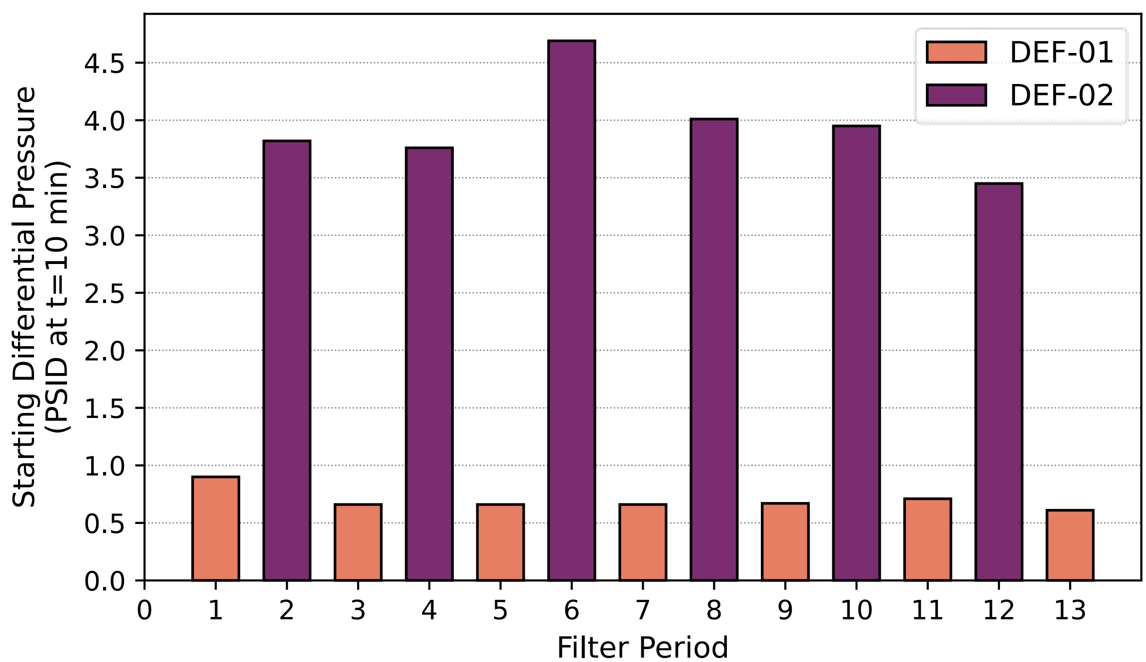

Figure 6.31. Starting differential pressure (PSID at t=10 min) for each W-05A filter period.

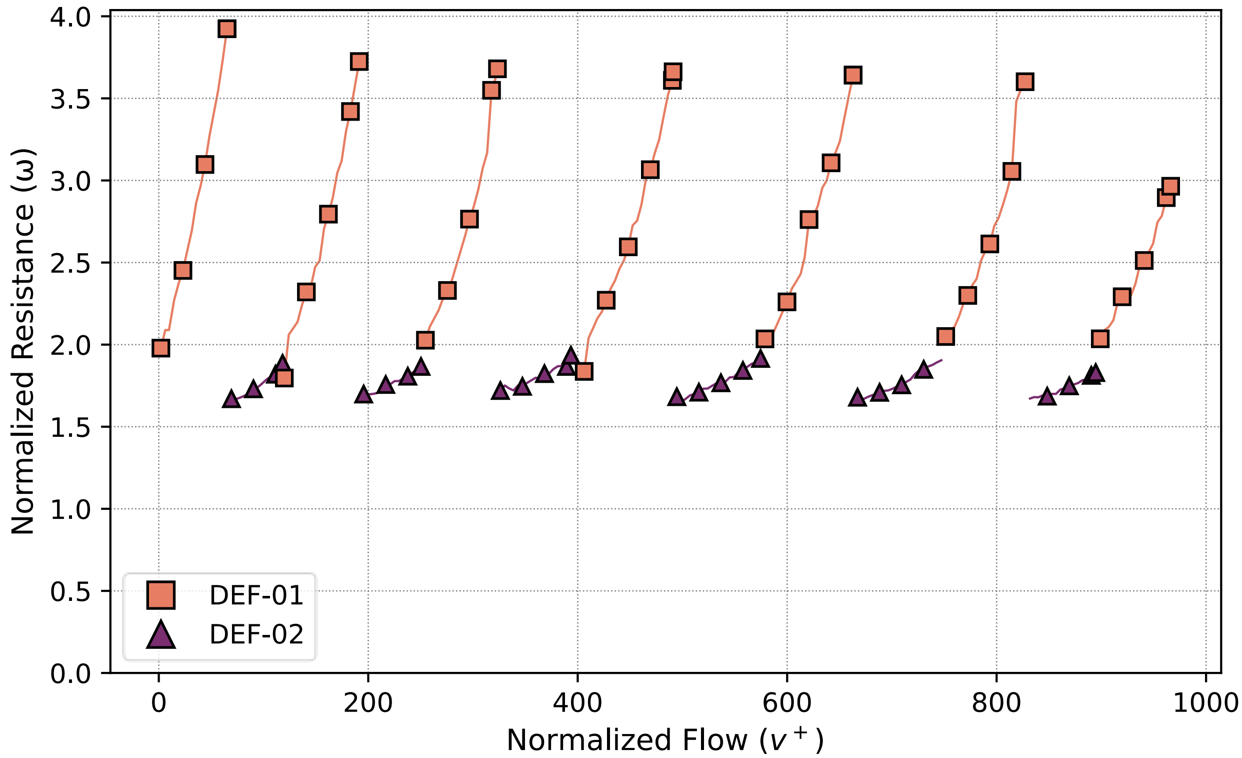

Figure 6.32. Normalized resistance (ω) over normalized flow (v^+) for each run W-05A filter period.

6.6.2 Run W-05B

The goal of run W-05B was to determine performance at a diluted solids concentration and check for precipitation of the S5 simulant at 16 °C. Supernatant was transferred from the as-received tote (TK-01), which contained roughly 45 gal of remaining 500 ppm simulant from W-05A, to achieve a total volume of 220 gal. The simulant was recirculated until it reached 22 ± 1 °C as measured by T-01 and the trim solids were added (see Table 4.2) to achieve the target concentration of 130 ppm. During the W-05B test, the system was operated for approximately 135 h with a flow rate tightly controlled to the target (130.0 ± 1 mL min^{-1}), except for 15 outliers out of the 212 recorded data points, which resulted in a processed volume of ~275 gal. The temperature of the feed tank was also maintained tightly around the targets; 22 ± 0.7 °C for filter periods 1 through 3 and 15 ± 0.7 °C for the remainder of the test. For the raw data collected during W-05B, see Appendix C, Section C.5 (Table C.13 and Table C.14), and for the time traces of flow rate, temperature, and system pressures, see Appendix D, Section D.7 (Figure D.43 through Figure D.46). The feed pressure to the system from the recirculation loop (P-02) was maintained at ~70 psig. (Recirculation loop pressure was controlled to ~75 psig.) Flow was introduced to DEF-02 first, then alternated between DEF-01 and DEF-02 for every period thereafter. Throughout the run, the trigger point pressure was 2 psid.

The initial ΔP values are shown in Figure 6.36 for each filter period of W-05B, which provides the baseline for the trigger point pressure; the ΔP curves for both DEFs are very similar for all periods. Over the 135 h of operation, DEF-01 was used two times and DEF-02 was used three times. Figure 6.33 and Figure 6.34 show the ΔP evolution for each DEF period. Consistent with other runs using the DEFs in the LS2 configuration, DEF-02 observed a higher on-average ΔP, but the psid·h^{-1} rate of change was similar for both filters as shown in Figure D.49. The ΔP increase in DEF-02 at 16 °C was slightly more pronounced than in DEF-01, but the observation is based on only a single filter period for each (and the

DEF-02 period is truncated). It is difficult to discern from this data whether the temperature drop impacted the filter period length, but it did appear to have a minor effect on the filter performance – as measured by ΔP slope – in W-05B.

The normalized resistance data for the filters is shown in Figure 6.37. The resistance increased from the baseline resistance, $R^{+}_{m,o}$, by a factor of ~1.4 for DEF-01 and ~1.9 for DEF-02. The data in Figure 6.36 and Figure 6.37 demonstrates that the DEFs did return to their initial performance level (ΔP after 10 min and initial ω remained less than 1) after each backflush and filter swap, indicating successful restoration of filters.

The differential pressure (DP-03) observed in the IXC (IXC-01) settled at ~4 psid during 22 °C periods and ~4.5 psid during 16 °C periods. The stable ΔP at each temperature suggests little to no solids breakthrough. For more details, see Figure D.46.

During run W-05B, the DEFs were consistently run for 24-h periods and only exhibited a slightly increased rate of change in differential pressure at lowered temperature. The slight increase in ΔP is reflected in filter periods 4 and 5 in Figure 6.33 and Figure 6.34 and mostly correlated to the higher viscosity of simulant due to a lowered temperature (although minor amounts of precipitation may have occurred). Since the IXC had minimal differential pressure increase over the run time, this is further evidence that the DEFs can reliably filter solids even at temperatures 16 °C with solids loadings greater than 100 ppm.

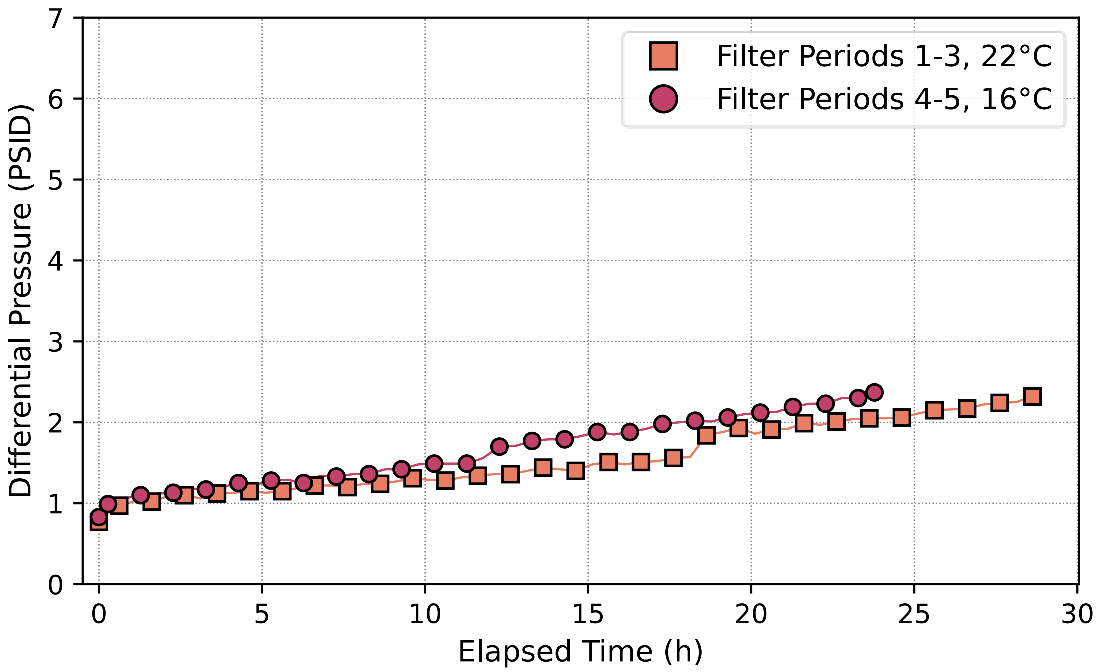

Figure 6.33. Differential pressure traces for each W-05B DEF-01 filter period.

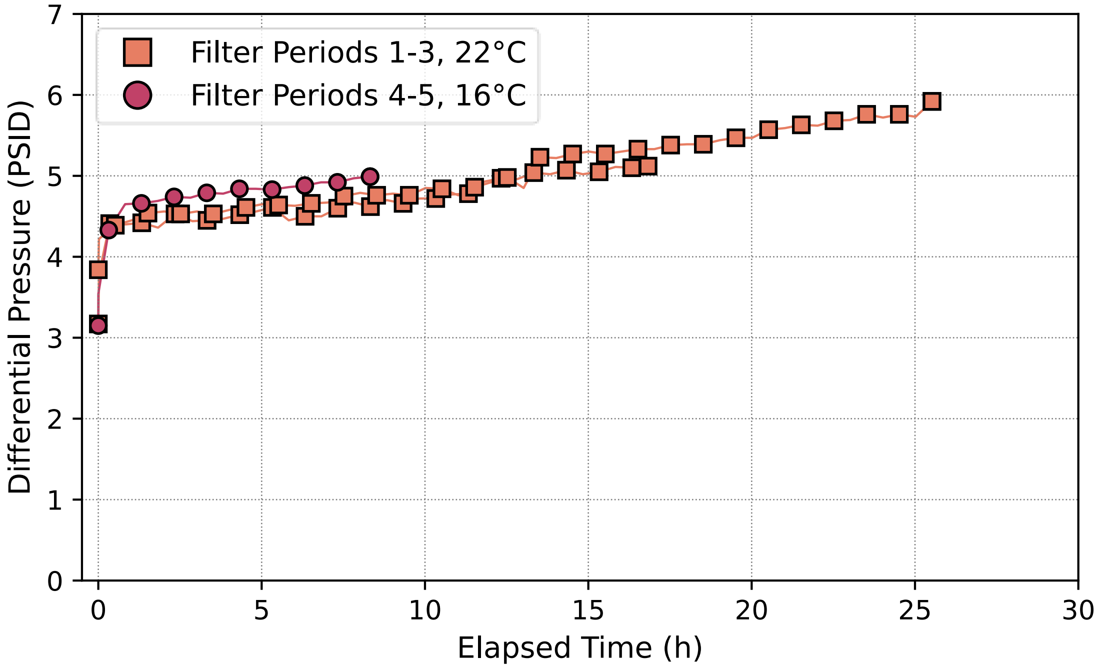

Figure 6.34. Differential pressure traces for each W-05B DEF-02 filter period.

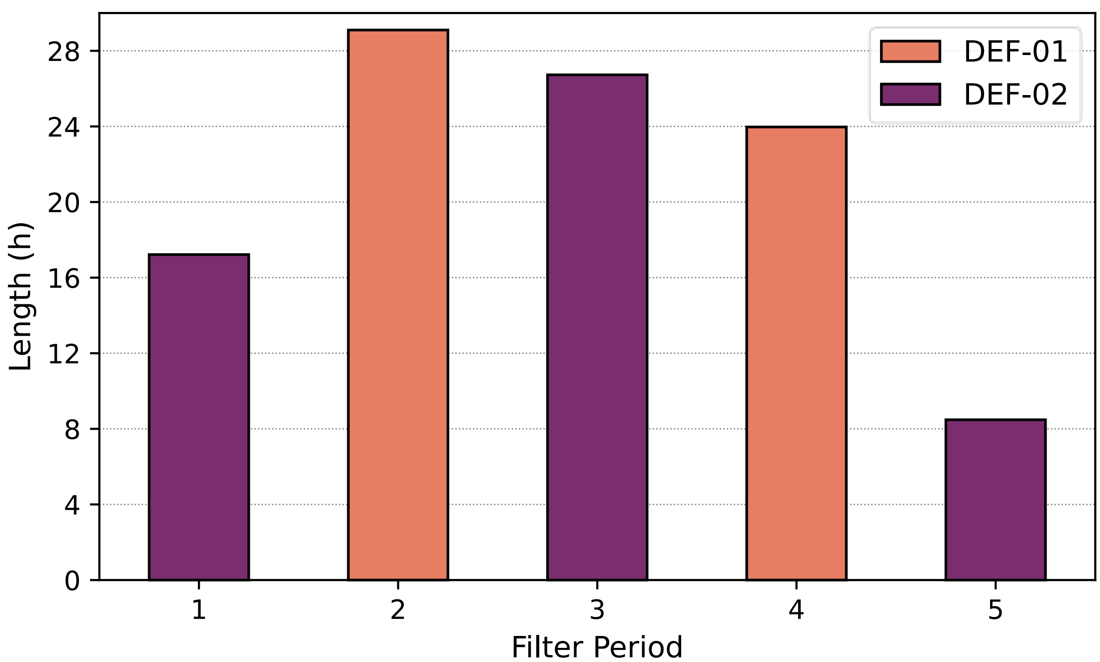

Figure 6.35. Filter period length (hours) for each W-05B filter period.

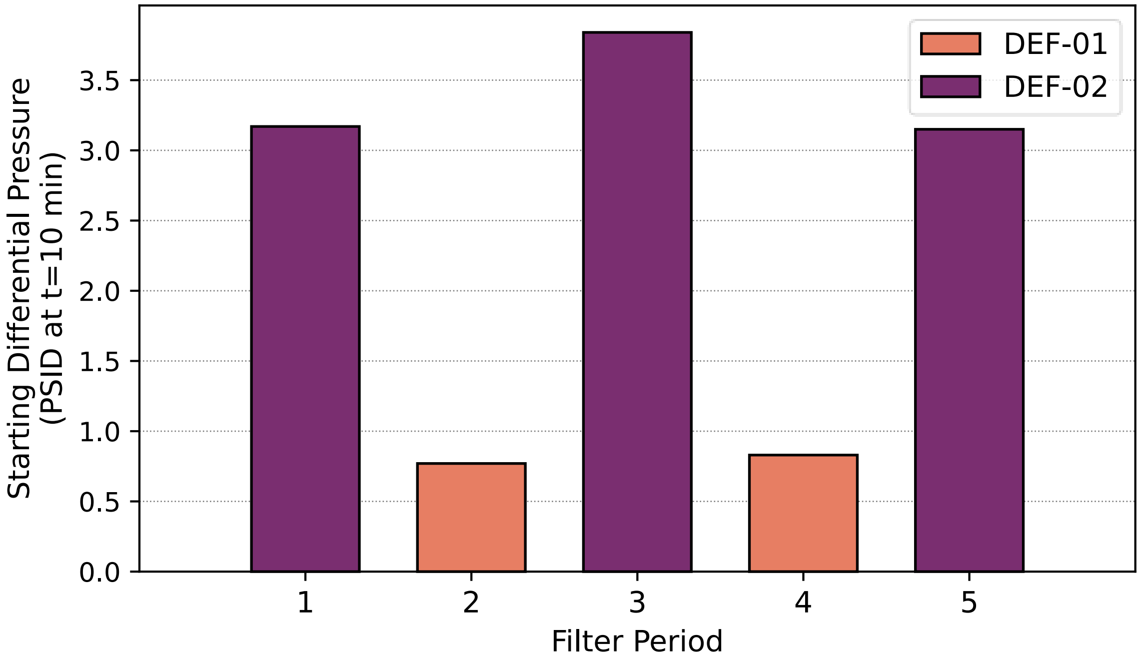

Figure 6.36. Starting differential pressure (PSID at t=10 min) for each W-05B filter period.

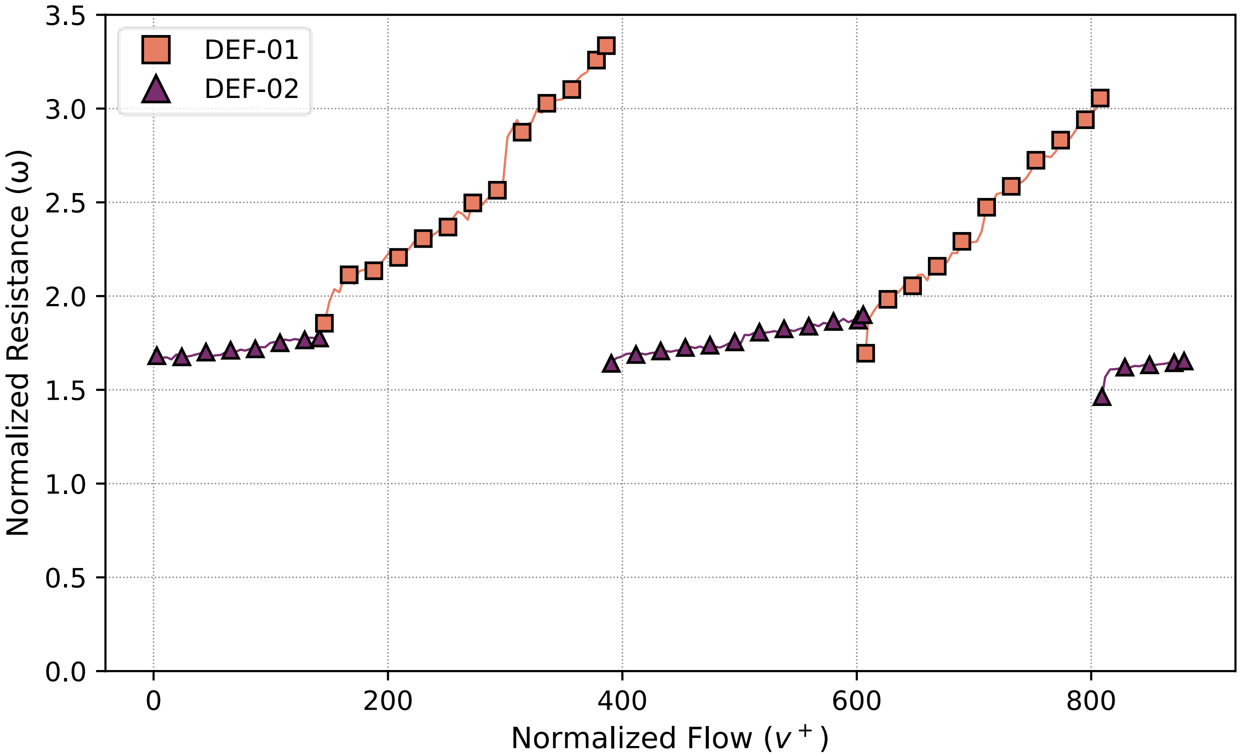

Figure 6.37. Normalized resistance (ω) over normalized flow (v^+) for each run W-05B filter period.

6.7 Run W-06

Run W-06 was a repeat of run W-01A using the same S1 simulant with the larger surface area filters in the LS2 system configuration to allow comparisons between different filter geometries. Process effluent from run W-01A was pumped into TK-01 and recirculated until it reached 22 ± 1 °C as measured by T-01, and the trim solids were added (see Table 4.2) to reach the desired loading of 130 ppm. During the W-06 test, the system was operated for approximately 102 h with a flow rate tightly controlled to the target (130.0 ± 1 mL min^{-1}), except for 1 outlier out of the 209 data points, which resulted in a processed volume of ~210 gal. The temperature of the feed tank was also maintained tightly around the target (22 ± 1.1 °C), except for 26 outliers out of the 209 data points. For the raw data collected during W-06, see Appendix C, Section C.6, Table C.15 and Table C.16. For the time traces of flow rate, temperature, and system pressures, see Appendix D, Section D.8 (Figure D.50 through Figure D.52). The feed pressure to the system from the recirculation loop (P-02) was maintained at ~55 psig as shown in Appendix D (Figure D.52). (The recirculation loop was controlled to ~62 psig.) Flow was introduced to DEF-01 first, then alternated between DEF-02 and DEF-01 for every period thereafter. For every filter period, the trigger point pressure was 2 psid.

The initial ΔP values are shown in Figure 6.41 for each filter period of W-06, which provides the baseline for the trigger point pressure; there is no discernible trend in starting ΔP values of DEFs, indicating effective filter backflushes. Over the 102 h of operation, each filter was used three times. Figure 6.38 and Figure 6.39 show the ΔP evolution for each DEF period – the only period that did not have flow for the full target 24 h was filter period 4. Filter period 6 is short due to the conclusion of run W-06. The differential pressure rate of change of DEF-02 was much higher than that of DEF-01, but neither filter increased more than 0.3 psid·h^{-1} on average. This higher rate can be seen in Appendix D, Section D.8 (Figure D.56), but is not easily discernible from Figure 6.38 and Figure 6.39; the smaller dataset of DEF-02 is also attributed to the higher standard deviation in average slope, and may contribute to the higher slope as well. Filter periods 4 and 6 were both short, and both were DEF-02 filter periods. The normalized resistance data for the filters is shown in Figure 6.42. The resistance increased from the baseline resistance, $R^{+}_{m,o}$, by a factor between ~1.5 and ~2. The data in Figure 6.42 demonstrates that the DEFs did return to their initial performance level (increase in ΔP after 10 min and ω with time) after each backflush and filter swap, indicating backflushes successfully restored filter performance.

The differential pressure (DP-03) observed in the IXC (IXC-01) was consistently ~6 psid during operation and did not increase notably throughout the duration of W-06, which had a shorter operating time than the other runs.

During run W-06, the DEFs exhibited a sharp increase in ΔP during the first hour of operation, followed by nearly constant differential pressure for the remainder of the period. The initial rise in ΔP was observed for all runs with the LS2 configuration; the increased shell volume for the 200W PM-scaled DEFs may be playing a role in the observed behavior because 0.1M NaOH is still being displaced after 10 min (when the first ΔP data is collected).

The DEFs performed better during W-06 than the most directly comparable filter periods (1-3) of run W-01A. After the initial ΔP "spike" in W-06, the ΔP increases across DEFs were nearly flat compared to the gradual linear increase observed during run W-01A. These comparisons in resistance are seen in Figure 6.45 and discussed in more detail in Section 6.8.1. The S1 simulant with ~200 ppm solids loading was demonstrated to be well within the capability of the DEFs with 200W PM-scaled filter flux.

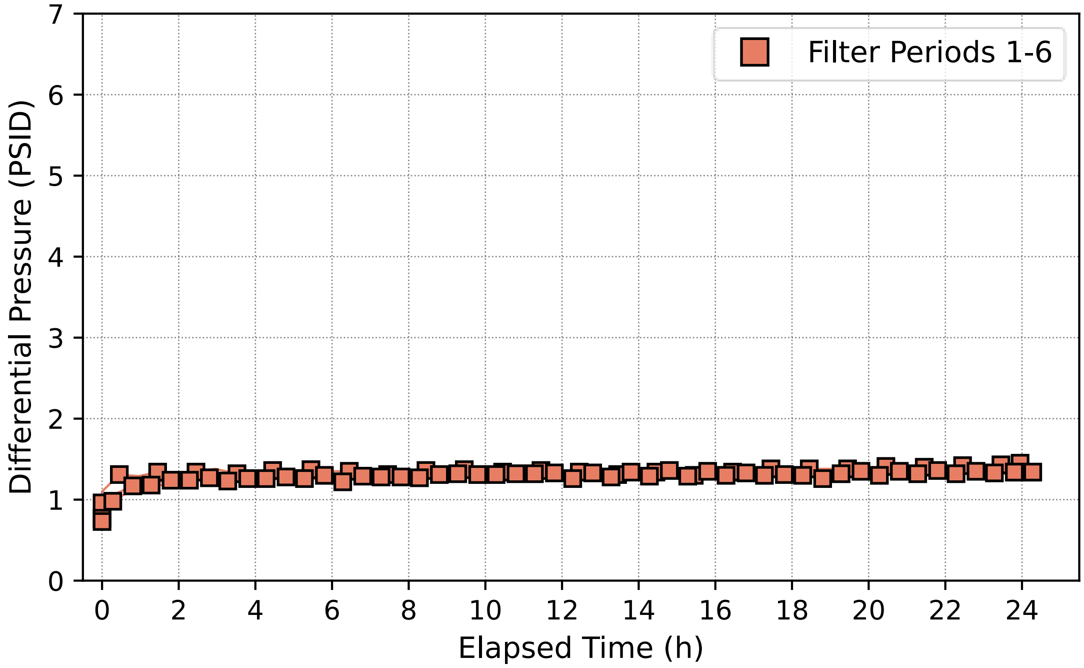

Figure 6.38. Differential pressure traces for each W-06 DEF-01 filter period.

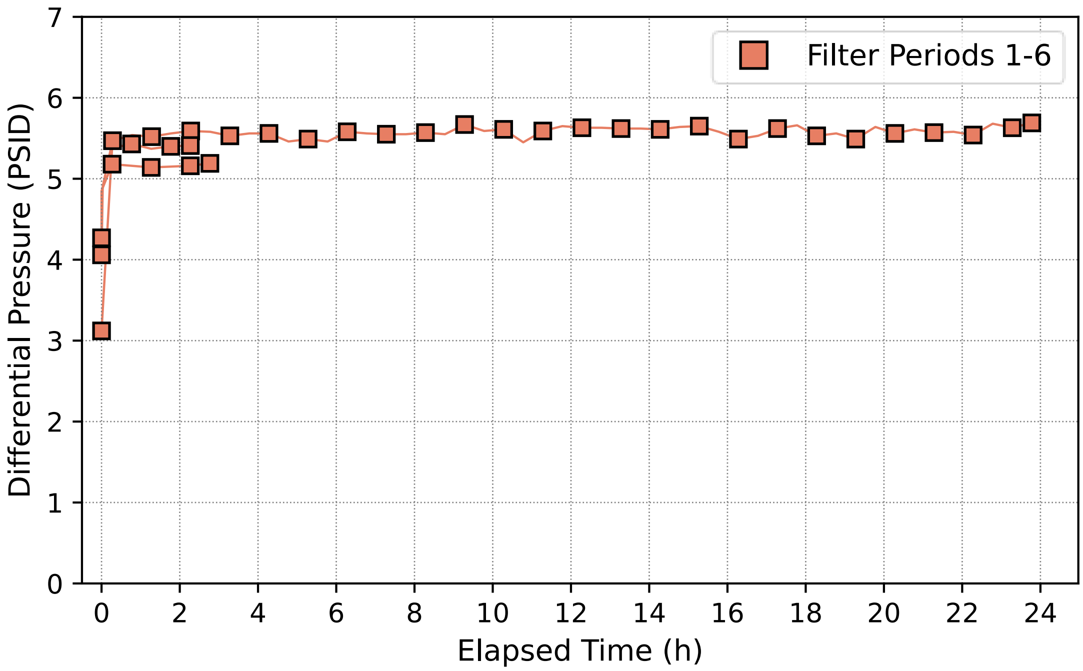

Figure 6.39. Differential pressure traces for each W-06 DEF-02 filter period.

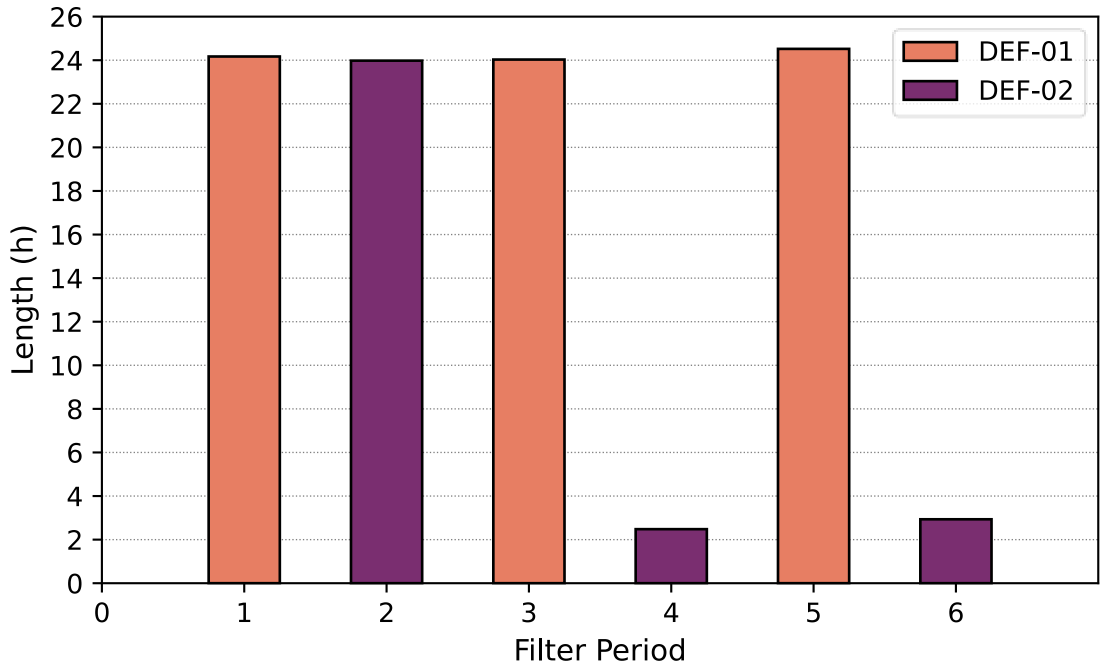

Figure 6.40. Filter period length (hours) for each W-06 filter period.

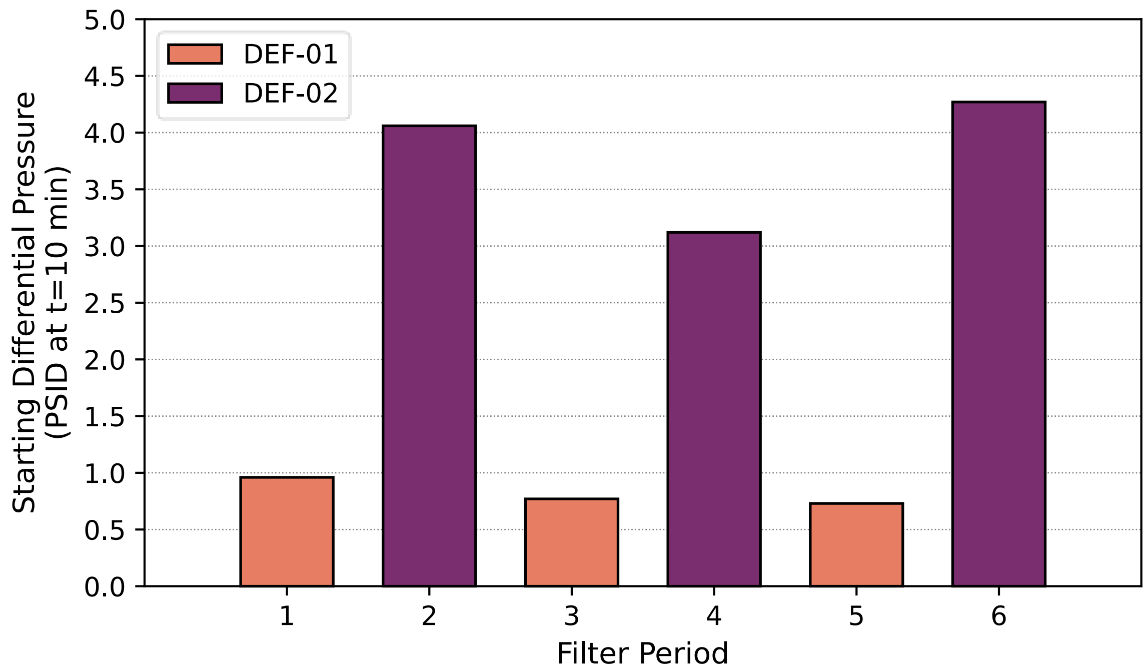

Figure 6.41. Starting differential pressure (PSID at t=10 min) for each W-06 filter period.

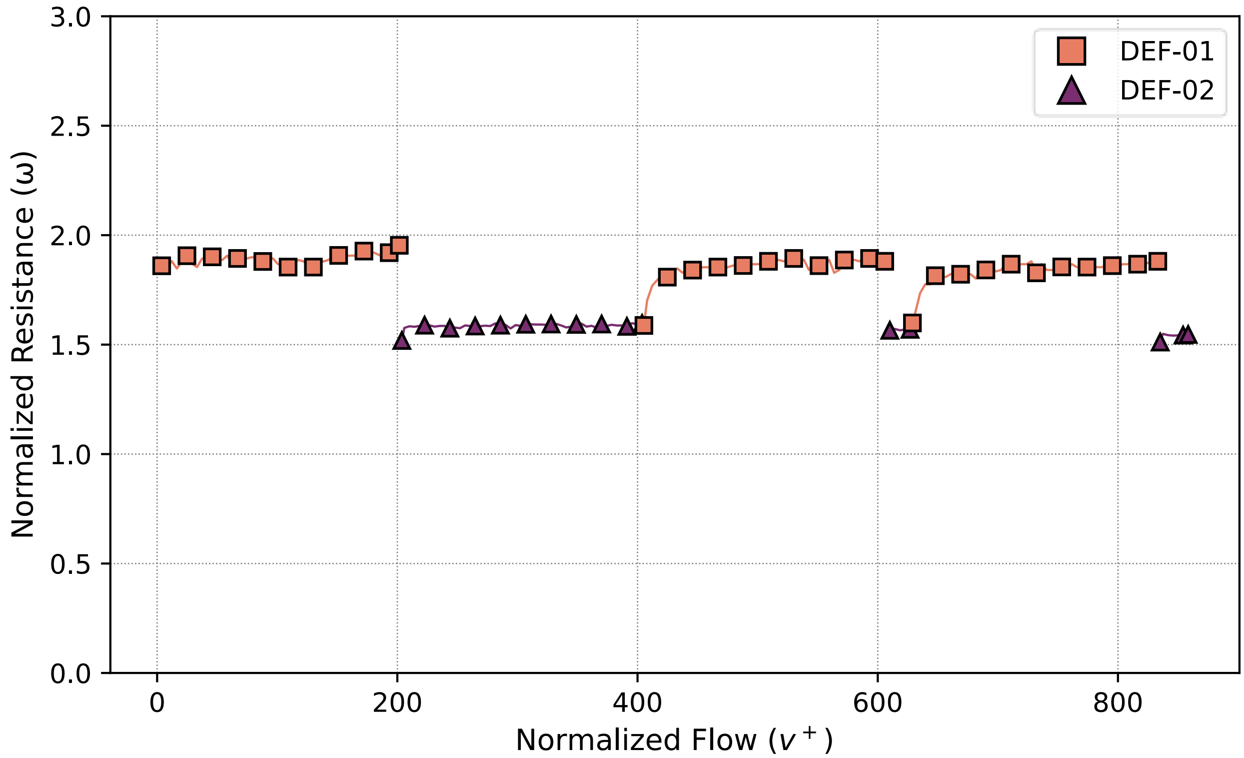

Figure 6.42. Normalized resistance (ω) over normalized flow (v^+) for each run W-06 filter period.

6.8 Comparisons

There are limitations with comparing the filter run data across the six runs due to the variation in the solid phase composition between simulants and imprecise knowledge of the "true" solids loading as a function of operating time. This is further compounded by the differences in temperature and flow rate between runs (in cases where they were varied). For runs where temperature in TK-01 was reduced to 16 °C and held for 24 h (W-01B, W-03, and W-05B), appreciable solid precipitation was not observed, and filtration performance was not significantly impacted. For runs with variable flow rates (W-02, W-03, and W-04), higher flow rates corresponded with larger initial differential pressures across the DEFs and IXC and shorter filter periods (as expected); however, the DEFs operated capable across the entire flow rate range. The normalized resistance provides an avenue for comparing across runs because it accounts for changes in flow rate and viscosity – this is the focus of Section 6.8.1.

For runs with the same simulant and process parameters (W-01A filter periods 1 through 3 and W-06), the increase in normalized resistance was much greater for the TSCR-scaled DEFs (W-01A). IXC pressures measured while operating at 130 mL min^{-1} maintained between 3 and 7 psid regardless of solids loading and run conditions, which provides evidence that the DEFs successfully protect the IXC and do not allow the accumulation of solids. Overall, the progression of runs (as determined by rate of differential pressure increase) from least challenging to most was observed to be W-04 (~80 ppm) < W-06 (~200 ppm) < W-05 (~700/300 ppm) ~ W-03 (~150 ppm) < W-01 (~200/>500/120 ppm) << W-02 (400/100 ppm). W-05 and W-03 could be interchanged in the order, but their similarity is important because W-05 had a much higher solids loading than W-03 – W-05 had the LS2 DEFs rather than the LS1 DEFs (as W-03 did). Note that this progression correlates – vaguely, but not exactly – with increasing target solids loading (W-02 and W-05 being obvious exceptions).

6.8.1 Comparison of DEF Data

Table 6.2 summarizes the process parameters – liquid viscosity, actual solids loading, flow rate, temperature – and compares the number and range of length of filter periods and the normalized resistance range of the five runs. Typically, runs with larger solids loading correspond with larger pressure differential rates of change, which is also reflected in the normalized resistance (faster increase) and filter period length (reduced in duration). Comparisons of normalized resistance versus specific volume filtered are grouped by DEF surface area and provided in Figure 6.42 and Figure 6.44. Comparison of normalized resistance between W-01A (first three filter periods) and W-06, which kept all parameters equal except for filter surface area, showed that the maximum normalized resistance for W-06 was slightly smaller than that of W-01A. The same relationships are observed with the differential pressure rate data in Figure 6.46. Note that the differential pressure rate data contains error bars that give insight into the significance of the relationships; thus, W-01B DEF-02 filter periods 1 through 10 and W-06 DEF-02 filter periods 1 through 6 should not be included in comparisons due to the high variability within data collected at the same process parameters. For the tabulated differential pressure rate of change and normalized resistance data, see Table E.1 through Table E.11 (Appendix E).

Table 6.2. Summary of Process Parameters with Filter Performance Data.

Run ID	Liquid Simulant	Liquid Simulant Viscosity at 22°C (mPa·s)	Actual Solids Loading (ppm)	Flow Rate (mL/min)	Temperature (°C)	Number of Filter Periods	Typical Filter Period Length (h)[(b)]	Normalized Resistance Range[(c)]
W-01A	S1	3.288	~200 (1st part) >500 (2nd part)	Fixed ~130	Fixed ~22	22	24 (1st part) 4 (2nd part)	1.9-3.8 (1st part) 2.3-8.9 (2nd part)
W-01B	S1	3.288	120 to 300	Fixed ~130	Variable ~15, ~22	15	10	1.1-7.6
W-02	S2	2.392	100 to 400	Variable ~70, ~90, ~130	Fixed ~22	102	5	1.2-51.1
W-03	S3	1.589	~150	Variable ~90, ~130, ~195	Variable ~15, ~22	10	24	2.7-31.6
W-04[(a)]	S4	2.168	~80	Gradient 90-195	Fixed ~22	6	24	1.3-1.9
W-05A[(a)]	S5	2.182	700 to 1000	Fixed ~130	Fixed ~22	13	11	1.7-3.9
W-05B[(a)]	S5	2.182	~300	Fixed ~130	Variable ~15, ~22	5	24	1.5-3.3
W-06[(a)]	S1	3.288	~200	Fixed ~130	Fixed ~22	6	24	1.5-2.0

(a) Runs W-04 through W-06 performed with LS2.
(b) Maximum filter period lengths rounded to the nearest hour. In cases where the filter period reached 24 h without exceeding the trigger point pressure, it is shown as 24 h even though the actual filter period was occasionally greater.
(c) Smaller normalized resistances occurred when the DEF was first brought on-line, while larger ones occur just before swapping.

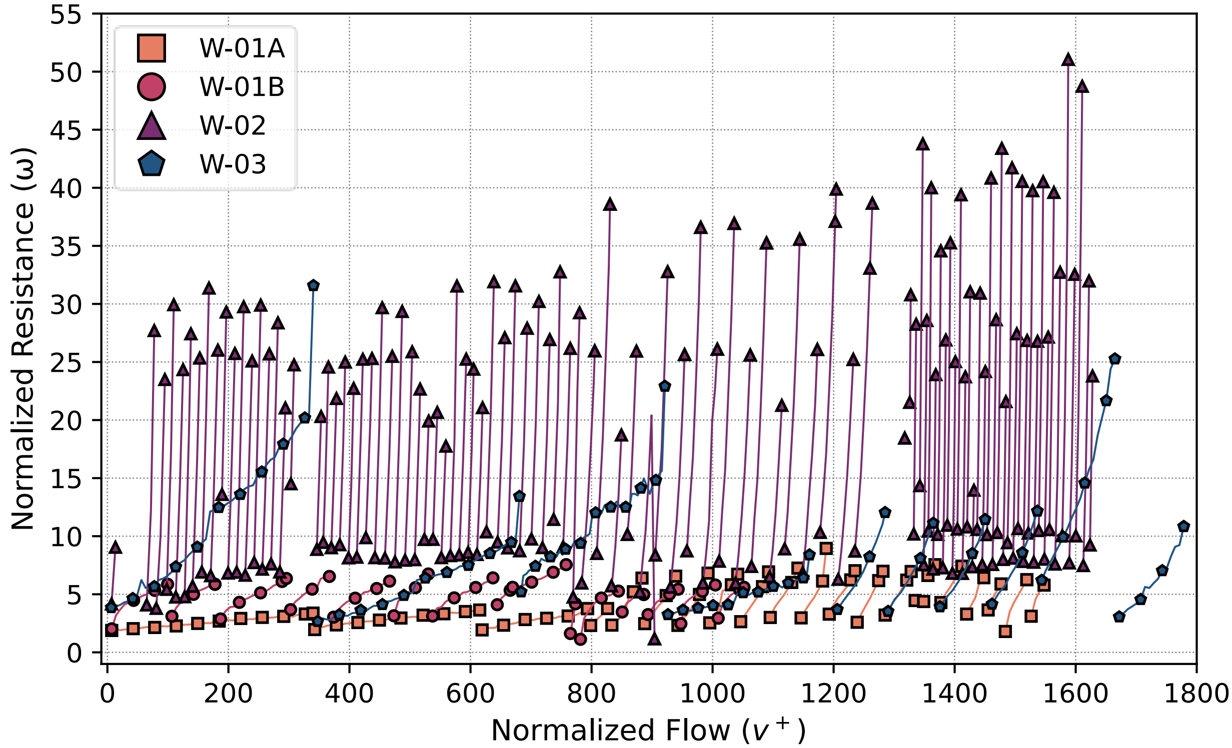

Figure 6.43. Normalized resistance (ω) over normalized flow (v^+) compared for runs W-01A, W-01B, W-02, and W-03.

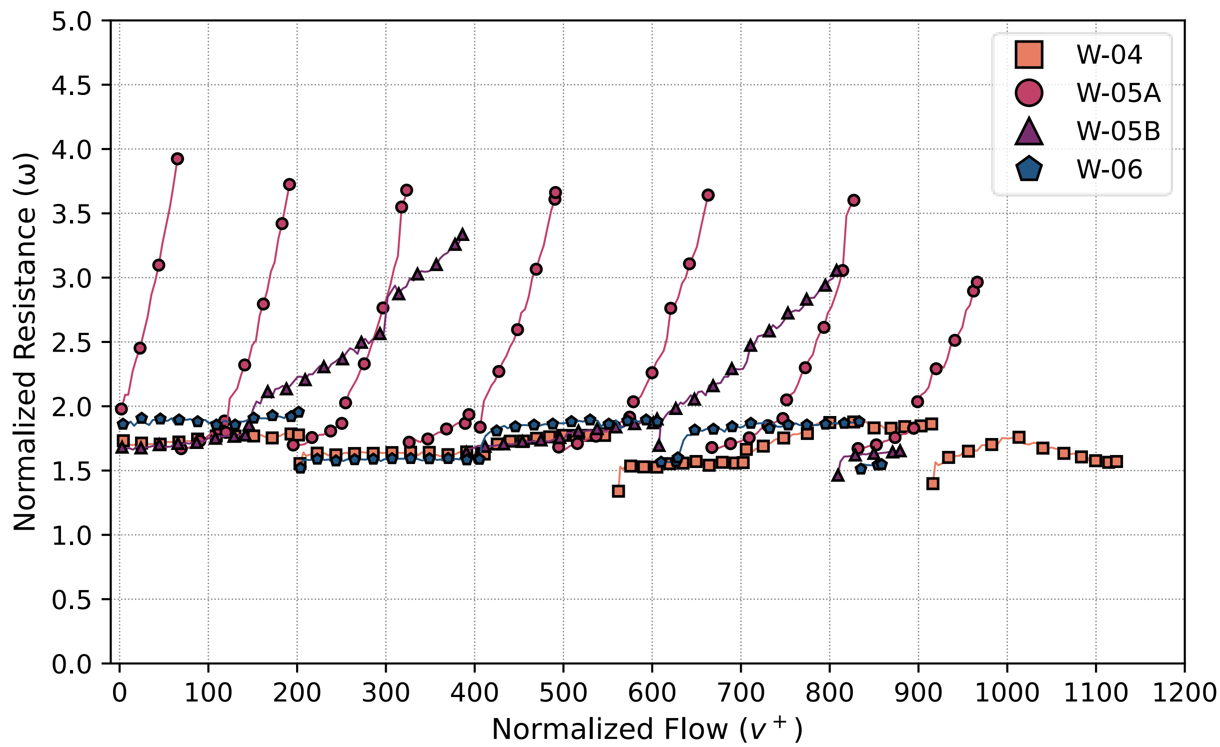

Figure 6.44. Normalized resistance (ω) over normalized flow (v^+) compared for runs W-04, W-05A, W-05B, and W-06.

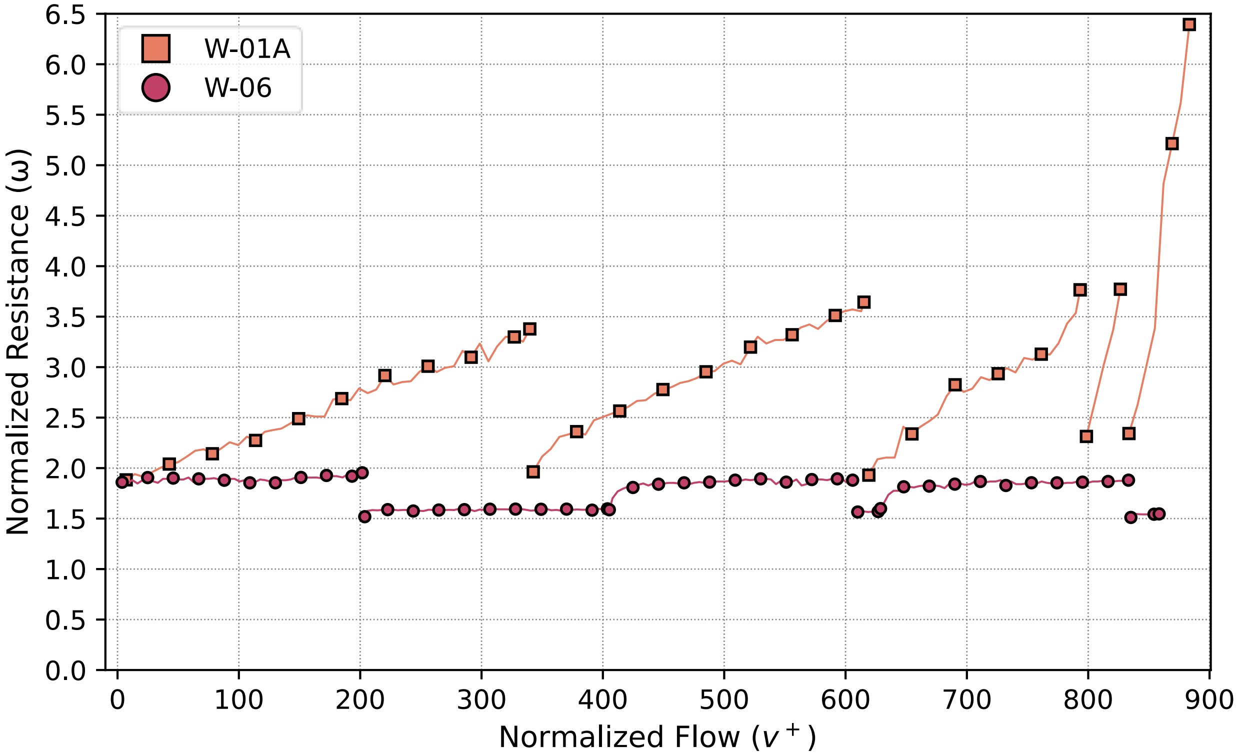

Figure 6.45. Normalized resistance (ω) over normalized flow (v^+) compared for the first part of run W-01A to the entirety of run W-06.

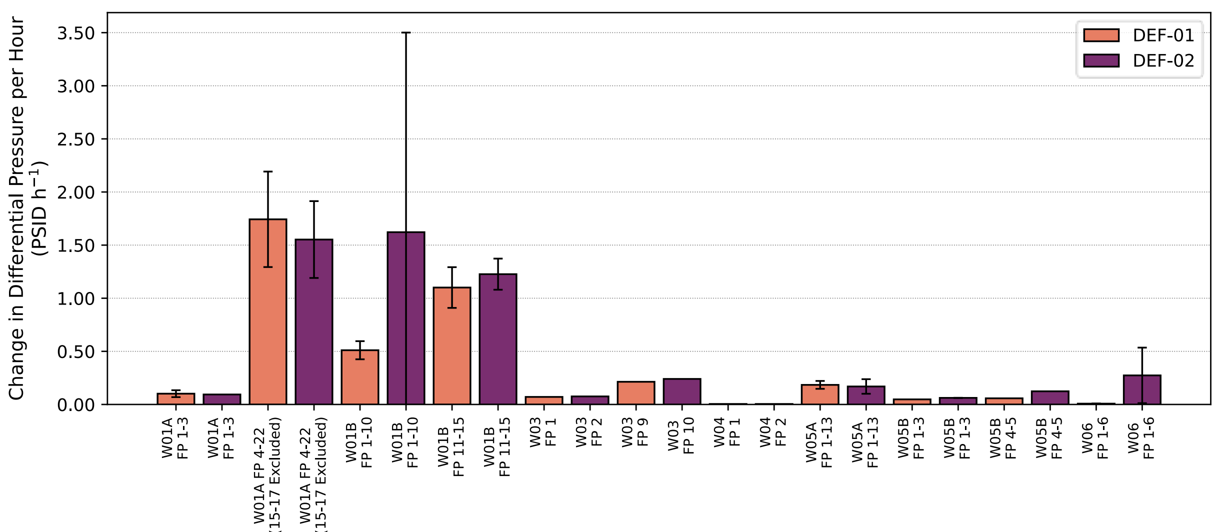

Figure 6.46. Differential pressure rate of change (with standard deviation bars) for each run. Run W-02 is excluded due to its high slope dwarfing other values. All differential pressure rate of change data are for flow rates of 130 mL min^{-1}. To see run-specific differential pressure rate of change data, see Appendix D.

6.8.2 Cesium Breakthrough Data for All Runs

Assessing the IXC performance was not a stated objective of the experimental program because the focus was on the behavior of the DEFs in the presence of 200W simulants with representative solid components and loadings. As was noted in each run-specific discussion earlier in the section, the IXC differential pressure was comparable to prior data measured by Schonewill et al. 2021 and did not show any evidence of solids accumulation or deposition over time. However, because the IXC is an integral part of the hydraulic response of the system, the column was packed with CST at the beginning of W-01. The CST remained in the column for all runs discussed in this report, which presented a unique opportunity to observe cesium removal performance of CST when it experienced an array of different simulants, flow rates, and temperatures. The CST media also was idle for periods between runs, during which it sat in the column after being blown down for an hour with compressed air.[1]

Figure 6.47 presents the cesium concentrations, as determined by ICP-MS analysis for the non-radiological cesium isotope Cs-133 from samples collected during experiments. The concentrations for each run (excluding W-06) include the values in the feed (TK-01) as indicated by solid diamonds and values in the effluent (liquid entering TK-03) as indicated by the lighter shaded circles of the same color. The data is presented as a continuous elapsed time series that ignores the passage of time between each run. For an idea of the approximate downtime between a pair of runs, refer to the start dates indicated in Table 4.3 and subtract around 10 days. W-01A had the largest Cs-133 concentration (~4100 µg L^{-1}), after which it was reduced by a factor of ~5 in W-01B when processed liquid was used to dilute the solid content in TK-01. The remaining runs all had feed concentrations between ~1000 and 2000 µg L^{-1}.

[1] Blowing down IXCs with compressed air is commonly performed in full-scale field deployments, i.e., TSCR, but only to prepare a column for removal and replacement. Therefore, CST sitting partially loaded with cesium in a column between periods of liquid processing is also unique to this experimental program and is not standard practice in Hanford Site use to-date

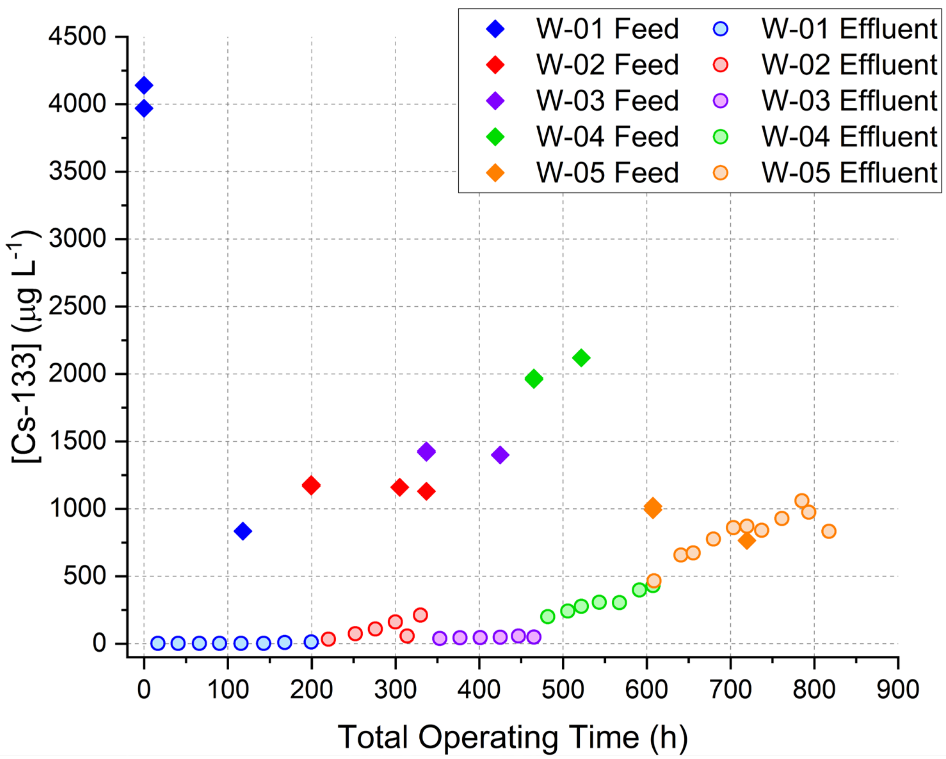

Figure 6.47. Evolution of cesium concentration during the experimental runs. The data is shown as continuous but there were periods of downtime between each run. Note: Samples were not analyzed for Run W-06.

If the feed concentrations shown in Figure 6.47 are used to normalize the effluent concentrations that occur after that point, a single breakthrough curve can be estimated from the data. The curve for this data is shown in Figure 6.48. This is an oversimplification of the data – which would more appropriately be handled with an integral approach – but it provides an estimate of the Cs breakthrough behavior under these conditions. The BV was also approximated by assuming that the flow rate was always 130 mL min^{-1}, which is imprecise but accurate on average. Proper accounting of the flow rate would both stretch and dilate the spacing between sample points at various spots depending on if the flow rate was greater or less than 130 mL min^{-1}. Note that there were also periods of operation at 16 °C, which represent <10% of the total run time.

Despite the simplifications and estimates, the breakthrough curve is consistent with what would be expected of CST based on historically collected performance data. Most of run W-01 did not show any detectable Cs, which is similar to the test results from Schonewill et al. 2021. After that point, the data (in general) continues to increase toward full breakthrough, which occurred at ~1300 BVs. Fifty-percent breakthrough occurred slightly earlier (perhaps 1100 to 1150 BVs); this is on par with the observations made in Westesen et al. 2026 (see Figure 4.1, Column A), which was performed with the same S1 material that was used in W-01.

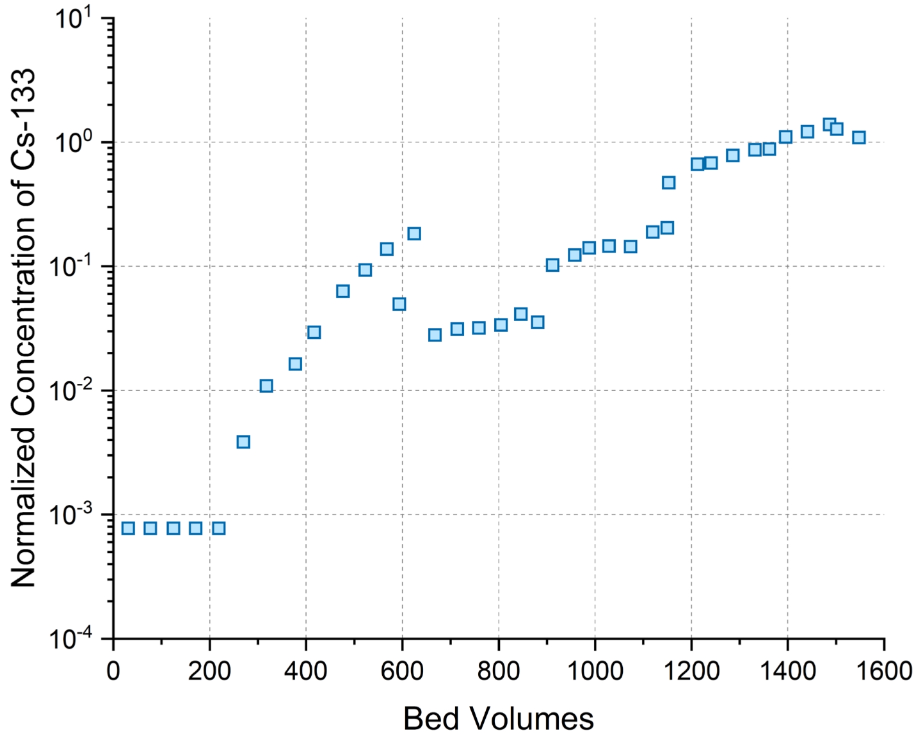

Figure 6.48. Normalized cesium concentration vs. approximate bed volume processed. The bed volume was estimated using a constant flow rate of 130 mL min^{-1} – this was the most commonly used flow rate during the experiments, but flow rate did vary.

7.0 Summary of Experimental Campaign

Six experimental runs were performed to assess the response of DEF modules to five different solid-containing simulants representative of retrieved 200W waste feeds. The experiments used a scaled system prototypic of Hanford site pretreatment processing systems (Schonewill et al. 2021) adopted for use in this campaign. The first three runs used DEFs scaled to match the filter flux of TSCR (LS1 configuration), and the second set of three used DEFs scaled to match the filter flux of the 200W PMs (LS2 configuration). The important observed outcomes of the runs are summarized in Table 7.1.

Table 7.1. Summary of Experimental Runs Conducted and Key Outcomes.

Run ID / *Simulant ID* / System Configuration	Simulant Represents	Solids Loading *Nominal* / Measured	Observed Outcome(s)
W-01 *S1* LS1	First feed waste (SY tanks)	*130 / 30 ppm* Initially 180 ppm >500 ppm after pump-in 120 ppm at the end, after dilution	• >16 h between backflushes for initial filter periods (when differential pressure increase reached 2 psid) • Shifted to more rapid differential pressure increase thereafter at both higher and lower solids loading (5 psid in ~4-6 h) • DEFs performed their function even at elevated solids loading
W-02 *S2* LS1	Earlier retrieved S farm tank waste	*50 ppm* Started at 400 ppm, at mid-point 100 ppm	• Difficult to filter from the start; differential pressure increased to ~25 psid in ~1 h • Colloidal, "sticky" solids were small and seemed to cause irreversible fouling • DEFs required acidic clean after run
W-03 *S3* LS1	Earlier retrieved U farm tank waste	*100 ppm* 140 – 150 ppm	• Initial filter periods ran for 24 h before backflushing (increase in differential pressure < 2 psid) • Adjusting flow rate accelerated or decelerated rate of differential pressure change
W-04 *S4* LS2	Later retrieved U farm tank waste	*20 ppm* 80 – 90 ppm	• All filter periods achieved 24 h of run time before backflushing (increase in differential pressure < 2 psid) • Gradient changes in flow rate did not significantly impact performance
W-05 *S5* LS2	Later retrieved S farm tank waste	*500 / 100 ppm* Started at 960 ppm 690 ppm after pump-in Diluted to 270 ppm	• In first part (higher solids loading), DEFs operated for ~10 h before backflushing (differential pressure increase reached 2 psid) • In second part (lower solids loading), DEFs ran for 24 h before a backflush was needed (differential pressure increase typically ~1 psid)
W-06 *S1* LS2	First feed waste (SY tanks)	*130 ppm* 210 ppm	• Repeat of first part of W-01 demonstrated reduction in differential pressure increase (~0.5 psid over 24 h) for DEFs scaled to 200W filter flux

The runs were conducted by processing the representative 200W waste simulant solutions at controlled flow rates (nominally 130 mL min^{-1}) and temperature (nominally 22 °C); in some runs, the flow rate (ranging from 91 to 195 mL min^{-1}) and/or temperature (reducing to 16 °C) was adjusted for a portion to examine their impact on filtration behavior. Apart from W-06, every run processed ~300 gal (or greater) over the course of >6 days.

Key observations and conclusions based on operational observations and the assessment of data collected from the entire campaign include the following:

- The DEFs successfully protected the IXC for all the representative simulants processed in the campaign. This conclusion is supported by:
  - Filtrate samples (post-DEF) that were not observed to contain solid particles.
  - No solid deposits were found after visual examination of the CST bed after some runs.
  - The measured ΔP data at all three heights in the IXC showed no appreciable increase over time in any of the runs.
  - The guard filters (FLT-01A, FLT-01B) did not experience substantial plugging events (except immediately after starting flow through the CST bed at the beginning of a run, which tended to dislodge a few CST fines).
  - The flow meter FM-02 and its associated control valve V-24 performed without issue for the entire campaign.
  - The estimated breakthrough curve demonstrated expected cesium removal performance.
- Solids loadings ≤ 500 ppm are within the capability of the DEFs to process without significant ΔP increases. This is best evidenced by the performance of the 200W PM-scaled DEFs used in W-04, W-05, and W-06, i.e., the LS2 configuration, which filtered simulants up to 500 ppm without rapid differential pressure increases.
  - This observation should hold for the types of solid particles that are expected in 200W waste feeds assuming the basis for the solid components used in the current campaign (refer to Schonewill et al. 2024) remains valid.
  - The performance data from run W-02 demonstrated that the DEFs are also impacted by what the solids are, not solely their concentration; solids of the sort found in the S2 simulant (recall these are discussed in detail in Section 4.2.4.3) had an adverse effect at solids loadings < 500 ppm.
  - As a counterpoint, Runs W-01A and W-05 demonstrated that even solid concentrations > 500 ppm (when the particles not colloidal and slightly larger) can be filtered readily.
  - Therefore, both the amount and the nature of the solids can impact filter performance when handling saturated salt solutions typical of 200W waste; unfortunately, a more dilute waste with particularly challenging solids will be substantially more difficult to predict or detect in 200W waste feeds than the solids loading.
- The DEFs exhibit changes in the rate of ΔP increase when the flow rate is adjusted, but this did not appear to affect their ability to recover performance after backflushing. Higher flow rates accelerate the rate of ΔP increase over lower flow rates. Note that the magnitude of the normalized resistance is not substantially impacted and increased throughput did not cause irreversible fouling in these runs.
- Operating at reduced temperature (16 °C) slightly increased the ΔP across the filters, but this was caused primarily by the increase in liquid viscosity. No significant precipitation was observed in W-01 and W-03. W-05B appeared to experience some precipitation (based on PSD data) and the DEF experienced a small increase in the rate at which the ΔP increased.

- Backflushing reliably recovered DEF performance back to its baseline state (initial resistance prior to the start of operations), except in the presence of solids that irreversibly foul. Even in the presence of irreversible fouling (Run W-02), the backflush permitted operation to continue for many periods.
- Data collected during this campaign agrees with the conclusion of Schonewill et al. 2021: The TSCR and 200W PM configuration and operational approach are robust. Key elements of the system, such as the recirculation/slip stream configuration, downstream flow control, and filter backflush protocols, can be applied without issue to maintain throughput and protect the IXC.

Quantifying the difference between the LS1 (TSCR-scaled DEFs) and LS2 (200W PM-scaled DEFs) configurations is challenged by the uniqueness of each run, which processed different simulants at different solids loadings. A comparison between the initial portion of W-01 (first half of W-01A) and W-06 – which did use the same simulant material (S1) – indicates that the LS2 configuration significantly reduced the rate of differential pressure increase and allowed the DEFs to be operated for (at least) a 24-h period with essentially a negligible increase in resistance ($\omega \sim 1$). In general, the runs conducted with the LS2 configuration had greatly reduced rates of ΔP increase and, for the most part, the 200W PM-scaled DEFs were able to operate for an entire 24-h period before backflushing. This suggests that the larger surface area filter modules planned for use in AMPS and 200W will be exhibit slower rates of ΔP increase than a TSCR-sized filter module.

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Appendix A – Analytical Data: Liquid Chemistry and Solid Phase Identification

This appendix collates analytical data collected from run samples collected across the experimental program. The first section covered data from chemical analysis of the liquid phase of each simulant used (Section A.1) and the second section collects solid phase identification data of solids recovered from system feed samples (Section A.2).

A.1 Liquid Chemical Analysis Data Comparisons

The first has the chemical concentrations of major analytes determined from the analytical techniques described in Section 4.2.3.1. Each figure contains data from all experimental runs for a single analyte as described in the reference list that follows. The liquid simulants correspond to the filtration performance experiments with the same number, i.e., W-01 used S1, W-02 used S2, and so on. The exception is Run W-06, which used a second batch of S1 simulant; however, W-06 samples were not analyzed and the simulant used in that run is represented by the “S1 Tote #2” data. For each run, samples were collected from the as-received tote (“S# Tote”), the initial feed in TK-01 via the recirculation line (“Initial Feed”), and one or two additional points during the run (typically around the midpoint, after dilution of the TK-01 contents, or at the end of the run). The sample data (triangles) is compared to the recipe targets (circles). The detection limit for the analysis is shown by the shaded region.

The analytes in the figures are: aluminum (Figure A.1), calcium (Figure A.2), cesium (Figure A.3), chloride (Figure A.4), chromium (Figure A.5), fluoride (Figure A.6), free hydroxide (Figure A.7), nitrate (Figure A.8), nitrite (Figure A.9), phosphate (Figure A.10), potassium (Figure A.11), sodium (Figure A.12), strontium (Figure A.13), sulfate (Figure A.14), and total carbon (Figure A.15).

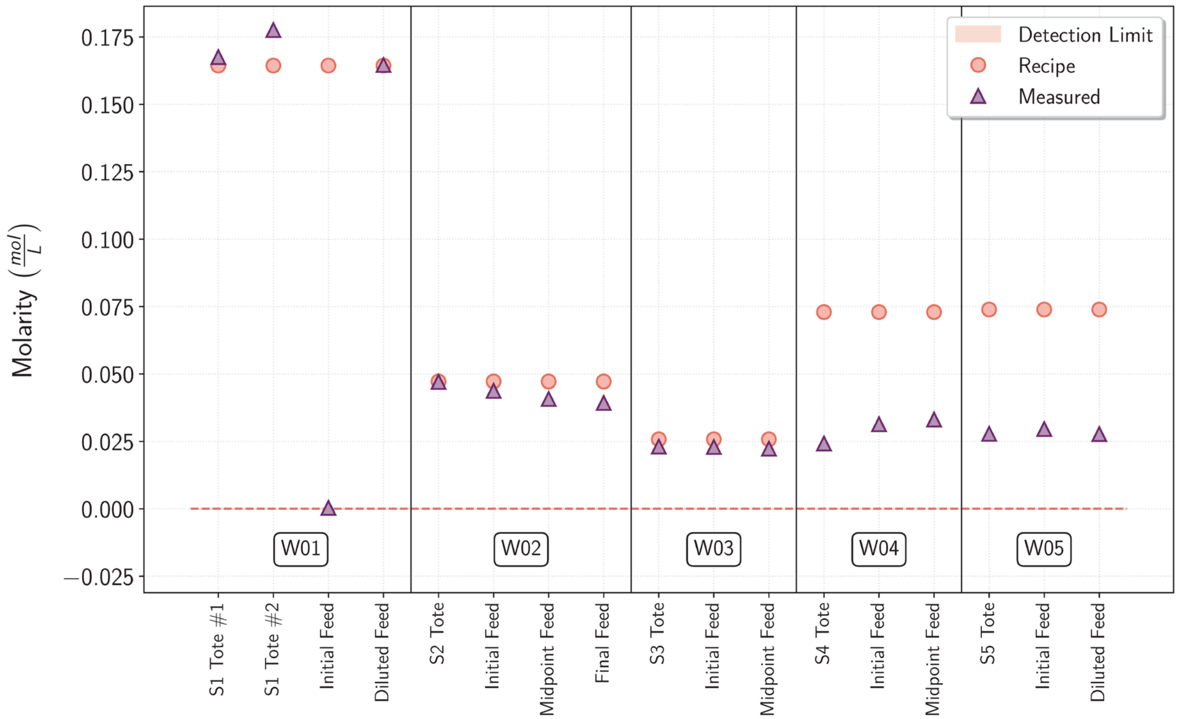


Figure A.1. Concentrations of aluminum in the liquid phase measured from samples and compared to the target (recipe) values for each experimental run. The detection limit of the analytical technique is indicated by the dashed line and, if visible, a shaded region.

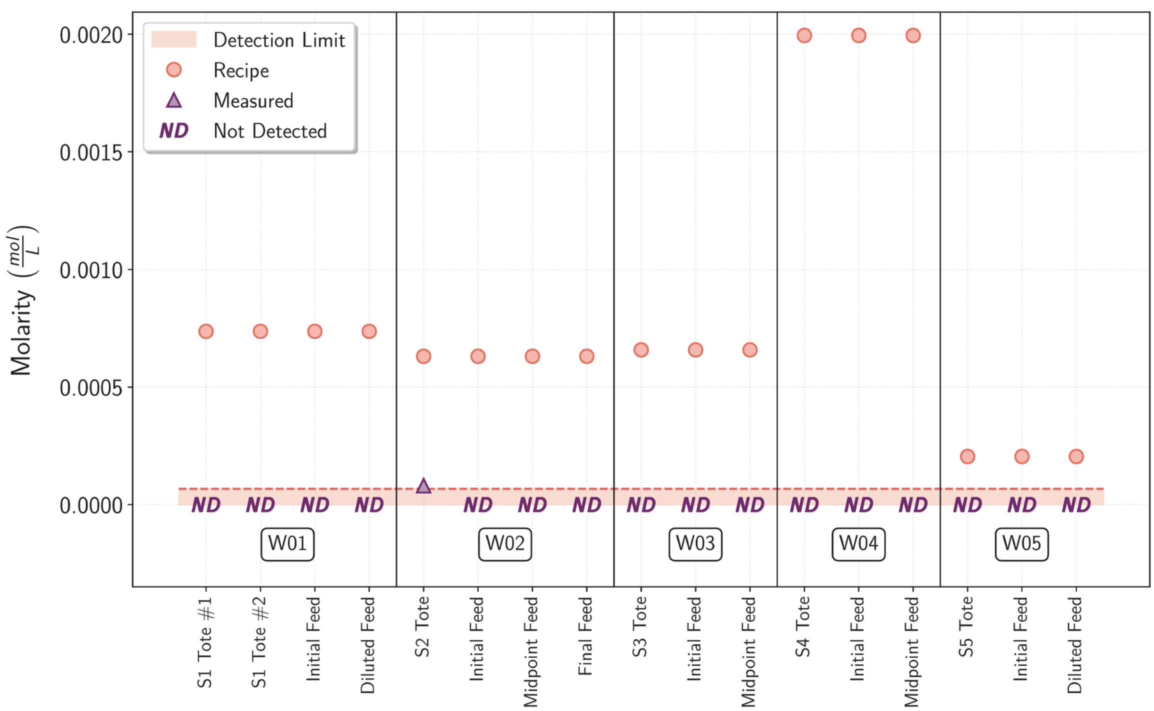


Figure A.2. Concentrations of calcium in the liquid phase measured from samples and compared to the target (recipe) values for each experimental run. The detection limit of the analytical technique is indicated by the dashed line and, if visible, a shaded region.

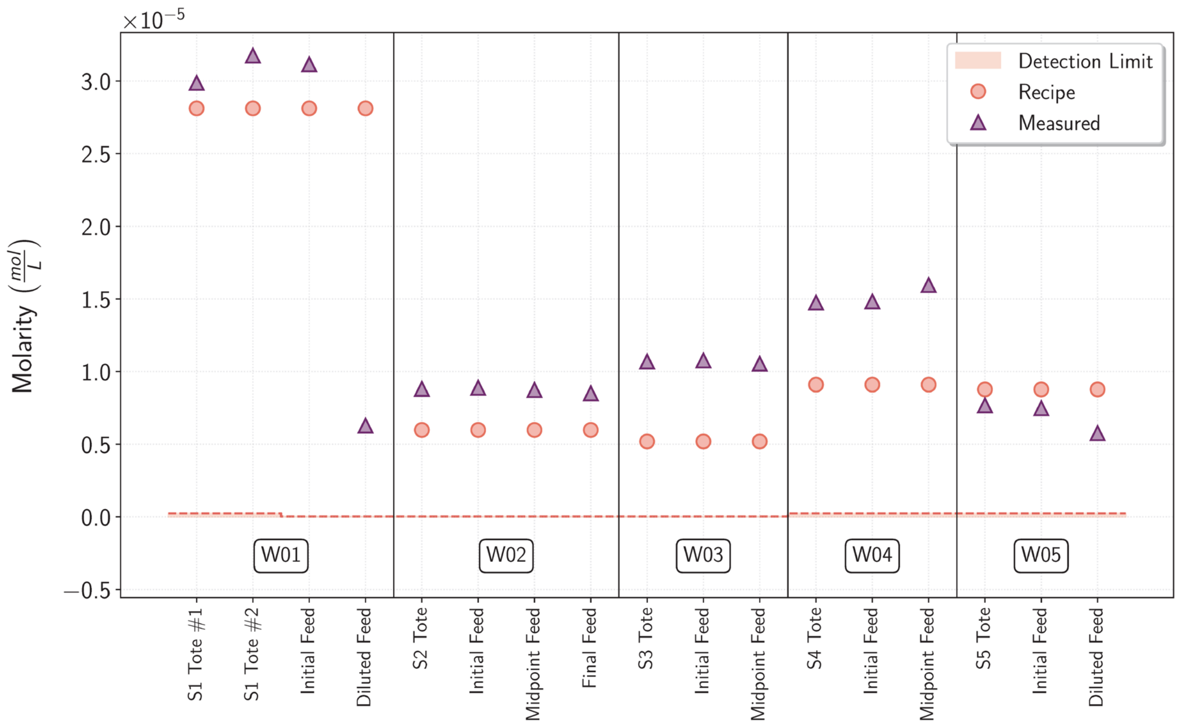


Figure A.3. Concentrations of cesium (Cs-133) in the liquid phase measured from samples and compared to the target (recipe) values for each experimental run. The detection limit of the analytical technique is indicated by the dashed line and, if visible, a shaded region.

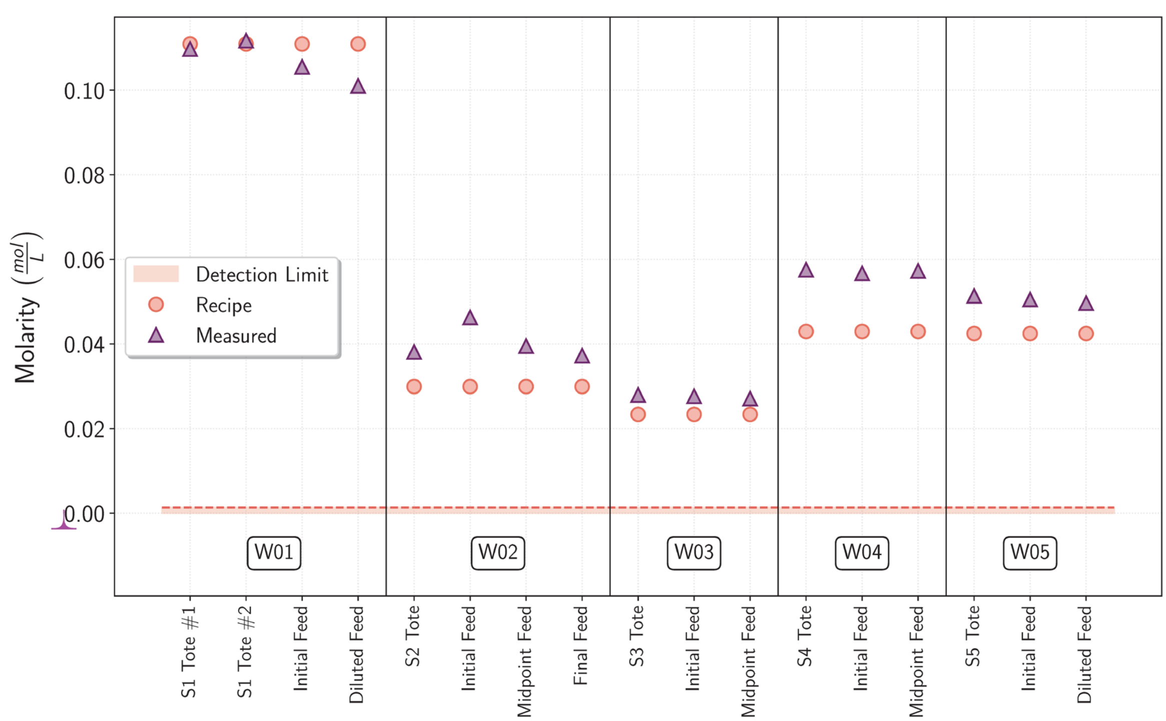


Figure A.4. Concentrations of chloride in the liquid phase measured from samples and compared to the target (recipe) values for each experimental run. The detection limit of the analytical technique is indicated by the dashed line and, if visible, a shaded region.

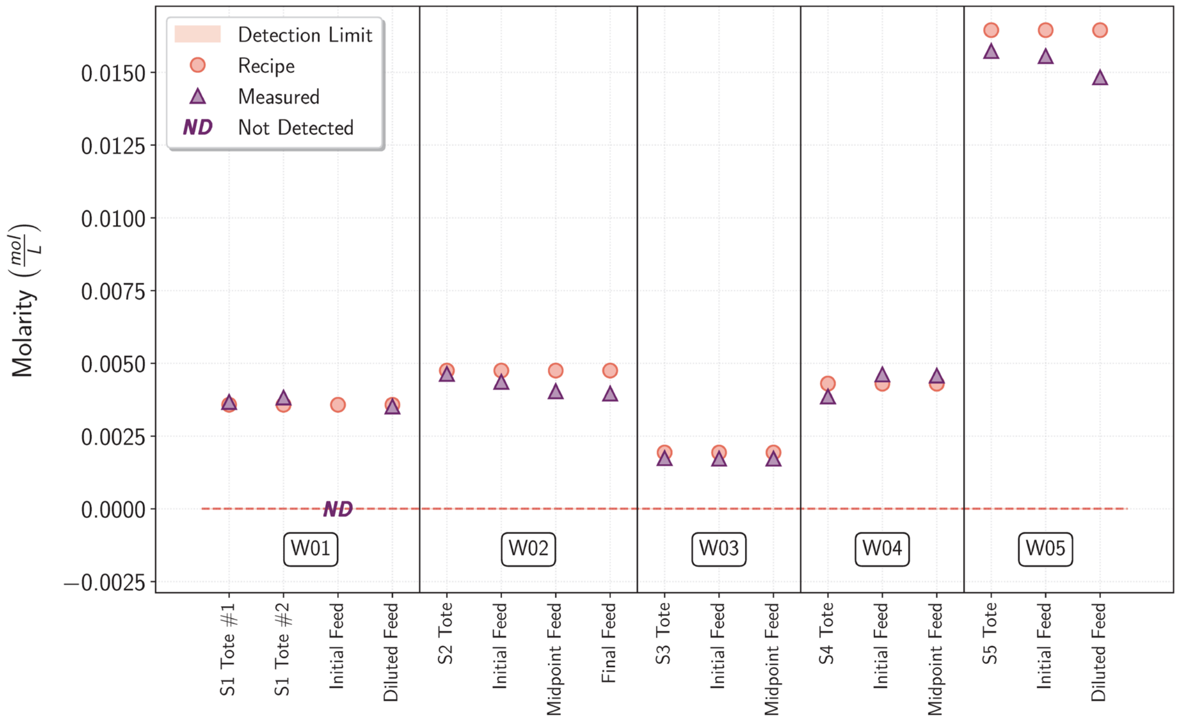


Figure A.5. Concentrations of chromium in the liquid phase measured from samples and compared to the target (recipe) values for each experimental run. The detection limit of the analytical technique is indicated by the dashed line and, if visible, a shaded region.

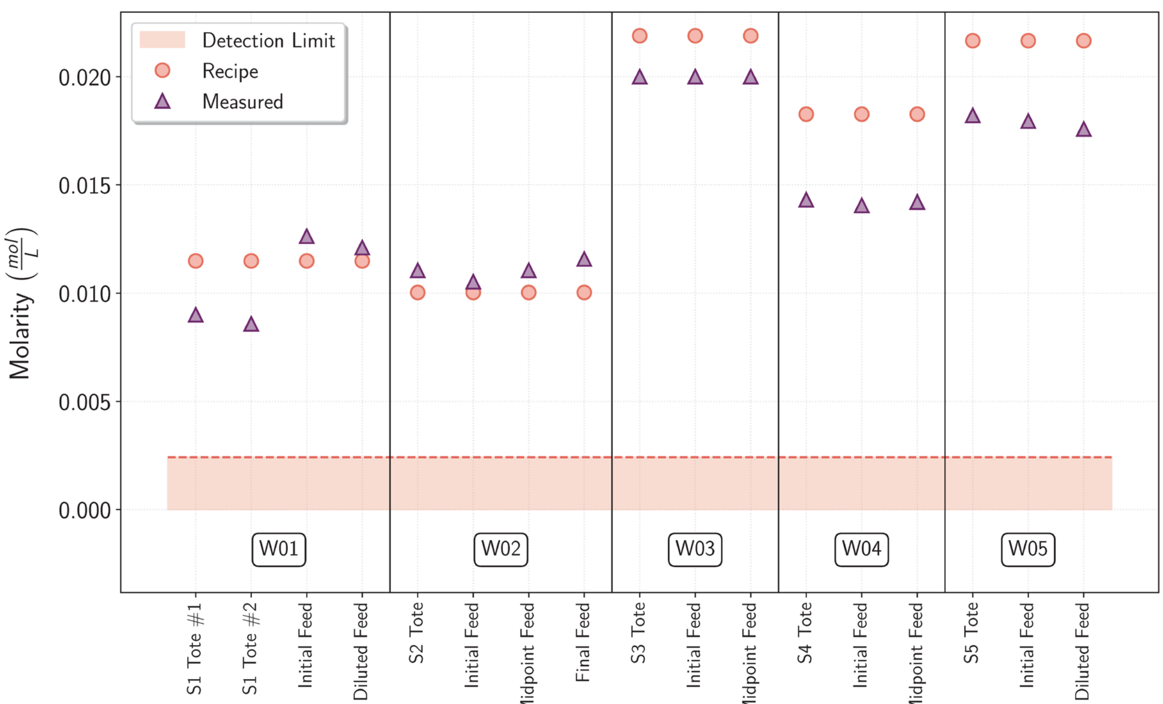


Figure A.6. Concentrations of fluoride in the liquid phase measured from samples and compared to the target (recipe) values for each experimental run. The detection limit of the analytical technique is indicated by the dashed line and, if visible, a shaded region.

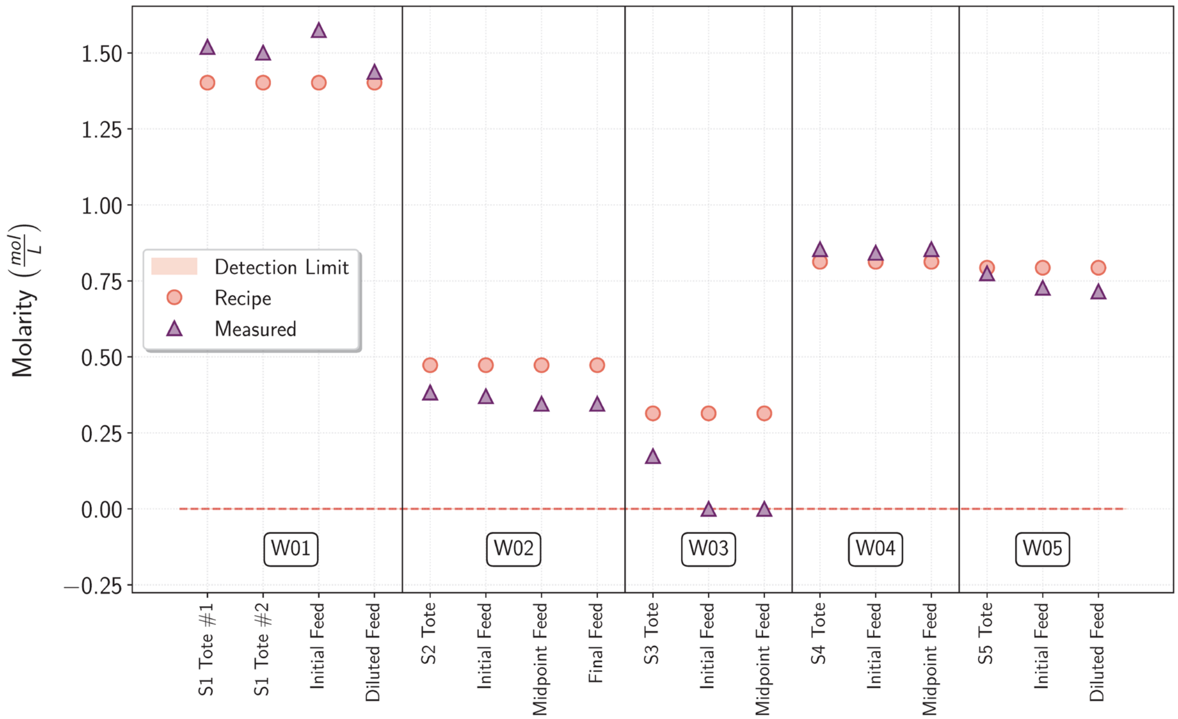


Figure A.7. Concentrations of free hydroxide in the liquid phase measured from samples and compared to the target (recipe) values for each experimental run. The detection limit of the analytical technique is indicated by the dashed line and, if visible, a shaded region

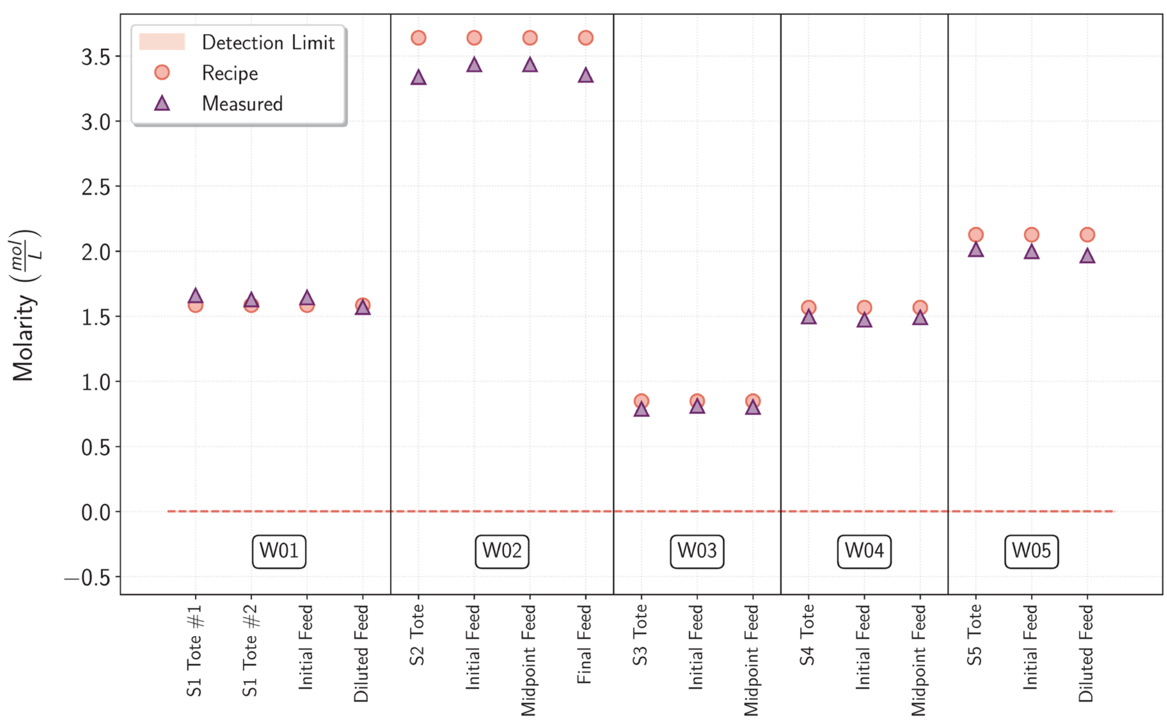


Figure A.8. Concentrations of nitrate in the liquid phase measured from samples and compared to the target (recipe) values for each experimental run. The detection limit of the analytical technique is indicated by the dashed line and, if visible, a shaded region.

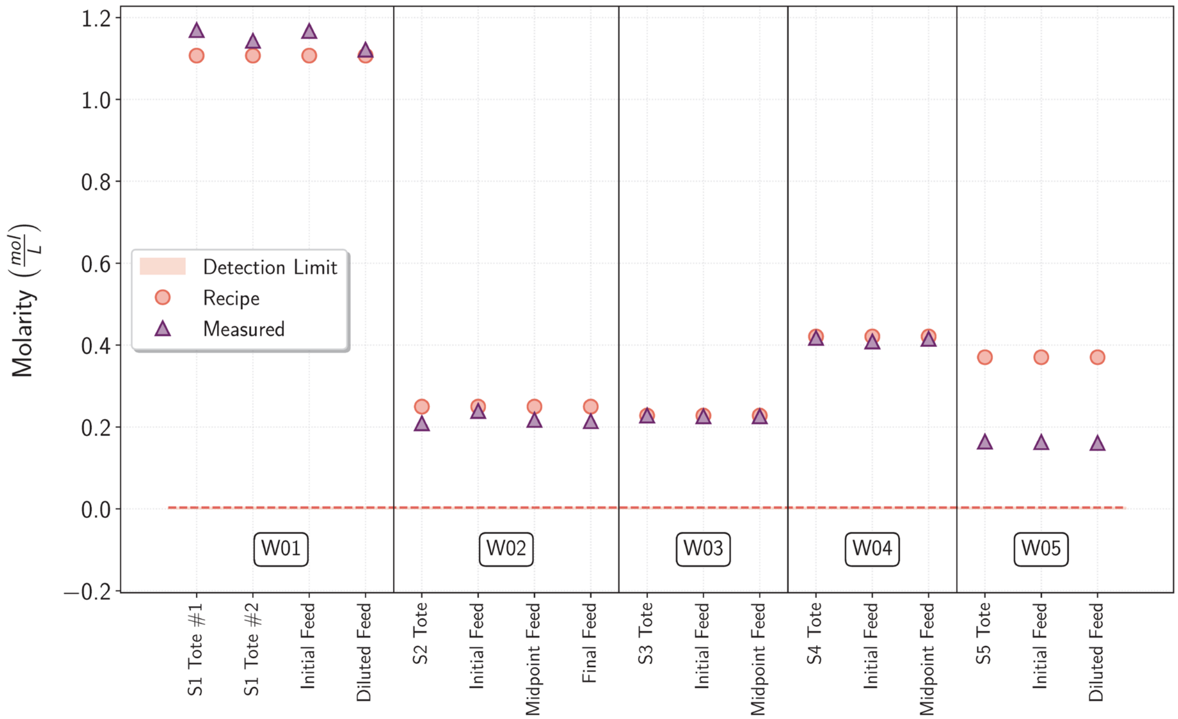


Figure A.9. Concentrations of nitrite in the liquid phase measured from samples and compared to the target (recipe) values for each experimental run. The detection limit of the analytical technique is indicated by the dashed line and, if visible, a shaded region.

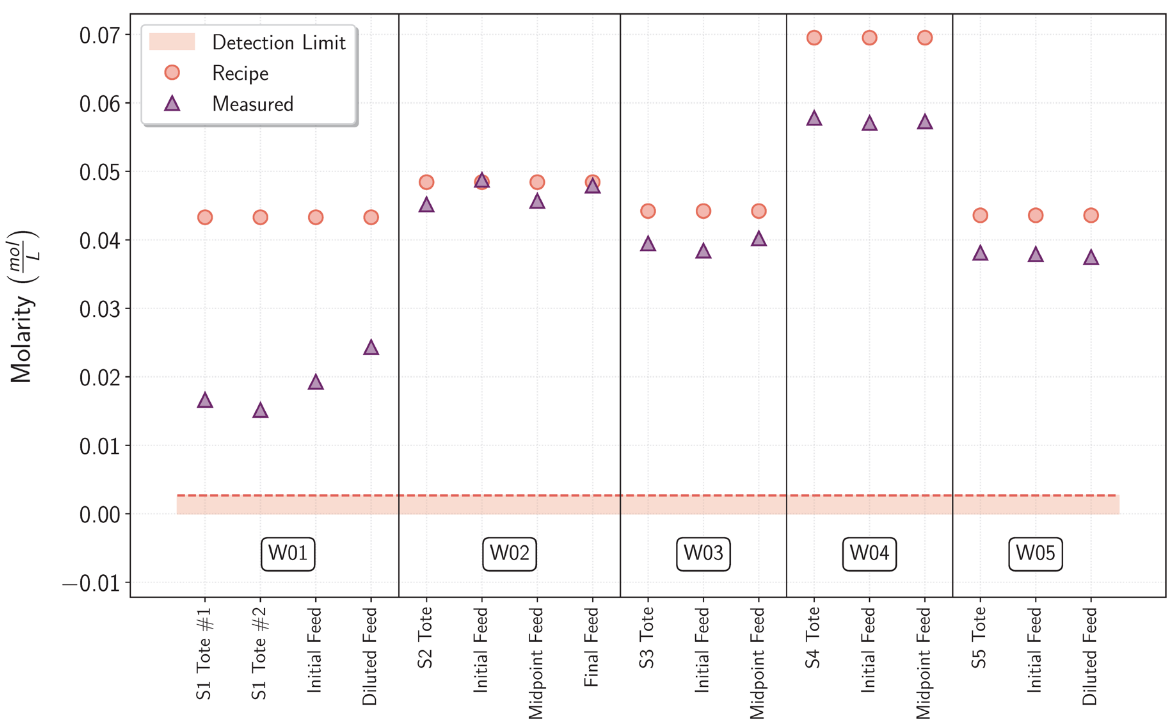


Figure A.10. Concentrations of phosphate in the liquid phase measured from samples and compared to the target (recipe) values for each experimental run. The detection limit of the analytical technique is indicated by the dashed line and, if visible, a shaded region.

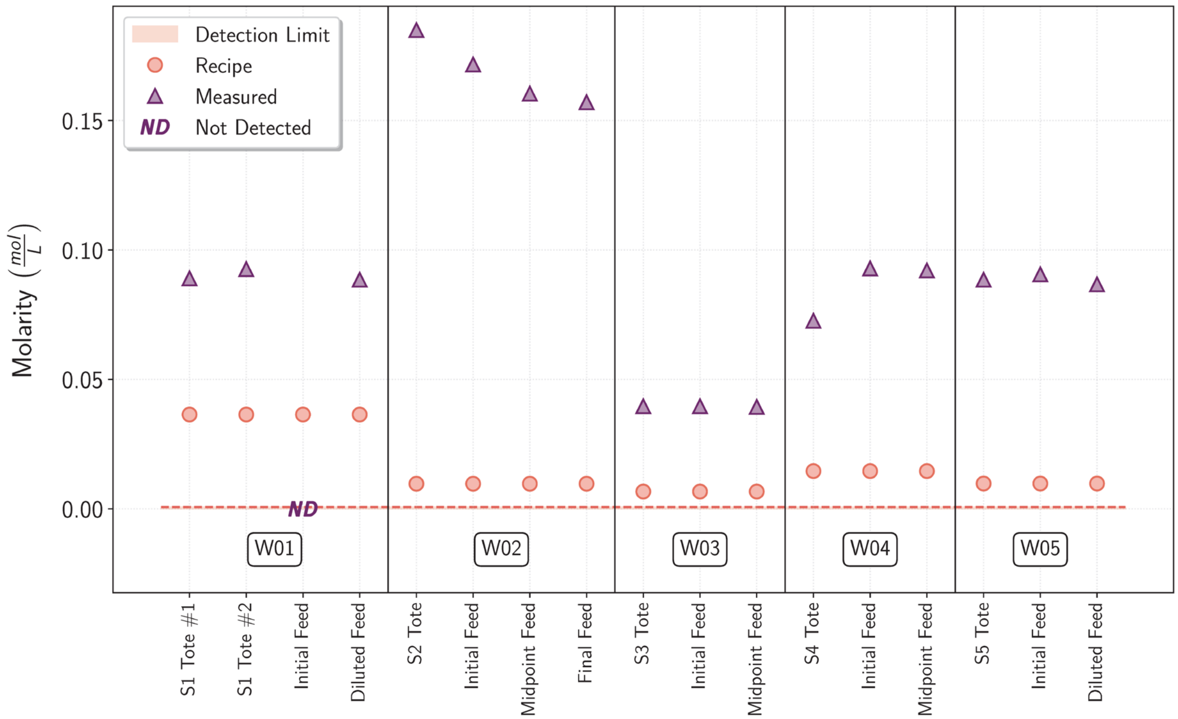


Figure A.11. Concentrations of potassium in the liquid phase measured from samples and compared to the target (recipe) values for each experimental run. The detection limit of the analytical technique is indicated by the dashed line and, if visible, a shaded region.

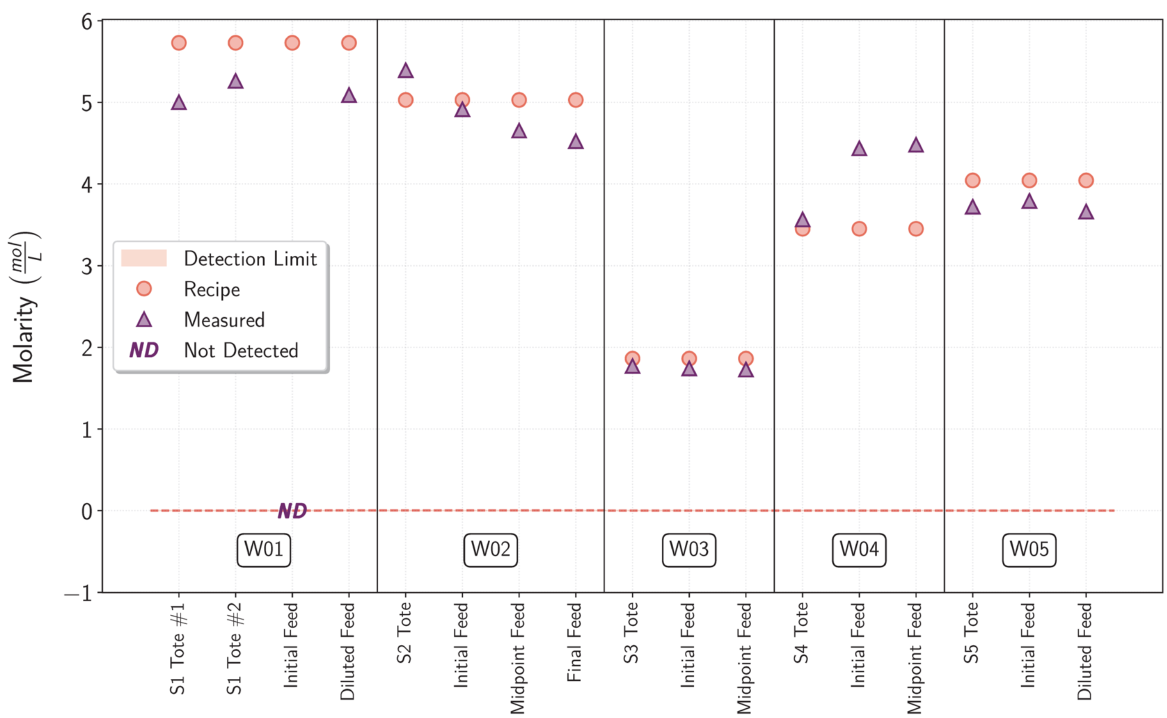


Figure A.12. Concentrations of sodium in the liquid phase measured from samples and compared to the target (recipe) values for each experimental run. The detection limit of the analytical technique is indicated by the dashed line and, if visible, a shaded region.

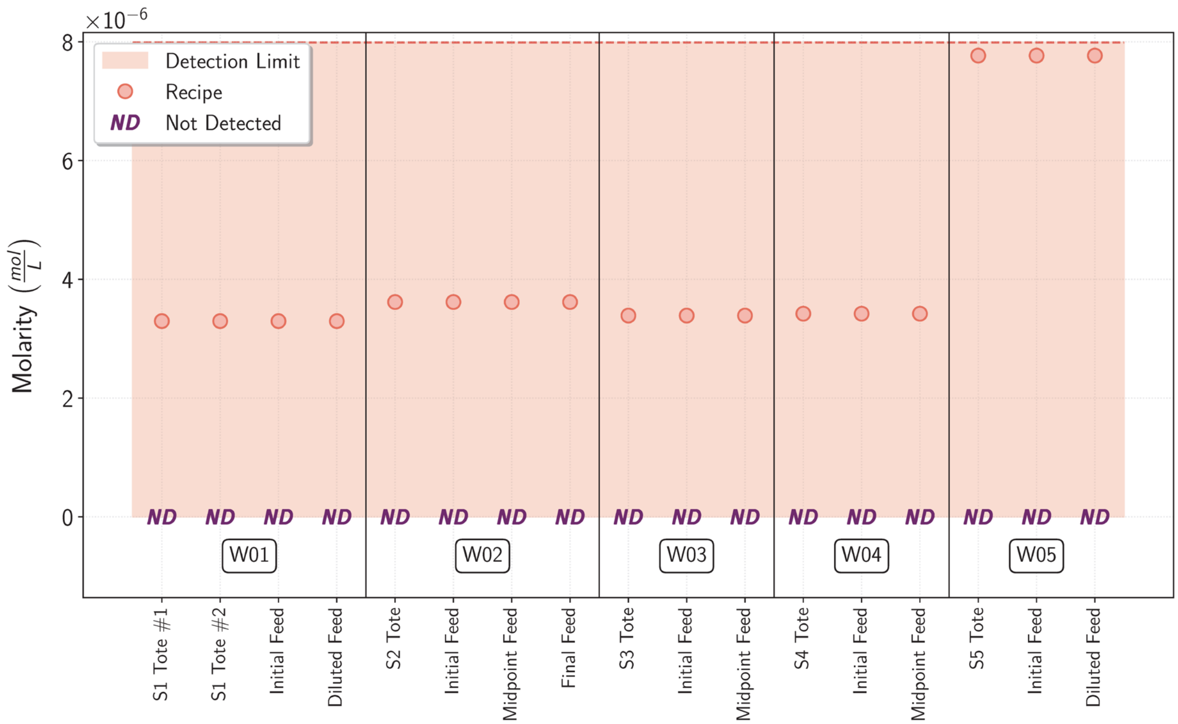


Figure A.13. Concentrations of strontium in the liquid phase measured from samples and compared to the target (recipe) values for each experimental run. The detection limit of the analytical technique is indicated by the dashed line and, if visible, a shaded region

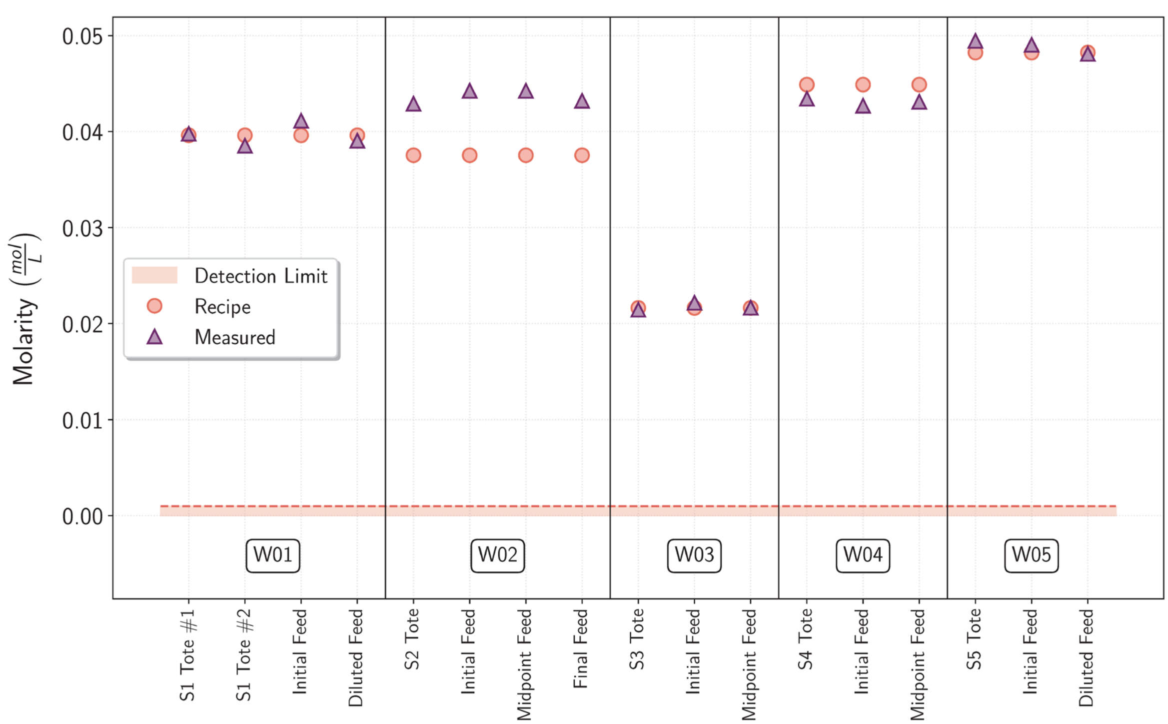


Figure A.14. Concentrations of sulfate in the liquid phase measured from samples and compared to the target (recipe) values for each experimental run. The detection limit of the analytical technique is indicated by the dashed line and, if visible, a shaded region

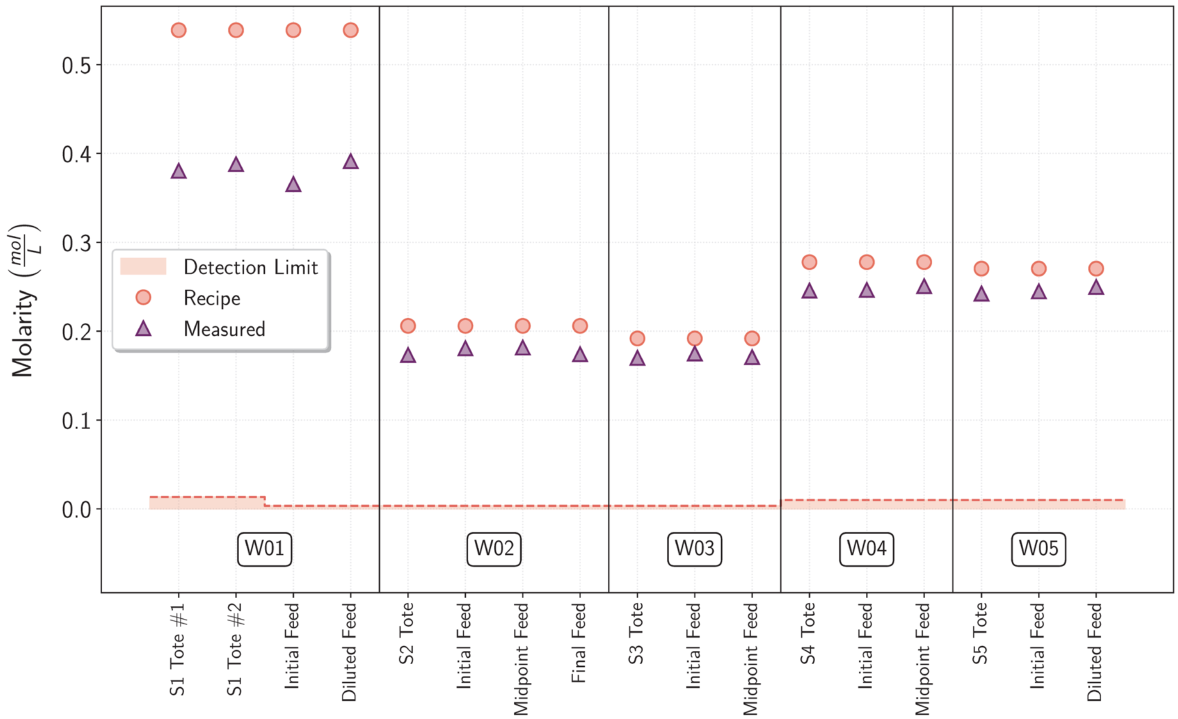


Figure A.15. Concentrations of total carbon in the liquid phase measured from samples and compared to the target (recipe) values for each experimental run. The detection limit of the analytical technique is indicated by the dashed line and, if visible, a shaded region

A.2 Solid Phase Analysis Data

This section presents all the XRD scan results for the individual samples that are discussed in Section 4.2.4.3. Each figure captures the peak identification and quantification of each identified phase. The samples with data that follows include:

- W02-S2-01 data is shown in Figure A.16. This was a preliminary *For Information Only* (non-quantitative) analysis performed on the initial feed sample from TK-01 at the start of run W-02.
- W01A-S1-05 data is shown in Figure A.17. The XRD scan analyzes solids from the initial feed sample collected at the start of run W-01A.
- W01B-S1-01 data is shown in Figure A.18. The XRD scan analyzes solids from the initial feed sample collected at the start of run W-01B, which was diluted W-01A simulant.
- W01B-S1-18 data is shown in Figure A.19: The XRD scan analyzes solids from a feed sample collected at the end of run W-01B, which was diluted W-01A simulant.
- W01B-S1-20 data is shown in Figure A.20. The XRD scan analyzes solids collected from the bottom of the S1 as-received tote. S1 was the simulant used in run W-01.
- W02-S2-28 data is shown in Figure A.21. The XRD scan analyzes solids from a feed sample collected at the midpoint of run W-02.

- W02-S2-31 data is shown in Figure A.22. The XRD scan analyzes solids collected from the bottom of the S2 as-received tote. S2 was the simulant used in run W-02.
- W03-S3-02 data is shown in Figure A.23. The XRD scan analyzes solids from the initial feed sample collected at the start of run W-03.
- W03-S3-02-1 data is shown in Figure A.24: The XRD scan is a duplicate analysis (of W03-S3-02) of the solids from the initial feed sample collected at the start of run W-03.
- W04-S4-02 data is shown in Figure A.25: The XRD scan analyzes solids from the initial feed sample collected at the start of run W-04.
- W05-S5-02 data is shown in Figure A.26: The XRD scan analyzes solids from the initial feed sample collected at the start of run W-05.

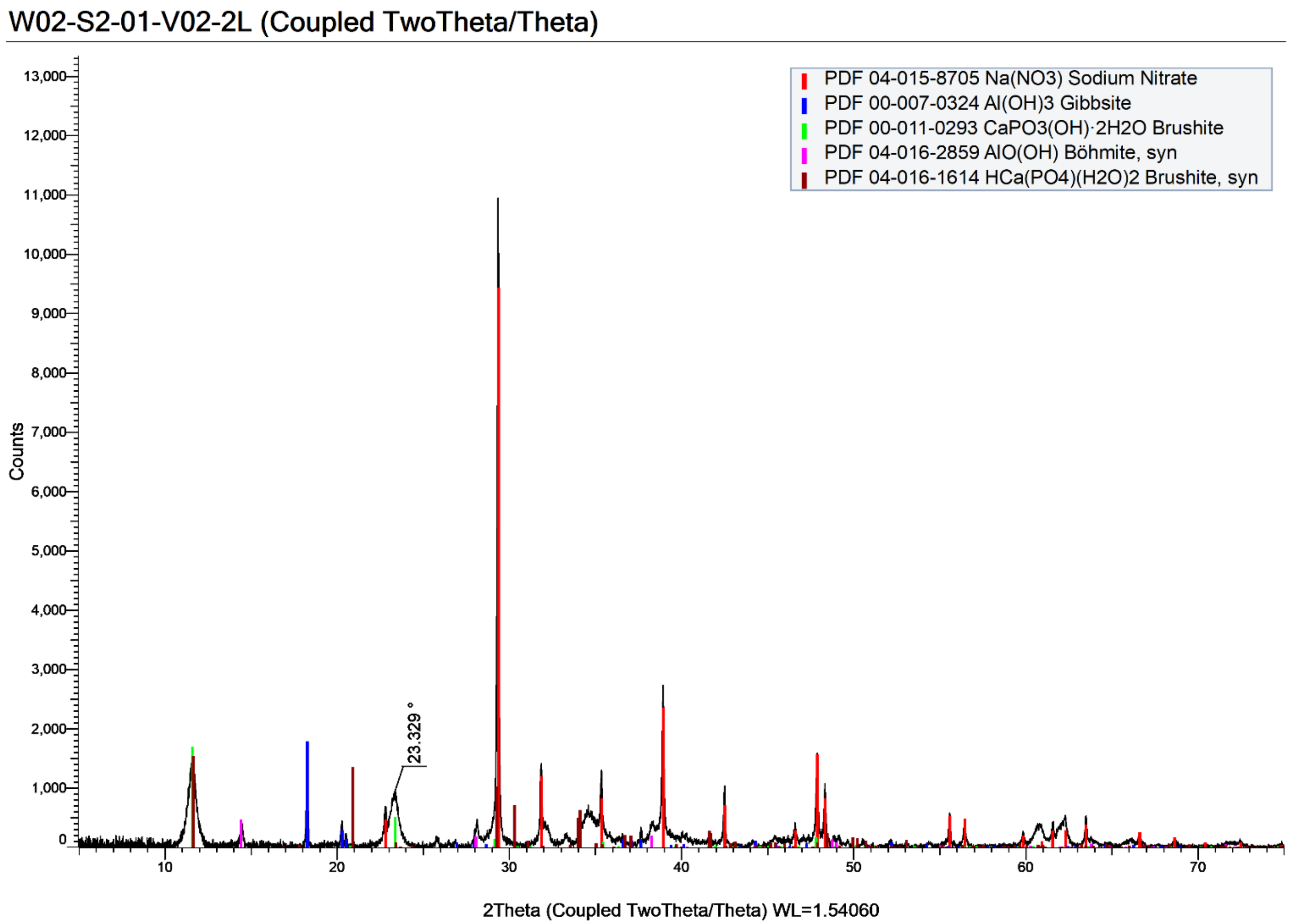
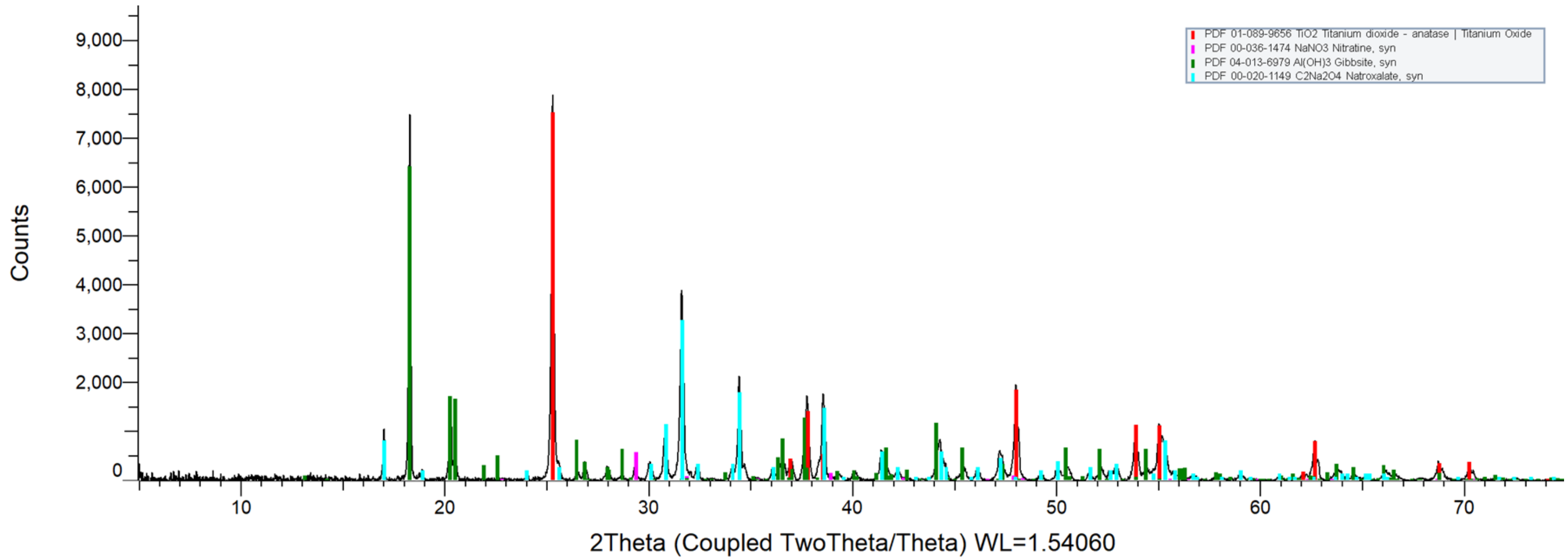


Figure A.16. Preliminary XRD scan conducted on sample W02-S2-01. The scan was not run with a standard and quantification of identified solid phases was not performed. This initial scan was performed to investigate W-02 feed solids and should be considered *For Information Only*.



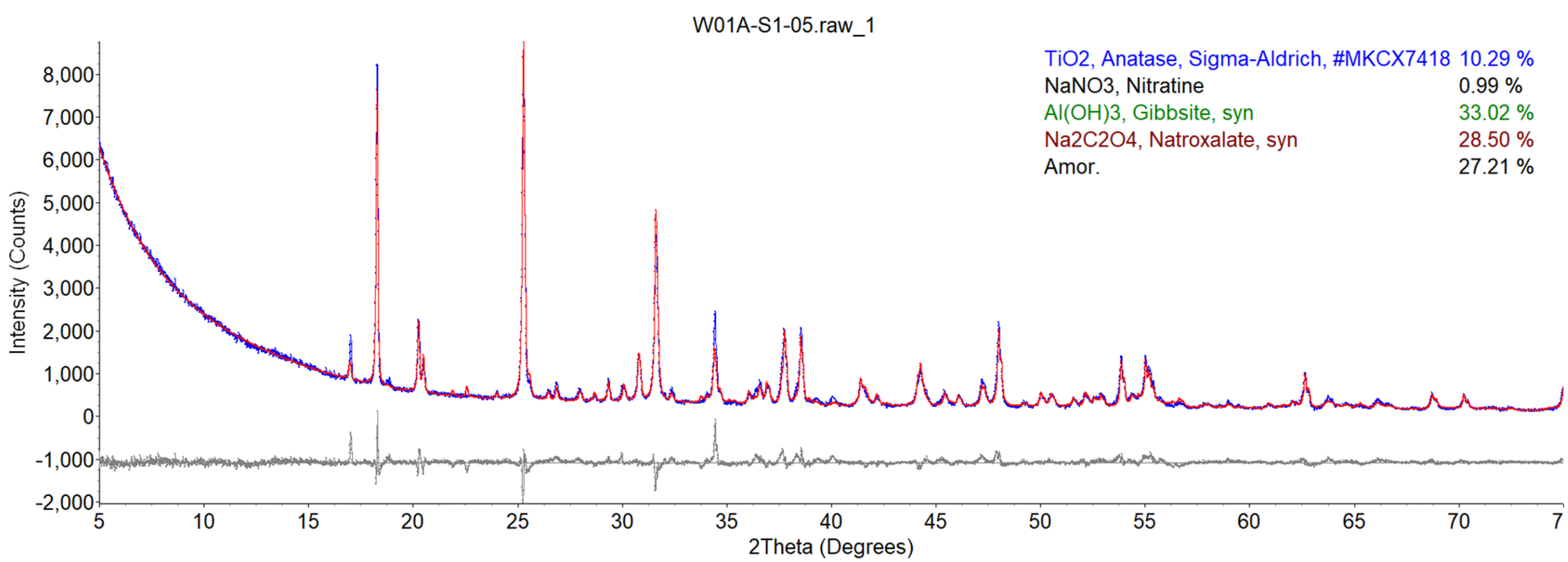


Figure A.17. XRD scan for sample W01A-S1-05. The bottom scan shows the quantitative results based on comparison with a known TiO_2 standard. The amount labeled “Amor.” Is either amorphous solid or could not be identified.

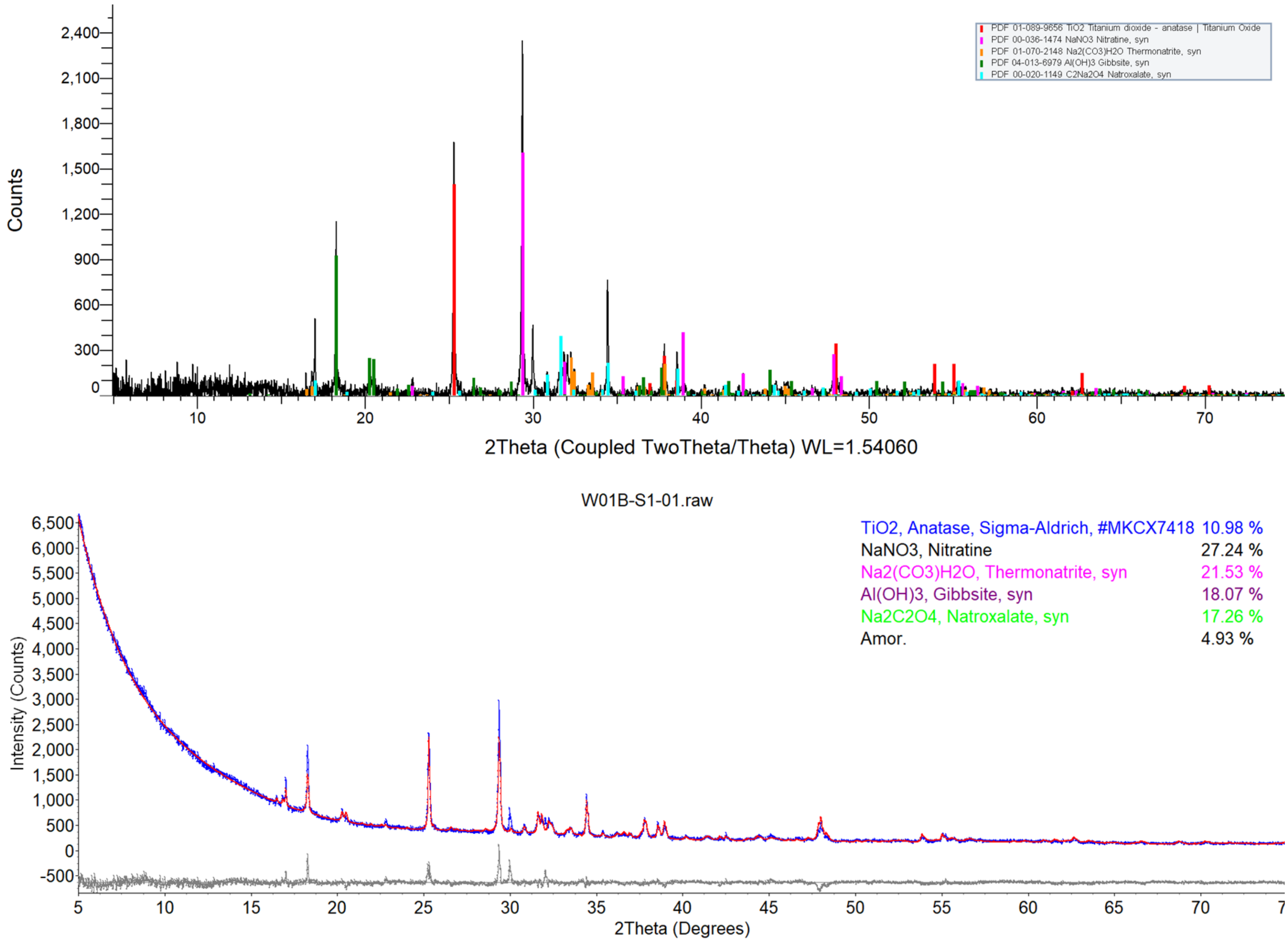


Figure A.18. XRD scan for sample W01B-S1-01. The bottom scan shows the quantitative results based on comparison with a known TiO_2 standard. The amount labeled “Amor.” Is either amorphous solid or could not be identified.

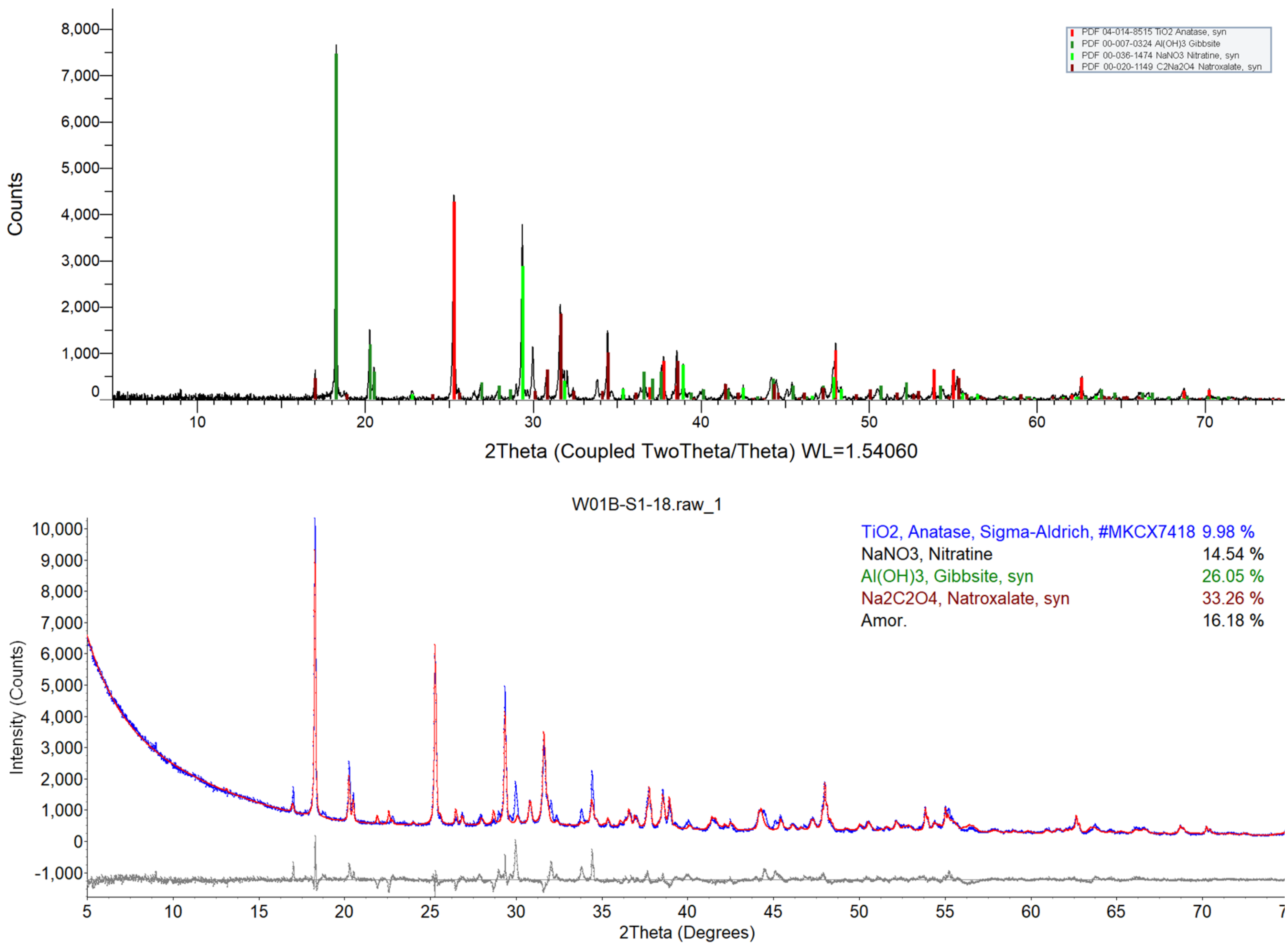


Figure A.19. XRD scan for sample W01B-S1-18. The bottom scan shows the quantitative results based on comparison with a known TiO_2 standard. The amount labeled “Amor.” Is either amorphous solid or could not be identified.

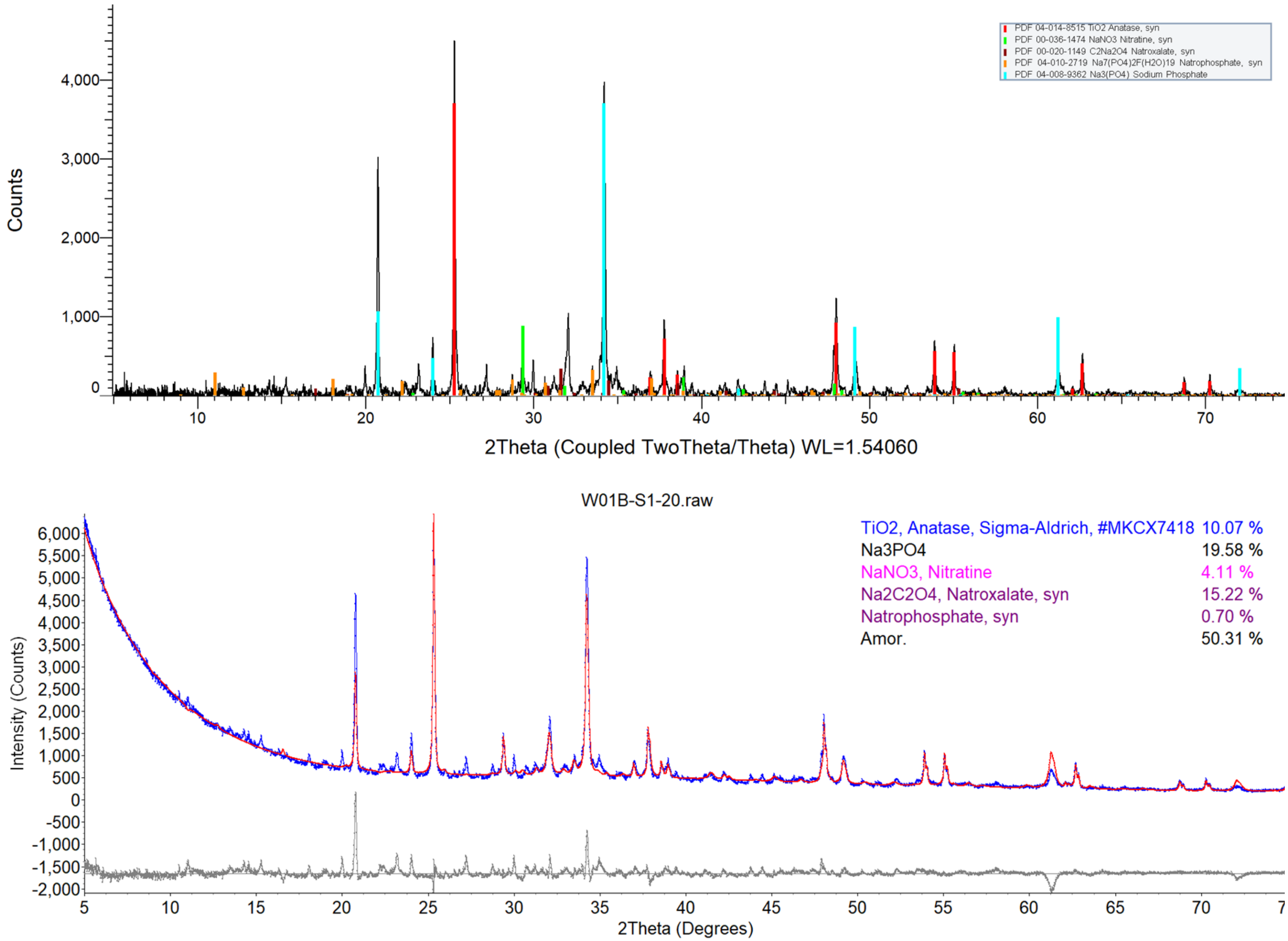


Figure A.20. XRD scan for sample W01B-S1-20. The bottom scan shows the quantitative results based on comparison with a known TiO_2 standard. The amount labeled “Amor.” Is either amorphous solid or could not be identified.

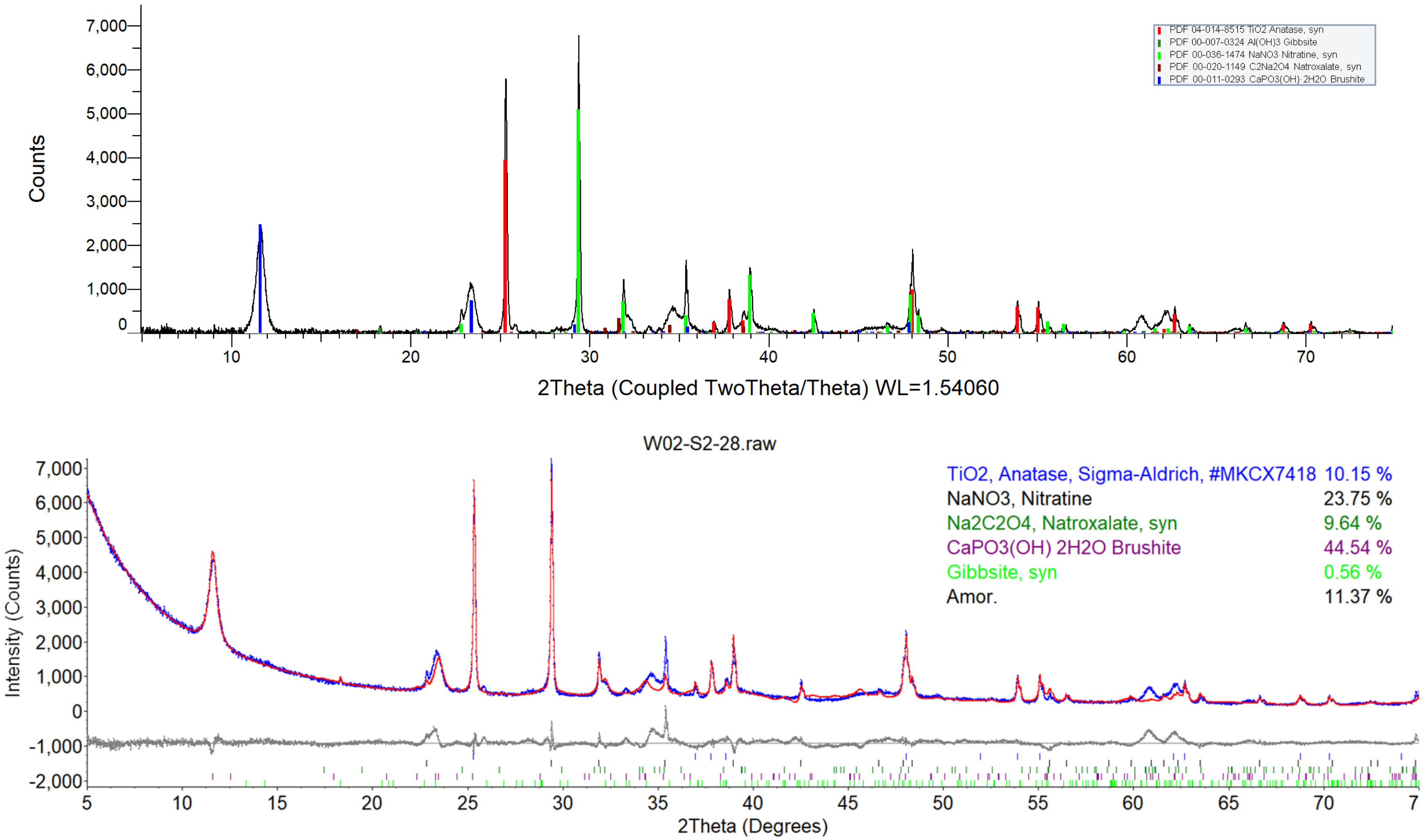


Figure A.21. XRD scan for sample W02-S2-28. The bottom scan shows the quantitative results based on comparison with a known TiO_2 standard. The amount labeled "Amor." Is either amorphous solid or could not be identified.

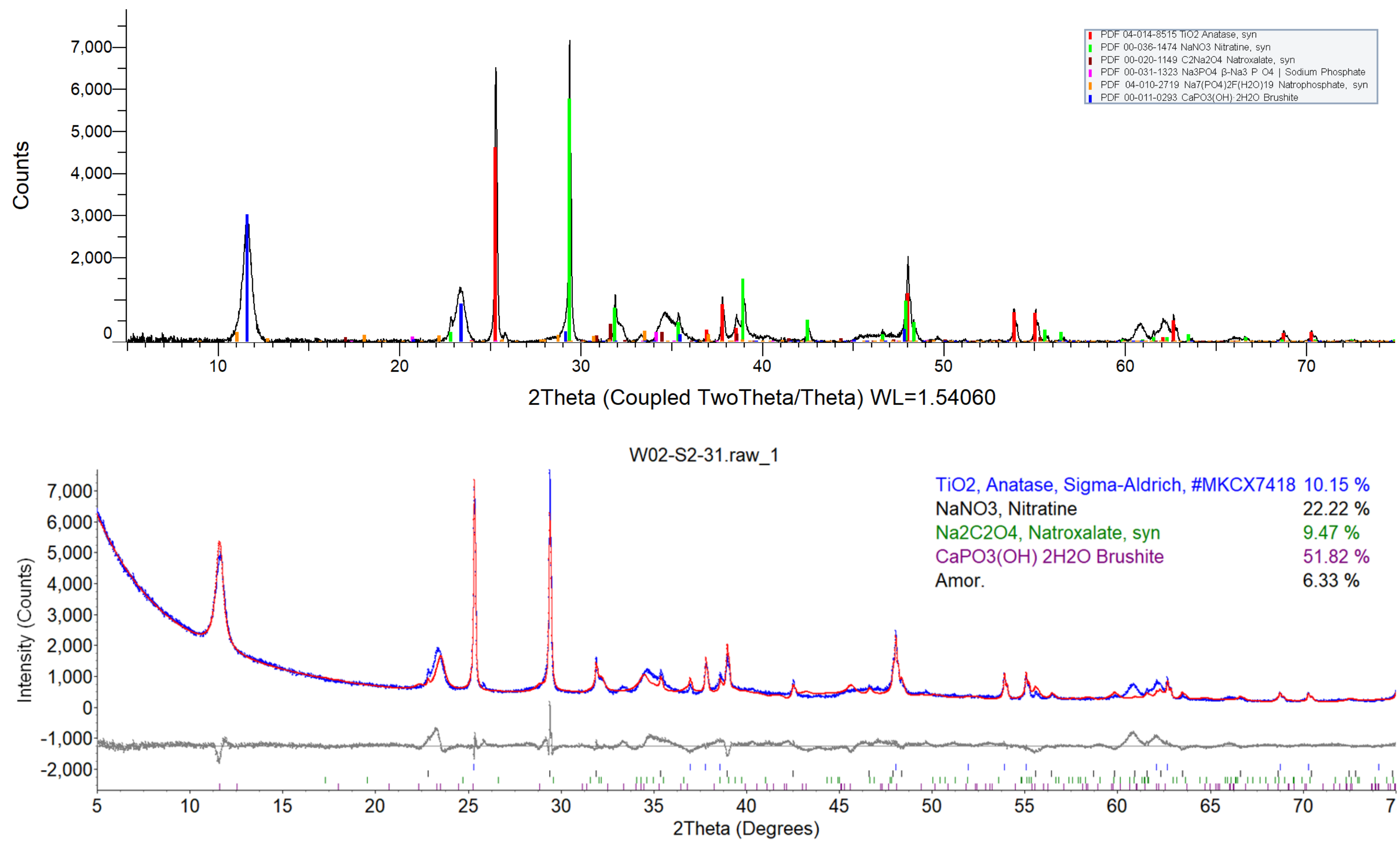


Figure A.22. XRD scan for sample W02-S2-31. The bottom scan shows the quantitative results based on comparison with a known TiO_2 standard. The amount labeled “Amor.” Is either amorphous solid or could not be identified.

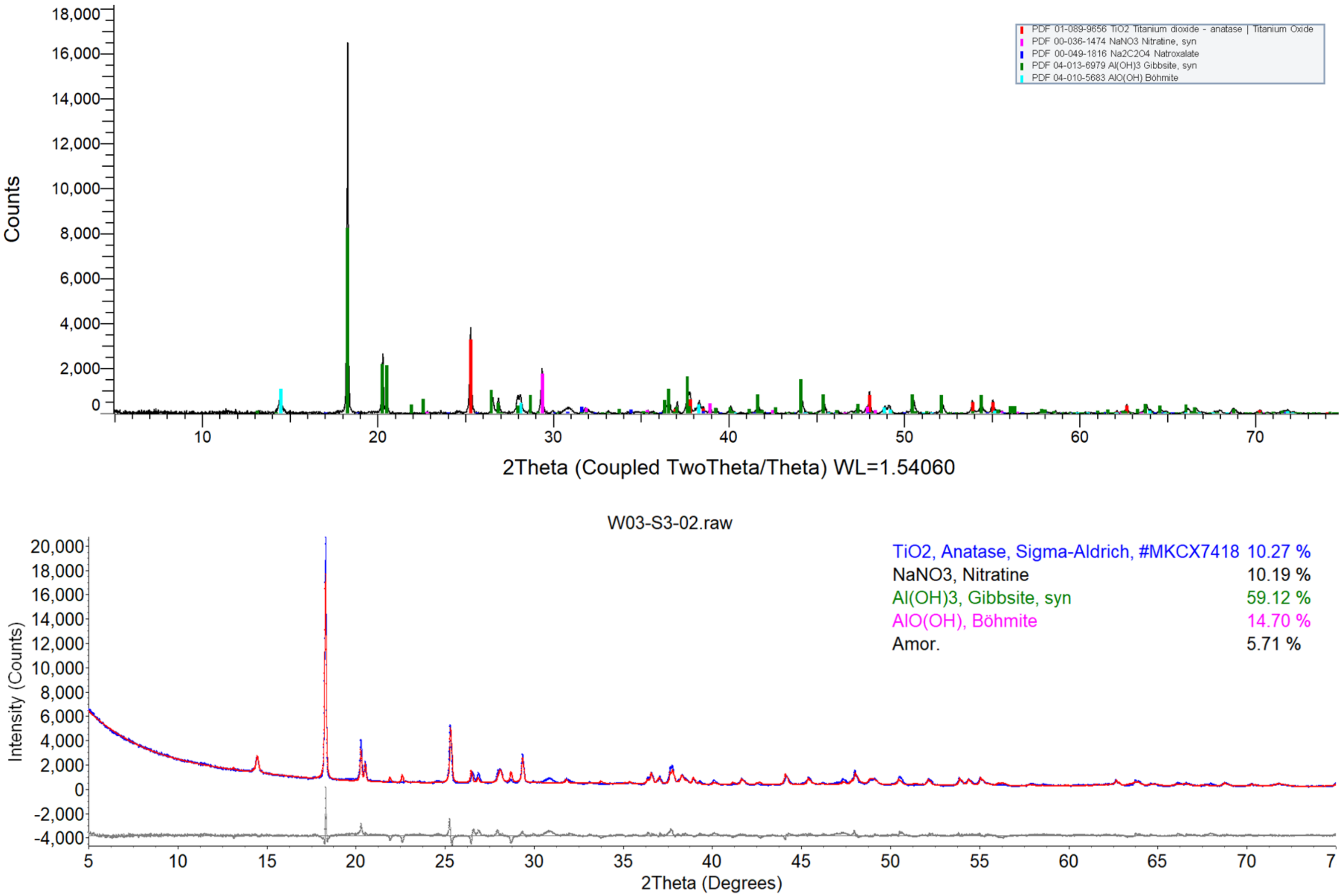


Figure A.23. XRD scan for sample W03-S3-02. The bottom scan shows the quantitative results based on comparison with a known TiO_2 standard. The amount labeled "Amor." Is either amorphous solid or could not be identified.

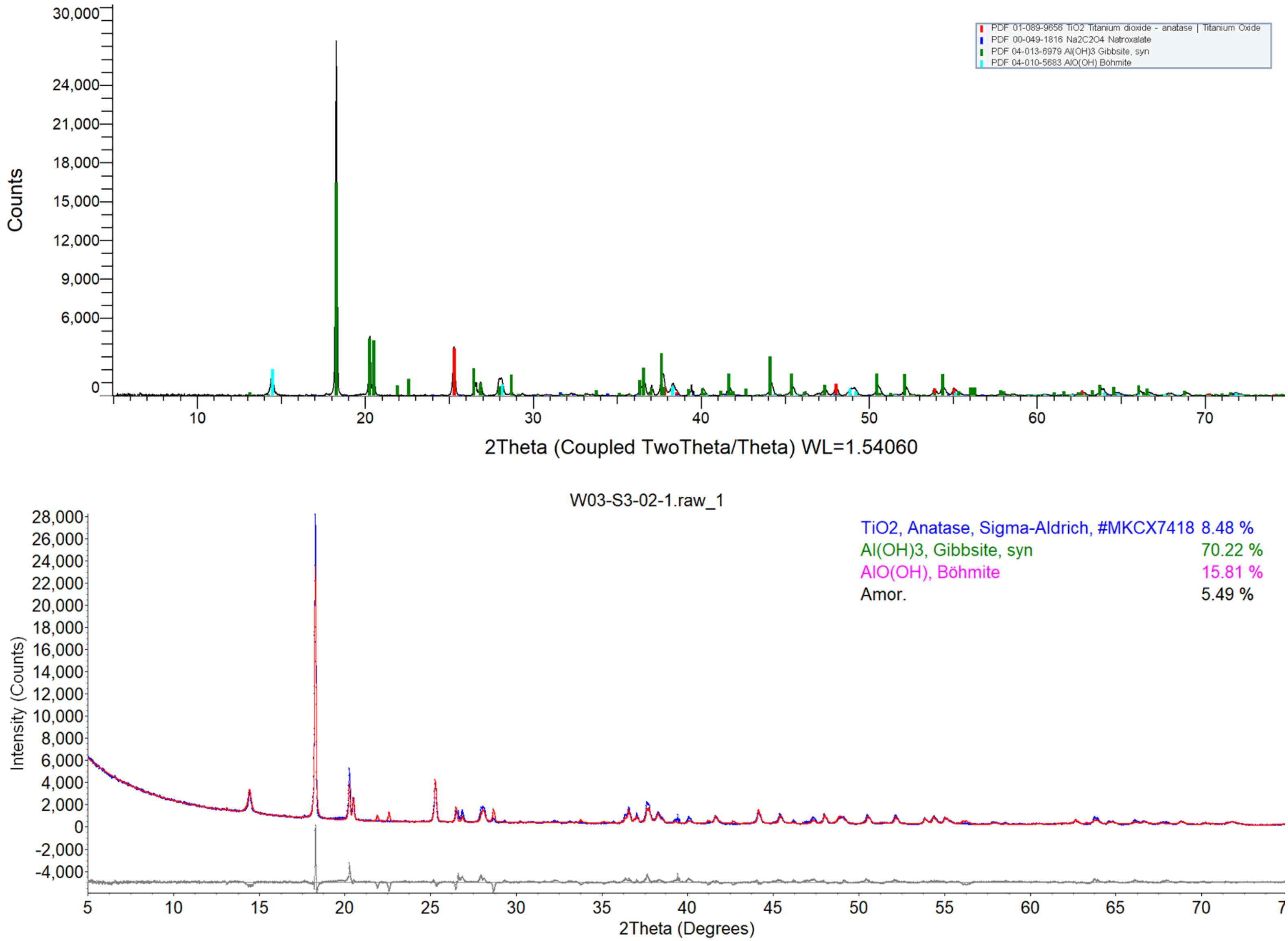


Figure A.24. XRD scan for sample W03-S3-02-1 (repeat using same material as previous scan). The bottom scan shows the quantitative results based on comparison with a known TiO_2 standard. The amount labeled “Amor.” Is either amorphous solid or could not be identified.

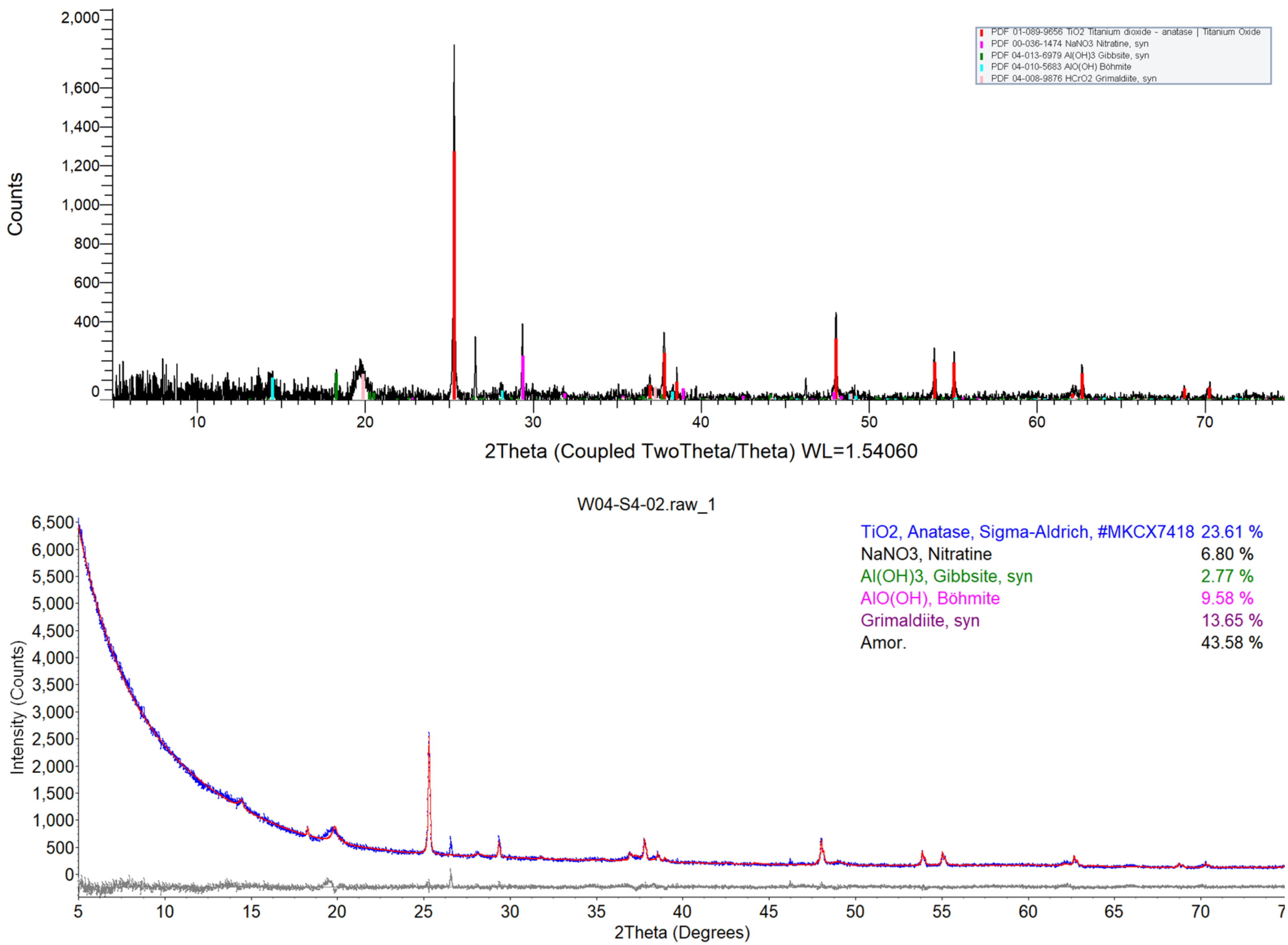


Figure A.25. XRD scan for sample W04-S4-02. The bottom scan shows the quantitative results based on comparison with a known TiO_2 standard. The amount labeled “Amor.” Is either amorphous solid or could not be identified.

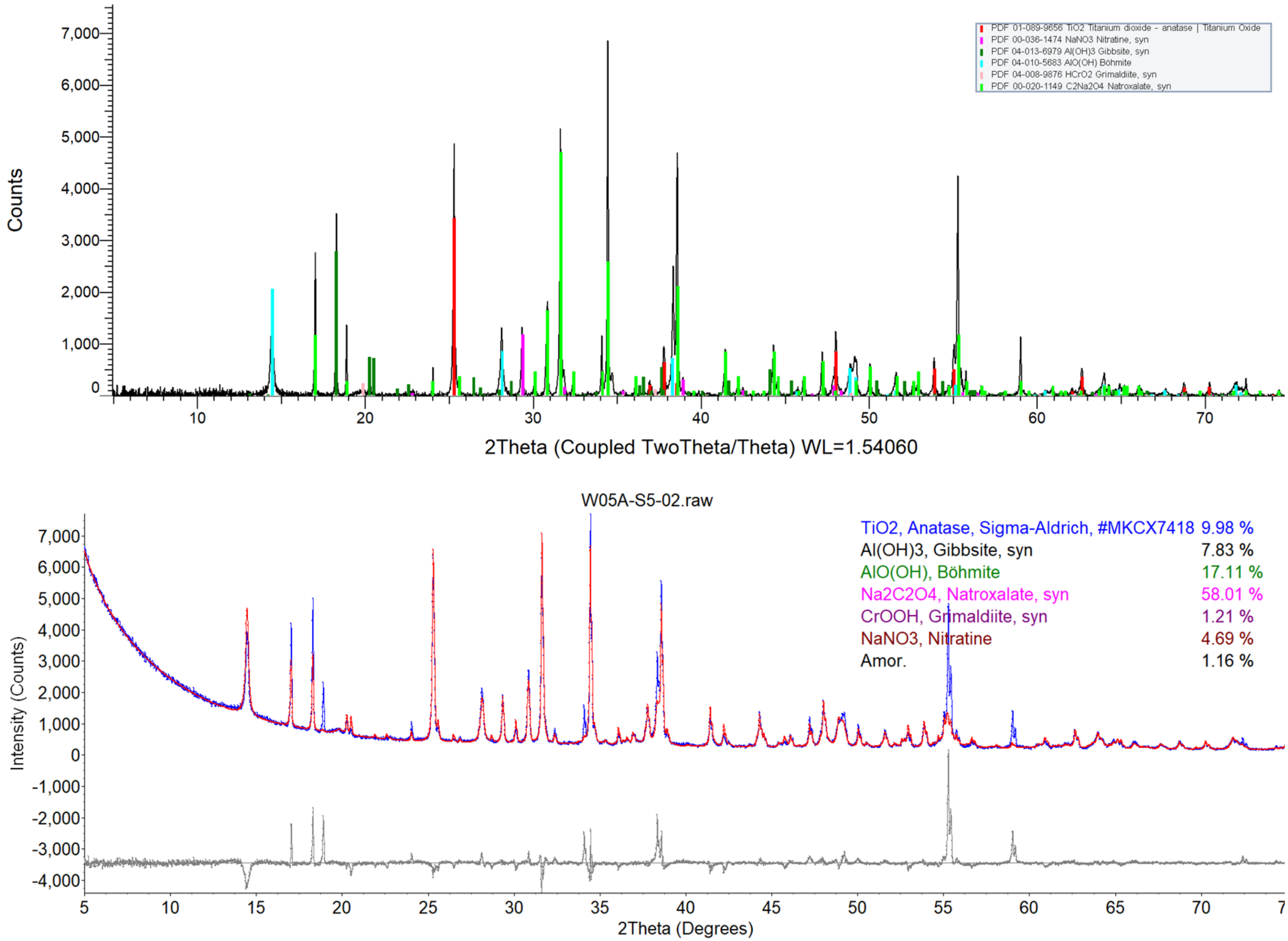


Figure A.26. XRD scan for sample W05A-S5-02. The bottom scan shows the quantitative results based on comparison with a known TiO_2 standard. The amount labeled “Amor.” Is either amorphous solid or could not be identified.

Appendix B – Run Narratives / Timelines

In this appendix, timelines of major events during the runs are summarized. Each run timeline contains activities that were conducted as part of the run preparation in one table, followed by a second table with the events that occurred during normal run operation. Note that post-run activities are only described in the W-02 run timeline due to off-normal cleaning that was significant to the subsequent run.

B.1 Timelines of Run W-01

Table B.1. W-01 Preparation Timeline

Date	Time (24 h)	Description
2/26/2025	NA	Created 0.1M NaOH - 26FEB2025
3/4/2025	15:40	0.1M NaOH Flow Check Start
3/4/2025	15:52	0.1M NaOH Flow Check End
3/5/2025	16:15	W01A Solids Spike 1
3/6/2025	8:32	W01A Pre-Run
3/8/2025	16:55	W01A Solids Spike 2
3/11/2025	10:06	W01B Solids Spike 1

Table B.2. W-01 Operations Timeline

Date	Time (24 h)	Description	Filter Period	Active Filter
3/4/2025	7:18	Sample Taken from as-received simulant tote W01A-S1-01	NA	NA
3/4/2025	7:26	Sample Taken from as-received simulant tote W01A-S1-012	NA	NA
3/5/2025	16:15	Samples Taken of W01A Spiked Simulant W01A-S1-03 W01A-S1-04 W01A-S1-05	NA	NA
3/6/2025	9:28	Start of W01A	1	1
3/6/2025	9:53	Start of Run Feed Sample Taken from SV-01 W01A-S1-08	1	1
3/6/2025	9:54	8hr Sample from SV-03: W01A-S1-06	1	1
3/6/2025	9:56	12hr Sample from SV-02: W01A-S1-07	1	1
3/6/2025	18:00	8hr Sample from SV-03: W01A-S1-09	1	1
3/6/2025	21:55	12hr Sample from SV-02: W01A-S1-10	1	1
3/7/2025	2:00	8hr Sample from SV-03: W01A-S1-11	1	1
3/7/2025	9:33	Start new filter period	2	2
3/7/2025	10:05	12hr Sample from SV-02: W01A-S1-12	2	2
3/7/2025	10:07	8hr Sample from SV-03: W01A-S1-13	2	2
3/7/2025	18:05	8hr Sample from SV-02: W01A-S1-14	2	2
3/7/2025	22:07	12hr Sample from SV-02: W01A-S1-15	2	2
3/8/2025	2:05	8hr Sample from SV-03: W01A-S1-16	2	2

Date	Time (24 h)	Description	Filter Period	Active Filter
3/8/2025	5:00	Start new filter period	3	1
3/8/2025	10:00	48hr Sample from SV-01: W01A-S1-17 8hr Sample from SV-03: W01A-S1-18 12hr Sample from SV-02: W01A-S1-19	3	1
3/8/2025	16:55	W01A Solids Spike 2 Sample from SV-01: W01A-S1-20	3	1
3/8/2025	17:29	Start new filter period	4	2
3/8/2025	18:30	8hr Sample from SV-03: W01A-S1-21	4	2
3/8/2025	19:49	Start new filter period Increase Target differential pressure from 2psid to 5psid	5	1
3/8/2025	22:00	12hr Sample from SV-02: W01A-S1-22	5	1
3/8/2025	23:50	Start new filter period	6	2
3/9/2025	3:30	8hr Sample from SV-03: W01A-S1-23	6	2
3/9/2025	4:45	Start new filter period	7	1
3/9/2025	8:30	Start new filter period	8	2
3/9/2025	10:04	12hr Sample from SV-02: W01A-S1-24	8	2
3/9/2025	11:31	8hr Sample from SV-03: W01A-S1-25	8	2
3/9/2025	12:00	Start new filter period	9	1
3/9/2025	15:23	Start new filter period	10	2
3/9/2025	18:58	Start new filter period	11	1
3/9/2025	19:31	8hr Sample from SV-03: W01A-S1-26	11	1
3/9/2025	22:04	12hr Sample from SV-02: W01A-S1-27	11	1
3/9/2025	22:15	Start new filter period	12	2
3/10/2025	1:35	Start new filter period	13	1
3/10/2025	3:31	8hr Sample from SV-03: W01A-S1-28	13	1
3/10/2025	4:50	Start new filter period	14	2
3/10/2025	8:10	Start new filter period Changed filter to remove air from system	15	1
3/10/2025	10:12	96hr Sample from SV-01: W01A-S1-29	15	1
3/10/2025	11:01	12hr Sample from SV-02: W01A-S1-30	15	1
3/10/2025	11:51	Start new filter period Closed V22, opened V20 and V50 to purge air from system	16	2
	13:05	8hr Sample from SV-03: W01A-S1-31	16	2
3/10/2025	15:52	Start new filter period	17	1
3/10/2025	18:51	Start new filter period	18	2
3/10/2025	21:12	8hr Sample from SV-03: W01A-S1-32	18	2
3/10/2025	21:59	Start new filter period	19	1
3/10/2025	23:45	12hr Sample from SV-01: W01A-S1-33	19	1
3/11/2025	0:36	Start new filter period	20	2
3/11/2025	2:47	Start new filter period	21	1
3/11/2025	5:09	8hr Sample from SV-03: W01A-S1-34	21	1
3/11/2025	5:31	Start new filter period	22	2
3/11/2025	7:30	End of Run Sample from SV-03: W01A-S1-35	22	2
3/11/2025	7:42	End of Run Sample from SV-02: W01A-S1-36	22	2

Date	Time (24 h)	Description	Filter Period	Active Filter
3/11/2025	10:06	W01B Spiked Solids Feed Samples: W01B-S1-01, W01B-S1-02, W01B-S1-03	NA	NA
3/11/2025	10:12	Start of W01B	1	1
3/11/2025	10:43	12hr Sample from SV-02 and SV-03: W01B-S1-04, W01B-S1-05 Initial Feed Sample for Comparison with 48hr and 96hr: W01B-S1-06	1	1
3/11/2025	17:14	Start of new filter period	2	2
3/11/2025	22:44	12hr Sample from SV-02 and SV-03: W01B-S1-07, W01B-S1-08	2	2
3/11/2025	22:53	Start of new filter period	3	1
3/12/2025	7:03	Start of new filter period	4	2
3/12/2025	10:44	12hr Sample from SV-02 and SV-03: W01B-S1-09, W01B-S1-10	4	2
3/12/2025	12:02	Start of new filter period	5	1
3/12/2025	19:17	Start of new filter period	6	2
3/12/2025	22:44	12hr Sample from SV-02 and SV-03: W01B-S1-11, W01B-S1-12	6	2
3/12/2025	23:32	Start of new filter period	7	1
3/13/2025	7:02	Start of new filter period	8	2
3/13/2025	12:00	12hr Sample from SV-02 and SV-03: W01B-S1-13, W01B-S1-14	8	2
3/13/2025	14:04	Start of new filter period	9	1
3/13/2025	15:45	53hr Sample from SV-01: W01B-S1-15	9	1
3/13/2025	23:52	Start of new filter period	10	2
3/13/2025	23:58	12hr Sample from SV-02 and SV-03: W01B-S1-16, W01B-S1-17	10	2
3/14/2025	0:45	Start recirculation to cool feed from 22C to 16C	NA	NA
3/14/2025	0:53	Sample from V-02: W01B-S1-18, W01B-S1-19	NA	NA
3/14/2025	4:35	Feed temperature at 16C, start 24-hr hold	NA	NA
3/14/2025	8:25	Sample of Solids Collected from Bottom of S1 Batch 1 Tote: W01B-S1-20	NA	NA
3/15/2025	4:35	Start of new filter period at 16C	11	1
3/15/2025	9:03	Start of new filter period	12	2
3/15/2025	11:59	Start of new filter period	13	1
3/15/2025	16:00	Last Sample from SV-02: W01B-S1-21	13	1
3/15/2025	16:02	Start of new filter period	14	2
3/15/2025	20:17	Start of new filter period	15	1
3/15/2025	23:37	Last Sample from SV-03: W01B-S1-22	15	1

B.2 Timelines of Run W-02

Table B.3. W-02 Preparation Timeline

Date	Time (24 h)	Description
4/2/2025	NA	Created 0.1M NaOH - 02APR2025
4/15/2025	NA	Created 0.1M NaOH - 15APR2025
4/3/2025	11:59	0.1M NaOH Flow Check Start
4/4/2025	12:13	0.1M NaOH Flow Check End
4/10/2025	15:54	W02 Solids Spike 1
4/15/2025	4:50	W02 Solids Spike 2 (No additional solids added)

Table B.4. W-02 Operations Timeline

Date	Time (24h)	Description	Filter Period	Active Filter
4/10/2025	15:54	Initial Feed Samples from V-02: W02-S2-01, W02-S2-02, W02-S2-03	NA	NA
4/10/2025	19:20	Start of W02	1	1
4/10/2025	20:01	Start of new filter period Target differential pressure for filter switch increased from 2psid to 5psid	2	2
4/11/2025	0:04	Start of new filter period	3	1
4/11/2025	1:10	Start of new filter period Target differential pressure for filter switch increased from 5psid to 25psid	4	2
4/11/2025	2:25	Start of new filter period	5	1
4/11/2025	3:26	Start of new filter period	6	2
4/11/2025	4:32	Start of new filter period	7	1
4/11/2025	5:25	Start of new filter period	8	2
4/11/2025	6:28	Start of new filter period	9	1
4/11/2025	7:31	Start of new filter period	10	2
4/11/2025	8:15	Second 8hr Sample from SV-03: W02-S2-04	10	2
4/11/2025	8:34	Start of new filter period	11	1
4/11/2025	9:32	Start of new filter period	12	2
4/11/2025	10:32	Start of new filter period	13	1
4/11/2025	11:32	Start of new filter period	14	2
4/11/2025	12:15	12hr Sample from SV-02: W02-S2-05	14	2
4/11/2025	12:33	Start of new filter period	15	1
4/11/2025	13:15	S2 Batch Sample from As-Received Tote: W02-S2-06	NA	NA
4/11/2025	13:31	Start of new filter period	16	2
4/11/2025	14:32	Start of new filter period	17	1
4/11/2025	15:33	Start of new filter period	18	2
4/11/2025	16:15	8hr Sample from SV-03: W02-S2-07	18	2
4/11/2025	16:34	Start of new filter period	19	1
4/11/2025	17:22	Put system in recirculation due to climbing DP	NA	NA

Date	Time (24h)	Description	Filter Period	Active Filter
4/11/2025	19:45	Recirculation stopped Start of new filter period	20	2
4/11/2025	20:34	Start of new filter period	21	1
4/11/2025	21:30	Start of new filter period	22	2
4/11/2025	22:28	Start of new filter period	23	1
4/11/2025	22:30	Start of new filter period	24	2
4/12/2025	0:15	8hr Sample from SV-03: W02-S2-08 12hr Sample from SV-02: W02-S2-09	24	2
4/12/2025	0:28	Start of new filter period	25	1
4/12/2025	1:32	Start of new filter period	26	2
4/12/2025	2:35	Start of new filter period	27	1
4/12/2025	3:45	Start of new filter period	28	2
4/12/2025	4:55	Start of new filter period	29	1
4/12/2025	6:05	Start of new filter period	30	2
4/12/2025	7:13	Start of new filter period	31	1
4/12/2025	8:15	8hr Sample from SV-03: W02-S2-10	31	1
4/12/2025	8:16	Start of new filter period	32	2
4/12/2025	9:16	Start of new filter period	33	1
4/12/2025	10:18	Start of new filter period	34	2
4/12/2025	11:21	Start of new filter period	35	1
4/12/2025	12:15	12hr Sample from SV-02: W02-S2-11	35	1
4/12/2025	12:23	Start of new filter period	36	2
4/12/2025	13:25	Start of new filter period	37	1
4/12/2025	14:27	Start of new filter period	38	2
4/12/2025	15:30	Start of new filter period	39	1
4/12/2025	16:15	8hr Sample from SV-03: W02-S2-12	39	1
4/12/2025	16:48	Start of new filter period	40	2
4/12/2025	18:01	Start of new filter period	41	1
4/12/2025	19:24	Start of new filter period	42	2
4/12/2025	20:47	Start of new filter period	43	1
4/12/2025	22:04	Start of new filter period	44	2
4/12/2025	23:22	Start of new filter period	45	1
4/13/2025	0:15	12hr Sample from SV-02: W02-S2-13 8hr Sample from SV-03: W02-S2-14	45	1
4/13/2025	0:28	Start of new filter period	46	2
4/13/2025	1:38	Start of new filter period	47	1
4/13/2025	2:44	Start of new filter period	48	2
4/13/2025	5:13	Start of new filter period	49	1
4/13/2025	7:39	Start of new filter period	50	2
4/13/2025	8:10	48hr Sample from SV-01 (taken 8 hr late): W02-S2-17	50	2
4/13/2025	8:15	8hr Sample from SV-03: W02-S2-15	50	2
4/13/2025	10:07	Start of new filter period	51	1
4/13/2025	12:15	12hr Sample from SV-02: W02-S2-16	51	1
4/13/2025	12:26	Start of new filter period	52	2
4/13/2025	14:58	Start of new filter period	53	1
4/13/2025	16:15	8hr Sample from SV-03: W02-S2-18	53	1
4/13/2025	17:30	Start of new filter period	54	2
4/13/2025	20:13	Start of new filter period	55	1

Date	Time (24h)	Description	Filter Period	Active Filter
4/13/2025	22:54	Start of new filter period	56	2
4/14/2025	0:15	12hr Sample from SV-02: W02-S2-19 8hr Sample from SV-03: W02-S2-20	56	2
4/14/2025	1:34	Start of new filter period	57	1
4/14/2025	4:18	Start of new filter period	58	2
4/14/2025	6:56	Start of new filter period	59	1
4/14/2025	8:17	8hr Sample from SV-03: W02-S2-21	59	1
4/14/2025	9:46	Start of new filter period	60	2
	12:15	12hr Sample from SV-02: W02-S2-22	60	2
4/14/2025	12:17	Start of new filter period	61	1
	16:15	8hr Sample from SV-03: W02-S2-23	61	1
4/14/2025	15:16	Start of new filter period	62	2
4/14/2025	18:06	Start of new filter period	63	1
4/14/2025	21:13	Start of new filter period	64	2
4/15/2025	0:04	8hr Sample from SV-03: W02-S2-24 12hr Sample from SV-02: W02-S2-25	64	2
4/15/2025	0:06	Start of new filter period	65	1
4/15/2025	2:44	96hr Sample from SV-01: W02-S2-26	65	1
4/15/2025	3:11	Put system in recirculation while preparing Second Addition	NA	NA
4/15/2025	4:50	Feed Sample after Second Addition from V-02: W02-S2-27	NA	NA
4/15/2025	5:30	Start of new filter period Target differential pressure for filter switch increased from 25psid to a total of 32psid Flowrate set to 195 mL min^{-1}	66	1
4/15/2025	6:02	Start of new filter period Flowrate set to 162.5 mL min^{-1}	67	2
4/15/2025	6:13	Put system in recirculation due to climbing DP	NA	NA
4/15/2025	6:37	Start of new filter period Flowrate set to 130 mL min^{-1}	68	1
4/15/2025	6:55	Put system in recirculation due to climbing DP	NA	NA
4/15/2025	7:13	Start of new filter period Flowrate set to 91 mL min^{-1}	69	2
4/15/2025	7:40	Feed Sample after Second Addition from V-02: W02-S2-28	69	2
4/15/2025	7:52	Put system in recirculation due to climbing DP	NA	NA
4/15/2025	8:13	Start of new filter period	70	1
4/15/2025	8:33	8hr Sample from SV-03: W02-S2-29	70	1
4/15/2025	8:53	Put system in recirculation due to climbing DP	NA	NA
4/15/2025	10:17	Start of new filter period	71	2
4/15/2025	11:03	Start of new filter period	72	1
4/15/2025	11:52	Start of new filter period	73	2
4/15/2025	12:06	12hr Sample from SV-02: W02-S2-30	73	2
4/15/2025	12:39	Start of new filter period	74	1
4/15/2025	13:29	Start of new filter period	75	2

Date	Time (24h)	Description	Filter Period	Active Filter
4/15/2025	14:14	Start of new filter period	76	1
4/15/2025	15:05	Start of new filter period	77	2
4/15/2025	15:54	Start of new filter period	78	1
4/15/2025	16:25	Sample of Precipitated solids from S2 tote (As-Received): W02-S2-31	NA	NA
4/15/2025	16:30	8hr Sample from SV-03: W02-S2-32	78	1
4/15/2025	16:44	Start of new filter period	79	2
4/15/2025	17:32	Start of new filter period	80	1
4/15/2025	18:22	Start of new filter period	81	2
4/15/2025	19:10	Start of new filter period	82	1
4/15/2025	20:01	Start of new filter period	83	2
4/15/2025	20:49	Start of new filter period	84	1
4/15/2025	21:43	Start of new filter period	85	2
4/15/2025	22:33	Start of new filter period	86	1
4/15/2025	23:29	Start of new filter period	87	2
4/16/2025	0:15	12hr Sample from SV-02: W02-S2-33	87	2
4/16/2025	0:16	Start of new filter period	88	1
4/16/2025	0:30	8hr Sample from SV-03: W02-S2-34	88	1
4/16/2025	1:10	Start of new filter period	89	2
4/16/2025	1:58	Start of new filter period	90	1
4/16/2025	2:51	Start of new filter period	91	2
4/16/2025	3:40	Start of new filter period	92	1
4/16/2025	4:34	Start of new filter period	93	2
4/16/2025	5:24	Start of new filter period	94	1
4/16/2025	6:20	Start of new filter period	95	2
4/16/2025	7:10	Start of new filter period	96	1
4/16/2025	8:07	Start of new filter period Flowrate set to 76 mL min^{-1}	97	2
4/16/2025	8:30	8hr Sample from SV-03: W02-S2-25	97	2
4/16/2025	9:33	Start of new filter period	98	1
4/16/2025	10:57	Start of new filter period	99	2
4/16/2025	12:14	Start of new filter period	100	1
4/16/2025	12:28	12hr Sample from SV-02: W02-S2-36	100	1
4/16/2025	13:44	Start of new filter period	101	2
4/16/2025	15:04	Start of new filter period	102	1
4/16/2025	15:32	End of Run Sample from SV-02: W02-S2-37	102	1
4/16/2025	15:45	End of Run Sample from SV-03: W02-S2-38	102	1

Table B.5. W-02 Post-Run Timeline

Date	Time (24h)	Description
5/9/2025	9:30	Cleaning 1 with 2.0M nitric acid
5/9/2025	12:13	Cleaning 2 with 2.0M nitric acid
5/15/2025	10:48	Start of flow test with 0.1M sodium hydroxide
5/15/2025	16:15	End of flow test with 0.1M sodium hydroxide

B.3 Timelines of Run W-03

Table B.6. W-03 Preparation Timeline

Date	Time (24 h)	Description
2/26/2025	16:34	Begin 0.1M NaOH Soak
2/28/2025	10:45	End 0.1M NaOH Soak
2/28/2025	14:49	Begin DW Soak
3/3/2025	10:08	End DW Soak
5/21/2025	NA	Created 0.1M NaOH - 21MAY2025
5/21/2025	N/A	Balance Check
5/22/2025	9:40	0.1M NaOH Flow Check Start
5/21/025	12:05	0.1M NaOH Flow Check End
5/27/2025	N/A	Balance Check
5/27/2025	N/A	Balance Check
5/27/2025	N/A	System pressure verification
5/28/2025	N/A	differential pressure zero check and adjustment
5/27/2025	15:25	W03 Solids Spike 1
6/1/2025	9:08	W03 Solids Spike 2

Table B.7. W-03 Operations Timeline

Date	Time (24 h)	Description	Filter Period	Active Filter
5/27/2025	11:47	S3 Batch #1 As-Received Sample: W03-S3-01	NA	NA
5/27/2025	16:01 - 16:03	S3 Solids Spike #1 Feed: W03-S3-02, W03-S3-03-20mL, W-03-S3-03-25mL	NA	NA
5/28/2025	7:53	Start of W03	1	1
5/28/2025	15:53	8hr Sample from SV-03: W03-S3-04	1	1
5/28/2025	19:53	12hr Sample from SV-02: W03-S3-05	1	1
5/28/2025	23:53	8hr Sample from SV-03: W03-S3-06	1	1
5/28/2025	7:53-7:56	12hr Sample from SV-02: W03-S3-07 8hr Sample from SV-03: W03-S3-08	1	1
5/29/2025	8:02	Start of new filter period	2	2
5/29/2025	15:56	8hr Sample from SV-03: W03-S3-09	2	2
5/29/2025	19:53	12hr Sample from SV-02: W03-S3-10	2	2
5/29/2025	23:56	8hr Sample from SV-03: W03-S3-11	2	2
5/30/2025	7:53-7:56	48hr Sampe from SV-01: W03-S3-12 12hr Sample from SV-02: W03-S3-13 8hr Sample from SV-03: W03-S3-14	2	2
5/30/2025	7:58	Start of new filter period	3	1
5/30/2025	8:30	Flowrate decreased from 130 mL min^{-1} to 91 mL min^{-1}	3	1
5/30/2025	15:56	8hr Sample from SV-03: W03-S3-15	3	1
5/30/2025	19:53	12hr Sample from SV-02: W03-S3-16	3	1

Date	Time (24 h)	Description	Filter Period	Active Filter
5/30/2025	23:56	8hr Sample from SV-03: W03-S3-17	3	1
5/31/2025	7:53-7:56	12hr Sample from SV-02: W03-S3-18 8hr Sample from SV-03: W03-S3-19	3	1
5/31/2025	8:02	Start of new filter period	4	2
5/31/2025	15:56	8hr Sample from SV-03: W03-S3-20	4	2
5/31/2025	19:56	12hr Sample from SV-02: W03-S3-21	4	2
5/31/2025	23:56	8hr Sample from SV-03: W03-S3-22	4	2
6/1/2025	7:53-7:56	12hr Sample from SV-02: W03-S3-23 8hr Sample from SV-03: W03-S3-24	4	2
6/1/2025	8:00	96hr Sample from SV-01: W03-S3-25	4	2
6/1/2025	9:50	S3 Solids Spike #2 Feed Sample from V-02: W03-S3-26	NA	NA
6/1/2025	9:53	Start of new filter period	5	1
6/1/2025	10:10	Flowrate increased from 91 mL min^{-1} to 195 mL min^{-1}	5	1
6/1/2025	13:55	Start of new filter period	6	2
6/1/2025	15:56	8hr Sample from SV-03: W03-S3-27	6	2
6/1/2025	17:52	Start of new filter period	7	1
6/1/2025	21:50	12hr Sample from SV-02: W03-S3-28	6	2
6/1/2025	21:54	Start of new filter period	8	2
6/1/2025	23:57	8hr Sample from SV-03: W03-S3-29	8	2
6/2/2025	1:43	Lowered temperature from 21C to 16C	NA	NA
6/2/2025	7:00	Start of 24hr hold at 16C	NA	NA
6/3/2025	7:01	Put system in line Start of new filter period	9	1
6/3/2025	15:12	8hr Sample from SV-03-30	9	1
6/3/2025	16:02	Start of new filter period	10	2
6/3/2025	19:01	12hr Sample from SV-02: W03-S3-31	10	2
6/4/2025	0:02	End of Test Sample from SV-03: W03-S3-32	10	2

B.4 Timelines of Run W-04

Table B.8. W-04 Preparation Timeline

Date	Time (24 h)	Description
N/A	N/A	0.1M NaOH used from W02
8/4/2025	15:26	0.1M NaOH Flow Check Start
8/4/2025	16:41	0.1M NaOH Flow Check End
8/6/2025	15:00	Balance Check
8/6/2025	15:32	W04 Solids Spike 1
8/10/2025	7:55	Balance Check
8/10/2025	9:20	W04 Solids Spike 2

Table B.9. W-04 Operations Timeline

Date	Time (24 h)	Description	Filter Period	Active Filter
8/6/2025	13:45	Sample W04-S4-01	N/A	N/A
8/7/2025	7:35	Start of filter period 1	1	DEF-01
8/7/2025	7:45	Sample W04-S4-02	1	DEF-01
8/7/2025	7:45	Sample W04-S4-03	1	DEF-01
8/7/2025	7:45	Sample W04-S4-04	1	DEF-01
8/7/2025	8:28	Sample W04-S4-05	1	DEF-01
8/7/2025	8:30	Sample W04-S4-06	1	DEF-01
8/7/2025	16:28	Sample W04-S4-07	1	DEF-01
8/7/2025	20:30	Sample W04-S4-08	1	DEF-01
8/8/2025	0:29	Sample W04-S4-09	1	DEF-01
8/8/2025	8:02	Start of filter period 2	2	DEF-02
8/8/2025	8:30	Sample W04-S4-10	2	DEF-02
8/8/2025	8:30	Sample W04-S4-11	2	DEF-02
8/8/2025	16:30	Sample W04-S4-12	2	DEF-02
8/8/2025	20:30	Sample W04-S4-13	2	DEF-02
8/9/2025	0:30	Sample W04-S4-14	2	DEF-02
8/9/2025	8:30	Sample W04-S4-15	2	DEF-02
8/9/2025	8:38	Start of filter period 3	3	DEF-01
8/9/2025	8:35	Sample W04-S4-16	3	DEF-01
8/9/2025	9:30	Flow Rate Changed to 91 mL min^{-1}	3	DEF-01
8/9/2025	13:35	Sample W04-S4-17	3	DEF-01
8/9/2025	16:30	Sample W04-S4-18	3	DEF-01
8/9/2025	20:30	Sample W04-S4-19	3	DEF-01
8/10/2025	0:30	Sample W04-S4-20	3	DEF-01
8/10/2025	10:27	Sample W04-S4-21	3	DEF-01
8/10/2025	10:30	Start of filter period 4	4	DEF-02
8/10/2025	10:44	Sample W04-S4-22	4	DEF-02
8/10/2025	10:46	Sample W04-S4-23	4	DEF-02
8/10/2025	16:30	Sample W04-S4-24	4	DEF-02
8/10/2025	23:20	Sample W04-S4-25	4	DEF-02

Date	Time (24 h)	Description	Filter Period	Active Filter
8/11/2025	0:30	Sample W04-S4-26	4	DEF-02
8/11/2025	8:33	Sample W04-S4-27	4	DEF-02
8/11/2025	10:20	Sample W04-S4-28	4	DEF-02
8/11/2025	10:32	Start of filter period 5	5	DEF-01
8/11/2025	12:30	Flow Rate Changed to 130 mL min^{-1}	5	DEF-01
8/11/2025	16:30	Flow Rate Changed to 170 mL min^{-1}	5	DEF-01
8/11/2025	16:30	Sample W04-S4-29	5	DEF-01
8/11/2025	18:30	Flow Rate Changed to 195 mL min^{-1}	5	DEF-01
8/11/2025	18:40	Switched from filter FLT-01A to FLT-01B	5	DEF-01
8/11/2025	20:30	Flow Rate Changed to 170 mL min^{-1}	5	DEF-01
8/11/2025	22:20	Sample W04-S4-30	5	DEF-01
8/11/2025	22:30	Flow Rate Changed to 150 mL min^{-1}	5	DEF-01
8/12/2025	0:30	Sample W04-S4-31	5	DEF-01
8/12/2025	0:30	Flow Rate Changed to 130 mL min^{-1}	5	DEF-01
8/12/2025	2:30	Flow Rate Changed to 110 mL min^{-1}	5	DEF-01
8/12/2025	4:30	Flow Rate Changed to 91 mL min^{-1}	5	DEF-01
8/12/2025	6:30	Flow Rate Changed to 110 mL min^{-1}	5	DEF-01
8/12/2025	8:28	Sample W04-S4-32	5	DEF-01
8/12/2025	8:30	Flow Rate Changed to 130 mL min^{-1}	5	DEF-01
8/12/2025	10:20	Sample W04-S4-33	5	DEF-01
8/12/2025	10:27	Start of filter period 6	6	DEF-02
8/12/2025	10:37	Flow Rate Changed to 110 mL min^{-1}	6	DEF-02
8/12/2025	12:30	Flow Rate Changed to 130 mL min^{-1}	6	DEF-02
8/12/2025	15:00	Flow Rate Changed to 150 mL min^{-1}	6	DEF-02
8/12/2025	16:30	Sample W04-S4-34	6	DEF-02
8/12/2025	16:30	Flow Rate Changed to 170 mL min^{-1}	6	DEF-02
8/12/2025	18:30	Flow Rate Changed to 195 mL min^{-1}	6	DEF-02
8/12/2025	20:30	Flow Rate Changed to 170 mL min^{-1}	6	DEF-02
8/12/2025	22:20	Sample W04-S4-35	6	DEF-02
8/12/2025	22:30	Flow Rate Changed to 150 mL min^{-1}	6	DEF-02
8/13/2025	0:25	TK-01 Propped Up, V-52 Closed and V-51 Opened	6	DEF-02
8/13/2025	0:30	Sample W04-S4-36	6	DEF-02
8/13/2025	0:42	System momentarily put into recirculation while whirly bird raised ~2 in., V-52 Opened and V-51 Closed	6	DEF-02
8/13/2025	1:00	Flow Rate Changed to 130 mL min^{-1}	6	DEF-02
8/13/2025	3:00	Flow Rate Changed to 110 mL min^{-1}	6	DEF-02
8/13/2025	5:00	Flow Rate Changed to 91 mL min^{-1}	6	DEF-02
8/13/2025	8:27	Sample W04-S4-37	6	DEF-02
8/13/2025	9:40	V-52 Closed and V-51 Opened, BPR-01 adjusted to maintain P-01	6	DEF-02
8/13/2025	10:15	Sample W04-S4-38	6	DEF-02
8/13/2025	10:19	Sample W04-S4-39	6	DEF-02
8/13/2025	10:22	Sample W04-S4-40	6	DEF-02
8/13/2025	10:30	End of Test	6	DEF-02

B.5 Timelines of Run W-05

Table B.10. W-05 Preparation Timeline

Date	Time (24 h)	Description
8/21/2025	10:09	Balance check
8/21/2025	N/A	0.1 M NaOH solution makeup
8/27/2025	N/A	System pressure verification
8/27/2025	N/A	Differential pressure zero check and adjustment
8/27/2025	10:20	0.1 M NaOH flow test
8/28/2025	N/A	Collected 2 L of W05 from TK-01 via V-02 for simulant solid spiking preparation
8/28/2025	7:49	Simulant solid spiking preparation for W-05A
9/2/2025	N/A	System pressure verification
9/2/2025	N/A	Differential pressure zero check and adjustment
9/4/2025	8:30	Simulant solid spiking preparation for W-05A
9/7/2025	8:03	Simulant solid spiking preparation for W-05B

Table B.11. W-05 Operations Timeline

Date	Time (24 h)	Description	Filter Period	Active Filter
8/19/2025	10:30	Begin W04 Post Flow Test	N/A	DEF-01
8/19/2025	14:45	End W04 Post Flow Test	N/A	DEF-01
8/27/2025	10:20	Begin W05 Pre Flow Test	N/A	DEF-02
8/27/2025	14:15	End W05 Pre Flow Test	N/A	DEF-02
9/2/2025	8:21	Sample W05A-S5-01	N/A	N/A
9/2/2025	8:24	Sample W05A-S5-02	N/A	N/A
9/2/2025	8:24	Sample W05A-S5-03	N/A	N/A
9/2/2025	8:24	Sample W05A-S5-04	N/A	N/A
9/2/2025	8:36	Start of filter period 1 for W05A	1	DEF-01
9/2/2025	9:13	Switched from filter FLT-01B to FLT-01A	1	DEF-01
9/2/2025	9:58	Sample W05A-S5-05	1	DEF-01
9/2/2025	9:59	Sample W05A-S5-06	1	DEF-01
9/2/2025	16:33	Start of filter period 2	2	DEF-02
9/2/2025	18:04	Sample W05A-S5-07	2	DEF-02
9/2/2025	22:02	Sample W05A-S5-08	2	DEF-02
9/2/2025	22:50	Start of filter period 3	3	DEF-01
9/3/2025	2:09	Sample W05A-S5-09	3	DEF-01
9/3/2025	7:31	Start of filter period 4	4	DEF-02
9/3/2025	10:04	Sample W05A-S5-10	4	DEF-02
9/3/2025	10:05	Sample W05A-S5-11	4	DEF-02
9/3/2025	14:31	Start of filter period 5	5	DEF-01
9/3/2025	18:02	Sample W05A-S5-12	5	DEF-01
9/3/2025	22:02	Sample W05A-S5-13	5	DEF-01
9/3/2025	23:12	Start of filter period 6	6	DEF-02

Date	Time (24 h)	Description	Filter Period	Active Filter
9/4/2025	2:00	Sample W05A-S5-14	6	DEF-02
9/4/2025	8:45	Sample W05A-S5-15	6	DEF-02
9/4/2025	8:50	Start of filter period 7	7	DEF-01
9/4/2025	10:01	Sample W05A-S5-16	7	DEF-01
9/4/2025	10:02	Sample W05A-S5-17	7	DEF-01
9/4/2025	18:04	Sample W05A-S5-18	7	DEF-01
9/4/2025	19:10	Start of filter period 8	8	DEF-02
9/4/2025	22:04	Sample W05A-S5-19	8	DEF-02
9/5/2025	2:08	Sample W05A-S5-20	8	DEF-02
9/5/2025	5:01	Start of filter period 9	9	DEF-01
9/5/2025	10:02	Sample W05A-S5-22	9	DEF-01
9/5/2025	10:03	Sample W05A-S5-21	9	DEF-01
9/5/2025	15:40	Start of filter period 10	10	DEF-02
9/5/2025	18:03	Sample W05A-S5-23	10	DEF-02
9/5/2025	22:03	Sample W05A-S5-24	10	DEF-02
9/6/2025	1:31	Start of filter period 11	11	DEF-01
9/6/2025	2:05	Sample W05A-S5-25	11	DEF-01
9/6/2025	10:01	Sample W05A-S5-27	11	DEF-01
9/6/2025	10:02	Sample W05A-S5-26	11	DEF-01
9/6/2025	12:02	Start of filter period 12	12	DEF-02
9/6/2025	18:01	Sample W05A-S5-28	12	DEF-02
9/6/2025	20:03	Start of filter period 13	13	DEF-01
9/6/2025	22:03	Sample W05A-S5-29	13	DEF-01
9/7/2025	2:05	Sample W05A-S5-30	13	DEF-01
9/7/2025	8:49	Sample W05B-S5-01	N/A	N/A
9/7/2025	8:57	Sample W05B-S5-02	N/A	N/A
9/7/2025	9:00	Start of filter period 1 for W05B	1	DEF-02
9/7/2025	16:49	Sample W05B-S5-03	1	DEF-02
9/7/2025	20:30	Switched from filter FLT-01A to FLT-01B	1	DEF-02
9/7/2025	20:49	Sample W05B-S5-04	1	DEF-02
9/8/2025	0:49	Sample W05B-S5-05	1	DEF-02
9/8/2025	2:13	Start of filter period 2	2	DEF-01
9/8/2025	8:47	Sample W05B-S5-06	2	DEF-01
9/8/2025	8:51	Sample W05B-S5-07	2	DEF-01
9/8/2025	16:48	Sample W05B-S5-08	2	DEF-01
9/8/2025	20:51	Sample W05B-S5-09	2	DEF-01
9/9/2025	0:48	Sample W05B-S5-10	2	DEF-01
9/9/2025	7:19	Start of filter period 3	3	DEF-02
9/9/2025	8:49	Sample W05B-S5-11	3	DEF-02
9/9/2025	8:51	Sample W05B-S5-12	3	DEF-02
9/9/2025	8:54	Sample W05B-S5-13	3	DEF-02
9/9/2025	16:49	Sample W05B-S5-14	3	DEF-02
9/9/2025	20:51	Sample W05B-S5-15	3	DEF-02

Date	Time (24 h)	Description	Filter Period	Active Filter
9/10/2025	0:49	Sample W05B-S5-16	3	DEF-02
9/10/2025	8:51	Sample W05B-S5-17	3	DEF-02
9/10/2025	8:54	Sample W05B-S5-18	3	DEF-02
9/10/2025	9:00	System placed in recirculation	3	DEF-02
9/10/2025	9:02	HX-01 set to 6 C	3	DEF-02
9/10/2025	14:00	HX-01 set to 10 C	3	DEF-02
9/10/2025	15:00	HX-01 set to 12 C	3	DEF-02
9/10/2025	15:05	HX-01 set to 13 C	3	DEF-02
9/10/2025	15:45	Closed V-51	3	DEF-02
9/10/2025	16:03	Stopped PMP-01	3	DEF-02
9/10/2025	20:01	Started PMP-01	3	DEF-02
9/10/2025	22:00	Stopped PMP-01	3	DEF-02
9/11/2025	1:01	Started PMP-01	3	DEF-02
9/11/2025	3:00	Stopped PMP-01	3	DEF-02
9/11/2025	7:00	Started PMP-01	3	DEF-02
9/11/2025	9:56	Stopped PMP-01	3	DEF-02
9/11/2025	15:00	Started PMP-01	3	DEF-02
9/11/2025	15:00	Sample W05B-S5-19	3	DEF-02
9/11/2025	15:03	Start of filter period 4	4	DEF-01
9/11/2025	15:16	Sample W05B-S5-20	4	DEF-01
9/11/2025	15:17	Sample W05B-S5-21	4	DEF-01
9/11/2025	17:30	Adjusted HX-01 from 13 C to 15 C	4	DEF-01
9/11/2025	23:16	Sample W05B-S5-22	4	DEF-01
9/12/2025	3:17	Sample W05B-S5-23	4	DEF-01
9/12/2025	7:16	Sample W05B-S5-24	4	DEF-01
9/12/2025	15:01	Start of filter period 5	5	DEF-02
9/12/2025	15:20	Sample W05B-S5-25	5	DEF-02
9/12/2025	15:19	Sample W05B-S5-26	5	DEF-02
9/12/2025	23:20	Sample W05B-S5-27	5	DEF-02

B.6 Timelines of Run W-06

Table B.12. W-06 Preparation Timeline

Date	Time (24 h)	Description
9/16/2025	N/A	System pressure verification
9/16/2025	N/A	Differential pressure zero check and adjustment
9/16/2025	10:20	0.1 M NaOH flow test
9/19/2025	N/A	Balance check
9/19/2025	7:10	Simulant solid spiking preparation
9/22/2025	N/A	System pressure verification
9/22/2025	N/A	Differential pressure zero check and adjustment

Table B.13. W-06 Operations Timeline

Date	Time (24 h)	Description	Filter Period	Active Filter
9/16/2025	10:20	Begin W06 Pre Flow Test	N/A	DEF-01
9/16/2025	12:15	End W06 Pre Flow Test	N/A	DEF-02
9/22/2025	7:51	W06-S1B2-1	N/A	N/A
9/22/2025	7:53	Start of filter period 1	1	DEF-01
9/22/2025	7:56	Sample W06-S1B2-2	1	DEF-01
9/22/2025	5:57	Sample W06-S1B2-3	1	DEF-01
9/22/2025	19:56	Sample W06-S1B2-4	1	DEF-01
9/23/2025	7:56	Sample W06-S1B2-5	1	DEF-01
9/23/2025	8:03	Start of filter period 2	2	DEF-02
9/23/2025	19:57	Sample W06-S1B2-6	2	DEF-02
9/24/2025	5:56	Sample W06-S1B2-7	2	DEF-02
9/24/2025	8:02	Start of filter period 3	3	DEF-01
9/24/2025	20:00	Sample W06-S1B2-8	3	DEF-01
9/25/2025	6:40	Switched from filter FLT-01A to FLT-01B	3	DEF-01
9/25/2025	8:00	Sample W06-S1B2-9	3	DEF-01
9/25/2025	8:04	Start of filter period 4	4	DEF-02
9/25/2025	10:33	Start of filter period 5	5	DEF-01
9/25/2025	20:00	Sample W06-S1B2-10	5	DEF-01
9/26/2025	0:00	BPR-01 adjusted to maintain backpressure	5	DEF-01
9/26/2025	8:00	Sample W06-S1B2-11	5	DEF-01
9/26/2025	11:04	Start of filter period 6	6	DEF-02
9/26/2025	12:22	Sample W06-S1B2-12	6	DEF-02
9/29/2025	11:20	Begin W06 Post Flow Test	N/A	DEF-01
9/29/2025	11:55	End W06 Post Flow Test	N/A	DEF-02

Appendix C – Tabulated Recorded Test Data

In this appendix, the manually recorded data from each test is tabulated. Each test contains two data sets that are tabulated in each section. The first data set is the data from all the system instruments recorded periodically throughout test operation. The second data set is the initial differential pressure data collected each time a filter swap was conducted and includes only the differential pressure measured for the active filter as it came on-line. Note that two instruments (indicated by [FM-01] and [P-01] in the appropriate columns) were not calibrated and the data is For Information Only (FIO); FIO values are shown in *italic text*. When instrument data was not recorded, it is indicated by "n/m" for "not measured". When instrument data was recorded but is not necessary, it is indicated by "n/a" for "not applicable". Typically, "n/m" is for instruments that were out of service during the run, like DP-05 during W-01 through W-03, and "n/a" is for either DP-01 or DP-02, whichever is not the active filter.

C.1 W-01 Tabulated Data

Table C.1. Periodically Recorded Data from Run W-01A

			[FM-01]	FM-02	DP-01	DP-02	DP-03	DP-04	DP-05	*[P-01]*	P-02	P-03	P-05	T-01	T-02	T-03	T-AMB
Filter Period	Date	Time	*(gpm)*	(mL min^{-1})	(psid)	(psid)	(psid)	(psid)	(psid)	*(psig)*	(psig)	(psig)	(psig)	(°C)	(°C)	(°C)	(°C)
1	3/6/2025	8:32	*4.01*	n/m	0.00	n/a	-0.03	0.01	3.39	*63*	3.48	1.25	3.60	20.9	22.3	22.1	23.5
1	3/6/2025	9:38	*4.03*	130.0	0.90	n/a	4.30	2.21	3.55	*64*	49.78	40.43	35.07	20.9	21.6	22.3	22.8
1	3/6/2025	10:08	*4.03*	130.5	0.98	n/a	5.52	2.08	3.82	*64*	57.52	47.93	41.85	21.0	21.7	21.4	22.3
1	3/6/2026	10:38	*4.03*	130.1	1.04	n/a	5.65	2.10	25.57	*63*	56.91	47.46	40.91	21.0	21.6	22.0	22.3
1	3/6/2025	11:08	*4.03*	130.0	1.01	n/a	5.59	1.89	n/m	*63*	56.67	47.26	40.70	21.0	21.4	21.9	21.8
1	3/6/2025	11:38	*4.03*	129.9	1.06	n/a	5.66	1.88	n/m	*63*	56.67	47.08	40.66	21.2	21.7	21.3	22.9
1	3/6/2027	12:08	*4.03*	130.1	1.11	n/a	5.66	1.83	n/m	*63*	55.83	46.50	40.15	21.2	22.0	21.5	22.2
1	3/6/2025	12:38	*4.03*	130.1	1.15	n/a	5.72	1.72	n/m	*63*	55.91	46.63	40.12	21.3	22.1	21.6	21.7
1	3/6/2025	13:08	*4.02*	130.1	1.17	n/a	5.60	1.75	n/m	*63*	53.93	45.32	38.71	21.4	21.7	21.5	21.6
1	3/6/2028	13:38	*4.03*	130.1	1.23	n/a	5.72	1.69	n/m	*63*	54.02	44.90	38.46	21.6	22.1	21.2	21.6
1	3/6/2025	14:08	*4.03*	129.5	1.29	n/a	5.62	1.78	n/m	*63*	54.62	44.53	38.49	21.7	22.0	21.5	22.9
1	3/6/2025	14:38	*4.03*	129.9	1.31	n/a	5.53	1.77	n/m	*63*	55.33	45.85	39.06	21.6	22.1	21.8	22.1
1	3/6/2029	15:08	*4.03*	129.8	1.26	n/a	5.49	1.60	n/m	*63*	55.41	45.51	38.27	21.7	22.3	21.9	21.5
1	3/6/2025	15:38	*4.03*	130.1	1.32	n/a	5.42	1.76	n/m	*63*	55.24	45.7	39.39	21.6	22.1	21.9	21.6
1	3/6/2025	16:08	*4.03*	130.2	1.39	n/a	5.52	1.75	n/m	*63*	55.63	45.93	39.48	21.7	22.4	21.5	21.5
1	3/6/2030	16:38	*4.03*	130.3	1.36	n/a	5.61	1.78	n/m	*63*	55.38	45.67	39.22	21.6	22.3	21.6	21.3
1	3/6/2025	17:08	*4.03*	130.1	1.45	n/a	5.55	1.77	n/m	*63*	55.37	45.62	39.09	21.9	22.4	21.3	21.1
1	3/6/2025	17:38	*4.03*	130.2	1.41	n/a	5.42	1.74	n/m	*63*	54.87	45.56	39.28	22.1	22.4	21.7	22.7

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
1	3/6/2031	18:10	*4.03*	129.8	1.5	n/a	5.58	1.7	n/m	*64*	55.24	45.31	38.77	21.9	22.4	21.9	21
1	3/6/2025	18:38	*4.03*	129.9	1.52	n/a	5.61	1.8	n/m	*63*	55.38	45.81	38.96	21.9	22.4	21.8	22.2
1	3/6/2025	19:08	*4.03*	130.2	1.54	n/a	5.52	1.75	n/m	*64*	55.47	45.65	38.87	21.9	22.3	22	21.4
1	3/6/2032	19:38	*4.02*	129.9	1.59	n/a	5.62	1.76	n/m	*64*	55.00	44.9	38.27	21.9	22.6	22.1	22.3
1	3/6/2025	20:08	*4.03*	130.3	1.65	n/a	5.59	1.74	n/m	*64*	55.5	45.53	38.49	22.2	22.7	22.1	22.8
1	3/6/2025	20:38	*4.03*	129.8	1.68	n/a	5.53	1.76	n/m	*63*	53.64	43.52	37.05	21.9	22.6	22.4	24.4
1	3/6/2033	21:08	*4.03*	130.1	1.67	n/a	5.53	1.83	n/m	*63*	53.21	42.8	36.57	22	22.6	22.3	22.1
1	3/6/2025	21:38	*4.03*	130	1.67	n/a	5.54	1.72	n/m	*63*	55.51	45.77	39.54	22.1	22.5	22.6	22.5
1	3/6/2025	22:08	*4.03*	130.2	1.86	n/a	5.5	1.72	n/m	*63*	56.15	45.62	39.48	22.1	22.7	22.3	24.5
1	3/6/2034	22:38	*4.03*	129.6	1.86	n/a	5.55	1.74	n/m	*63*	55.54	46.1	39.57	22.1	22.6	22.4	22.1
1	3/6/2025	23:08	*4.03*	130.2	1.85	n/a	5.56	1.78	n/m	*64*	55.88	45.58	39.08	22.2	22.6	22.3	23.1
1	3/6/2025	23:38	*4.03*	130.2	1.98	n/a	5.52	1.76	n/m	*63*	55.82	45.36	39.14	22.2	23	22.6	25.1
1	3/7/2025	0:08	*4.03*	130.3	1.93	n/a	5.47	1.63	n/m	*63*	55.92	45.77	39.11	22.3	22.9	22.6	21.7
1	3/7/2025	00:38	*4.03*	129.7	1.96	n/a	5.59	1.68	n/m	*63*	54.86	43.97	37.8	22.1	22.6	22.6	23.3
1	3/7/2025	01:08	*4.03*	130.1	2.12	n/a	5.6	1.63	n/m	*63*	55.76	45.09	39.07	22.3	23	22.5	25.3
1	3/7/2025	01:38	*4.03*	130	2.02	n/a	5.53	1.71	n/m	*62*	55.67	45	39.09	22.2	22.5	22.6	21.6
1	3/7/2025	02:08	*4.03*	130.2	2.05	n/a	5.56	1.7	n/m	*63*	55.59	45.48	30.16	22.2	22.8	22.5	23
1	3/7/2025	02:38	*4.03*	130.3	2.06	n/a	5.53	1.73	n/m	*63*	55.6	45.53	39.2	22.3	22.6	22.5	25.3
1	3/7/2025	03:08	*4.03*	130.1	2.16	n/a	5.52	1.83	n/m	*64*	55.38	45.25	38.82	22.2	22.5	22.5	21.9
1	3/7/2025	03:38	*4.02*	130	2.22	n/a	5.58	1.66	n/m	*63*	55.58	45.22	38.84	22.3	22.7	22.5	22.7
1	3/7/2025	04:08	*4.01*	130.2	2.16	n/a	5.48	1.78	n/m	*63*	55.98	45.11	38.91	22.2	22.8	22.5	24.6
1	3/7/2025	04:38	*4.02*	129.8	2.2	n/a	5.42	1.66	n/m	*63*	55.43	45.39	38.89	22.3	22.7	22.5	24.6
1	3/7/2025	05:08	*4.03*	130.0	2.22	n/a	5.57	1.69	n/m	*63*	55.45	45.01	38.71	22.1	22.3	22.3	22.1
1	3/7/2025	05:38	*4.03*	130.1	2.39	n/a	5.43	1.68	n/m	*62*	55.26	44.93	38.51	22.3	22.7	22.6	23.6
1	3/7/2025	06:08	*4.03*	130.1	2.32	n/a	5.6	1.73	n/m	*63*	55.77	45.19	38.81	22.1	22.6	22.5	25.4
1	3/7/2025	06:38	*4.03*	130.1	2.47	n/a	5.56	1.8	n/m	*63*	55.36	44.62	38.38	22.0	22.2	22.4	21.6
1	3/7/2025	07:08	*4.03*	129.8	2.27	n/a	5.67	1.73	n/m	*63*	56.00	45.17	38.42	22.0	22.4	22.5	22.7
1	3/7/2025	07:38	*4.02*	130.2	2.44	n/a	5.59	1.69	n/m	*63*	55.08	43.05	36.98	22.0	22.4	22.4	22.8
1	3/7/2025	08:08	*4.03*	129.9	2.54	n/a	5.64	1.75	n/m	*63*	52.66	41.90	36.96	21.7	22.4	22.3	21.6
1	3/7/2025	08:38	*4.03*	130.0	2.54	n/a	5.65	1.75	n/m	*62*	54.95	43.85	37.35	21.9	22.4	22.4	23.1
1	3/7/2025	09:08	*4.03*	130.1	2.49	n/a	5.62	1.74	n/m	*62*	56.13	45.20	38.78	21.7	22.2	22.1	21.6
1	3/7/2025	09:32	*4.02*	129.6	2.62	n/a	5.71	1.73	n/m	*63*	55.70	44.74	38.15	21.7	22.7	22.3	22.8

			[FM-01]	FM-02	DP-01	DP-02	DP-03	DP-04	DP-05	*[P-01]*	P-02	P-03	P-05	T-01	T-02	T-03	T-AMB
Filter Period	Date	Time	*(gpm)*	(mL min^{-1})	(psid)	(psid)	(psid)	(psid)	(psid)	*(psig)*	(psig)	(psig)	(psig)	(°C)	(°C)	(°C)	(°C)
2	3/7/2025	09:44	*4.03*	129.7	n/a	1.13	5.02	1.68	n/m	*62*	54.39	47.55	41.71	22.0	22.6	22.2	23.4
2	3/7/2025	10:15	*4.03*	129.9	n/a	1.31	5.66	1.72	n/m	*62*	55.41	47.60	40.97	21.9	22.3	22.1	22.0
2	3/7/2025	10:45	*4.03*	130.0	n/a	1.40	5.57	1.73	n/m	*62*	55.05	47.50	40.97	22.0	22.5	22.1	23.3
2	3/7/2025	11:15	*4.03*	130.0	n/a	1.54	5.62	1.76	n/m	*62*	54.88	47.30	40.66	21.8	22.4	22.4	21.9
2	3/7/2025	11:45	*4.03*	130.2	n/a	1.57	5.70	1.77	n/m	*62*	55.10	47.07	40.43	21.9	22.3	21.8	22.4
2	3/7/2025	12:15	*4.03*	129.9	n/a	1.60	5.69	1.76	n/m	*62*	53.65	45.56	38.86	21.8	22.4	22.2	22.2
2	3/7/2025	12:45	*4.03*	130.3	n/a	1.57	5.52	1.72	n/m	*62*	51.52	42.99	36.33	21.9	22.0	22.1	21.4
2	3/7/2025	13:15	*4.03*	129.8	n/a	1.73	5.73	1.75	n/m	*62*	55.05	45.79	39.20	21.9	22.1	22.0	21.6
2	3/7/2025	13:45	*4.03*	130.0	n/a	1.77	5.73	1.77	n/m	*62*	49.84	40.75	34.22	21.7	22.0	21.6	21.3
2	3/7/2025	14:15	*4.03*	130.1	n/a	1.81	5.77	1.75	n/m	*62*	50.00	39.93	33.10	21.8	22.3	21.6	21.4
2	3/7/2025	14:45	*4.03*	129.9	n/a	1.84	5.72	1.75	n/m	*64*	51.38	41.91	35.40	21.9	22.0	21.6	21.3
2	3/7/2025	15:15	*4.03*	129.9	n/a	1.89	5.74	1.76	n/m	*62*	49.21	39.85	33.42	21.6	22.3	21.6	22.0
2	3/7/2025	15:45	*4.03*	130.1	n/a	1.96	5.77	1.73	n/m	*64*	48.41	38.00	31.52	21.7	22.5	21.6	22.0
2	3/7/2025	16:15	*4.03*	131.5	n/a	1.99	5.71	1.75	n/m	*63*	43.18	32.54	26.06	21.6	22.1	22.0	21.5
2	3/7/2025	16:45	*4.03*	129.9	n/a	2.04	5.69	1.78	n/m	*63*	44.12	34.16	27.55	21.8	22.2	21.6	21.6
2	3/7/2025	17:15	*4.03*	129.9	n/a	2.09	5.70	1.78	n/m	*62*	47.37	37.31	30.71	21.7	22.3	21.8	21.1
2	3/7/2025	17:45	*4.03*	129.4	n/a	2.11	5.71	1.76	n/m	*62*	41.42	31.2	24.68	21.7	22.0	21.6	21.8
2	3/7/2025	18:15	*4.03*	130.1	n/a	2.17	5.71	1.75	n/m	*63*	42.63	32.66	26.08	21.5	22.3	21.8	22.2
2	3/7/2025	18:45	*4.03*	130.0	n/a	2.19	5.73	1.76	n/m	*63*	41.43	31.46	24.90	21.9	22.3	21.5	20.9
2	3/7/2025	19:15	*4.03*	130.1	n/a	2.23	5.71	1.75	n/m	*63*	43.65	33.51	26.96	21.6	22.2	21.6	22.4
2	3/7/2025	19:45	*4.03*	130.1	n/a	2.30	5.74	1.76	n/m	*62*	48.67	38.57	31.88	21.5	22.5	21.5	21.1
2	3/7/2025	20:15	*4.03*	130.2	n/a	2.31	5.73	1.75	n/m	*62*	47.20	37.11	30.49	21.7	22.0	21.9	22.6
2	3/7/2025	20:45	*4.03*	129.9	n/a	2.39	5.73	1.74	n/m	*62*	50.65	40.40	33.74	21.6	22.4	22.0	23.8
2	3/7/2025	21:15	*4.03*	130.1	n/a	2.43	5.68	1.76	n/m	*62*	49.66	39.31	32.69	21.6	22.0	22.1	23.9
2	3/7/2025	21:45	*4.02*	129.7	n/a	2.38	5.55	1.71	n/m	*62*	51.15	41.56	35.15	21.6	22.0	22.1	22.1
2	3/7/2025	22:20	*4.03*	129.2	n/a	2.57	5.62	1.76	n/m	*62*	45.2	35.78	29.25	21.7	22.3	22.3	23.4
2	3/7/2025	22:45	*4.03*	129.2	n/a	2.69	5.85	1.78	n/m	*62*	41.36	31.78	25.27	21.6	22.2	22.3	23.6
2	3/7/2025	23:15	*4.03*	130.1	n/a	2.63	5.68	1.75	n/m	*62*	48.09	38.81	32.23	21.6	22.5	22.2	22.3
2	3/7/2025	23:45	*4.03*	130.1	n/a	2.67	5.66	1.76	n/m	*62*	47.01	37.89	31.33	21.9	22.3	22.3	24.6
2	3/8/2025	00:15	*4.03*	130	n/a	2.67	5.7	1.76	n/m	*63*	53.52	44.16	37.81	21.5	22.6	22.5	23.1
2	3/8/2025	00:45	*4.01*	130	n/a	2.73	5.71	1.76	n/m	*63*	49.8	40.41	33.66	21.8	22.2	22.4	22.3
2	3/8/2025	01:15	*4.03*	129.8	n/a	2.81	5.68	1.69	n/m	*63*	49.86	39.55	33.12	21.6	22.4	22.3	24.3

			[FM-01]	FM-02	DP-01	DP-02	DP-03	DP-04	DP-05	*[P-01]*	P-02	P-03	P-05	T-01	T-02	T-03	T-AMB
Filter Period	Date	Time	*(gpm)*	(mL min^{-1})	(psid)	(psid)	(psid)	(psid)	(psid)	*(psig)*	(psig)	(psig)	(psig)	(°C)	(°C)	(°C)	(°C)
2	3/8/2025	01:45	*4.02*	130	n/a	2.85	5.75	1.76	n/m	*62*	48.49	39.27	32.65	21.7	22.1	22.5	23.7
2	3/8/2025	02:15	*4.03*	130.1	n/a	2.8	5.68	1.71	n/m	*63*	49.26	39.39	32.98	21.6	22.5	22.6	22.4
2	3/8/2025	02:45	*4.03*	130	n/a	2.89	5.64	1.78	n/m	*63*	49.35	39	32.46	21.9	22.5	22.4	24.5
2	3/8/2025	03:15	*4.03*	129.8	n/a	2.95	5.69	1.73	n/m	*62*	48.56	38.15	31.75	21.9	22.3	22.4	23.2
2	3/8/2025	03:45	*4.02*	129.9	n/a	3	5.69	1.75	n/m	*63*	51.58	40.83	34.26	21.9	22.3	22.4	22.6
2	3/8/2025	04:15	*4.02*	129.8	n/a	3.02	5.66	1.72	n/m	*62*	52.15	41	34.41	21.7	22.6	22.4	24.6
2	3/8/2025	04:45	*4.03*	130.3	n/a	3.01	5.78	1.77	n/m	*62*	51.44	34.83	28.18	21.8	22.3	22.3	21.9
2	3/8/2025	04:55	*4.02*	130	n/a	3.11	5.75	1.66	n/m	*63*	52.18	41.96	35.25	21.7	22.5	22.3	25.6
3	3/8/2025	05:12	*4.03*	129	1.02	n/a	4.91	1.70	n/m	*62*	45.1	35.94	30.04	21.7	22.3	22.3	23.3
3	3/8/2025	05:42	*4.02*	129.8	1.2	n/a	5.66	1.78	n/m	*62*	54.76	44.22	38.36	21.7	22.5	22.4	25.3
3	3/8/2025	06:12	*4.02*	130	1.22	n/a	5.8	1.77	n/m	*63*	54.33	44.53	38.31	22	22.1	22.4	22.1
3	3/8/2025	06:42	*4.03*	130	1.22	n/a	5.64	1.70	n/m	*62*	54.42	44.53	37.98	21.6	22.7	22.3	23.8
3	3/8/2025	07:12	*4.02*	130.2	1.56	n/a	5.76	1.78	n/m	*62*	54.73	44.6	37.99	21.8	22.5	22.2	23.6
3	3/8/2025	07:42	*4.02*	130.1	1.48	n/a	5.64	1.70	n/m	*62*	54.71	44.30	38.00	21.6	22.4	22.5	22.6
3	3/8/2025	08:12	*4.03*	130.1	1.56	n/a	5.54	1.71	n/m	*62*	54.62	44.45	37.85	21.8	22.3	22.3	22.7
3	3/8/2025	08:42	*4.02*	130.1	1.62	n/a	5.75	1.75	n/m	*62*	54.17	42.85	36.38	21.6	22.1	22.1	21.8
3	3/8/2025	09:12	*4.03*	129.9	1.69	n/a	5.84	1.74	n/m	*62*	54.70	42.85	36.33	22.0	22.3	21.6	22.2
3	3/8/2025	09:42	*4.03*	130	1.89	n/a	5.82	1.81	n/m	*62*	54.26	42.98	36.4	21.7	22.3	22.1	22
3	3/8/2025	10:12	*4.02*	130.2	2.02	n/a	5.8	1.76	n/m	*62*	54.51	44.42	37.85	21.7	22.2	22	21.1
3	3/8/2025	10:42	*4.02*	130.1	1.94	n/a	5.81	1.76	n/m	*62*	54.56	44.55	38.03	21.9	22.3	21.9	23
3	3/8/2025	11:12	*4.03*	129.7	1.97	n/a	5.74	1.82	n/m	*61*	53.96	44.14	37.83	21.8	22.4	22	22.3
3	3/8/2025	11:42	*4.02*	130	2.1	n/a	5.71	1.82	n/m	*61*	54.6	44.11	37.68	21.7	22.1	22	22
3	3/8/2025	12:12	*4.03*	130.1	2.07	n/a	5.75	1.81	n/m	*61*	54.05	44.26	37.48	21.6	22.1	22	21.6
3	3/8/2025	12:42	*4.02*	130.1	2.14	n/a	5.78	1.78	n/m	*61*	54.11	43.35	36.97	21.8	22.2	22	21.7
3	3/8/2025	13:12	*4.02*	130.1	2.2	n/a	5.85	1.76	n/m	*61*	53.31	43.64	36.71	21.6	22.3	21.8	22
3	3/8/2025	13:42	*4.02*	129.9	2.15	n/a	5.92	1.82	n/m	*61*	54.48	44.36	37.55	21.7	22.1	21.7	22
3	3/8/2025	14:12	*4.02*	130	2.31	n/a	5.9	1.8	n/m	*61*	54.21	43.85	37.52	21.6	22	21.8	22.4
3	3/8/2025	14:42	*4.03*	129.9	2.29	n/a	5.9	1.78	n/m	*61*	54.04	44.17	37.46	21.7	22.1	22.1	22.2
3	3/8/2025	15:12	*4.02*	129.9	2.35	n/a	5.82	1.81	n/m	*61*	54.46	44.21	37.53	22	22.2	22.2	22.4
3	3/8/2025	15:42	*4.02*	130.1	2.35	n/a	5.77	1.79	n/m	*61*	54.48	44.13	37.46	20.9	22.6	22.1	22.6
3	3/8/2025	16:12	*4.03*	129.9	2.47	n/a	6.01	1.83	n/m	*62*	52.6	42.43	35.5	21.6	22	22	22.2
3	3/8/2025	16:42	*4.03*	130.1	2.69	n/a	6	1.81	n/m	*63*	55.05	44.11	37.4	21.6	22.1	21.8	22

			[FM-01]	FM-02	DP-01	DP-02	DP-03	DP-04	DP-05	*[P-01]*	P-02	P-03	P-05	T-01	T-02	T-03	T-AMB
Filter Period	Date	Time	*(gpm)*	(mL min^{-1})	(psid)	(psid)	(psid)	(psid)	(psid)	*(psig)*	(psig)	(psig)	(psig)	(°C)	(°C)	(°C)	(°C)
3	3/8/2025	17:12	*4.02*	129.9	2.8	n/a	5.92	1.85	n/m	*63*	55.36	43.95	37.11	21.7	22.1	22	21.6
3	3/8/2025	17:27	*4.03*	130.2	3.06	n/a	5.88	1.85	n/m	*62*	54.77	43.85	36.89	21.5	22	22	21.5
4	3/8/2025	17:49	*4.03*	130.4	n/a	1.55	5.38	1.87	n/m	*62*	55.21	46.99	40.72	21.4	22.1	22.1	21.4
4	3/8/2025	18:19	*4.03*	130.1	n/a	1.96	6.05	1.82	n/m	*63*	55.05	46.4	39.48	21.7	22.3	21.7	21.2
4	3/8/2025	18:49	*4.03*	130.1	n/a	2.38	6.01	1.82	n/m	*62*	54.46	46.04	39.42	21.4	22.2	21.6	21
4	3/8/2025	19:22	*4.03*	130.1	n/a	2.79	6.01	1.83	n/m	*62*	55.14	45.97	38.69	21.5	22.1	21.2	22.4
4	3/8/2025	19:47	*4.02*	130	n/a	3.26	6.01	1.87	n/m	*63*	54.71	45.36	38.47	21.6	22.1	21.9	21.7
5	3/8/2025	20:17	*4.03*	129.7	1.48	n/a	5.89	1.88	n/m	*62*	55.12	44.73	38.16	21.6	22.1	21.9	20
5	3/8/2025	20:47	*4.03*	130.1	1.8	n/a	6.01	1.88	n/m	*63*	55.05	44.84	38.01	21.6	22.1	21.3	22.6
5	3/8/2025	21:17	*4.03*	130.2	2.22	n/a	5.99	1.81	n/m	*62*	55.44	44.39	37.67	21.6	22.1	21.6	21.2
5	3/8/2025	21:47	*4.02*	130.2	2.64	n/a	5.98	1.83	n/m	*62*	55.19	43.98	37.45	21.5	22.3	22.1	22.1
5	3/8/2025	22:17	*4.03*	130.1	4.22	n/a	5.86	1.81	n/m	*63*	54.64	42.17	35.09	21.8	22.1	21.9	22.1
5	3/8/2025	22:47	*4.03*	130.1	4.66	n/a	5.96	1.81	n/m	*62*	54.55	41.65	34.72	21.8	22.1	21.8	21.5
5	3/8/2025	23:17	*4.03*	129.9	5.1	n/a	5.89	1.81	n/m	*62*	54.32	40.65	33.95	21.7	22.2	21.8	22.3
5	3/8/2025	23:47	*4.03*	130	5.96	n/a	5.92	1.8	n/m	*63*	54.03	39.56	33	21.6	22.1	22	21.6
6	3/9/2025	0:06	*4.03*	129.8	n/a	1.73	5.09	1.82	n/m	*63*	54.85	46.62	40.69	21.5	22.1	21.6	22.5
6	3/9/2025	00:36	*4.02*	130.1	n/a	2.42	5.91	1.8	n/m	*63*	55.15	45.91	39.29	21.5	22.4	22	23.9
6	3/9/2025	01:06	*4.02*	129.9	n/a	2.79	5.86	1.78	n/m;	*63*	54.05	44.47	37.91	21.6	22.3	22	24.9
6	3/9/2025	01:36	*4.02*	130	n/a	3.42	5.92	1.79	n/m	*64*	53.69	44.18	37.39	21.6	22.4	22.2	22
6	3/9/2025	03:06	*4.02*	129.7	n/a	3.9	5.89	1.79	n/m	*62*	53.71	43.6	36.81	21.8	22.5	22.3	23.8
6	3/9/2025	03:36	*4.03*	129.6	n/a	4.56	5.87	1.82	n/m	*63*	53.66	42.89	36.22	21.6	22.1	22.3	23.8
6	3/9/2025	04:06	*4.02*	130.1	n/a	5.51	5.87	1.79	n/m	*63*	53.86	42.05	35.3	21.7	22.3	22.3	22.3
6	3/9/2025	04:36	*4.02*	130	n/a	6.36	5.8	1.78	n/m	*63*	53.54	40.6	33.9	21.9	22.3	22.5	24.6
6	3/9/2025	04:42	*4.02*	130	0.12	6.54	5.92	1.78	n/m	*64*	53.61	40.31	33.66	21.9	22.4	22.4	23.5
7	3/9/2025	04:58	*4.02*	130	1.46	n/a	4.88	1.74	n/m	*62*	54.34	44.47	38.6	21.5	22.1	22.3	21.8
7	3/9/2025	05:28	*4.02*	130	2.01	n/a	5.99	1.8	n/m	*63*	54.21	43.5	37.07	22	22.2	22.1	23.8
7	3/9/2025	05:58	*4.01*	130	2.45	n/a	5.88	1.82	n/m	*64*	54.26	43.54	36.83	21.7	22.3	22.2	24.7
7	3/9/2025	06:28	*4.02*	130	2.97	n/a	5.89	1.72	n/m	*63*	54.09	42.71	35.98	21.9	22.2	22.2	22.4
7	3/9/2025	06:58	*4.02*	130	3.61	n/a	5.76	1.72	n/m	*62*	54.37	42.19	35.67	21.8	22.6	22.3	24.3
7	3/9/2025	07:28	*4.02*	129.9	4.40	n/a	5.80	1.77	n/m	*63*	54.04	41.36	34.83	21.7	22.1	22.4	24.0
7	3/9/2025	07:58	*4.02*	129.7	5.40	n/a	5.86	1.78	n/m	*62*	54.72	40.90	34.07	21.7	22.7	22.3	22.4
7	3/9/2025	08:28	*4.03*	129.8	6.42	n/a	5.90	1.78	n/m	*61*	54.30	39.76	32.97	21.7	22.7	22.3	24.6

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
8	3/9/2025	08:40	*4.02*	130.0	n/a	1.81	5.02	1.77	n/m	*62*	53.62	45.39	39.14	21.9	22.6	22.5	22.7
8	3/9/2025	09:10	*4.02*	129.9	n/a	2.49	6.04	1.80	n/m	*63*	55.79	46.65	39.64	21.7	22.3	22.0	24.5
8	3/9/2025	09:40	*4.03*	129.8	n/a	3.02	5.92	1.80	n/m	*62*	55.43	45.86	38.98	21.9	22.3	22.4	22.3
8	3/9/2025	10:10	*4.03*	129.7	n/a	5.04	5.98	1.86	n/m	*63*	55.46	44.18	37.13	21.6	22.5	22.2	22.7
8	3/9/2025	10:40	*4.02*	130.1	n/a	5.23	5.90	1.82	n/m	*62*	55.13	43.59	36.92	21.9	22.3	22.3	22.6
8	3/9/2025	11:11	*4.02*	130.1	n/a	5.67	5.92	1.83	n/m	*63*	55.47	43.50	36.30	21.6	22.0	22.0	21.8
8	3/9/2025	11:41	*4.02*	130.1	n/a	6.30	6.02	1.85	n/m	*63*	55.74	42.91	36.04	21.8	22.2	22.0	21.9
8	3/9/2025	11:55	*4.02*	130.1	n/a	6.74	6.01	1.83	n/m	*62*	55.54	42.46	35.56	21.7	22.0	22.1	21.3
9	3/9/2025	12:16	*4.02*	130.6	1.82	n/a	5.26	1.74	n/m	*62*	55.15	45.79	39.81	21.7	22.4	22.1	21.9
9	3/9/2025	12:46	*4.02*	130.0	2.46	n/a	7.05	1.87	n/m	*63*	55.83	44.62	38.05	21.5	22.6	21.9	21.8
9	3/9/2025	13:16	*4.02*	130.1	3.05	n/a	6.00	1.83	n/m	*62*	55.35	44.02	37.22	21.9	22.6	21.7	22.1
9	3/9/2025	13:46	*4.02*	130.1	3.65	n/a	6.02	1.81	n/m	*62*	55.71	43.76	36.97	21.7	22.3	21.7	22.3
9	3/9/2025	14:16	*4.02*	130.0	4.22	n/a	6.02	1.82	n/m	*62*	55.50	43.12	36.33	21.9	22.1	21.9	22.4
9	3/9/2025	14:48	*4.03*	130.1	5.15	n/a	5.99	1.85	n/m	*62*	55.05	42.07	35.47	21.6	22.3	22.1	22.1
9	3/9/2025	15:16	*4.02*	130.0	6.05	n/a	5.97	1.85	n/m	*61*	53.70	39.21	32.18	21.9	22.1	22.2	22.5
9	3/9/2025	15:30	*4.02*	130.2	6.56	n/a	5.95	1.84	n/m	*62*	53.50	38.55	31.92	21.8	22.3	22.3	22.6
10	3/9/2025	15:42	*4.02*	129.7	n/a	2.35	4.20	1.84	n/m	*62*	55.17	46.84	40.72	22.1	22.3	22.2	22.3
10	3/9/2025	16:12	*4.02*	129.9	n/a	3.34	5.96	1.81	n/m	*62*	55.55	45.42	38.83	21.6	22.1	21.5	21.5
10	3/9/2025	16:42	*4.02*	130.2	n/a	3.97	5.95	1.87	n/m	*62*	55.56	44.77	38.16	21.7	22.4	21.6	22.1
10	3/9/2025	17:12	*4.02*	130.1	n/a	4.52	5.91	1.80	n/m	*62*	54.83	44.26	37.34	21.6	22.3	21.9	21.7
10	3/9/2025	17:42	*4.02*	130.1	n/a	5.20	5.95	1.83	n/m	*61*	54.74	43.48	36.44	21.7	22.3	22.1	22.3
10	3/9/2025	18:12	*4.02*	130.0	n/a	5.90	5.86	1.83	n/m	*62*	55.32	42.87	35.64	21.9	22.4	22.0	22.2
10	3/9/2025	18:42	*4.02*	130.0	n/a	6.98	5.92	1.82	n/m	*62*	54.70	41.43	34.82	21.6	22.3	22.1	21.9
10	3/9/2025	18:55	*4.02*	130.1	n/a	7.36	6.01	1.81	n/m	*62*	54.50	40.67	33.92	21.9	22.1	22.1	21.8
11	3/9/2025	19:17	*4.02*	130.5	2.18	n/a	5.30	1.81	n/m	*62*	54.51	44.52	38.7	21.8	22.4	22.0	21.9
11	3/9/2025	19:47	*4.02*	130.1	2.90	n/a	5.99	1.83	n/m	*62*	54.74	43.38	36.7	21.8	22.4	21.6	21.1
11	3/9/2025	20:17	*4.02*	129.9	3.53	n/a	6.04	1.82	n/m	*62*	54.24	42.55	35.59	21.6	22.2	21.6	22.5
11	3/9/2025	20:47	*4.02*	130.1	4.09	n/a	5.91	1.83	n/m	*62*	53.43	41.09	34.16	21.7	22.2	21.8	21.4
11	3/9/2025	21:19	*4.02*	130.0	4.88	n/a	5.97	1.85	n/m	*61*	53.57	40.52	33.70	21.8	22.2	21.6	21.6
11	3/9/2025	21:47	*4.02*	130.0	5.68	n/a	5.85	1.82	n/m	*62*	53.78	39.92	33.02	21.6	22.5	21.7	22.8
11	3/9/2025	22:12	*4.02*	130.1	8.79	n/a	5.97	1.88	n/m	*62*	55.03	37.71	30.73	21.6	22.3	21.9	21.0
12	3/9/2025	22:33	*4.02*	130.9	n/a	2.71	5.29	1.82	n/m	*62*	54.44	45.22	39.30	21.6	22.2	22.0	22.0

Filter Period	Date	Time	*[FM-01]*	FM-02	DP-01	DP-02	DP-03	DP-04	DP-05	*[P-01]*	P-02	P-03	P-05	T-01	T-02	T-03	T-AMB
			(gpm)	(mL min^{-1})	(psid)	(psid)	(psid)	(psid)	(psid)	*(psig)*	(psig)	(psig)	(psig)	(°C)	(°C)	(°C)	(°C)
12	3/9/2025	23:03	*4.02*	130.1	n/a	3.60	5.99	1.81	n/m	*62*	54.39	44.35	37.55	21.6	22.1	21.7	22.3
12	3/9/2025	23:33	*4.02*	130.1	n/a	4.31	6.01	1.82	n/m	*63*	54.84	43.7	36.84	21.5	22.1	21.9	21
12	3/10/2025	0:03	*4.03*	130	n/a	4.86	5.96	1.87	n/m	*64*	54.51	43.31	36.45	21.4	22.2	21.6	22.6
12	3/10/2025	00:33	*4.02*	130	n/a	5.4	6.08	1.82	n/m	*64*	54.52	42.82	35.78	21.6	21.9	21.6	21.2
12	3/10/2025	01:03	*4.02*	129.8	n/a	6.15	5.99	1.78	n/m	*63*	54.66	41.6	34.73	21.8	22.1	21.8	22
12	3/10/2025	01:33	*4.02*	130	n/a	7.09	5.99	1.86	n/m	*64*	54.31	40.43	33.71	21.7	22.1	21.7	21.7
13	3/10/2025	01:48	*4.02*	130.1	1.76	n/a	5.2	1.89	n/m	*62*	54.87	45.2	38.93	21.8	22	22	21.2
13	3/10/2025	02:18	*4.02*	129.9	2.58	n/a	6.05	1.84	n/m	*62*	55.16	44.25	37.52	21.8	22.1	21.1	22.5
13	3/10/2025	02:48	*4.03*	130	3.33	n/a	6.03	1.85	n/m	*63*	55.04	43.27	36.57	21.5	22.1	21.9	21
13	3/10/2025	03:18	*4.02*	129.9	4.05	n/a	6	1.83	n/m	*62*	55.21	42.9	35.72	21.8	22.3	21.7	22.4
13	3/10/2025	03:48	*4.02*	129.9	4.9	n/a	5.99	1.84	n/m	*64*	55.26	41.74	35.06	21.7	22.2	22	21.4
13	3/10/2025	04:18	*4.02*	130	5.72	n/a	5.82	1.81	n/m	*62*	55	41.07	34.47	21.9	22.2	21.8	24
13	3/10/2025	04:48	*4.02*	130.2	6.62	n/a	5.79	1.82	n/m	*62*	54.7	39.81	33.33	21.7	22.1	22.2	22.5
14	3/10/2025	05:03	*4.02*	130.1	n/a	2.6	5.14	1.72	n/m	*64*	54.65	45.59	39.75	21.6	22.4	22	24.3
14	3/10/2025	05:33	*4.02*	130	n/a	3.31	8.11	1.9	n/m	*62*	55.21	45.22	36.18	21.8	22.3	21.9	21.8
14	3/10/2025	06:03	*4.02*	130.7	n/a	4	7.89	1.8	n/m	*62*	55.3	44.72	36.02	21.7	22.5	22.5	23
14	3/10/2025	06:33	*4.01*	130	n/a	4.58	7.84	1.86	n/m	*63*	55.24	44.25	35.72	21.8	22.5	22.3	25.4
14	3/10/2025	07:03	*4.01*	131.2	n/a	5.38	7.85	1.81	n/m	*63*	55.01	42.98	34.23	21.7	22.2	22.6	22.1
14	3/10/2025	07:33	*4.02*	131.5	n/a	6.21	7.81	1.83	n/m	*63*	55.04	42.17	33.45	21.5	22.6	22	24.7
14	3/10/2025	08:03	*4.02*	134.1	n/a	7.23	7.66	1.82	n/m	*62*	54.96	40.95	32.31	21.7	22.4	22.3	22.1
15	3/10/2025	08:33	*4.01*	120	3.53	n/a	9.43	2.55	n/m	*62*	52.08	33.93	26.69	21.7	22.4	22.6	23.2
15	3/10/2025	09:32	*4.02*	130.7	3.75	n/a	7.35	1.87	n/m	*62*	55.62	43.37	35.15	21.7	22.1	22.5	22.6
15	3/10/2025	09:38	*n/m*	n/m	n/m	n/m	9.23	n/m	n/m	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	n/m
16	3/10/2025	11:58	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	n/m
16	3/10/2025	12:15	*4.02*	n/m	n/a	2.81	5.03	1.75	n/m	*62*	55.37	47.5	42.04	21.9	22.2	22.3	22.1
16	3/10/2025	12:47	*4.02*	n/m	n/a	2.6	4.5	1.26	n/m	*62*	57.65	50.49	46.47	21.7	22.2	22.1	21.6
16	3/10/2025	13:22	*4.03*	n/m	n/a	3.25	4.3	1.25	n/m	*62*	59.09	51.1	47.46	21.7	22	21.9	21.5
16	3/10/2025	13:51	*4.03*	n/m	n/a	3.27	4.07	1.16	n/m	*63*	58.74	51.51	48.19	21.7	22.1	21.4	21.6
16	3/10/2025	14:15	*4.03*	n/m	n/a	3.24	3.96	1.02	n/m	*62*	59.71	51.34	48.45	21.7	22.3	21.7	21.7
16	3/10/2025	15:06	*4.04*	n/m	n/a	3.31	3.24	0.96	n/m	*63*	60.15	52.53	50.74	21.8	22.1	21.6	21.7
16	3/10/2025	15:23	*4.02*	n/m	n/a	7.08	7.06	2.22	n/m	*62*	53.8	40.07	32.01	22	22.3	21.6	22
16	3/10/2025	15:49	*4.02*	n/m	n/a	7.24	6.77	2.08	n/m	*63*	54.3	39.66	32.16	21.6	22.1	21.6	21.5

Filter Period	Date	Time	[FM-01] (gpm)	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	[P-01] (psig)	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
17	3/10/2025	16:15	4.02	n/m	2.64	n/a	6.44	2.33	n/m	62	53.3	38.49	30.24	21.5	21.4	21.5	19.3
17	3/10/2025	16:30	4.02	n/m	3.49	n/a	6.64	2.15	n/m	62	54.74	35.14	27.5	21.4	22.1	21.3	22.6
17	3/10/2025	17:01	4.02	n/m	4.81	n/a	7.08	2.36	n/m	62	53.42	38.79	30.18	21.6	22.1	22	22.5
17	3/10/2025	17:30	4.01	n/m	5.94	n/a	7.25	2.39	n/m	62	53.24	37.25	28.48	21.5	22	22.1	22.2
17	3/10/2025	18:00	4.02	129.8	6.2	n/a	5.97	1.92	n/m	62	55.22	40.68	34.32	21.4	22.2	22.1	21.3
17	3/10/2025	18:30	4.02	130.1	6.86	n/a	6.02	1.99	n/m	62	55.38	40.07	33.4	21.7	22.2	21.6	21.1
17	3/10/2025	18:49	4.02	130.1	7.24	n/a	6.02	1.92	n/m	62	55.22	39.15	32.78	21.5	21.9	21.7	21.2
18	3/10/2025	19:30	4.02	130.5	n/a	3.88	6.03	1.89	n/m	61	55.44	45.09	38.14	21.8	22.3	20.9	21.8
18	3/10/2025	20:02	4.02	130.1	n/a	4.75	4.94	1.94	n/m	62	54.86	43.92	37.41	21.4	22.3	21.9	21.7
18	3/10/2025	20:30	4.02	129.9	n/a	5.31	5.96	1.94	n/m	70	61.02	49.36	42.84	21.6	22.2	21.9	22.3
18	3/10/2025	21:00	4.02	129.7	n/a	6.02	5.98	1.94	n/m	63	55.6	43.03	36.46	21.6	22.3	21.8	21.5
18	3/10/2025	21:30	4.02	130.1	n/a	6.77	5.97	1.94	n/m	63	55.64	42.38	35.86	21.8	22.1	21.8	22.6
18	3/10/2025	21:57	4.02	130	n/a	7.55	5.97	1.96	n/m	63	55.66	41.64	34.92	21.8	21.9	21.8	21.2
19	3/10/2025	22:30	4.02	128.8	2.51	n/a	5.86	1.93	n/m	63	55.83	44.89	38.49	21.7	22.3	21.2	22.9
19	3/10/2025	23:00	4.02	130.1	3.33	n/a	5.92	1.95	n/m	63	55.85	44.09	37.57	21.6	22.4	22	21.9
19	3/10/2025	23:30	4.02	130.1	4.08	n/a	5.99	1.96	n/m	63	55.95	43.33	36.65	21.6	22.2	21.7	22.5
19	3/11/2025	00:00	4.02	129.6	5.54	n/a	6	1.96	n/m	62	55.83	43.81	35.13	21.8	22	21.7	21.8
19	3/11/2025	00:30	4.02	130.1	6	n/a	6.03	1.97	n/m	62	55.92	41.4	35.68	21.7	22.3	22	21.9
20	3/11/2025	01:00	4.02	130.6	n/a	3.13	5.49	1.97	n/m	62	55.95	46.19	40.1	21.5	22.4	22.4	22.1
20	3/11/2025	01:30	4.02	129.9	n/a	4.26	6.01	1.95	n/m	62	56.09	45.22	38.55	22	22.3	21.9	21.7
20	3/11/2025	02:00	4.02	130.0	n/a	5.03	5.96	1.94	n/m	62	56.07	44.44	37.87	21.9	22.4	21.9	24.6
20	3/11/2025	02:30	4.02	130.0	n/a	5.75	5.97	1.95	n/m	62	56.05	43.73	37.08	21.7	22.7	22.3	22.8
21	3/11/2025	03:00	4.02	130.1	0.88	n/a	5.2	1.95	n/m	62	56.1	46.79	41.19	21.9	22.4	22.5	22.6
21	3/11/2025	03:30	4.03	129.9	2.74	n/a	5.81	1.9	n/m	62	56.24	45.12	38.86	21.9	22.5	21.9	24.9
21	3/11/2025	04:00	4.02	130.0	3.64	n/a	5.94	1.95	n/m	62	56.24	43.95	37.46	21.9	22.3	22.5	21.7
21	3/11/2025	04:30	4.02	130.0	4.35	n/a	5.93	1.94	n/m	62	56.1	43.25	36.74	22.1	22.6	22.6	23.5
21	3/11/2025	05:00	4.02	130.0	5.06	n/a	5.93	1.94	n/m	62	56.3	42.64	36.05	21.9	22.3	22.5	24.6
21	3/11/2025	05:30	4.02	130.0	5.81	n/a	5.92	1.95	n/m	62	55.94	41.74	35.19	21.7	22.4	22.5	22.3
22	3/11/2025	06:00	4.02	130.4	n/a	2.49	5.68	1.92	n/m	62	56.22	47.22	40.95	21.9	22.4	22.6	24.2
22	3/11/2025	06:30	4.02	130.0	n/a	4.18	5.92	1.94	n/m	62	56.27	45.58	39.06	21.9	22.1	22.4	22.5
22	3/11/2025	07:00	4.02	129.9	n/a	5.03	5.94	1.94	n/m	62	56.2	44.69	38.1	21.7	22.3	22.4	22.5
22	3/11/2025	07:30	4.03	130	n/a	5.63	5.92	1.93	n/m	62	56.07	44.14	37.53	21.9	22.4	22.4	25.2

Table C.2. Initial Differential Pressure Data for DEFs from Run W-01A

Filter Period	Date	Active Filter ID	Start Time	ΔP at t = 2 min (psid)	ΔP at t = 4 min (psid)	ΔP at t = 6 min (psid)	ΔP at t = 8 min (psid)	ΔP at t = 10 min (psid)	Target ΔP for Filter Switch (psid)
1	3/6/2025	1	09:28	0.76	0.82	0.83	0.88	0.88	2.88
2	3/7/2025	2	09:33	0.64	0.88	1.05	1.14	1.11	3.11
3	3/8/2025	1	05:00	0.69	0.89	0.98	1.01	1.03	3.03
4	3/8/2025	2	17:29	0.38	0.52	0.86	1.14	1.25	3.25
5	3/8/2025	1	19:49	0.55	0.69	0.91	1.05	1.17	6.17
6	3/8/2025	2	23:50	0.55	0.94	1.28	1.44	1.56	6.56
7	3/9/2025	1	04:45	0.68	0.92	1.03	1.26	1.41	6.41
8	3/9/2025	2	08:30	0.49	0.75	1.29	1.57	1.73	6.73
9	3/9/2025	1	12:00	0.65	0.79	0.97	1.30	1.52	6.52
10	3/9/2025	2	15:32	0.50	1.06	1.73	2.06	2.30	7.30
11	3/9/2025	1	18:58	0.65	0.84	1.13	1.52	1.74	6.74
12	3/9/2025	2	22:15	0.40	0.63	1.35	1.96	2.19	7.19
13	3/10/2025	1	01:35	0.7	0.92	1.26	1.56	1.72	6.72
14	3/10/2025	2	04:50	0.57	1.26	2.100	2.33	2.48	7.48
15	3/10/2025	1	08:10	0.67	0.88	1.39	1.82	2.05	7.05
16	3/10/2025	2	11:51	0.26	0.65	1.85	2.04	2.14	7.14
17	3/10/2025	1	15:52	0.49	0.85	1.55	2.08	2.2	7.2
18	3/10/2025	2	18:51	0.35	0.52	1.14	1.93	2.33	7.33
19	3/10/2025	1	21:59	0.39	0.49	0.69	0.86	1.11	6.11
20	3/11/2025	2	00:36	0.30	0.42	0.65	0.83	1.11	6.11
21	3/11/2025	1	02:47	0.43	0.54	0.71	0.76	0.82	5.82
22	3/11/2025	2	05:31	0.36	0.43	0.62	0.71	0.76	5.76

Table C.3. Periodically Recorded Data from Run W-01B

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min⁻¹)	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
1	3/11/2025	10:12	*4.03*	130.2	0.37	n/a	5.00	1.02	n/m	*62*	56.11	49.69	45.92	21.4	22.0	21.7	22.6
1	3/11/2025	10:42	*4.03*	129.9	1.13	n/a	5.76	1.90	n/m	*63*	56.36	46.95	40.82	21.5	22.2	22.0	23.0
1	3/11/2025	11:12	*4.03*	130.1	2.42	n/a	5.76	1.88	n/m	*64*	57.29	46.63	40.54	21.5	22.0	22.1	22.8
1	3/11/2025	11:41	*4.02*	129.9	2.96	n/a	5.80	1.82	n/m	*65*	56.57	45.19	38.90	21.4	22.1	22.1	21.2
1	3/11/2025	12:12	*4.02*	130.1	3.45	n/a	5.73	1.83	n/m	*65*	56.95	45.09	38.93	21.6	22.1	21.8	22.9
1	3/11/2025	12:42	*4.03*	130.0	3.63	n/a	5.75	1.91	n/m	*65*	50.85	38.93	32.66	21.5	22.1	22.1	21.7
1	3/11/2025	13:15	*4.02*	130.0	3.84	n/a	5.88	1.91	n/m	*65*	55.86	43.60	37.00	21.6	22.1	21.9	22.0
1	3/11/2025	13:41	*4.02*	130.0	3.95	n/a	5.84	1.94	n/m	*64*	55.08	42.98	36.24	21.5	22.2	22.0	22.4
1	3/11/2025	14:12	*4.03*	130.1	4.25	n/a	5.89	1.91	n/m	*63*	53.60	41.07	34.45	21.5	22.1	22.0	21.3
1	3/11/2025	14:41	*4.03*	129.9	4.38	n/a	5.95	1.90	n/m	*65*	53.65	40.97	34.34	21.5	22.1	21.6	21.3
1	3/11/2025	15:13	*4.03*	130.1	4.68	n/a	5.86	1.93	n/m	*65*	52.60	40.62	34.90	21.6	22.1	21.8	22.6
1	3/11/2025	15:42	*4.02*	130.3	4.80	n/a	5.85	1.97	n/m	*64*	53.78	40.30	34.13	21.4	22.1	22.0	21.2
1	3/11/2025	16:12	*4.03*	129.8	5.09	n/a	5.85	1.93	n/m	*64*	54.06	40.67	33.98	21.8	22.1	21.9	22.1
1	3/11/2025	16:42	*4.03*	130.2	5.27	n/a	5.86	1.92	n/m	*64*	52.67	39.06	32.82	21.6	22.2	22.1	22.0
1	3/11/2025	17:12	*4.03*	129.7	5.36	n/a	5.93	1.92	n/m	*64*	56.45	42.46	36.01	21.6	22.2	21.7	21.0
2	3/11/2025	17:42	*4.02*	131.3	n/a	2.50	5.75	1.87	n/m	*64*	56.86	48.13	41.27	21.6	21.7	21.8	22.3
2	3/11/2025	18:12	*4.03*	130.5	n/a	3.36	5.83	1.98	n/m	*63*	57.16	46.44	41.09	21.6	22.0	21.6	21.8
2	3/11/2025	18:42	*4.02*	130.1	n/a	3.87	5.81	1.91	n/m	*63*	57.31	45.55	39.41	21.6	22.1	21.7	21.5
2	3/11/2025	19:12	*4.02*	130.1	n/a	4.26	5.86	1.85	n/m	*64*	56.95	45.14	38.56	21.6	22.0	21.8	22.5
2	3/11/2025	19:42	*4.02*	130.3	n/a	4.55	5.91	1.93	n/m	*64*	57.39	46.16	39.72	21.5	22.1	21.8	21.3
2	3/11/2025	20:12	*4.03*	130.1	n/a	4.70	5.87	1.94	n/m	*64*	56.15	45.63	39.75	21.8	22.2	21.6	22.7
2	3/11/2025	20:42	*4.02*	130.1	n/a	5.02	5.85	1.94	n/m	*64*	56.81	45.74	38.66	21.6	22.2	21.8	21.0
2	3/11/2025	21:12	*4.03*	130.0	n/a	5.18	5.93	1.95	n/m	*63*	57.15	45.62	38.79	21.6	22.3	21.6	22.6
2	3/11/2025	21:42	*4.02*	130.4	n/a	5.39	5.95	1.97	n/m	*64*	56.59	45.33	38.41	21.7	22.1	21.6	21.1
2	3/11/2025	22:12	*4.02*	129.7	n/a	5.61	5.75	1.96	n/m	*64*	56.98	44.67	38.66	21.7	22.4	21.9	22.6
2	3/11/2025	22:42	*4.02*	130.1	n/a	5.72	5.83	1.94	n/m	*63*	56.14	44.88	38.24	21.6	22.2	21.9	22.5
3	3/11/2025	23:21	*4.02*	130.1	2.07	n/a	5.67	1.73	n/m	*64*	56.43	46.55	40.43	21.4	22.0	22.3	23.6
3	3/11/2025	23:51	*4.02*	130.1	2.73	n/a	5.73	1.85	n/m	*64*	56.03	45.69	39.71	21.7	22.0	22.3	23.6
3	3/12/2025	0:00	*4.02*	129.9	2.88	n/a	5.81	1.85	n/m	*62*	56.94	45.9	39.53	21.9	22.5	21.9	25.1
3	3/12/2025	0:30	*4.03*	129.8	3.20	n/a	5.62	1.95	n/m	*62*	56.18	45.03	38.72	21.7	22.5	22.2	22.0

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
3	3/12/2025	1:00	*4.02*	129.6	3.25	n/a	5.77	1.85	n/m	*62*	56.84	44.66	38.56	21.7	22.3	22.3	23.8
3	3/12/2025	1:32	*4.03*	130.0	3.65	n/a	5.74	1.84	n/m	*62*	56.97	44.82	38.64	21.7	22.4	22.4	24.0
3	3/12/2025	2:00	*4.02*	130.2	3.88	n/a	5.74	1.90	n/m	*62*	57.17	44.53	38.40	21.7	22.5	22.3	22.8
3	3/12/2025	2:30	*4.02*	130.0	4.04	n/a	5.75	1.89	n/m	*62*	56.28	44.31	38.21	21.7	22.7	22.3	25.4
3	3/12/2025	3:00	*4.02*	130.1	4.26	n/a	5.88	1.91	n/m	*62*	56.67	44.16	37.89	21.7	22.4	22.5	22.0
3	3/12/2025	3:30	*4.02*	130.2	4.42	n/a	5.8	1.87	n/m	*62*	56.17	43.97	37.66	21.7	22.4	22.5	23.8
3	3/12/2025	4:00	*4.02*	130.2	4.56	n/a	5.76	1.82	n/m	*62*	55.6	42.47	36.26	22.1	22.2	22.3	23.6
3	3/12/2025	4:30	*4.02*	129.8	4.66	n/a	5.77	1.90	n/m	*62*	52.22	39.81	33.47	21.7	22.7	22.3	22.7
3	3/12/2025	5:00	*4.03*	129.9	4.91	n/a	5.76	1.83	n/m	*62*	52.63	38.89	32.89	22.0	22.5	22.5	24.8
3	3/12/2025	5:30	*4.03*	130.1	5.24	n/a	5.75	1.89	n/m	*62*	56.60	43.27	37.04	21.7	22.5	22.4	22.0
3	3/12/2025	6:00	*4.02*	130.0	5.40	n/a	5.83	1.91	n/m	*62*	57.27	42.71	36.85	21.6	22.5	22.4	23.4
3	3/12/2025	6:30	*4.03*	129.9	5.63	n/a	5.74	1.90	n/m	*62*	56.72	42.34	37.57	21.9	22.4	22.3	25.4
3	3/12/2025	7:00	*4.01*	129.5	5.90	n/a	5.81	1.91	n/m	*62*	56.18	39.01	33.06	21.9	22.3	22.6	22.3
4	3/12/2025	7:30	*4.02*	129.7	n/a	3.14	5.55	1.93	n/m	*62*	54.18	47.05	41.17	21.1	22.4	22.6	24.0
4	3/12/2025	8:00	*4.02*	130.1	n/a	3.92	5.78	1.89	n/m	*64*	57.07	46.06	40.05	22.0	22.5	22.4	22.9
4	3/12/2025	8:30	*4.02*	130.2	n/a	4.28	5.82	1.87	n/m	*64*	56.51	45.22	39.16	21.9	22.6	22.5	22.9
4	3/12/2025	9:00	*4.02*	130.0	n/a	4.68	5.83	1.91	n/m	*64*	56.82	45.68	39.69	21.6	22.5	22.5	25.1
4	3/12/2025	9:30	*4.03*	129.9	n/a	4.95	5.83	1.91	n/m	*64*	56.43	45.65	38.82	21.6	22.4	22.6	22.1
4	3/12/2025	10:00	*4.03*	130.0	n/a	5.22	5.75	1.93	n/m	*64*	56.87	45.33	39.13	21.7	22.7	22.5	24.5
4	3/12/2025	10:30	*4.03*	130.0	n/a	5.31	5.83	1.86	n/m	*64*	55.83	44.62	38.67	21.8	22.4	22.4	22.3
4	3/12/2025	11:00	*4.02*	130.2	n/a	6.30	5.85	1.93	n/m	*64*	56.46	44.16	37.41	21.9	22.4	22.1	21.4
4	3/12/2025	11:30	*4.02*	130.1	n/a	6.42	5.95	1.90	n/m	*64*	56.23	43.52	36.96	21.9	22.3	21.8	21.7
4	3/12/2025	12:00	*4.02*	130.0	n/a	6.51	5.86	1.95	n/m	*64*	56.60	42.96	37.11	21.7	22.5	22.1	22.5
5	3/12/2025	12:30	*4.02*	129.8	2.24	n/a	5.74	1.92	n/m	*64*	56.01	45.47	39.56	21.7	22.2	22.1	21.6
5	3/12/2025	13:00	*4.02*	129.9	2.91	n/a	5.85	1.90	n/m	*64*	56.26	45.02	37.99	21.7	22.1	21.4	21.1
5	3/12/2025	13:30	*4.02*	130.0	3.33	n/a	5.97	1.95	n/m	*64*	56.13	44.10	37.18	21.9	22.4	21.6	20.9
5	3/12/2025	14:00	*4.02*	130.1	3.68	n/a	5.93	1.93	n/m	*64*	55.94	43.51	37.37	21.7	22.4	21.6	22.7
5	3/12/2025	14:30	*4.02*	130.1	3.86	n/a	5.85	1.92	n/m	*64*	55.37	43.30	37.45	21.7	22.3	22.0	21.6
5	3/12/2025	15:00	*4.02*	130.1	4.05	n/a	5.95	1.92	n/m	*64*	55.90	43.05	36.91	21.6	22.2	21.7	21.7
5	3/12/2025	15:30	*4.02*	130.0	4.20	n/a	5.88	1.92	n/m	*64*	55.58	43.04	36.39	21.8	22.3	22.0	22.3
5	3/12/2025	16:00	*4.02*	130.2	4.60	n/a	5.97	1.92	n/m	*64*	55.88	43.02	36.12	21.6	22.2	21.6	21.4
5	3/12/2025	16:30	*4.02*	129.9	4.66	n/a	5.89	1.94	n/m	*63*	56.31	42.61	36.40	21.8	22.4	21.7	22.6

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
5	3/12/2025	17:00	*4.02*	130.0	4.93	n/a	5.96	1.92	n/m	*64*	54.99	42.60	35.80	21.6	22.0	21.8	21.2
5	3/12/2025	17:30	*4.02*	130.1	4.97	n/a	5.96	1.91	n/m	*63*	55.92	42.14	35.56	21.7	22.3	21.7	22.9
5	3/12/2025	18:00	*4.01*	130.1	5.31	n/a	5.87	1.92	n/m	*64*	56.15	42.06	35.29	21.5	22.0	22.0	21.0
5	3/12/2025	18:30	*4.02*	130.1	5.45	n/a	5.95	1.97	n/m	*63*	55.60	41.85	35.05	21.7	22.3	21.8	22.6
5	3/12/2025	19:00	*4.02*	130.0	5.67	n/a	5.98	1.97	n/m	*64*	55.86	41.67	35.59	21.7	22.1	21.9	21.2
6	3/12/2025	19:30	*4.02*	130.2	n/a	2.53	5.18	1.88	n/m	*63*	55.64	47.58	41.61	21.8	22.2	22.0	22.4
6	3/12/2025	20:00	*4.02*	129.9	n/a	3.99	5.81	1.93	n/m	*64*	55.96	45.87	39.57	21.5	22.2	21.6	24.6
6	3/12/2025	20:30	*4.02*	130.1	n/a	4.42	5.78	1.86	n/m	*63*	56.12	45.72	39.38	21.5	22.4	22.0	23.9
6	3/12/2025	21:00	*4.03*	130.1	n/a	4.79	5.83	1.90	n/m	*63*	56.02	44.43	38.19	21.7	22.3	22.0	22.4
6	3/12/2025	21:30	*4.02*	129.9	n/a	5.08	5.86	1.82	n/m	*63*	56.23	44.62	38.06	21.7	22.1	22.3	24.5
6	3/12/2025	22:00	*4.02*	130.4	n/a	5.39	5.76	1.98	n/m	*63*	56.25	44.42	38.01	21.8	22.1	22.3	21.6
6	3/12/2025	22:30	*4.03*	130.3	n/a	5.59	5.81	1.91	n/m	*63*	56.32	44.15	37.42	21.9	22.3	22.4	22.8
6	3/12/2025	23:00	*4.02*	130.1	n/a	6.58	5.79	1.93	n/m	*63*	55.99	43.17	36.26	21.9	22.3	22.3	24.6
6	3/12/2025	23:30	*4.02*	130.2	n/a	6.77	5.80	1.94	n/m	*63*	55.66	42.95	36.62	22.1	22.2	22.4	21.5
7	3/13/2025	0:00	*4.02*	129.9	2.35	n/a	5.71	1.95	n/m	*62*	55.55	44.96	39.25	21.6	22.2	22.7	23.1
7	3/13/2025	0:30	*4.02*	131.1	3.11	n/a	5.87	1.83	n/m	*62*	55.91	44.44	38.42	21.8	22.5	22.5	25.4
7	3/13/2025	1:00	*4.02*	130.3	3.21	n/a	5.81	1.90	n/m	*62*	56.24	44.22	37.53	21.9	22.4	22.5	22.3
7	3/13/2025	1:30	*4.02*	130.1	3.71	n/a	5.77	1.91	n/m	*62*	55.39	43.72	37.68	21.7	22.2	22.3	21.7
7	3/13/2025	2:00	*4.02*	130.1	3.96	n/a	5.84	1.92	n/m	*62*	55.88	43.92	37.14	21.7	22.3	22.1	22.6
7	3/13/2025	2:30	*4.03*	130.1	4.08	n/a	5.82	1.96	n/m	*62*	56.07	43.51	37.01	21.6	22.5	22.4	22.7
7	3/13/2025	3:07	*4.02*	130.1	4.29	n/a	5.80	1.92	n/m	*62*	56.29	43.36	36.60	21.7	22.3	22.3	22
7	3/13/2025	3:30	*4.02*	129.7	4.56	n/a	5.80	1.93	n/m	*62*	55.96	42.99	36.49	21.9	22.2	22.4	22.8
7	3/13/2025	4:00	*4.02*	129.9	4.64	n/a	5.86	1.86	n/m	*62*	56.05	42.68	36.30	21.6	22.7	22.3	25
7	3/13/2025	4:30	*4.02*	130.1	4.83	n/a	5.88	1.88	n/m	*62*	55.88	43.57	35.80	21.9	22.2	22.4	21.5
7	3/13/2025	5:00	*4.02*	130.1	5.07	n/a	5.77	1.90	n/m	*62*	56.32	42.25	36.09	21.7	22.6	22.5	23.3
7	3/13/2025	5:30	*4.02*	130.3	5.23	n/a	5.87	1.86	n/m	*62*	54.96	42.39	35.99	21.7	22.5	22.2	25.3
7	3/13/2025	6:00	*4.02*	130.3	5.52	n/a	5.85	1.92	n/m	*62*	55.10	41.35	35.38	21.7	22.2	22.3	21.6
7	3/13/2025	6:30	*4.02*	130.1	5.66	n/a	5.81	1.89	n/m	*62*	55.72	41.65	35.49	22.1	22.6	22.3	23.8
7	3/13/2025	7:00	*4.02*	130.2	5.99	n/a	5.88	1.89	n/m	*62*	55.84	41.6	35.28	21.7	22.5	22.4	24.7
8	3/13/2025	7:30	*4.02*	130.5	n/a	3.66	5.55	1.88	n/m	*62*	55.82	45.99	40.08	22	22.3	22.6	21.8
8	3/13/2025	8:00	*4.02*	130.3	n/a	4.33	5.79	1.92	n/m	*61*	56.02	44.84	38.92	22.1	22.6	22.3	24
8	3/13/2025	8:30	*4.02*	130.2	n/a	4.71	5.79	1.87	n/m	*62*	56.05	44.37	38.01	21.8	22.2	22.4	23.5

Filter Period	Date	Time	*[FM-01]* (*gpm*)	FM-02 (mL min⁻¹)	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* (*psig*)	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
8	3/13/2025	9:00	*4.02*	130	n/a	5.11	5.77	1.89	n/m	*64*	55.57	44.14	37.88	22.2	22.3	22.3	22.5
8	3/13/2025	10:30	*4.02*	n/m	n/a	3.26	6.02	1.81	n/m	*63*	58.06	48.07	42.06	21.4	22.5	22.6	23.3
8	3/13/2025	11:00	*4.03*	n/m	n/a	3.16	5.00	1.54	n/m	*63*	58.32	50.42	45.85	21.6	22.5	21.4	21.5
8	3/13/2025	11:30	*4.02*	n/m	n/a	2.98	4.30	1.43	n/m	*63*	59.61	51.98	48.25	21.5	22.6	21.5	23.2
8	3/13/2025	12:00	*4.01*	n/m	n/a	5.79	8.39	2.59	n/m	*62*	54.35	40.12	30.01	21.9	22.4	22.1	21.3
8	3/13/2025	12:30	*4.02*	n/m	n/a	6.45	8.13	2.57	n/m	*62*	54.01	40.08	30.45	21.6	22.3	22.3	23.1
8	3/13/2025	13:00	*4.02*	n/m	n/a	6.58	7.88	2.48	n/m	*62*	54.00	40.10	31.04	22.1	22.3	22.3	21.9
8	3/13/2025	13:30	*4.01*	n/m	n/a	6.75	7.75	2.48	n/m	*63*	54.27	40.21	31.05	21.5	22.5	21.8	22.3
8	3/13/2025	14:00	*4.01*	n/m	n/a	6.96	7.69	2.51	n/m	*62*	54.36	39.34	30.42	22.1	22.2	22	22.1
9	3/13/2025	14:32	*4.02*	n/m	3.50	n/a	7.68	2.55	n/m	*62*	54.60	41.06	31.93	21.9	22.2	21.5	21.3
9	3/13/2025	15:00	*4.01*	n/m	4.13	n/a	7.42	2.55	n/m	*62*	53.81	40.42	31.53	21.7	22.1	21.7	21.4
9	3/13/2025	15:30	*4.02*	n/m	4.49	n/a	7.42	2.39	n/m	*62*	54.89	40.00	31.36	21.8	22.0	21.4	21.1
9	3/13/2025	16:00	*4.02*	n/m	5.00	n/a	7.33	2.54	n/m	*63*	54.83	39.56	30.81	21.7	22.2	21.4	20.9
9	3/13/2025	16:30	*4.02*	n/m	5.33	n/a	7.45	2.56	n/m	*62*	53.29	38.45	29.60	21.7	22.1	21.7	22.3
9	3/13/2025	17:00	*4.01*	n/m	6.00	n/a	7.66	2.63	n/m	*62*	53.30	36.76	27.43	21.6	22.2	21.9	21.5
9	3/13/2025	17:17	*4.02*	129.9	5.08	n/a	6.06	2.09	n/m	*62*	56.12	43.13	36.14	21.6	22.0	21.8	21.0
9	3/13/2025	17:30	*4.02*	130.1	4.95	n/a	5.99	2.07	n/m	*63*	56.16	42.94	36.70	21.8	22.0	21.6	22.3
9	3/13/2025	18:00	*4.02*	130.1	5.16	n/a	6.01	2.05	n/m	*63*	56.74	42.40	36.26	21.6	22.3	21.9	22.4
9	3/13/2025	18:30	*4.02*	130.1	5.28	n/a	5.96	2.09	n/m	*63*	56.69	42.54	36.18	21.7	22.2	21.6	21.9
9	3/13/2025	19:02	*4.02*	130.0	5.45	n/a	6.03	2.02	n/m	*63*	56.74	42.51	35.13	21.4	22.3	21.9	22.8
9	3/13/2025	19:30	*4.02*	130.2	5.58	n/a	5.80	2.07	n/m	*62*	56.86	42.41	36.13	21.7	22.2	22.3	22.7
9	3/13/2025	20:00	*4.02*	129.7	5.79	n/a	5.78	2.03	n/m	*62*	56.03	42.23	35.45	21.7	22.1	22.3	24.9
9	3/13/2025	20:30	*4.02*	130.1	5.87	n/a	5.83	1.95	n/m	*62*	55.48	42.36	35.66	21.9	22.1	22.4	21.5
9	3/13/2025	21:00	*4.02*	129.9	6.06	n/a	5.80	2.05	n/m	*62*	55.41	42.14	35.51	21.7	22.4	22.4	22.8
9	3/13/2025	21:30	*4.02*	130.2	6.30	n/a	5.82	1.96	n/m	*63*	56.66	41.43	35.44	21.7	22.5	22.5	24.8
9	3/13/2025	22:00	*4.02*	129.9	6.51	n/a	5.87	2.06	n/m	*62*	56.93	41.46	35.23	21.7	22.4	22.4	22.2
9	3/13/2025	22:30	*4.02*	130.2	6.74	n/a	5.79	2.05	n/m	*62*	56.41	40.78	34.91	22.0	22.4	22.3	22.7
9	3/13/2025	23:00	*4.02*	130.2	6.93	n/a	5.84	1.95	n/m	*63*	55.31	41.05	34.84	21.7	22.6	22.2	24.8
9	3/13/2025	23:30	*4.02*	130.2	7.25	n/a	5.84	2.06	n/m	*62*	56.12	40.91	34.25	21.7	22.2	22.3	23.1
10	3/14/2025	0:00	*4.02*	130.1	n/a	0.73	5.3	2.1	n/m	*62*	56.45	40.39	43.14	21.8	22.3	22.3	22
10	3/14/2025	0:35	*4.01*	130.2	n/a	3.74	5.79	2.02	n/m	*62*	56.75	45.3	39.5	21.6	22.3	22	23.3
n/a	3/14/2025	0:45	*4.06*	-1	n/a	0.15	0.12	0.26	n/m	*63*	1.32	3.92	1.11	22	22.1	22.2	22

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
n/a	3/14/2025	0:57	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	22	22.5	21.9	24
n/a	3/14/2025	2:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	20.1	12	13.9	15.2
n/a	3/14/2025	3:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	18.1	12.4	13.1	20.7
n/a	3/14/2025	4:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	17.1	23	22.1	25.3
n/a	3/14/2025	4:35	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.1	6.6	9.1	16.4
n/a	3/14/2025	5:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.3	18.4	19	24.1
n/a	3/14/2025	6:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.4	22.1	21.6	22.2
n/a	3/14/2025	7:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.3	21.8	21.4	22.3
n/a	3/14/2025	8:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.2	23.5	22.9	24.3
n/a	3/14/2025	9:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16	23	22.9	23.3
n/a	3/14/2025	10:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16	22.3	22.6	22.2
n/a	3/14/2025	11:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.7	22.4	21.9	21.9
n/a	3/14/2025	12:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.8	22.6	22	21.8
n/a	3/14/2025	13:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.7	22.4	21.7	21.9
n/a	3/14/2025	14:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.8	22.2	21	22.2
n/a	3/14/2025	15:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.9	22.3	21.1	21.5
n/a	3/14/2025	16:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.8	22.4	21.8	22.9
n/a	3/14/2025	17:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.7	21.9	21.2	21.0
n/a	3/14/2025	18:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.6	22.5	22.1	22.5
n/a	3/14/2025	19:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.6	22.5	22.5	22.8
n/a	3/14/2025	20:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.8	22.2	22.5	22.9
n/a	3/14/2025	21:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.8	22.4	22.5	22.8
n/a	3/14/2025	22:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.7	22.6	22.6	23.9
n/a	3/14/2025	23:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.8	23.4	22.7	22.6
n/a	3/15/2025	0:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.6	22.7	22.1	22.0
n/a	3/15/2025	1:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.8	23.0	22.7	25.1
n/a	3/15/2025	2:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.9	23.5	23.2	24.4
n/a	3/15/2025	3:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.0	23.2	23.0	22.9
n/a	3/15/2025	4:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.0	22.7	22.1	21.7
11	3/15/2025	4:35	*3.98*	131.3	0.16	n/a	4.82	1.16	n/m	*62*	55.78	48.73	45.62	16.0	18.0	22.1	23.1
11	3/15/2025	5:00	*3.99*	130.1	2.50	n/a	5.61	2.22	n/m	*61*	55.35	43.72	38.15	16.0	17.0	23.1	25.1
11	3/15/2025	5:30	*3.99*	130.1	3.29	n/a	6.38	2.12	n/m	*61*	55.99	43.56	36.08	15.9	16.9	20.3	22.1

Filter Period	Date	Time	*[FM-01]* (*gpm*)	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* (*psig*)	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
11	3/15/2025	6:00	*3.99*	130.1	4.00	n/a	6.42	2.27	n/m	*61*	55.20	43.59	35.73	15.7	16.9	19.6	24.0
11	3/15/2025	6:30	*3.99*	129.9	4.44	n/a	6.42	2.24	n/m	*61*	55.65	43.50	35.04	15.8	16.9	19.5	24.0
11	3/15/2025	7:00	*3.99*	130.2	4.79	n/a	6.44	2.16	n/m	*61*	55.28	41.77	34.63	15.8	16.9	19.6	22.0
11	3/15/2025	7:30	*3.99*	130.1	4.99	n/a	6.39	2.22	n/m	*61*	56.18	41.99	34.84	15.7	16.9	19.4	24.4
11	3/15/2025	8:00	*3.99*	130.1	5.08	n/a	6.25	2.21	n/m	*63*	55.03	41.59	34.29	15.6	16.6	19.4	21.3
11	3/15/2025	8:30	*3.99*	130.1	5.36	n/a	6.40	2.13	n/m	*63*	55.16	41.27	34.74	15.7	16.9	19.5	22.7
11	3/15/2025	9:00	*3.99*	129.8	5.55	n/a	6.42	2.23	n/m	*64*	55.53	40.87	33.66	15.8	16.6	18.4	22.6
12	3/15/2025	9:26	*3.99*	129.7	n/a	3.42	5.78	2.18	n/m	*62*	55.04	44.24	36.14	15.7	16.9	19.5	23.2
12	3/15/2025	9:56	*3.99*	130.1	n/a	4.46	6.42	2.11	n/m	*64*	54.72	43.34	36.81	15.8	16.8	19.6	25.0
12	3/15/2025	10:26	*3.99*	130.1	n/a	4.85	6.38	2.12	n/m	*63*	54.81	43.28	36.41	15.7	16.8	19.6	21.7
12	3/15/2025	10:56	*3.99*	129.9	n/a	5.35	6.48	2.24	n/m	*63*	56.01	43.02	35.84	15.7	16.9	19.2	23.3
12	3/15/2025	11:26	*3.99*	130.2	n/a	5.44	6.40	2.16	n/m	*63*	55.39	43.20	35.83	15.7	16.8	19.2	21.5
12	3/15/2025	11:56	*3.99*	130.2	n/a	5.52	6.43	2.31	n/m	*63*	55.57	42.50	35.48	15.8	17.1	19.2	23.0
13	3/15/2025	12:26	*3.99*	130.1	2.93	n/a	6.05	2.15	n/m	*64*	55.88	42.31	36.25	15.5	16.9	19.3	22.9
13	3/15/2025	12:56	*3.99*	130.0	3.63	n/a	6.30	2.20	n/m	*63*	55.64	43.68	35.48	15.5	17.0	19.5	22.5
13	3/15/2025	13:26	*3.99*	129.9	4.32	n/a	6.44	2.26	n/m	*63*	55.53	41.36	33.79	15.7	17.0	19.0	23.0
13	3/15/2025	13:56	*3.99*	130.1	4.63	n/a	6.32	2.25	n/m	*63*	55.51	40.09	32.60	15.8	16.6	19.0	21.9
13	3/15/2025	14:26	*3.99*	130.1	4.86	n/a	6.51	2.22	n/m	*63*	54.38	40.25	33.71	15.7	16.8	19.1	23.1
13	3/15/2025	14:56	*3.99*	130	5.22	n/a	6.3	2.24	n/m	*63*	55.86	40.52	32.83	15.5	16.7	19.1	21.5
13	3/15/2025	15:26	*3.99*	130.2	5.21	n/a	6.43	2.27	n/m	*63*	55.74	40.02	32.51	15.6	16.8	19.3	22.7
13	3/15/2025	15:56	*3.99*	130.1	5.77	n/a	6.44	2.25	n/m	*62*	55.86	39.69	31.45	15.6	16.7	19.1	21.5
14	3/15/2025	16:15	*3.99*	130.1	n/a	2.03	5.25	2.08	n/m	*63*	54.2	45.56	39.61	15.6	16.5	18.9	21.9
14	3/15/2025	16:45	*3.99*	129.8	n/a	4.48	6.48	2.27	n/m	*63*	55.06	43.74	36.61	15.6	16.9	19.8	22.9
14	3/15/2025	17:15	*3.99*	130.3	n/a	4.98	6.42	2.26	n/m	*63*	54.48	43.42	36.2	15.6	16.5	19.1	21.5
14	3/15/2025	17:45	*3.99*	130.1	n/a	5.34	6.46	2.27	n/m	*63*	55.51	42.85	35.61	15.7	16.8	19.1	22.6
14	3/15/2025	18:15	*3.99*	130.2	n/a	5.66	6.51	2.27	n/m	*63*	55.34	42.1	35.19	15.6	16.6	18.7	21.5
14	3/15/2025	18:45	*3.99*	130.1	n/a	5.89	6.36	2.21	n/m	*63*	55.56	42.18	35.06	15.7	16.9	19	22.9
14	3/15/2025	19:15	*3.99*	130.2	n/a	6.22	6.43	2.28	n/m	*63*	55.26	42.25	34.51	15.6	16.9	18.9	21.6
14	3/15/2025	19:45	*3.99*	130.2	n/a	6.38	6.48	2.25	n/m	*63*	55.91	42.22	35.15	15.5	16.5	18.9	22.7
14	3/15/2025	20:15	*3.99*	130.3	n/a	6.66	6.49	2.15	n/m	*63*	55.62	41.65	34.66	15.7	16.8	19	21.8
15	3/15/2025	20:35	*3.99*	131.3	2.55	n/a	5.49	2.15	n/m	*63*	54.45	43.86	37.45	15.5	16.6	19	21.8
15	3/15/2025	21:05	*3.99*	129.7	4.05	n/a	6.5	2.27	n/m	*63*	55.31	41.93	34.69	15.6	16.5	19.6	22.9

Filter Period	Date	Time	*[FM-01]* (*gpm*)	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* (*psig*)	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
15	3/15/2025	21:35	*3.99*	130.1	4.65	n/a	6.32	2.16	n/m	*63*	55.02	41.76	34.41	15.7	16.9	19.3	22.8
15	3/15/2025	22:05	*3.99*	130.1	5.15	n/a	6.49	2.24	n/m	*63*	54.75	41.1	34.76	15.6	16.8	19.6	23.9
15	3/15/2025	22:35	*3.99*	130.1	5.44	n/a	6.52	2.24	n/m	*63*	55.3	40.67	33.6	15.5	16.6	19.4	21.7
15	3/15/2025	23:05	*3.99*	129.9	5.7	n/a	6.46	2.26	n/m	*62*	55.11	40.11	33.54	15.7	16.8	19.4	24.2
15	3/15/2025	23:35	*3.99*	130.1	5.99	n/a	6.44	2.14	n/m	*62*	54.43	40.17	33.23	15.8	16.7	19.5	23

Table C.4. Initial Differential Pressure Data for DEFs from Run W-01B

Filter Period	Date	Active Filter ID	Start Time	ΔP at t = 2 min (psid)	ΔP at t = 4 min (psid)	ΔP at t = 6 min (psid)	ΔP at t = 8 min (psid)	ΔP at t = 10 min (psid)	Target ΔP for Filter Switch (psid)
1	3/11/2025	1	10:12	N/A	N/A	N/A	N/A	0.37	5.37
2	3/11/2025	2	17:14	0.46	0.54	0.74	0.93	1.19	6.19
3	3/11/2025	1	22:53	0.54	0.65	0.65	0.97	0.99	5.99
4	3/12/2025	2	7:03	0.51	0.68	0.87	1.21	1.57	6.57
5	3/12/2025	1	12:02	0.32	0.35	0.45	0.69	0.72	5.72
6	3/12/2025	2	19:17	0.61	0.69	0.92	1.24	1.76	6.76
7	3/12/2025	1	23:32	0.31	0.42	0.77	0.63	0.96	5.96
8	3/13/2025	2	7:02	0.47	0.64	0.94	1.34	1.90	6.90
9	3/13/2025	1	14:04	0.53	0.84	0.99	1.44	2.40	7.40
10	3/13/2025	2	23:52	0.13	0.23	0.33	0.58	1.01	4.01
11	3/15/2025	1	4:35	0.24	0.33	0.47	0.56	0.77	5.77
12	3/15/2025	2	9:03	0.02	0.18	0.34	0.49	0.82	5.82
13	3/15/2025	1	11:59	0.30	0.42	0.56	0.62	0.85	5.85
14	3/15/2025	2	16:02	0.20	0.42	0.56	0.91	1.68	6.68
15	3/15/2025	1	20:17	0.33	0.41	0.50	0.60	0.91	5.91

C.2 W-02 Tabulated Data

Table C.5. Periodically Recorded Data from Run W-02

			[FM-01]	FM-02	DP-01	DP-02	DP-03	DP-04	DP-05	*[P-01]*	P-02	P-03	P-05	T-01	T-02	T-03	T-AMB
Filter Period	Date	Time	*(gpm)*	(mL min^{-1})	(psid)	(psid)	(psid)	(psid)	(psid)	*(psig)*	(psig)	(psig)	(psig)	(°C)	(°C)	(°C)	(°C)
1	4/10/2025	19:41	*3.97*	128.9	6.02	n/a	3.71	1.53	n/m	*63*	57.7	44.73	39.7	22.1	22.4	22.9	23
2	4/10/2025	20:10	*3.97*	129.9	n/a	3.96	3.47	1.46	n/m	*63*	57.28	47.99	43.96	22	22.4	22.6	22.9
2	4/10/2025	20:37	*3.97*	130.6	n/a	10.12	3.89	1.48	n/m	*63*	56.94	41.32	36.88	22.1	22.3	22.1	22.6
3	4/11/2025	0:15	*4.10*	129.9	3.37	n/a	3.66	1.57	n/m	*62*	55.75	45.32	40.83	22.4	23	21.7	22
3	4/11/2025	0:45	*4.11*	129.9	12.32	n/a	3.96	1.56	n/m	*63*	58.08	37.35	32.58	22.3	22.6	21.4	21.1
3	4/11/2025	1:08	*4.11*	130.1	29.29	n/a	4.02	1.55	n/m	*76*	69.23	31.58	26.78	22.3	22.8	22.1	22.2
4	4/11/2025	1:22	*4.11*	129.7	n/a	3.48	3.63	1.55	n/m	*75*	69.63	44.46	38.78	22.2	22.8	22	22.6
4	4/11/2025	1:52	*4.11*	130.5	n/a	11.39	4.01	1.57	n/m	*79*	71.75	53.82	49.21	22.3	22.7	21.4	21.5
4	4/11/2025	2:22	*4.1*	130.1	n/a	28.18	4.03	1.54	n/m	*79*	71.76	38.35	33.64	22.3	22.5	22.0	22
5	4/11/2025	2:35	*4.1*	130.1	4.85	n/a	3.77	1.57	n/m	*79*	71.49	59.42	55.08	22.2	22.6	22.1	22.3
5	4/11/2025	3:05	*4.1*	129.9	17.85	n/a	3.98	1.57	n/m	*79*	70.75	45.3	40.78	22.3	22.6	21.5	21.7
5	4/11/2025	3:24	*4.1*	129.9	31.68	n/a	4.01	1.57	n/m	*79*	71.31	32.24	27.59	22.2	22.4	22.0	20.9
6	4/11/2025	3:38	*4.1*	130.1	n/a	4.71	5.79	1.59	n/m	*79*	71.58	61.35	57.19	22.3	22.6	21.9	21.8
6	4/11/2025	4:08	*4.1*	129.9	n/a	17.36	4.04	1.58	n/m	*79*	72.13	49.12	44.15	22.3	22.6	21.6	22.8
6	4/11/2025	4:29	*4.1*	130.1	n/a	29.24	4.03	1.58	n/m	*79*	71.83	37.98	32.45	22.3	22.7	22.1	21.5
7	4/11/2025	4:40	*4.1*	129.8	4.14	n/a	3.75	1.59	n/m	*79*	71.78	60.42	55.78	22.3	22.8	22.2	21.1
7	4/11/2025	5:10	*4.1*	132.4	20.35	n/a	4.05	1.58	n/m	*79*	72.36	43.93	39.23	22.3	22.9	21.1	22.8
7	4/11/2025	5:23	*4.1*	130	28.96	n/a	4.03	1.58	n/m	*79*	72.39	35.43	30.77	22.5	22.8	21.8	22.8
8	4/11/2025	5:35	*4.1*	130.1	n/a	5.88	3.78	1.6	n/m	*79*	72.08	60.4	56.35	22.4	23.0	22.3	22.6
8	4/11/2025	6:05	*4.1*	130	n/a	18.74	4.01	1.58	n/m	*79*	72.24	48.05	43.63	22.6	23	21.8	21.9
8	4/11/2025	6:25	*4.1*	130.1	n/a	30.49	4.03	1.59	n/m	*79*	72.28	36.49	31.86	22.6	23.1	22.4	22.3
9	4/11/2025	6:39	*4.1*	130.1	6.48	n/a	3.73	1.59	n/m	*79*	71.22	57.63	53.57	22.6	23.4	22.2	22.7
9	4/11/2025	7:09	*4.1*	129.9	21.19	n/a	3.98	1.58	n/m	*79*	71.72	43.27	38.26	22.6	23.1	21.8	23.6
9	4/11/2025	7:29	*4.1*	129.9	33.25	n/a	3.99	1.59	n/m	*79*	69.61	28.42	23.76	22.3	22.9	22.5	21.8
10	4/11/2025	7:41	*4.1*	130.1	n/a	7.01	3.73	1.55	n/m	*80*	69.32	56.72	52.18	22.4	22.8	22.6	25.1
10	4/11/2025	8:00	*4.1*	131.1	n/a	14.85	3.96	1.55	n/m	*80*	69.07	48.39	43.75	22.4	23.1	22.3	23.5
10	4/11/2025	8:31	*4.1*	130.0	n/a	31.32	4.03	1.59	n/m	*80*	69.24	31.95	27.34	22.2	23.0	22.6	21.8
11	4/11/2025	9:00	*4.1*	129.4	13.74	n/a	4.05	1.62	n/m	*80*	65.8	43.73	39.37	22.1	22.7	22.4	23.2

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
11	4/11/2025	9:30	*4.1*	129.9	30.99	n/a	4.04	1.6	n/m	*80*	65.48	27.24	22.6	22.1	22.4	22.3	21.7
12	4/11/2025	9:42	*4.09*	130.2	n/a	7.3	3.81	1.65	n/m	*80*	71.04	58.85	54.5	22.1	22.4	22.3	21.6
12	4/11/2025	10:00	*4.1*	130.1	n/a	15.14	4.12	1.61	n/m	*80*	71.66	50.8	46.48	21.8	22.3	21.8	21.5
12	4/11/2025	10:30	*4.1*	129.8	n/a	30.91	4.12	1.62	n/m	*80*	72.1	35.44	30.78	21.8	22.3	21.8	22.4
13	4/11/2025	10:42	*4.1*	131.0	6.51	n/a	3.81	1.54	n/m	*80*	71.61	57.68	53.18	21.7	22.5	22.1	23.2
13	4/11/2025	11:00	*4.1*	130.6	14.09	n/a	4.04	1.62	n/m	*80*	72.27	50.02	45.21	22.0	22.5	22	22.8
13	4/11/2025	11:31	*4.1*	130.1	31.54	n/a	4.06	1.56	n/m	*80*	71.54	32.81	28	21.9	22.5	22.1	22.4
14	4/11/2025	11:42	*4.1*	130.2	n/a	7.07	3.89	1.59	n/m	*80*	71.74	59.99	54.6	22.0	22.5	22.3	22.6
14	4/11/2025	12:00	*4.1*	130.2	n/a	14.75	4.05	1.61	n/m	*80*	71.8	51.53	47.07	21.7	22.2	21.6	22.2
14	4/11/2025	12:30	*4.1*	130.0	n/a	30.15	4.09	1.63	n/m	*80*	72.19	36.12	31.44	21.7	22.6	22.1	22.7
15	4/11/2025	12:44	*4.1*	130.5	7.4	n/a	3.83	1.62	n/m	*80*	72.32	56.94	52.43	21.7	22.4	22	22.6
15	4/11/2025	13:00	*4.1*	129.6	15.19	n/a	4.06	1.64	n/m	*80*	72.40	49	44.21	21.7	22.6	22	23.0
15	4/11/2025	13:30	*4.1*	129.9	31.64	n/a	4.07	1.62	n/m	*80*	72.41	32.88	28.17	21.9	22.5	22.3	23.2
16	4/11/2025	13:41	*4.1*	130.0	n/a	7.71	3.79	1.61	n/m	*82*	72.06	58.88	54.09	21.6	22.2	22.3	23.1
16	4/11/2025	14:00	*4.1*	130.4	n/a	15.5	3.99	1.56	n/m	*80*	72.9	50.9	46.33	21.6	22.2	22	23.4
16	4/11/2025	14:30	*4.1*	130.0	n/a	30.91	4.09	1.6	n/m	*80*	72.59	35.86	31.24	21.6	22.1	22.5	23.6
17	4/11/2025	14:42	*4.1*	129.7	7.22	n/a	3.77	1.59	n/m	*80*	72.22	57.57	53.33	21.7	22.5	22.2	23.6
17	4/11/2025	15:00	*4.1*	129.7	15.27	n/a	4.02	1.59	n/m	*80*	72.74	48.65	44.33	21.6	22.3	22.3	23.6
17	4/11/2025	15:30	*4.1*	129.9	29.97	n/a	4.02	1.55	n/m	*80*	72.99	34.96	30.39	21.5	22.3	22.8	23.9
18	4/11/2025	15:43	*4.1*	130.4	n/a	7.43	3.81	1.59	n/m	*80*	72.57	59.14	54.08	21.7	22.2	22.7	22
18	4/11/2025	16:00	*4.09*	127.9	n/a	14.84	4	1.58	n/m	*80*	71.78	51.45	46.84	21.6	22.1	22.5	22.2
18	4/11/2025	16:22	*4.1*	130.0	n/a	25.09	4.08	1.61	n/m	*80*	72.82	41.61	36.74	21.6	22	22.2	23.3
19	4/11/2025	17:00	*4.1*	132.2	15.06	n/a	4.14	1.65	n/m	*81*	72.17	49.35	44.86	21.9	22.3	22.5	22.2
19	4/11/2025	17:22	*4.1*	130.0	26.03	n/a	4.15	1.61	n/m	*80*	72.42	38.60	33.84	21.9	22.3	22.1	22.8
20	4/11/2025	20:00	*4.1*	130.6	n/a	9.89	3.7	1.54	n/m	*80*	72.78	57.30	52.96	21.6	22.1	22.5	22.3
20	4/11/2025	20:30	*4.1*	129.8	n/a	24.13	4.01	1.6	n/m	*79*	73.04	42.91	38.31	21.4	22.2	22.1	22
21	4/11/2025	20:45	*4.1*	130.3	9.3	n/a	3.84	1.61	n/m	*80*	72.3	55.93	51.28	21.5	22.1	22.0	21.8
21	4/11/2025	21:01	*4.1*	129.9	15.63	n/a	4.03	1.60	n/m	*80*	72.53	48.93	44.37	21.5	21.9	21.7	21.7
21	4/11/2025	21:21	*4.1*	129.9	25.80	n/a	4.20	1.60	n/m	*80*	72.77	38.9	34.17	21.4	21.6	21.6	21.3
22	4/11/2025	21:41	*4.09*	129.5	n/a	9.98	3.91	1.63	n/m	*80*	72.5	56.76	52.19	21.5	22.0	21.5	20.9
22	4/11/2025	22:00	*4.1*	130.4	n/a	18.06	4.19	1.61	n/m	*80*	72.33	49.19	44.34	21.6	22.2	20.9	22.0
22	4/11/2025	22:17	*4.1*	130.1	n/a	26.13	4.20	1.64	n/m	*80*	72.7	41.09	36.31	21.5	22.0	21.6	22.7

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
23	4/11/2025	22:40	*4.1*	130.1	9.06	n/a	3.89	1.56	n/m	*80*	72.57	55.71	51.43	21.6	22.1	22.0	21.7
23	4/11/2025	23:04	*4.1*	130.3	18.50	n/a	4.23	1.58	n/m	*80*	72.21	46.24	41.46	21.4	21.5	20.9	21.0
23	4/11/2025	23:18	*4.1*	130.0	26.29	n/a	4.20	1.63	n/m	*80*	72.36	38.28	33.55	21.4	21.8	21.4	22.1
24	4/11/2025	23:41	*4.1*	130.5	n/a	8.96	3.90	1.66	n/m	*80*	72.55	57.47	53.09	21.5	22.3	21.9	22.8
24	4/12/2025	0:00	*4.1*	130	n/a	16.56	4.26	1.62	n/m	*80*	72.53	50.51	45.58	21.4	22.1	21.3	24.7
24	4/12/2025	0:17	*4.1*	130	n/a	27.2	4.18	1.61	n/m	*80*	72.68	39.47	34.64	21.4	22.0	21.7	22.3
25	4/12/2025	0:39	*4.1*	130.2	7.89	n/a	3.91	1.63	n/m	*80*	71.87	56.45	52.18	21.4	22.1	22	23.4
25	4/12/2025	1:09	*4.1*	129.9	20.33	n/a	4.17	1.59	n/m	*80*	72.45	44.27	39.73	21.5	22	21.6	23.8
25	4/12/2025	1:21	*4.1*	130.1	26.58	n/a	4.12	1.58	n/m	*80*	72.23	38.06	33.43	21.5	22.2	22.1	23.2
26	4/12/2025	1:42	*4.1*	130.2	n/a	11.12	3.93	1.59	n/m	*80*	72.46	55.81	51.29	21.3	22	22.1	22.6
26	4/12/2025	2:12	*4.1*	129.9	n/a	23.23	4.16	1.59	n/m	*80*	72.41	43.46	38.89	21.4	22.3	21.7	22.7
26	4/12/2025	2:25	*4.1*	130	n/a	30.42	4.18	1.59	n/m	*80*	72.66	36.49	31.87	21.6	22.3	22.3	21.8
27	4/12/2025	2:45	*4.1*	130.1	7.84	n/a	3.94	1.59	n/m	*80*	72.8	57.13	52.49	21.6	22.3	22.3	24.4
27	4/12/2025	3:15	*4.1*	130.4	19.94	n/a	4.15	1.58	n/m	*80*	72.72	44.84	40.34	21.4	22.1	21.7	22.1
27	4/12/2025	3:36	*4.1*	130	31.42	n/a	4.15	1.59	n/m	*80*	72.68	33.32	28.58	21.5	22.3	22.3	24
28	4/12/2025	3:55	*4.1*	129.9	n/a	8.89	3.89	1.62	n/m	*80*	72.51	57.95	53.52	21.4	22	22.3	22
28	4/12/2025	4:25	*4.1*	130.4	n/a	19.78	4.11	1.56	n/m	*80*	72.43	47.13	42.67	21.3	22.2	22	23.8
28	4/12/2025	4:46	*4.1*	129.9	n/a	30.63	4.18	1.61	n/m	*80*	72.65	35.51	30.74	21.2	22.1	22.2	21.8
29	4/12/2025	5:05	*4.1*	130.2	7.45	n/a	3.85	1.65	n/m	*80*	72.67	57.33	53.41	21.4	22.1	22.3	24.9
29	4/12/2025	5:35	*4.1*	130.5	19.58	n/a	4.13	1.59	n/m	*80*	72.46	45.37	40.72	21.5	21.8	21.9	21.8
29	4/12/2025	5:55	*4.1*	129.8	31.02	n/a	4.13	1.59	n/m	*80*	72.57	33.34	28.68	21.4	22.2	22.3	24.4
30	4/12/2025	6:15	*4.1*	130.2	n/a	8.69	3.84	1.64	n/m	*80*	72.41	58.05	53.59	21.3	22	22.2	22.1
30	4/12/2025	6:45	*4.1*	129.8	n/a	20.48	4.16	1.58	n/m	*80*	72.58	46.43	41.89	21.5	22.1	21.7	23.9
30	4/12/2025	7:05	*4.1*	130	n/a	31.14	4.17	1.61	n/m	*80*	72.31	35.62	30.76	21.5	22.1	22.3	22.1
31	4/12/2025	7:23	*4.1*	130.1	7.65	n/a	3.87	1.63	n/m	*80*	72.55	57.21	52.63	21.4	22	22.1	25.7
31	4/12/2025	7:53	*4.1*	130.4	19.83	n/a	4.12	1.58	n/m	*80*	72.48	45.12	40.56	21.5	22.1	21.6	22.2
31	4/12/2025	8:00	*4.1*	130.1	23.76	n/a	4.15	1.61	n/m	*80*	72.3	40.59	35.77	21.6	22.1	22.1	21.7
32	4/12/2025	8:30	*4.1*	129.8	n/a	10.9	3.84	1.65	n/m	*80*	72.66	55.46	51.21	21.3	22	22	23
32	4/12/2025	9:00	*4.1*	130	n/a	23.68	4.28	1.59	n/m	*80*	72.73	42.93	38.07	21.3	22.4	21.7	21.6
33	4/12/2025	9:30	*4.1*	130.1	9.57	n/a	3.9	1.61	n/m	*80*	72.86	55.03	50.63	21.6	22.1	21.6	22.9
33	4/12/2025	10:00	*4.1*	130	21.54	n/a	4.19	1.62	n/m	*80*	71.87	42.85	38.01	21.4	22.3	21.3	22
34	4/12/2025	10:28	*4.1*	130	n/a	8.95	3.92	1.66	n/m	*80*	72.12	57.73	53.09	21.5	22.2	21.8	21.9

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^-1)	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
34	4/12/2025	10:30	*4.1*	130.1	n/a	9.67	4.00	1.61	n/m	*80*	72.51	56.97	52.32	21.3	22.2	22	22
34	4/12/2025	11:00	*4.1*	130	n/a	20.97	4.20	1.56	n/m	*80*	72.85	45.73	40.95	21.3	22	21.5	23.5
35	4/12/2025	11:31	*4.1*	130.1	8.03	n/a	3.88	1.65	n/m	*80*	72.43	56.35	51.91	21.5	22.1	21.9	22.2
35	4/12/2025	12:00	*4.1*	129.8	19.02	n/a	4.26	1.67	n/m	*80*	72.15	45.47	40.75	21.4	21.8	21	21.6
35	4/12/2025	12:17	*4.1*	129.9	33.44	n/a	4.28	1.65	n/m	*80*	71.48	30.95	26.10	21.4	21.9	21.5	21.4
36	4/12/2025	12:33	*4.1*	130.1	n/a	9.25	4.02	1.67	n/m	*80*	72.38	57.26	52.66	21.4	22	21.4	21.3
36	4/12/2025	13:00	*4.1*	129.4	n/a	19.27	4.26	1.59	n/m	*80*	71.69	47.61	42.60	21.4	22.1	20.6	22.5
36	4/12/2025	13:22	*4.1*	130	n/a	30.35	4.28	1.62	n/m	*80*	71.86	36.50	31.52	21.6	22	21.8	23.1
37	4/12/2025	13:35	*4.1*	129.9	8.33	n/a	3.94	1.62	n/m	*80*	72.06	56.35	51.99	21.4	22.1	22	22.6
37	4/12/2025	14:00	*4.1*	130.1	17.99	n/a	4.22	1.64	n/m	*80*	72.75	46.47	41.78	21.4	22.1	21.1	22
37	4/12/2025	14:14	*4.1*	129.9	25.60	n/a	4.24	1.65	n/m	*80*	72.05	39.06	34.20	21.4	22.1	21.6	21.6
38	4/12/2025	14:37	*4.1*	130.1	n/a	9.30	3.99	1.62	n/m	*80*	72.33	57.40	52.73	21.5	22	21.5	21.8
38	4/12/2025	15:01	*4.1*	129.7	n/a	17.73	4.29	1.62	n/m	*80*	72.43	49.00	44.49	21.5	22.2	20.6	21.8
38	4/12/2025	15:16	*4.1*	130	n/a	25.12	4.31	1.65	n/m	*80*	72.72	41.64	36.97	21.3	22.0	21.5	21.8
39	4/12/2025	15:43	*4.1*	130	10.27	n/a	3.89	1.64	n/m	*80*	72.02	54.43	50.11	21.3	22.1	21.6	21.7
39	4/12/2025	16:13	*4.1*	130	21.39	n/a	4.25	1.65	n/m	*80*	72.51	43.24	38.49	21.4	21.9	21.5	22.1
39	4/12/2025	16:35	*4.1*	129.9	33.84	n/a	4.28	1.62	n/m	*80*	72.77	31.12	26.27	21.2	22	21.4	22.1
40	4/12/2025	17:01	*4.1*	130.1	n/a	10.64	4	1.64	n/m	*80*	71.96	56.14	51.35	21.2	22.0	22	21.9
40	4/12/2025	17:31	*4.1*	130	n/a	21.5	4.25	1.61	n/m	*80*	72.67	44.94	40.46	21.4	22	21.4	22.2
40	4/12/2025	17:51	*4.1*	130	n/a	32.66	4.27	1.62	n/m	*80*	72.58	34.36	29.38	21.3	22.2	21.6	22
41	4/12/2025	18:12	*4.1*	130.1	8.76	n/a	3.99	1.66	n/m	*80*	72.27	55.91	51.21	21.2	22	21.4	22.1
41	4/12/2025	18:42	*4.1*	129.8	20.74	n/a	4.3	1.62	n/m	*80*	72.55	45.5	39.3	21.3	21.6	21	21.1
41	4/12/2025	19:05	*4.1*	130	33.48	n/a	4.3	1.63	n/m	*80*	72.01	43.53	26.69	21.4	21.7	21.5	21.2
42	4/12/2025	19:35	*4.1*	130.3	n/a	9.71	3.95	1.63	n/m	*80*	71.96	56.79	52.14	21.4	21.9	21.3	21.9
42	4/12/2025	20:05	*4.1*	130.1	n/a	21.35	4.25	1.62	n/m	*80*	72.32	45.95	40.71	21.3	22	21.2	22.7
42	4/12/2025	20:27	*4.1*	129.8	n/a	33.63	4.26	1.62	n/m	*80*	72.12	33.03	28.17	21.3	21.5	21.7	21.8
43	4/12/2025	20:57	*4.1*	129.4	9.55	n/a	3.93	1.62	n/m	*80*	71.75	55.35	50.71	21.6	22.1	22.1	22.2
43	4/12/2025	21:27	*4.1*	130.3	20.47	n/a	4.26	1.62	n/m	*80*	72.17	44.73	39.89	21.3	21.7	21.1	22.6
43	4/12/2025	21:49	*4.1*	130	32.01	n/a	4.28	1.61	n/m	*80*	72.87	32.53	27.63	21.6	21.9	21.6	21.1
44	4/12/2025	22:14	*4.1*	129.6	n/a	10	4.05	1.65	n/m	*80*	72.16	56.79	52.19	21.4	21.5	21.8	25.4
44	4/12/2025	22:44	*4.1*	130	n/a	21.48	4.17	1.58	n/m	*80*	72.45	45.38	40.91	21.4	22	21.6	22
44	4/12/2025	23:05	*4.09*	129.9	n/a	32.43	4.21	1.61	n/m	*80*	72.5	34.34	29.54	21.4	21.9	22.2	23.4

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
45	4/12/2025	23:32	*4.1*	129.8	11.43	n/a	3.98	1.63	n/m	*80*	72.57	53.43	49.25	21.5	21.9	22.1	24.6
45	4/13/2025	0:02	*4.09*	130.4	22.43	n/a	4.23	1.58	n/m	*80*	72.81	42.87	38.08	21.3	21.6	21.7	22.2
45	4/13/2025	0:17	*4.1*	129.7	34.72	n/a	4.26	1.61	n/m	*80*	72.69	29.3	24.6	21.5	22	22.1	23.3
46	4/13/2025	0:38	*4.1*	130.5	n/a	10.16	3.89	1.61	n/m	*80*	72.62	56.47	52.12	21.6	21.8	22.1	23.2
46	4/13/2025	1:08	*4.1*	129.8	n/a	21.17	4.19	1.58	n/m	*80*	72.41	45.82	41.95	21.6	22.1	21.7	25.4
46	4/13/2025	1:28	*4.1*	130	n/a	31.51	4.21	1.59	n/m	*80*	72.36	35.75	31.86	21.4	22.2	22.2	23
47	4/13/2025	1:48	*4.1*	129.9	4.11	n/a	3.97	1.61	n/m	*80*	72.35	52.89	48.25	21.6	22.2	22.1	23.6
47	4/13/2025	2:18	*4.1*	129.8	23.78	n/a	4.21	1.58	n/m	*80*	71.94	41.55	36.74	21.4	21.9	21.8	22.5
47	4/13/2025	2:33	*4.1*	130.1	30.97	n/a	4.24	1.61	n/m	*80*	72.38	34.21	29.41	21.4	22.1	22.3	23.1
48	4/13/2025	2:54	*4.11*	91.3	n/a	6.12	2.6	1.02	n/m	*80*	74.25	64.54	62.23	21.5	22.2	22.3	23.6
48	4/13/2025	3:24	*4.11*	91.2	n/a	10.01	2.56	1.01	n/m	*80*	74.31	60.51	58.54	21.6	22.1	21.9	25.5
48	4/13/2025	3:54	*4.11*	91.1	n/a	14.45	2.75	1.01	n/m	*80*	75.09	56.61	53.98	21.6	22.1	22.1	21.9
48	4/13/2025	4:24	*4.1*	91	n/a	20.33	2.72	1.01	n/m	*80*	75.24	50.28	48.16	21.6	22.5	22.4	23.7
48	4/13/2025	4:54	*4.11*	90.9	n/a	27.24	2.78	1.04	n/m	*80*	74.6	42.57	40.34	21.4	22	22.4	25.3
48	4/13/2025	5:04	*4.11*	91	n/a	30.67	2.74	1.03	n/m	*80*	74.92	40.08	37.86	21.6	22.4	22.5	24.6
49	4/13/2025	5:24	*4.11*	91.2	6.16	n/a	2.62	0.99	n/m	*80*	74.81	63.24	61.24	21.7	22.1	22.3	21.8
49	4/13/2025	5:54	*4.11*	91.3	10.23	n/a	2.71	1.03	n/m	*80*	74.74	59.24	57.53	21.5	22.3	22.1	23.5
49	4/13/2025	6:24	*4.11*	90.9	14.27	n/a	2.72	1.03	n/m	*80*	74.72	54.89	52.78	21.6	22.3	22.3	25.4
49	4/13/2025	6:54	*4.11*	91	20.14	n/a	2.78	1.03	n/m	*80*	75.11	45.24	47.02	21.6	22.1	22.3	21.5
49	4/13/2025	7:24	*4.1*	91.1	26.39	n/a	2.75	1.02	n/m	*80*	74.64	42.59	40.39	21.4	22	22.5	23.4
49	4/13/2025	7:36	*4.11*	91	30.75	n/a	2.77	1.05	n/m	*80*	74.24	38.52	36.3	21.5	22.1	22.2	21.6
50	4/13/2025	7:50	*4.11*	90.9	n/a	5.79	2.64	1.03	n/m	*80*	74.83	64.6	62.57	21.5	22.6	22.5	22.1
50	4/13/2025	8:03	*4.11*	90.1	n/a	6.74	2.53	1.02	n/m	*80*	74.69	63.66	61.6	21.5	22.2	22.5	23.3
50	4/13/2025	8:30	*4.1*	90.8	n/a	10.05	2.71	1.02	n/m	*80*	75.1	60.62	58.43	21.6	22.1	21.5	21.8
50	4/13/2025	9:00	*4.1*	90.9	n/a	15.08	2.83	1.07	n/m	*80*	74.50	55.33	53	21.5	22.2	22	23.1
50	4/13/2025	9:30	*4.1*	90	n/a	21.53	2.79	1.03	n/m	*80*	74.78	48.41	46.2	21.2	21.9	21.9	21.5
51	4/13/2025	10:30	*4.1*	90.7	7.46	n/a	2.55	1.02	n/m	*80*	74.67	62.43	60.26	21.6	21.7	22	22.4
51	4/13/2025	11:00	*4.1*	91.3	10.04	n/a	2.67	1	n/m	*80*	75.17	59.05	56.75	21.6	21.8	21.6	22
51	4/13/2025	11:30	*4.11*	91	14.92	n/a	2.82	1.03	n/m	*80*	75.16	54.18	51.94	21.3	21.9	21.9	22.3
51	4/13/2025	12:00	*4.11*	90.9	20.38	n/a	2.76	1.03	n/m	*80*	74.99	58.75	46.45	21.4	22	22.1	23.3
52	4/13/2025	12:35	*4.10*	91.6	n/a	5.19	2.55	0.93	n/m	*80*	74.35	64.84	62.8	21.6	22.1	22.2	22.7
52	4/13/2025	13:02	*4.10*	91.1	n/a	8.54	2.74	1.02	n/m	*80*	74.19	61.62	60.17	21.7	22.2	22.1	22.5

			[FM-01]	FM-02	DP-01	DP-02	DP-03	DP-04	DP-05	*[P-01]*	P-02	P-03	P-05	T-01	T-02	T-03	T-AMB
Filter Period	Date	Time	*(gpm)*	(mL min^{-1})	(psid)	(psid)	(psid)	(psid)	(psid)	*(psig)*	(psig)	(psig)	(psig)	(°C)	(°C)	(°C)	(°C)
52	4/13/2025	13:30	*4.10*	91.1	n/a	11.5	2.74	1.05	n/m	*80*	74.78	58.77	56.52	21.4	22.2	21.7	22.6
52	4/13/2025	14:00	*4.10*	90.9	n/a	16.84	2.73	1.03	n/m	*80*	74.60	53.47	51.04	21.3	22.1	22	23.1
52	4/13/2025	14:30	*4.10*	91	n/a	23.85	2.78	1.02	n/m	*80*	74.87	46.99	44.6	21.4	22.1	22.3	23.1
52	4/13/2025	15:00	*4.10*	90.9	0.50	n/a	2.42	0.68	n/m	*80*	74.63	69.95	68.95	21.5	22	22.3	23.3
53	4/13/2025	15:08	*4.11*	91.3	6.05	n/a	2.59	0.98	n/m	*80*	74.71	63.22	61.53	21.3	21.9	22.3	23.4
53	4/13/2025	15:41	*4.11*	90.4	10.16	n/a	2.63	0.99	n/m	*80*	74.67	59.54	56.79	21.3	22.5	22	23.6
53	4/13/2025	16:11	*4.11*	91.1	13.48	n/a	2.69	0.96	n/m	*80*	74.76	55.75	53.93	21.7	22.0	22.5	23.5
53	4/13/2025	16:41	*4.10*	91.1	19.56	n/a	2.74	1.01	n/m	*80*	74.37	49.8	47.53	21.6	22.4	22.2	22.9
53	4/13/2025	17:11	*4.10*	90.8	25.94	n/a	2.73	1.01	n/m	*80*	74.52	43.26	40.94	21.6	22.2	22.3	23.1
54	4/13/2025	17:40	*4.11*	90.7	n/a	5.64	2.53	0.91	n/m	*80*	75.17	64.84	62.80	21.4	22	22.4	23.3
54	4/13/2025	18:10	*4.1*	89.9	n/a	8.92	2.66	1.02	n/m	*80*	74.76	61.92	59.45	21.6	22.2	22.4	23
54	4/13/2025	18:40	*4.11*	91.6	n/a	12.58	2.72	1.03	n/m	*80*	74.82	59.24	55.83	21.4	22.1	22.5	23.1
54	4/13/2025	19:10	*4.1*	91.1	n/a	17.49	2.74	1.02	n/m	*80*	75.11	52.64	50.14	21.4	22.3	22.4	22.8
54	4/13/2025	19:40	*4.1*	91.0	n/a	24.56	2.76	1.06	n/m	*80*	74.91	46.27	43.92	21.7	22	22.3	22.1
54	4/13/2025	20:00	*4.11*	91.1	n/a	30.31	2.82	1.01	n/m	*80*	75.15	40.6	38.26	21.3	21.6	22.1	21.7
55	4/13/2025	20:23	*4.1*	91.2	6.34	n/a	2.62	1.03	n/m	*80*	74.67	63.11	60.83	21.4	22	22	21.3
55	4/13/2025	20:53	*4.1*	91.1	9.82	n/a	2.79	1.01	n/m	*80*	75.27	59.74	57.47	21.3	21.6	21.4	21.6
55	4/13/2025	21:23	*4.1*	91.1	12.95	n/a	2.77	1.05	n/m	*80*	79.55	56.26	53.76	21.4	22	21.6	23
55	4/13/2025	21:53	*4.1*	91.1	18.28	n/a	2.81	1.02	n/m	*80*	74.68	57.49	28.81	21.4	21.3	21.9	21.1
55	4/13/2025	22:23	*4.1*	91.1	24.18	n/a	2.83	1.05	n/m	*80*	74.86	45.08	42.68	21.3	21.5	21.8	22.3
55	4/13/2025	22:41	*4.1*	90.1	28.83	n/a	2.84	1.05	n/m	*80*	74.1	40.39	38.07	21.2	21.6	21.7	22.1
56	4/13/2025	23:04	*4.1*	91.4	n/a	6.13	2.67	1.03	n/m	*80*	74.94	64.49	62.49	21.3	22.1	21.8	21.5
56	4/13/2025	23:34	*4.11*	91.3	n/a	9.18	2.85	1	n/m	*80*	74.6	61.32	59.03	21.4	21.9	21.6	22.8
56	4/14/2025	0:04	*4.1*	90.9	n/a	12.72	2.75	1.01	n/m	*80*	74.59	57.71	55.69	21.4	21.9	21.5	22.6
56	4/14/2025	0:34	*4.1*	91.2	n/a	23.22	2.78	1.01	n/m	*80*	74.63	47.22	44.85	21.4	22	22.3	24.4
56	4/14/2025	1:04	*4.1*	90.9	n/a	26.68	2.84	1.02	n/m	*80*	74.16	43.58	41.16	21.4	22.1	22.1	22.5
56	4/14/2025	1:26	*4.1*	91	n/a	30.84	2.79	1.03	n/m	*80*	74.96	39.73	37.47	21.6	22.2	22.4	23.4
57	4/14/2025	1:44	*4.1*	91.5	5.63	n/a	2.56	1.01	n/m	*80*	74.39	64.24	61.85	21.6	22.1	22.4	21.9
57	4/14/2025	2:14	*4.1*	90.7	9.07	n/a	2.68	1.01	n/m	*80*	74.5	60.69	57.86	21.4	22.1	22.3	22.9
57	4/14/2025	2:44	*4.1*	91.1	12.06	n/a	2.73	1.02	n/m	*80*	74.71	67.48	55.41	21.4	22.1	22.3	24.9
57	4/14/2025	3:14	*4.1*	91.1	17.21	n/a	2.82	1.04	n/m	*80*	74.94	52.03	49.72	21.3	21.6	22.1	22
57	4/14/2025	3:44	*4.1*	91.1	22.54	n/a	2.79	1.02	n/m	*80*	74.78	46.87	44.49	21.4	22	22.3	22.9

Filter Period	Date	Time	[FM-01] (gpm)	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	[P-01] (psig)	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
57	4/14/2025	4:14	4.1	91.1	29.43	n/a	2.79	1.02	n/m	80	74.79	39.65	37.56	21.3	22.3	22.5	24.5
58	4/14/2025	4:28	4.11	90.6	n/a	6.08	2.58	1.02	n/m	80	74.53	64.39	62.56	21.4	22.2	22.5	22.4
58	4/14/2025	4:58	4.11	91.2	n/a	9.22	2.78	1.03	n/m	80	74.87	61.19	58.73	21.3	22.1	22.3	24.4
58	4/14/2025	5:28	4.1	90.9	n/a	13.1	2.75	1.02	n/m	80	74.24	57.53	55.13	21.6	22	22.4	24.5
58	4/14/2025	5:58	4.11	91.1	n/a	17.78	2.77	1.01	n/m	80	75.28	52.67	50.19	21.6	22.2	22.4	22.3
58	4/14/2025	6:28	4.1	91	n/a	23.72	2.76	1.02	n/m	80	74.85	46.83	44.57	21.4	22.3	22.5	24.6
58	4/14/2025	6:54	4.1	91.1	n/a	30.26	2.76	1.05	n/m	80	75.25	39.93	37.64	21.3	22	22.3	21.3
59	4/14/2025	7:06	4.11	91.3	5.25	n/a	2.58	1.01	n/m	80	74.78	64.35	62.15	21.4	22.2	22.5	25
59	4/14/2025	7:36	4.11	91.2	8.68	n/a	2.73	1.01	n/m	80	74.61	60.36	58.64	21.3	21.9	21.8	21.3
59	4/14/2025	8:06	4.11	91	11.45	n/a	2.74	1.01	n/m	80	75.01	58.12	55.55	21.4	22.1	22.3	23.6
59	4/14/2025	8:36	4.1	91.1	16.11	n/a	2.82	1.02	n/m	80	74.76	52.97	50.96	21.2	21.8	22.1	21.4
59	4/14/2025	9:06	4.11	91	21.53	n/a	2.79	1.05	n/m	80	74.49	47.52	45.32	21.5	22.2	22	23.1
59	4/14/2025	9:36	4.1	91.1	28.05	n/a	2.8	1.02	n/m	80	74.47	41.29	38.92	21.3	22	22.1	21.6
60	4/14/2025	10:06	4.1	91.7	n/a	6.83	2.62	1.03	n/m	80	74.51	63.33	61.12	21.6	22.1	22	22.9
60	4/14/2025	10:36	4.11	91.2	n/a	9.53	2.71	1.01	n/m	80	74.54	60.49	60.49	21.4	22.2	21.5	22.5
60	4/14/2025	11:06	4.11	91	n/a	13.47	2.78	1.02	n/m	80	74.96	56.6	54.54	21.5	22.1	22	21.7
60	4/14/2025	11:36	4.11	91.1	n/a	18.63	2.81	1.04	n/m	80	74.52	51.77	49.62	21.6	21.8	21.8	21.7
60	4/14/2025	12:08	4.1	91	n/a	24.9	2.78	1.05	n/m	80	75.27	45.71	43.36	21.3	22.1	21.7	22.1
61	4/14/2025	12:36	4.1	91.3	6.49	n/a	2.61	1.02	n/m	80	75.22	63.25	60.97	21.5	22.3	21.6	22.1
61	4/14/2025	13:06	4.1	91.4	9.09	n/a	2.79	1.04	n/m	80	74.57	59.92	57.73	21.3	22.2	21	22.5
61	4/14/2025	13:36	4.1	91.1	12.73	n/a	2.83	1.01	n/m	80	74.59	56.43	54.55	21.5	22	22.1	22.9
61	4/14/2025	14:06	4.11	91.1	16.61	n/a	2.79	1.02	n/m	80	74.56	52.36	50.29	21.4	22.3	22.1	23.3
61	4/14/2025	14:36	4.11	91	21.85	n/a	2.77	1.01	n/m	80	74.63	47.52	45.34	21.5	22.4	22.4	23.7
61	4/14/2025	15:06	4.11	91	28.28	n/a	2.78	1.02	n/m	80	75.13	41.02	38.8	21.6	22.3	22.6	22.3
62	4/14/2025	15:36	4.11	90.2	n/a	7.11	2.63	1.02	n/m	80	74.21	63.18	61.09	21.6	22.4	22.6	23.5
62	4/14/2025	16:06	4.11	91.2	n/a	10.31	2.75	1.01	n/m	80	74.51	59.7	57.87	21.4	21.9	21.6	22.1
62	4/14/2025	16:36	4.1	91.1	n/a	14.84	2.82	1.01	n/m	80	74.11	56.4	54.33	21.5	22	22.6	23.9
62	4/14/2025	17:09	4.1	91	n/a	19.58	2.8	1.02	n/m	80	74.91	50.75	48.52	21.7	22.2	22.5	23
62	4/14/2025	17:40	4.1	91	n/a	25.01	2.81	1.01	n/m	80	74.77	45.16	42.62	21.4	22.1	22.3	22.1
62	4/14/2025	18:02	4.1	90.9	n/a	30.78	2.81	1.02	n/m	80	74.85	39.65	37.23	21.6	22.1	22.5	23.4
63	4/14/2025	18:30	4.11	90.4	7.58	n/a	2.55	1.02	n/m	80	74.98	62.1	60.02	21.5	22.5	22.4	22.5
63	4/14/2025	19:00	4.1	90.4	10.08	n/a	2.75	0.99	n/m	80	75.23	59.63	57.53	21.6	22	21.9	23.5

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
63	4/14/2025	19:30	*4.1*	91.7	13.31	n/a	2.72	1.01	n/m	*80*	74.52	55.67	53.76	21.4	22.3	22.4	23.6
63	4/14/2025	20:00	*4.11*	91	17.68	n/a	2.76	1.01	n/m	*80*	74.78	51.26	49.38	21.5	22.3	22.7	23.5
63	4/14/2025	20:32	*4.1*	91.2	23.2	n/a	2.75	1.01	n/m	*80*	74.73	45.57	43.76	21.6	22.2	22.6	23
63	4/14/2025	21:00	*4.1*	91.1	29.57	n/a	2.78	1.02	n/m	*80*	74.57	39.77	37.56	21.6	22	22.4	22.4
63	4/14/2025	21:10	*4.1*	91	31.81	n/a	2.81	1.03	n/m	*80*	74.83	37.2	34.9	21.6	22.2	22.1	22.3
64	4/14/2025	21:30	*4.1*	90.8	n/a	6.48	2.64	1.04	n/m	*80*	74.59	63.55	61.49	21.3	22.1	22.3	22.3
64	4/14/2025	22:00	*4.1*	91.4	n/a	9.43	2.76	1	n/m	*80*	74.86	61.04	59.17	21.4	21.9	21.5	21.8
64	4/14/2025	22:30	*4.1*	91.2	n/a	13.23	2.79	1.02	n/m	*80*	75.19	57.28	55.18	21.5	22.1	21.6	21.1
64	4/14/2025	23:00	*4.1*	91	n/a	17.6	2.86	1.03	n/m	*80*	74.27	52.37	50.38	21.4	22.1	21.7	22.5
64	4/14/2025	23:29	*4.1*	90.9	n/a	23.13	2.84	1.03	n/m	*80*	74.06	47.34	45	21.4	22.1	21.6	22.4
64	4/15/2025	0:00	*4.1*	91	n/a	29.76	2.84	1.04	n/m	*80*	74.87	40.67	38.33	21.4	22	21.9	21.8
65	4/15/2025	0:16	*4.11*	91.3	6.33	n/a	2.65	1.01	n/m	*80*	74.24	63.43	61.27	21.4	21.9	21.8	22.7
65	4/15/2025	0:46	*4.1*	91.6	9.01	n/a	2.73	1.02	n/m	*80*	75.2	59.67	57.83	21.4	22	21.7	21.9
65	4/15/2025	1:16	*4.1*	91	11.83	n/a	2.81	1.01	n/m	*80*	74.89	57.51	55.1	21.4	21.9	21.6	21.6
65	4/15/2025	1:46	*4.1*	90.9	15.95	n/a	2.84	1.02	n/m	*80*	74.34	53.42	51.18	21.2	22.1	21.7	23.2
65	4/15/2025	2:16	*4.1*	91	20.47	n/a	2.83	1.03	n/m	*80*	75.06	48.76	46.82	21.6	22.3	21.9	24.9
65	4/15/2025	2:46	*4.1*	91	26.24	n/a	2.82	1.02	n/m	*80*	74.64	43.09	40.87	21.6	22	22	24.1
65	4/15/2025	3:10	*4.1*	91.1	30.85	n/a	2.79	1.02	n/m	*80*	74.87	38.33	36.15	21.4	22.1	22.4	23.2
67	4/15/2025	6:12	*4.09*	161.3	n/a	31.69	4.94	2.17	n/m	*80*	71.69	33.54	27.04	21.6	22.2	22.7	22.3
68	4/15/2025	6:47	*4.09*	129.6	22.42	n/a	3.78	1.61	n/m	*80*	73.56	44.29	40.11	21.4	22.1	22.2	23.1
68	4/15/2025	6:54	*4.1*	129.7	32.56	n/a	3.81	1.56	n/m	*80*	73.67	32.45	29.3	21.6	22.2	22.1	22.6
69	4/15/2025	7:24	*4.11*	90.8	n/a	11.26	2.45	0.93	n/m	*80*	76.13	60.76	59.03	21.5	22.1	22.3	24.9
69	4/15/2025	7:48	*4.1*	91.2	n/a	33.56	2.71	1.04	n/m	*80*	77.31	39.79	37.61	21.3	22.2	22	22.4
70	4/15/2025	8:25	*4.1*	90.4	10.85	n/a	2.65	1.03	n/m	*80*	77.7	61.82	59.63	21.5	21.8	22.7	22.7
70	4/15/2025	8:55	*4.1*	90.3	34.73	n/a	2.77	1.02	n/m	*80*	77.33	38.16	35.31	21.5	22.2	22.1	23
71	4/15/2025	10:30	*4.11*	9.04	n/a	7.98	2.45	0.99	n/m	*80*	77.27	65.08	63.02	21.4	21.8	21.6	22.3
71	4/15/2025	10:50	*4.11*	91.4	n/a	23.41	2.74	1.01	n/m	*80*	76.84	49.45	47.46	21.4	21.8	21.9	22.3
71	4/15/2025	11:00	*4.11*	90.9	n/a	33.84	2.81	1.02	n/m	*80*	77.45	38.51	36.32	21.6	21.7	21.1	22.5
72	4/15/2025	11:15	*4.1*	90.5	7.68	n/a	2.74	0.98	n/m	*80*	76.59	64.08	61.93	21.6	22.2	21.3	22.6
72	4/15/2025	11:30	*4.11*	90.6	15.76	n/a	2.61	0.99	n/m	*80*	77.06	55.46	53.73	21.4	21.9	22	22.9
72	4/15/2025	11:45	*4.1*	90.5	31.73	n/a	2.78	0.98	n/m	*80*	76.38	40.04	37.71	21.6	22.1	21.4	23
73	4/15/2025	12:02	*4.11*	90.6	n/a	7.54	2.56	0.89	n/m	*80*	76.79	64.83	63.17	21.6	22.2	21.7	23.3

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min-1)	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
73	4/15/2025	12:17	*4.11*	89.5	n/a	15.88	2.6	0.95	n/m	*80*	76.38	56.47	54.91	21.4	22	22	23.3
73	4/15/2025	12:30	*4.11*	90.9	n/a	28.12	2.71	0.97	n/m	*80*	77.31	44.22	42.28	21.3	21.9	22.4	23.6
74	4/15/2025	12:50	*4.11*	91.3	7.51	n/a	2.54	0.88	n/m	*80*	76.25	64.22	62.3	21.8	22.1	21.9	24
74	4/15/2025	13:05	*4.11*	91.4	14.47	n/a	2.56	0.96	n/m	*80*	76.56	57.15	55.11	21.4	22.1	22.5	24
74	4/15/2025	13:20	*4.11*	91.5	27.61	n/a	2.75	0.95	n/m	*80*	76.98	43.08	41.02	22	22.3	22.5	22.6
75	4/15/2025	13:40	*4.1*	91.3	n/a	7.73	2.64	0.88	n/m	*80*	76.68	65	63.26	21.6	22.2	22.2	23.3
75	4/15/2025	13:55	*4.11*	90.4	n/a	16.21	2.6	0.95	n/m	*80*	76.66	55.76	53.95	21.6	22.1	22.7	23.7
75	4/15/2025	14:10	*4.11*	90.9	n/a	31.78	2.73	0.97	n/m	*80*	76.43	40.52	39.07	21.8	22.1	22.3	21.8
76	4/15/2025	14:25	*4.1*	91.4	8.17	n/a	2.7	0.96	n/m	*80*	76.12	63.13	61.06	21.6	22.1	21.5	23.3
76	4/15/2025	14:40	*4.11*	91.2	14.95	n/a	2.55	0.97	n/m	*80*	76.65	56.45	54.93	21.8	22.3	22.3	23.4
76	4/15/2025	14:55	*4.1*	93.2	28.7	n/a	2.79	0.99	n/m	*80*	76.74	42.84	40.62	21.8	22	22	22.2
77	4/15/2025	15:15	*4.1*	90.2	n/a	7.07	2.55	0.86	n/m	*80*	77.09	66.07	64.04	21.7	22.3	22.1	23.9
77	4/15/2025	15:30	*4.11*	91.5	n/a	15.79	2.57	1.02	n/m	*80*	77.06	56.77	54.76	21.6	22.4	22.1	22.1
77	4/15/2025	15:45	*4.1*	90.3	n/a	29.3	2.76	1.01	n/m	*80*	76.91	43.66	41.35	21.7	22.1	22.2	22.3
78	4/15/2025	16:05	*4.1*	91.4	7.9	n/a	2.64	0.93	n/m	*80*	76.67	63.68	61.36	21.6	22.3	22	22.1
78	4/15/2025	16:20	*4.11*	91.3	15.17	n/a	2.66	0.97	n/m	*80*	76.72	56.47	54.32	21.7	22	22.2	23.5
78	4/15/2025	16:41	*4.11*	91	31.41	n/a	2.72	0.97	n/m	*80*	76.93	39.87	37.82	21.4	22	21.6	22.1
79	4/15/2025	16:54	*4.11*	91.3	n/a	7.14	2.54	0.9	n/m	*80*	76.3	65.33	63.1	21.5	22	21.9	23.2
79	4/15/2025	17:09	*4.11*	92.4	n/a	14.92	2.6	0.97	n/m	*80*	76.89	57.51	55.49	21.7	22.3	22.2	22.7
79	4/15/2025	17:24	*4.1*	92.1	n/a	28.26	2.82	1.02	n/m	*80*	76.59	43.95	41.2	21.6	22.3	22.2	22.7
80	4/15/2025	17:42	*4.1*	90.5	7.97	n/a	2.62	0.93	n/m	*80*	76.19	63.37	61.24	21.9	22.3	21.8	23.4
80	4/15/2025	17:57	*4.1*	90.2	14.59	n/a	2.68	1.01	n/m	*80*	76.25	56.82	54.44	21.5	22.1	22.3	22.3
80	4/15/2025	18:12	*4.11*	93	25.11	n/a	2.78	1	n/m	*80*	76.4	45.42	43.61	21.7	22.3	22.2	23.6
81	4/15/2025	18:33	*4.1*	90.7	n/a	7.79	2.63	0.94	n/m	*80*	76.89	64.8	62.79	21.8	22.2	22.1	22.1
81	4/15/2025	18:49	*4.1*	92.3	n/a	16.15	2.63	1.02	n/m	*80*	76.76	56.58	54.27	21.6	22.2	22.5	23.5
82	4/15/2025	19:21	*4.1*	90.9	7.83	n/a	2.63	0.94	n/m	*80*	76.31	63.4	61.08	21.6	22	21.9	22.8
82	4/15/2025	19:36	*4.1*	90.8	14.34	n/a	2.69	0.97	n/m	*80*	76.35	57.15	55.09	21.5	22.6	22.5	23.3
82	4/15/2025	19:51	*4.1*	91.7	24.67	n/a	2.79	1.01	n/m	*80*	76.7	46.34	44.7	21.8	22.3	22.1	23.6
83	4/15/2025	20:12	*4.11*	90.2	n/a	7.96	2.59	0.94	n/m	*80*	76.96	64.3	62.76	21.7	22.3	22.2	23.6
83	4/15/2025	20:27	*4.11*	90.6	n/a	15.49	2.65	0.96	n/m	*80*	76.92	57.89	54.75	21.6	22.3	22.6	23.7
83	4/15/2025	20:43	*4.11*	90.8	n/a	28.41	2.73	0.96	n/m	*80*	76.22	43.34	42.01	21.7	22.4	22.4	23.9
84	4/15/2025	21:00	*4.1*	92.1	7.56	n/a	2.53	0.91	n/m	*80*	76.55	63.53	62.48	21.6	22.3	22.2	24

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
84	4/15/2025	21:15	*4.1*	90.6	13.28	n/a	2.6	0.98	n/m	*80*	76.4	57.72	55.94	21.5	22.2	22.7	23.6
84	4/15/2025	21:30	*4.1*	89.4	23.9	n/a	2.73	0.97	n/m	*80*	76.33	46.95	44.61	21.6	22.1	22.6	23.4
84	4/15/2025	21:41	*4.1*	90.9	32.55	n/a	2.77	0.99	n/m	*80*	76.34	39.04	36.65	21.7	22.4	22	23.4
85	4/15/2025	21:54	*4.1*	91.5	n/a	8.11	2.63	0.91	n/m	*80*	76.62	64.4	62.9	21.6	22.1	22.3	23.4
85	4/15/2025	22:09	*4.11*	90.6	n/a	16.03	2.62	0.96	n/m	*80*	75.79	56.9	54.6	21.7	22.4	22.7	23.3
85	4/15/2025	22:24	*4.1*	90.1	n/a	27.97	2.83	1.01	n/m	*80*	76.11	44.54	42.18	21.6	22.5	22.3	23.2
85	4/15/2025	22:31	*4.11*	90.5	n/a	33.77	2.72	0.95	n/m	*80*	76.31	38.31	36.3	21.5	22.4	22.2	23.2
86	4/15/2025	22:43	*4.1*	91.3	7.64	n/a	2.57	0.91	n/m	*80*	76.58	64.14	62.11	21.8	22.3	22.3	23.1
86	4/15/2025	22:58	*4.1*	90.9	13.42	n/a	2.62	0.98	n/m	*80*	76.37	57.19	55.94	21.6	22.4	22.4	22.6
86	4/15/2025	23:13	*4.11*	92.3	23.53	n/a	2.84	1.02	n/m	*80*	76.28	47.12	44.49	21.6	22.2	22.1	22.6
86	4/15/2025	23:27	*4.1*	91.1	34.72	n/a	2.81	0.99	n/m	*80*	76.75	35.47	34.03	21.5	22	21.9	22.7
87	4/15/2025	23:40	*4.1*	90.7	n/a	8.57	2.67	0.97	n/m	*80*	76.28	63.39	61.42	21.5	22.1	22	22.2
87	4/15/2025	23:55	*4.1*	91.2	n/a	16.36	2.66	0.98	n/m	*80*	76.33	59.6	53.86	21.7	22.3	22.2	22.3
87	4/16/2025	0:08	*4.1*	90.8	n/a	25.24	2.88	1.02	n/m	*80*	76.44	47.75	45.27	21.5	22.3	22.1	22.3
88	4/16/2025	0:24	*4.11*	91.5	6.94	n/a	2.56	0.84	n/m	*80*	76.72	64.48	63.01	21.4	22.1	21.6	22.1
88	4/16/2025	0:39	*4.1*	91.1	11.96	n/a	2.64	1.01	n/m	*80*	76.29	58.7	56.75	21.7	22.1	21.6	22
88	4/16/2025	0:54	*4.1*	91.6	20.82	n/a	2.85	1.04	n/m	*80*	76.38	49.52	47.93	21.5	21.6	21.9	21.6
88	4/16/2025	1:09	*4.11*	91	33.31	n/a	2.92	1.02	n/m	*80*	76.49	37.55	35.25	21.4	22.1	21.2	21.3
89	4/16/2025	1:20	*4.11*	91.4	n/a	8.77	2.71	0.99	n/m	*80*	75.95	63.7	61.16	21.4	21.8	21.4	21.8
89	4/16/2025	1:50	*4.1*	92.3	n/a	27.25	2.93	1.04	n/m	*80*	76.17	44.76	42.11	21.2	21.8	21.5	20.9
89	4/16/2025	1:56	*4.11*	91.2	n/a	32.55	2.94	1.03	n/m	*80*	76.28	39.41	36.83	21.5	21.5	20.9	21.3
90	4/16/2025	2:08	*4.1*	90.9	7.89	n/a	2.69	0.98	n/m	*80*	76.78	63.11	60.89	21.4	21.8	21	22
90	4/16/2025	2:38	*4.11*	91.4	23.03	n/a	2.82	1.04	n/m	*80*	76.39	47.38	45.02	21.6	22	21.3	22.6
90	4/16/2025	2:50	*4.1*	91.3	32.46	n/a	2.91	1.04	n/m	*80*	75.88	38.43	36.03	21.5	21.6	20.9	21.9
91	4/16/2025	3:01	*4.1*	91.6	n/a	8.44	2.68	0.96	n/m	*80*	76.49	63.75	61.74	21.4	21.9	21.2	21.4
91	4/16/2025	3:31	*4.1*	91.2	n/a	26.31	2.96	1.07	n/m	*80*	76.51	46.36	43.73	21.4	21.7	21.7	22.2
91	4/16/2025	3:39	*4.11*	90.9	n/a	31.73	2.84	1.01	n/m	*80*	76.24	39.28	37.1	21.3	21.8	21	22.6
92	4/16/2025	3:50	*4.1*	91.5	7.62	n/a	2.65	0.94	n/m	*80*	76.31	63.93	61.95	21.4	22	21	23.1
92	4/16/2025	4:20	*4.1*	91.8	22.08	n/a	2.88	1.05	n/m	*80*	76.17	48.78	46.47	21.3	21.4	21.7	21.2
92	4/16/2025	4:33	*4.11*	90.8	31.63	n/a	2.94	1.03	n/m	*80*	76.24	38.29	35.95	21.3	22.1	20.7	21.6
93	4/16/2025	4:44	*4.1*	91.3	n/a	8.33	2.68	0.95	n/m	*80*	75.9	63.58	62.06	21.3	21.8	21.3	22.5
93	4/16/2025	5:14	*4.1*	91	n/a	24.91	2.88	1.04	n/m	*80*	75.87	46.92	44.94	21.5	22.1	21.6	22.3

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
93	4/16/2025	5:22	*4.1*	91.5	n/a	31.85	2.86	1.03	n/m	*80*	76.32	40.05	37.7	21.3	22	21	22
94	4/16/2025	5:34	*4.1*	91.6	7.81	n/a	2.68	0.96	n/m	*80*	76.59	62.23	61.24	21.4	22.1	21.6	21.1
94	4/16/2025	6:04	*4.1*	91.4	21.31	n/a	2.86	1.05	n/m	*80*	76.07	49.37	47.03	21.3	21.6	21.5	22.7
94	4/16/2025	6:18	*4.1*	90.8	32.26	n/a	2.93	1.02	n/m	*80*	76.49	37.54	35.15	21.4	21.9	20.9	23
95	4/16/2025	6:30	*4.1*	90.4	n/a	8.57	2.73	0.99	n/m	*80*	76.36	63.74	61.39	21.4	22.1	21.5	22
95	4/16/2025	7:00	*4.1*	92.3	n/a	25.21	2.89	1.04	n/m	*80*	76.29	46.54	44.28	21.2	21.6	21.6	21.8
95	4/16/2025	7:08	*4.1*	90.9	n/a	32.09	2.92	1.04	n/m	*80*	76.35	39.22	36.68	21.3	21.8	20.8	22.1
96	4/16/2025	7:20	*4.11*	90.2	7.76	n/a	2.68	0.91	n/m	*80*	76.5	62.97	60.74	21.3	21.9	21	23
96	4/16/2025	7:50	*4.1*	92.3	21.81	n/a	2.86	1.02	n/m	*80*	76.08	48.46	46.14	21.5	21.7	21.6	22.1
96	4/16/2025	8:04	*4.1*	90.8	31.51	n/a	2.92	1.04	n/m	*80*	76.55	39.79	37.5	21.4	22	21	21.7
97	4/16/2025	8:17	*4.11*	76	n/a	6.77	2.16	0.75	n/m	*80*	77.01	67.12	65.92	21.6	21.5	21.4	21.5
97	4/16/2025	8:47	*4.11*	77.9	n/a	15.25	2.26	0.85	n/m	*80*	77.05	58.16	57.34	21.3	21.9	21.6	21.6
97	4/16/2025	9:18	*4.11*	76	n/a	32.55	2.36	0.85	n/m	*80*	77.19	43.47	40.15	21.4	21.9	21.4	21.5
98	4/16/2025	9:43	*4.11*	77	6.26	n/a	2.26	0.71	n/m	*80*	76.9	66.45	65.72	21.5	22.3	21.3	22.1
98	4/16/2025	10:13	*4.11*	76.3	12.99	n/a	2.3	0.84	n/m	*80*	77.35	59.62	58.35	21.3	22.1	21.7	22.1
98	4/16/2025	10:43	*4.11*	75.9	24.3	n/a	2.33	0.82	n/m	*80*	77.53	47.76	46.35	21.3	22.3	21.3	22.2
98	4/16/2025	10:55	*4.11*	72	32.4	n/a	2.3	0.83	n/m	*80*	77.23	40.39	38.98	21.3	22.1	21.6	22.5
99	4/16/2025	11:07	*4.11*	76	n/a	6.87	2.17	0.72	n/m	*80*	77.29	66.75	65.62	21.5	22.1	21.6	22.7
99	4/16/2025	11:37	*4.1*	75.2	n/a	15.46	2.29	0.83	n/m	*80*	77.3	58.31	56.78	21.6	22.2	21	22.9
99	4/16/2025	12:07	*4.11*	75.9	n/a	29.7	2.28	0.8	n/m	*80*	77.08	44.56	43.1	21.4	22.1	21.7	23.1
99	4/16/2025	12:12	*4.11*	75.9	n/a	32.33	2.29	0.8	n/m	*80*	76.92	41.61	40.27	21.8	21.6	22	23.1
100	4/16/2025	12:26	*4.11*	75.7	6.14	n/a	2.17	0.77	n/m	*80*	76.95	66.29	65.03	21.8	22	22.1	23.6
100	4/16/2025	12:56	*4.11*	76.4	13.15	n/a	2.14	0.81	n/m	*80*	76.82	58.87	58.05	21.5	22.3	22.6	23.6
100	4/16/2025	13:26	*4.11*	76	24.63	n/a	2.25	0.8	n/m	*80*	77.04	47.96	46.66	21.6	22.1	22.1	23.6
100	4/16/2025	13:42	*4.11*	76	32.62	n/a	2.25	0.8	n/m	*80*	77.01	39.67	38.35	21.6	22.5	22.5	23.5
101	4/16/2025	13:55	*4.11*	75.9	n/a	6.63	2.15	0.72	n/m	*80*	77.24	66.94	66.07	21.4	22.4	22.8	23.7
101	4/16/2025	14:25	*4.11*	76.3	n/a	15.32	2.25	0.82	n/m	*80*	77.28	58	56.76	21.4	22.3	22.9	23.9
101	4/16/2025	14:55	*4.11*	75.9	n/a	27.47	2.22	0.79	n/m	*80*	77.59	46.2	45.05	21.6	22.2	22.7	24.1
101	4/16/2025	15:03	*4.11*	76.1	n/a	31.83	2.22	0.8	n/m	*80*	77.4	42.38	41.11	21.5	22.4	22.8	24
102	4/16/2025	15:15	*4.11*	76	5.63	n/a	2.15	0.7	n/m	*80*	77.03	66.98	66.14	21.5	22.3	23	23.7
102	4/16/2025	15:45	*4.11*	75	15.37	n/a	2.22	0.8	n/m	*80*	76.9	56.31	55.25	21.6	22.1	22.5	22.6

Table C.6. Initial Differential Pressure Data from DEFs from Run W-02

Filter Period	Date	Active Filter ID	Start Time	ΔP at t = 2 min (psid)	ΔP at t = 4 min (psid)	ΔP at t = 6 min (psid)	ΔP at t = 8 min (psid)	ΔP at t = 10 min (psid)	Target ΔP for Filter Switch (psid)
1	4/10/2025	1	19:20	2.23	2.81	3.23	3.55	3.79	8.79
2	4/10/2025	2	20:01	1.96	2.95	3.21	3.49	3.6	8.6
3	4/11/2025	1	00:0	0.37	0.67	1.86	2.45	2.82	27.82
4	4/11/2025	2	01:10	0.39	0.58	1.02	1.94	2.68	27.68
5	4/11/2025	1	02:25	0.49	1.13	2.09	3.23	4.19	29.19
6	4/11/2025	2	03:26	0.42	0.59	1.73	3.21	4.1	29.1
7	4/11/2025	1	04:32	0.2	0.35	1.11	2.41	3.74	28.74
8	4/11/2025	2	05:25	0.41	0.62	1.83	3.99	5.23	30.23
9	4/11/2025	1	06:28	0.29	1.6	2.9	4.47	5.64	30.64
10	4/11/2025	2	07:31	0.5	1.01	2.17	4.59	6.5	31.5
11	4/11/2025	1	08:34	0.27	0.88	3.34	4.57	5.57	30.57
12	4/11/2025	2	09:32	0.54	0.87	3.33	5.76	6.86	31.86
13	4/11/2025	1	10:32	0.21	0.53	3.01	5.00	6.19	31.39
14	4/11/2025	2	11:32	0.38	0.56	2.47	N/A	6.72	31.72
15	4/11/2025	1	12:33	0.33	0.99	3.75	5.70	6.95	31.95
16	4/11/2025	2	13:31	0.38	0.65	N/A	6.02	7.23	32.00
17	4/11/2025	1	14:32	0.24	0.67	3.84	5.64	6.82	31.82
18	4/11/2025	2	15:33	0.40	0.73	3.28	5.68	7.06	32.00
19	4/11/2025	1	16:34	0.24	0.85	4.08	5.81	7.2	32.00
20	4/11/2025	2	19:45	0.40	0.80	3.77	6.38	7.33	32.00
21	4/11/2025	1	20:34	0.23	0.87	4.22	6.06	8.56	32.00
22	4/11/2025	2	21:30	0.78	3.88	7.00	8.11	9.05	32.00
23	4/11/2025	1	22:28	0.40	3.37	5.21	6.18	6.78	31.78
24	4/11/2025	2	22:30	N/A	4.45	6.39	7.48	8.4	32.00
25	4/12/2025	1	00:28	0.48	4.02	5.5	N/A	7.22	32.00
26	4/12/2025	2	01:32	1.47	7.56	8.6	9.58	10.5	32.00
27	4/12/2025	1	02:35	0.22	1.62	5.36	6.33	7.28	32.00
28	4/12/2025	2	03:45	0.46	4.91	6.55	8.02	8.38	32.00
29	4/12/2025	1	04:55	0.24	3.09	5.47	6.34	7.37	32.00
30	4/12/2025	2	06:05	0.47	5.43	6.83	7.81	8.31	32.00

Filter Period	Date	Active Filter ID	Start Time	ΔP at t = 2 min (psid)	ΔP at t = 4 min (psid)	ΔP at t = 6 min (psid)	ΔP at t = 8 min (psid)	ΔP at t = 10 min (psid)	Target ΔP for Filter Switch (psid)
31	4/12/2025	1	07:13	0.3	1.54	5.73	6.79	7.49	32.00
32	4/12/2025	2	08:16	0.42	2.03	7.34	8.62	9.24	32.00
33	4/12/2025	1	09:16	0.2	0.71	5.36	6.75	7.73	32.00
34	4/12/2025	2	10:18	0.38	0.86	6.36	7.84	8.5	32.00
35	4/12/2025	1	11:21	0.35	1.83	5.71	6.94	7.67	32.00
36	4/12/2025	2	12:23	0.42	2.55	7.03	8.21	9	32.00
37	4/12/2025	1	13:25	0.27	0.55	6.35	6.94	7.92	32.00
38	4/12/2025	2	14:27	0.41	2.5	6.95	8.38	8.96	32.00
39	4/12/2025	1	15:30	0.34	1.24	6.23	7.53	8.52	32.00
40	4/12/2025	2	16:48	0.40	3.69	7.54	8.52	9.2	32.00
41	4/12/2025	1	18:01	0.36	1.54	6.07	7.37	8.32	32.00
42	4/12/2025	2	19:24	0.55	5.35	7.32	8.42	9.01	32.00
43	4/12/2025	1	20:47	0.64	6.22	7.1	8.33	9	32.00
44	4/12/2025	2	22:04	0.47	4.08	7.75	8.63	9.27	32.00
45	4/12/2025	1	23:22	0.59	4.88	8.15	9.73	10.72	32.00
46	4/13/2025	2	00:28	0.52	5.54	8.1	8.93	9.78	32.00
47	4/13/2025	1	01:38	0.93	7.68	9.42	10.69	11.64	32.00
48	4/13/2025	2	02:44	0.38	0.76	4.34	5.55	5.93	30.93
49	4/13/2025	1	05:13	0.42	0.7	4.61	5.22	5.91	30.91
50	4/13/2025	2	07:39	0.32	0.47	2.8	5.2	5.42	30.42
51	4/13/2025	1	10:07	0.48	0.73	4.51	5.33	5.95	30.95
52	4/13/2025	2	12:26	0.26	0.39	1.27	4.28	5.08	30.08
53	4/13/2025	1	14:58	0.48	0.65	2.62	5.25	5.78	30.78
54	4/13/2025	2	17:30	0.32	0.43	1.81	4.8	5.34	30.34
55	4/13/2025	1	20:13	0.52	0.75	4.51	5.45	6.31	31.31
56	4/13/2025	2	22:54	0.3	0.44	2.05	5.12	5.68	30.68
57	4/14/2025	1	01:34	0.38	0.52	0.92	4.75	5.47	30.47
58	4/14/2025	2	04:18	0.28	0.47	2.23	5.21	5.58	30.58
59	4/14/2025	1	06:56	0.44	0.68	1.99	4.97	5.36	30.36
60	4/14/2025	2	9:46	0.23	0.36	0.93	4.42	5.54	30.54
61	4/14/2025	1	12:17	0.45	0.53	1.23	4.75	5.29	30.29
62	4/14/2025	2	15:16	0.29	0.4	1.61	5.04	5.73	30.73

Filter Period	Date	Active Filter ID	Start Time	ΔP at t = 2 min (psid)	ΔP at t = 4 min (psid)	ΔP at t = 6 min (psid)	ΔP at t = 8 min (psid)	ΔP at t = 10 min (psid)	Target ΔP for Filter Switch (psid)
63	4/14/2025	1	18:06	0.45	0.58	1.52	5.27	5.78	30.78
64	4/14/2025	2	21:13	0.27	0.44	1.88	4.86	5.59	30.59
65	4/15/2025	1	0:06	0.42	0.55	3.8	5.94	6.07	31.07
66	4/15/2025	1	5:30	0.78	13.78	23.04	30.74	NA	NA
67	4/15/2025	2	6:02	0.92	6.64	16.56	21.74	28.68	32
68	4/15/2025	1	6:37	0.41	1.12	4.1	18.6	21.13	32
69	4/15/2025	2	7:13	0.38	0.42	1.67	5.46	10.82	32
70	4/15/2025	1	8:13	0.38	0.65	2.71	6.73	8.13	32
71	4/15/2025	2	10:19	0.33	0.55	2.11	5.88	7.16	32
72	4/15/2025	1	11:03	0.49	0.63	3.19	5.47	6.32	32
73	4/15/2025	2	11:52	0.24	0.45	1.09	4.66	6.94	32
74	4/15/2025	1	12:39	0.3	0.55	2.31	5.82	7.09	32
75	4/15/2025	2	13:29	0.32	0.45	1.37	5.34	7	32
76	4/15/2025	1	14:14	0.31	0.5	2.85	6.66	7.24	32
77	4/15/2025	2	15:05	0.36	0.46	1.29	5.51	6.74	32
78	4/15/2025	1	15:54	0.31	0.48	2.63	6.42	7.19	32
79	4/15/2025	2	16:44	0.32	0.55	1.14	4.55	6.85	32
80	4/15/2025	1	17:32	0.32	0.76	4.77	6.71	7.57	32
81	4/15/2025	2	18:22	0.4	0.67	2.54	6.29	7.28	32
82	4/15/2025	1	19:10	0.39		1.76	6.74	7.56	32
83	4/15/2025	2	20:01	0.45	0.59	1.25	5.85	7.27	32
84	4/15/2025	1	20:49	0.47	0.73		6.48	7.21	32
85	4/15/2025	2	21:43	0.42	0.61	1.77	6.13	7.34	32
86	4/15/2025	1	22:33	0.42	0.64	1.43	6.54	7.3	32
87	4/15/2025	2	23:29	0.44	0.58	1.87	6.59	7.87	32
88	4/16/2025	1	0:16	0.39	0.47	1.07	5.29	6.4	32
89	4/16/2025	2	1:10	0.38	0.57	2.11	7.14	8.35	32
90	4/16/2025	1	1:58	0.19	0.29	2.85	7.2	7.68	32
91	4/16/2025	2	2:51	0.19	0.6	0.84	5.72	7.97	32
92	4/16/2025	1	3:40	0.21	0.34	2.17	5.67	7.48	32
93	4/16/2025	2	4:34	0.28	0.53	1.14	6.65	8.22	32
94	4/16/2025	1	5:24	0.32	0.51	4.51	7.2	7.5	32

Filter Period	Date	Active Filter ID	Start Time	ΔP at t = 2 min (psid)	ΔP at t = 4 min (psid)	ΔP at t = 6 min (psid)	ΔP at t = 8 min (psid)	ΔP at t = 10 min (psid)	Target ΔP for Filter Switch (psid)
95	4/16/2025	2	6:20	0.42	0.69	1.03	6.84	8.3	32
96	4/16/2025	1	7:10	0.41	0.57	1.61	7.28	7.72	32
97	4/16/2025	2	8:07	0.78	0.8	1.48	5.74	6.58	32
98	4/16/2025	1	9:33	0.44	0.64	1.24	5.52	6.19	32
99	4/16/2025	2	10:57	0.49	0.79	1.71	5.16	6.72	32
100	4/16/2025	1	12:14	0.16	0.4	3.86	5.34	6	32
101	4/16/2025	2	13:44	0.81	0.95	3.71	5.73	6.51	32
102	4/16/2025	1	15:04	0.34	0.43	0.73	3.33	5.48	32

C.3 W-03 Tabulated Data

Table C.7. Periodically Recorded Data from Run W-03

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
1	5/28/2025	8:03	*4.04*	130.1	0.24	n/a	2.72	0.87	n/m	*65*	61.5	55.41	53.03	21.4	22.1	21.8	22.5
1	5/28/2025	8:30	*4.04*	129.4	0.25	n/a	2.95	0.88	n/m	*63*	61.3	54.9	52.13	21.5	22.0	22.0	22.8
1	5/28/2025	9:00	*4.03*	130.0	0.26	n/a	2.92	0.9	n/m	*63*	61.3	54.64	52.02	21.4	22.0	22.2	23.2
1	5/28/2025	9:30	*4.03*	130.0	0.27	n/a	2.95	0.91	n/m	*63*	61.0	54.42	51.80	21.4	22.1	22.4	23.7
1	5/28/2025	10:00	*4.03*	129.9	0.29	n/a	2.96	0.93	n/m	*63*	61.1	54.31	51.63	21.5	22.0	22.5	23.5
1	5/28/2025	10:30	*4.03*	130.0	0.30	n/a	2.98	0.94	n/m	*63*	61.0	54.07	51.31	21.5	22.1	22.3	23.8
1	5/28/2025	11:00	*4.03*	130.0	0.32	n/a	2.94	0.95	n/m	*63*	60.7	54.22	51.24	21.6	22.1	22.3	23.4
1	5/28/2025	11:30	*4.03*	130.1	0.34	n/a	3.00	0.99	n/m	*63*	60.9	54.06	51.17	21.5	22.2	22.4	22.6
1	5/28/2025	12:00	*4.03*	130.0	0.46	n/a	2.97	0.97	n/m	*63*	60.9	54.04	51.29	21.6	21.9	22.3	22.6
1	5/28/2025	12:30	*4.03*	130.0	0.40	n/a	3.00	0.90	n/m	*63*	60.9	54.00	51.09	21.4	22.0	22.4	23.2
1	5/28/2025	13:00	*4.03*	130.1	0.41	n/a	2.94	0.97	n/m	*63*	60.6	54.05	51.34	21.6	22.2	22.3	23.8
1	5/28/2025	13:30	*4.03*	129.9	0.41	n/a	2.99	0.97	n/m	*63*	60.78	53.71	51.21	22.2	22.5	22.4	24.0
1	5/28/2025	14:00	*4.03*	130.0	0.46	n/a	2.96	0.94	n/m	*63*	60.9	53.68	51.22	22.4	22.3	22.5	24.4
1	5/28/2025	14:30	*4.03*	129.9	0.47	n/a	2.99	0.94	n/m	*63*	60.87	54.30	51.23	22.4	22.3	22.4	23.7
1	5/28/2025	15:00	*4.03*	130.1	0.49	n/a	2.99	0.98	n/m	*63*	60.41	53.4	50.85	22.3	22.3	22.3	22.6

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
1	5/28/2025	15:30	4.03	130	0.52	n/a	2.99	0.97	n/m	63	60.62	53.8	50.79	22.4	22.3	22.3	22.5
1	5/28/2025	16:00	4.03	130	0.56	n/a	2.98	0.98	n/m	65	60.77	53.74	50.92	22.5	22.3	22.4	22.4
1	5/28/2025	16:30	4.03	130.1	0.59	n/a	2.98	0.96	n/m	65	60.83	53.66	51.06	21.4	22.2	22.3	22.9
1	5/28/2025	17:00	4.03	130	0.61	n/a	2.95	0.96	n/m	65	60.46	53.57	50.93	21.6	22.3	22.6	23.2
1	5/28/2025	17:30	4.03	130.1	0.65	n/a	2.97	0.95	n/m	65	60.7	53.65	50.77	21.6	22.4	22.6	23.8
1	5/28/2025	18:00	4.03	130	0.68	n/a	2.94	0.98	n/m	64	60.68	53.51	50.79	21.4	22.5	22.4	24.2
1	5/28/2025	18:30	4.03	130.1	0.71	n/a	2.99	0.96	n/m	64	60.68	53.54	50.8	21.5	22.3	22.5	24.0
1	5/28/2025	19:00	4.03	129.9	0.74	n/a	2.98	0.98	n/m	64	60.46	53.65	50.72	21.4	22.4	22.5	24
1	5/28/2025	19:30	4.03	130.1	0.77	n/a	3.01	0.98	n/m	64	60.3	53.35	50.72	21.4	22.4	22.5	23.1
1	5/28/2025	20:00	4.03	130.0	0.98	n/a	3.02	0.99	n/m	64	60.48	53.45	50.73	21.3	22.5	22.5	22.9
1	5/28/2025	20:30	4.03	130.0	0.99	n/a	2.99	0.92	n/m	63	60.47	53.42	50.78	21.6	22	22.3	22.8
1	5/28/2025	21:00	4.03	130.0	1.01	n/a	3.05	0.97	n/m	63	60.52	53.28	50.65	21.4	22.0	22.3	22.3
1	5/28/2025	21:30	4.03	130.2	1.02	n/a	3.01	0.99	n/m	64	60.39	53.1	50.63	21.6	22.4	22.3	22.1
1	5/28/2025	22:00	4.03	130.0	1.04	n/a	2.99	0.96	n/m	64	60.47	53.17	50.57	21.3	22.3	22.5	22.6
1	5/28/2025	22:30	4.03	129.9	1.06	n/a	2.97	0.99	n/m	63	60.56	53.2	50.5	21.3	22.5	22.4	23.8
1	5/28/2025	23:00	4.03	130.0	1.09	n/a	3.04	0.98	n/m	63	60.4	53.29	50.37	21.5	22.1	22.3	23.1
1	5/28/2025	23:30	4.03	130.1	1.11	n/a	3.02	0.98	n/m	63	60.52	53.33	50.17	21.4	22.0	22.3	21.9
1	5/29/2025	0:00	4.03	130.0	1.15	n/a	3.02	0.98	n/m	64	60.43	53.14	50.31	21.4	22.3	22.3	23.2
1	5/29/2025	0:30	4.03	130.1	1.17	n/a	3.03	1.02	n/m	63	60.55	53.15	50.23	21.4	22.2	22.2	23.4
1	5/29/2025	1:00	4.03	130.1	1.18	n/a	3.02	1	n/m	63	60.54	53.1	50.08	21.5	22.3	22.3	21.6
1	5/29/2025	1:30	4.03	130.0	1.25	n/a	3.03	1.03	n/m	63	60.02	52.92	50.46	21.4	22.1	22.3	23.9
1	5/29/2025	2:00	4.03	130.1	1.28	n/a	3.02	1.02	n/m	63	60.64	53.09	50.02	21.5	22.2	22.1	22.5
1	5/29/2025	2:30	4.03	130.0	1.33	n/a	3.01	1.00	n/m	63	60.31	53.85	49.89	21.5	22.3	22.1	23.8
1	5/29/2025	3:00	4.02	130.0	1.37	n/a	3.06	1.02	n/m	63	60.55	53.03	50.11	21.2	22.0	22.1	22.5
1	5/29/2025	3:30	4.03	130.1	1.39	n/a	3.05	1.01	n/m	63	60.25	52.82	50.24	21.4	22.0	22.1	23.1
1	5/29/2025	4:00	4.03	129.9	1.46	n/a	3.06	1	n/m	63	60.69	52.56	50.01	21.4	22.0	22.2	21.6
1	5/29/2025	4:30	4.03	130.0	1.49	n/a	3.06	1.01	n/m	63	60.44	52.81	50.02	21.6	22.0	22	23.2
1	5/29/2025	5:00	4.03	130.0	1.50	n/a	2.97	0.98	n/m	63	60.38	52.87	50.12	21.6	22.2	22.4	23.5
1	5/29/2025	5:30	4.03	130.1	1.55	n/a	3.04	1.02	n/m	63	60.22	52.9	50.11	21.3	22.0	22.5	23.7
1	5/29/2025	6:00	4.03	130.1	1.61	n/a	3.07	0.95	n/m	63	60.43	52.69	49.95	21.3	22	22.5	23.5
1	5/29/2025	6:30	4.03	130.0	1.65	n/a	3.06	1.01	n/m	63	60.01	52.47	49.68	21.4	22.1	22.6	23.8
1	5/29/2025	7:00	4.03	130.1	1.69	n/a	3.01	0.96	n/m	63	60.33	52.46	49.79	21.4	22.6	22.7	24.1

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
1	5/29/2025	7:30	*4.03*	130.1	1.72	n/a	2.99	1.03	n/m	*63*	60.01	52.32	49.7	21.3	22.2	23	22.1
1	5/29/2025	8:00	*4.03*	129.9	2.69	n/a	3.03	1.01	n/m	*63*	60.55	51.82	48.81	21.6	22.2	22.6	23.9
2	5/29/2025	8:30	*4.03*	130.3	n/a	0.38	2.91	0.95	n/m	*63*	60.27	55.4	52.87	21.4	22.2	22.3	23.2
2	5/29/2025	9:00	*4.03*	130.1	n/a	0.44	3.02	0.99	n/m	*62*	60.4	55.42	52.6	21.5	21.6	22.5	23.6
2	5/29/2025	9:30	*4.02*	130.1	n/a	0.42	2.99	0.99	n/m	*62*	60.14	55.02	52.4	21.9	22	22.3	22.2
2	5/29/2025	10:00	*4.03*	130.1	n/a	0.41	3.09	0.99	n/m	*62*	60.01	55.12	52.55	22.2	22.2	22.4	22.4
2	5/29/2025	10:30	*4.03*	130.2	n/a	0.48	3.02	1	n/m	*62*	61.36	55.17	51.99	22.5	22.1	22.5	24.3
2	5/29/2025	11:00	*4.03*	130.0	n/a	0.51	3.04	1.01	n/m	*62*	59.9	54.72	52.49	22.3	22.1	22.6	24.1
2	5/29/2025	11:30	*4.03*	130.0	n/a	0.49	2.99	1.01	n/m	*62*	60.53	54.60	52.11	22.2	21.6	22.4	22.7
2	5/29/2025	12:00	*4.03*	130.0	n/a	0.49	3.05	0.98	n/m	*62*	60.09	55.1	52.01	22.4	22.0	22.1	22.1
2	5/29/2025	12:30	*4.03*	129.9	n/a	0.54	2.99	1.01	n/m	*62*	60.37	55.21	52.11	22.3	22.1	22.3	22.9
2	5/29/2025	13:00	*4.03*	130	n/a	0.55	3.05	0.96	n/m	*62*	60.24	54.88	52.38	22.5	22.0	22.4	23.6
2	5/29/2025	13:30	*4.03*	130.1	n/a	0.60	3.04	1.04	n/m	*62*	59.97	55.01	52.37	22.4	22.0	22.6	24.0
2	5/29/2025	14:00	*4.02*	131	n/a	0.57	2.99	1.00	n/m	*62*	59.8	55.17	52.03	23.2	23.2	22.4	23.4
2	5/29/2025	14:30	*4.03*	131	n/a	0.64	3.04	1.00	n/m	*62*	60.17	54.51	52.41	22.1	21.1	22.0	22.4
2	5/29/2025	15:00	*4.03*	131.0	n/a	0.69	3.02	0.98	n/m	*62*	60.14	54.70	51.90	22.4	22.1	22.2	22.1
2	5/29/2025	15:30	*4.03*	131	n/a	0.69	3.06	0.95	n/m	*62*	60.41	54.8	51.79	21.3	22.1	22.2	22.5
2	5/29/2025	16:00	*4.03*	130	n/a	0.71	3.01	0.99	n/m	*63*	60.33	54.55	52.08	21.7	22.4	22.4	22.8
2	5/29/2025	16:30	*4.03*	130	n/a	0.77	2.98	0.99	n/m	*62*	60.36	54.68	51.87	21.6	22.5	22.4	23.7
2	5/29/2025	17:00	*4.03*	130.1	n/a	0.78	2.98	0.98	n/m	*63*	60.36	54.89	52.13	21.6	22.2	22.3	24.1
2	5/29/2025	17:30	*4.02*	129.9	n/a	0.82	3.01	0.99	n/m	*63*	60.19	54.44	51.70	21.6	22.2	22.3	23.4
2	5/29/2025	18:00	*4.03*	130	n/a	0.84	3.03	1.01	n/m	*63*	60.26	54.59	51.57	21.3	22.3	22.3	22.9
2	5/29/2025	18:30	*4.03*	130	n/a	0.89	3.03	1.02	n/m	*64*	60.01	54.4	51.51	21.5	21.9	22.2	22.5
2	5/29/2025	19:00	*4.03*	130	n/a	0.92	3.03	0.99	n/m	*64*	60.08	54.29	51.54	21.4	22.1	22.3	22.5
2	5/29/2025	19:30	*4.03*	129.9	n/a	0.94	3.03	0.97	n/m	*64*	60.19	54.58	51.66	21.6	22	22.3	22.1
2	5/29/2025	20:00	*4.03*	130.1	n/a	1.19	2.98	1.02	n/m	*64*	60.06	53.82	51.57	21.4	21.9	22.3	22.3
2	5/29/2025	20:30	*4.03*	130.1	n/a	1.21	3.04	1	n/m	*64*	60.25	54.03	51.58	21.4	22.1	22.3	23.6
2	5/29/2025	21:00	*4.03*	130	n/a	1.23	3.05	1.02	n/m	*63*	60.23	54.18	51.07	21.4	22	22.2	23
2	5/29/2025	21:30	*4.03*	130.1	n/a	1.27	3.03	0.98	n/m	*63*	59.85	53.88	51.05	21.5	22.2	22.3	23.6
2	5/29/2025	22:00	*4.03*	130	n/a	1.27	3.04	1.03	n/m	*64*	59.9	53.96	51.14	21.4	21.9	22.2	22.5
2	5/29/2025	22:30	*4.03*	130	n/a	1.3	2.99	1.02	n/m	*63*	60.21	53.66	51.18	21.4	22	22.1	23.4
2	5/29/2025	23:00	*4.03*	130	n/a	1.31	3.02	0.97	n/m	*63*	60.24	54.1	51.14	21.4	22.5	22.3	23.1

			[FM-01]	FM-02	DP-01	DP-02	DP-03	DP-04	DP-05	*[P-01]*	P-02	P-03	P-05	T-01	T-02	T-03	T-AMB
Filter Period	Date	Time	*(gpm)*	(mL min^{-1})	(psid)	(psid)	(psid)	(psid)	(psid)	*(psig)*	(psig)	(psig)	(psig)	(°C)	(°C)	(°C)	(°C)
2	5/29/2025	23:30	*4.03*	130	n/a	1.34	3.02	0.98	n/m	*63*	60.06	53.95	51.27	21.5	22	22.3	23
2	5/30/2025	0:00	*4.03*	130.1	n/a	1.38	3.03	1.01	n/m	*63*	60.11	53.86	51.1	21.3	22.4	22.4	22.6
2	5/30/2025	0:30	*4.03*	130	n/a	1.4	3.02	1.02	n/m	*63*	60.14	53.58	51.11	21.3	22	22.3	22.8
2	5/30/2025	1:00	*4.02*	130.1	n/a	1.46	3.05	1.03	n/m	*63*	60.26	53.35	50.81	21.4	22.6	22.2	22.4
2	5/30/2025	1:30	*4.02*	130	n/a	1.47	3.06	0.97	n/m	*64*	60.19	53.74	51	21.3	22.1	22	22.2
2	5/30/2025	2:00	*4.02*	130.1	n/a	1.48	3	0.97	n/m	*63*	60.07	54	50.89	21.4	22.4	22	21.8
2	5/30/2025	2:30	*4.03*	130.1	n/a	1.55	3.11	1	n/m	*63*	60.36	53.67	50.76	21.4	21.6	22	21.6
2	5/30/2025	3:00	*4.03*	130.2	n/a	1.6	3.04	1.03	n/m	*63*	59.97	53.73	50.99	21.2	21.9	21.5	21.6
2	5/30/2025	3:30	*4.03*	130	n/a	1.64	3.01	1.04	n/m	*63*	60.14	53.72	50.9	21.1	21.6	21.5	21.2
2	5/30/2025	4:00	*4.03*	130	n/a	1.69	3.12	1.02	n/m	*63*	60.05	53.62	50.91	21.2	21.9	21.4	22.3
2	5/30/2025	4:30	*4.02*	129.9	n/a	1.71	3.05	1.06	n/m	*62*	60.1	53.37	50.66	21.2	22	22	22.6
2	5/30/2025	5:00	*4.03*	129.9	n/a	1.74	3.03	1.03	n/m	*64*	59.8	53.18	50.9	21.2	22	21.6	21.5
2	5/30/2025	5:30	*4.03*	130	n/a	1.78	2.99	1	n/m	*64*	60.27	53.53	50.86	21.2	21.9	21.7	21.4
2	5/30/2025	6:00	*4.03*	130	n/a	1.85	3.09	0.99	n/m	*63*	60.16	53.21	50.59	21.1	21.9	21.6	23.1
2	5/30/2025	6:30	*4.02*	130.1	n/a	1.9	3.11	1.03	n/m	*63*	59.91	53.22	50.52	21.1	22.1	22.1	22
2	5/30/2025	7:00	*4.03*	130.1	n/a	1.93	3.10	0.99	n/m	*62*	59.75	53.14	50.48	21.1	21.8	22	21.5
2	5/30/2025	7:30	*4.03*	130.1	n/a	1.97	3.10	1.02	n/m	*63*	59.87	53.42	50.27	21.2	22.4	21.7	21.5
2	5/30/2025	7:56	*4.02*	129.9	n/a	2.83	3.04	0.99	n/m	*63*	59.72	52.22	49.77	21.4	22	21.6	21.6
3	5/30/2025	8:08	*4.03*	129.9	0.37	n/a	3.06	1.06	n/m	*62*	59.88	53.67	50.87	21.2	21.5	21.9	21.7
3	5/30/2025	8:30	*4.04*	90.8	0.34	n/a	2.03	0.54	n/m	*62*	62.16	57.23	56.53	21.3	21.5	21.3	21.9
3	5/30/2025	9:00	*4.03*	90.9	0.35	n/a	1.96	0.51	n/m	*62*	62.19	57.07	56.48	21.3	22.3	22	22.4
3	5/30/2025	9:30	*4.04*	91.1	0.37	n/a	2.01	0.58	n/m	*62*	61.79	57.23	56.38	21.3	21.6	22	22.9
3	5/30/2025	10:00	*4.03*	91.1	0.37	n/a	2.03	0.57	n/m	*62*	62.16	56.63	56.58	21.2	22.1	22	23.4
3	5/30/2025	10:30	*4.03*	91	0.39	n/a	1.96	0.58	n/m	*62*	62.11	56.87	56.36	21.4	22	22.4	23.9
3	5/30/2025	11:00	*4.04*	90.9	0.40	n/a	2.05	0.55	n/m	*62*	62.19	56.84	56.63	21.2	22	22.6	22.3
3	5/30/2025	11:30	*4.03*	91.1	0.43	n/a	1.95	0.54	n/m	*62*	61.86	57.13	55.94	21.1	22.1	22.6	24.2
3	5/30/2025	12:00	*4.04*	91	0.42	n/a	1.95	0.59	n/m	*62*	61.83	56.77	55.78	21.3	22.1	22.3	22.5
3	5/30/2025	12:30	*4.04*	91.1	0.42	n/a	1.98	0.57	n/m	*62*	61.36	57.08	56.04	21.6	21.7	22.6	22.7
3	5/30/2025	13:00	*4.04*	91.1	0.44	n/a	1.99	0.58	n/m	*62*	62.18	57.24	56.29	21.3	22.4	22.7	23.8
3	5/30/2025	13:30	*4.03*	91.1	0.43	n/a	2.01	0.55	n/m	*62*	62.27	57.39	56.61	21.4	21.8	22.4	24.1
3	5/30/2025	14:00	*4.04*	91.1	0.44	n/a	1.96	0.62	n/m	*62*	62.19	56.88	56.28	21.4	22.0	22.5	23.5
3	5/30/2025	14:30	*4.03*	91	0.47	n/a	1.91	0.58	n/m	*62*	61.55	57.26	56.39	21.4	22.2	22.2	23

			[FM-01]	FM-02	DP-01	DP-02	DP-03	DP-04	DP-05	*[P-01]*	P-02	P-03	P-05	T-01	T-02	T-03	T-AMB
Filter Period	Date	Time	*(gpm)*	(mL min^{-1})	(psid)	(psid)	(psid)	(psid)	(psid)	*(psig)*	(psig)	(psig)	(psig)	(°C)	(°C)	(°C)	(°C)
3	5/30/2025	15:00	*4.04*	91	0.45	n/a	2.06	0.64	n/m	*62*	61.39	56.62	56.1	21.2	22.1	22.3	22.1
3	5/30/2025	15:30	*4.03*	91.1	0.48	n/a	1.93	0.64	n/m	*62*	61.56	56.66	55.9	21.3	22.7	22.2	22
3	5/30/2025	16:00	*4.04*	90.9	0.47	n/a	2.04	0.57	n/m	*62*	62.17	56.92	56.15	21.4	22	22.5	22.4
3	5/30/2025	16:30	*4.04*	91	0.49	n/a	2.02	0.59	n/m	*62*	61.58	56.67	56.02	21.6	22.2	22.4	22.8
3	5/30/2025	17:00	*4.03*	91	0.52	n/a	2.02	0.58	n/m	*63*	62.19	57.12	56.02	21.3	22.6	22.4	23.5
3	5/30/2025	17:30	*4.03*	91.1	0.52	n/a	2.01	0.58	n/m	*63*	61.99	56.94	56.35	21.5	22.1	22.4	23.9
3	5/30/2025	18:00	*4.04*	91	0.51	n/a	2	0.58	n/m	*63*	62.15	56.64	56.21	21.4	22.2	22.4	24
3	5/30/2025	18:30	*4.04*	91.1	0.54	n/a	2.04	0.56	n/m	*63*	62.13	57.02	55.95	21.3	22.1	22.4	23.5
3	5/30/2025	19:00	*4.04*	91.1	0.55	n/a	2.04	0.58	n/m	*63*	62.1	56.92	56	21.4	22.3	22.3	23.1
3	5/30/2025	19:30	*4.04*	91.1	0.56	n/a	2	0.62	n/m	*63*	62.24	57.12	55.99	21.4	22.2	22.6	23.4
3	5/30/2025	20:00	*4.03*	91	0.67	n/a	2.01	0.59	n/m	*63*	61.97	56.72	56.27	21.3	22.1	22.4	23
3	5/30/2025	20:30	*4.04*	91	0.67	n/a	2.07	0.63	n/m	*63*	61.89	56.61	55.79	21.5	22.1	22.6	22.5
3	5/30/2025	21:00	*4.04*	91.1	0.65	n/a	1.99	0.64	n/m	*63*	62.22	56.78	55.69	21.4	22.1	22.3	21.6
3	5/30/2025	21:30	*4.03*	91	0.67	n/a	2.04	0.59	n/m	*63*	62.14	56.87	56.12	21.3	22	22.5	23
3	5/30/2025	22:00	*4.04*	91.1	0.71	n/a	2.08	0.57	n/m	*63*	62.18	56.74	56.03	21.4	22.2	22.4	23.4
3	5/30/2025	22:30	*4.03*	91.2	0.7	n/a	2.05	0.64	n/m	*63*	62.04	56.78	55.96	21.4	22.1	22.2	21.6
3	5/30/2025	23:00	*4.04*	91	0.7	n/a	2	0.6	n/m	*63*	61.81	56.92	55.6	21.4	22.1	22.4	23.3
3	5/30/2025	23:30	*4.04*	91	0.71	n/a	2.04	0.59	n/m	*63*	62.13	57.02	56.23	21.3	21.7	22.2	23.3
3	5/31/2025	0:00	*4.04*	91.1	0.73	n/a	2.06	0.57	n/m	*63*	62	56.72	56.03	21.3	22.2	22.5	23.5
3	5/31/2025	0:30	*4.03*	91	0.7	n/a	2.02	0.55	n/m	*62*	61.76	56.8	55.82	21.3	21.6	22.7	23.4
3	5/31/2025	1:00	*4.04*	90.9	0.72	n/a	1.92	0.54	n/m	*63*	62.04	57.07	55.93	21.4	22	22.6	23.4
3	5/31/2025	1:30	*4.04*	91.1	0.7	n/a	1.98	0.53	n/m	*63*	61.73	56.66	56.1	21.4	22.2	22.8	23.2
3	5/31/2025	2:00	*4.03*	90.9	0.68	n/a	1.96	0.6	n/m	*64*	62.19	56.94	55.95	21.3	22	22.6	22.9
3	5/31/2025	2:30	*4.04*	91.1	0.77	n/a	1.99	0.63	n/m	*63*	62.05	56.66	56.09	21.5	22.3	22.4	22.9
3	5/31/2025	3:00	*4.03*	91.1	0.77	n/a	2.03	0.57	n/m	*63*	61.93	56.8	55.59	21.5	22	22.4	22.9
3	5/31/2025	3:30	*4.03*	90.9	0.76	n/a	1.98	0.59	n/m	*62*	61.76	56.58	55.77	21.2	22	22.3	22.8
3	5/31/2025	4:00	*4.03*	91.1	0.8	n/a	1.99	0.58	n/m	*63*	62.18	56.41	55.49	21.3	22.1	22.3	22.8
3	5/31/2025	4:30	*4.04*	91	0.85	n/a	2	0.61	n/m	*62*	61.71	56.53	55.72	21.2	22	22.4	22.5
3	5/31/2025	5:00	*4.04*	91.1	0.81	n/a	1.94	0.59	n/m	*62*	61.84	56.68	55.96	21.2	22.1	22.2	22.1
3	5/31/2025	5:30	*4.03*	91.1	0.77	n/a	2	0.62	n/m	*63*	62.15	56.34	55.38	21.3	21.9	22.0	22.0
3	5/31/2025	6:00	*4.03*	90.9	0.82	n/a	2.1	0.63	n/m	*63*	61.47	56.29	55.33	21.3	22.0	21.9	21.7
3	5/31/2025	6:30	*4.04*	91	0.84	n/a	2.05	0.61	n/m	*62*	62.1	56.4	55.41	21.1	22.1	21.4	21.6

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
3	5/31/2025	7:00	*4.03*	91	0.87	n/a	2.12	0.65	n/m	*62*	61.89	56.33	55.65	21.2	21.8	21.4	22.3
3	5/31/2025	7:30	*4.03*	91	0.89	n/a	2.06	0.57	n/m	*63*	61.93	56.42	55.55	21.1	21.6	21.8	22.7
3	5/31/2025	8:00	*4.04*	90.8	1.33	n/a	2.06	0.58	n/m	*62*	61.66	55.99	55.24	21.3	22.2	22.3	23.2
4	5/31/2025	8:30	*4.03*	91.5	n/a	0.41	1.99	0.55	n/m	*62*	62.08	57.99	57.07	21.2	22.2	22.4	23.7
4	5/31/2025	9:00	*4.03*	91.1	n/a	0.41	1.95	0.51	n/m	*62*	62.74	58	57.11	21.2	22.3	22.9	23.9
4	5/31/2025	9:30	*4.04*	91.2	n/a	0.43	1.93	0.57	n/m	*62*	61.52	57.66	56.95	21.3	22	22.5	23.4
4	5/31/2025	10:00	*4.03*	91	n/a	0.45	2.01	0.63	n/m	*62*	61.70	57.66	56.77	21.2	22.4	22.3	23.0
4	5/31/2025	10:31	*4.03*	91.1	n/a	0.46	1.94	0.58	n/m	*62*	62.11	57.91	57.02	21.4	22.3	22.3	22.3
4	5/31/2025	11:00	*4.04*	91.1	n/a	0.48	1.99	0.52	n/m	*63*	62.2	57.84	57.01	21.5	22.2	22.5	22.3
4	5/31/2025	11:30	*4.03*	91.1	n/a	0.48	1.99	0.65	n/m	*62*	62.03	57.96	57.04	21.4	22.3	22.4	23.4
4	5/31/2025	12:00	*4.04*	91.1	n/a	0.47	1.95	0.52	n/m	*62*	61.97	57.7	57.17	21.4	22.5	22.4	24
4	5/31/2025	12:30	*4.03*	91	n/a	0.47	2.02	0.56	n/m	*62*	61.87	57.76	56.97	21.4	22.3	22.4	24.3
4	5/31/2025	13:00	*4.04*	91.0	n/a	0.50	2.05	0.57	n/m	*62*	62.08	57.9	57.18	21.4	22	22.3	23.9
4	5/31/2025	13:30	*4.03*	91.1	n/a	0.51	1.99	0.59	n/m	*62*	61.52	57.88	57.09	21.5	22.2	22.3	23.0
4	5/31/2025	14:00	*4.03*	91.1	n/a	0.52	1.99	0.58	n/m	*63*	62.19	57.33	56.55	21.4	22.2	22.5	22.4
4	5/31/2025	14:30	*4.04*	91.1	n/a	0.52	1.95	0.64	n/m	*62*	62.1	57.91	56.71	21.5	21.9	22.5	22.2
4	5/31/2025	15:00	*4.04*	91.1	n/a	0.53	1.91	0.56	n/m	*62*	62.14	57.76	57.28	21.3	21.8	22.6	22.8
4	5/31/2025	15:30	*4.03*	91.0	n/a	0.52	1.96	0.6	n/m	*62*	62.06	57.44	57.13	21.6	22	22.5	23.2
4	5/31/2025	16:00	*4.03*	91.0	n/a	0.55	2	0.57	n/m	*62*	62.42	57.6	56.82	21.3	22.2	22.6	23.9
4	5/31/2025	16:30	*4.03*	91.0	n/a	0.55	1.96	0.51	n/m	*63*	62.27	57.52	57.04	21.5	22.2	22.4	24
4	5/31/2025	17:00	*4.04*	91.0	n/a	0.55	2	0.52	n/m	*63*	62.01	57.91	57	21.6	22.3	22.5	24.3
4	5/31/2025	17:30	*4.03*	90.9	n/a	0.53	2.01	0.61	n/m	*64*	62.02	58.43	57.09	21.3	22.2	22.3	24.1
4	5/31/2025	18:00	*4.04*	91	n/a	0.57	2.01	0.63	n/m	*63*	62.09	57.88	56.74	21.6	22.3	22.3	23.7
4	5/31/2025	18:30	*4.03*	91	n/a	0.56	1.96	0.59	n/m	*64*	62.08	57.92	56.23	21.5	22	22.3	23.4
4	5/31/2025	19:00	*4.04*	91	n/a	0.6	1.98	0.55	n/m	*63*	62.26	57.79	56.4	21.4	22.1	22.4	22.9
4	5/31/2025	19:30	*4.03*	91	n/a	0.61	2.03	0.57	n/m	*64*	61.85	57.78	56.7	21.7	21.9	22.3	22.3
4	5/31/2025	20:00	*4.03*	91	n/a	0.73	2	0.65	n/m	*63*	61.78	57.26	56.79	22.2	22	22.4	23.4
4	5/31/2025	20:30	*4.04*	91	n/a	0.75	2.02	0.56	n/m	*63*	61.48	56.87	56.49	21.8	21.8	22.5	23.1
4	5/31/2025	21:00	*4.03*	91	n/a	0.75	2.03	0.6	n/m	*63*	61.7	57.46	56.83	22.2	22.1	22.3	23.3
4	5/31/2025	21:30	*4.03*	91	n/a	0.71	1.96	0.57	n/m	*63*	61.75	57.01	57.02	22.5	22.1	22.4	23.6
4	5/31/2025	22:00	*4.04*	91.2	n/a	0.72	1.98	0.51	n/m	*63*	62.19	57.24	56.7	22.3	22	22.6	23.3
4	5/31/2025	22:30	*4.04*	91	n/a	0.75	1.92	0.51	n/m	*63*	62.19	57.29	56.38	22.4	22.1	22.7	23.3

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
4	5/31/2025	23:00	*4.04*	91.1	n/a	0.76	1.98	0.59	n/m	*64*	61.45	57.85	56.5	22.2	22.2	22.7	23.1
4	5/31/2025	23:30	*4.04*	90.9	n/a	0.76	1.89	0.59	n/m	*63*	62.01	57.6	56.37	22	22	22.5	23
4	6/1/2025	0:00	*4.04*	91.1	n/a	0.76	2	0.57	n/m	*64*	61.68	57.57	56.35	22.1	21.6	22.2	22.6
4	6/1/2025	0:30	*4.04*	91.1	n/a	0.8	2.12	0.55	n/m	*62*	62.12	57.72	56.74	22.1	22	22.1	22.5
4	6/1/2025	1:00	*4.03*	90.9	n/a	0.81	2.04	0.59	n/m	*62*	62.02	57.42	56.28	21.4	21.6	22.1	22.5
4	6/1/2025	1:30	*4.04*	91	n/a	0.77	2.04	0.6	n/m	*62*	61.85	57.1	56.07	21.2	21.9	21.8	22.4
4	6/1/2025	2:00	*4.03*	91.1	n/a	0.85	2.08	0.54	n/m	*63*	61.77	57.52	56.18	21.3	22.1	21.5	21.9
4	6/1/2025	2:30	*4.04*	91.2	n/a	0.87	2.15	0.63	n/m	*62*	62.04	57	56.1	21.3	21.7	21.7	21.5
4	6/1/2025	3:00	*4.04*	91.1	n/a	0.86	2.04	0.7	n/m	*62*	62.11	57.11	55.93	21.2	22	21.7	21.4
4	6/1/2025	3:30	*4.04*	91	n/a	0.83	2.08	0.66	n/m	*63*	62.19	57.02	56.21	21.3	22.1	21.6	21.2
4	6/1/2025	4:00	*4.04*	90.9	n/a	0.88	2.05	0.59	n/m	*62*	62.2	56.75	56.26	21.2	22.2	21.7	22.7
4	6/1/2025	4:30	*4.04*	91	n/a	0.9	2.02	0.54	n/m	*62*	62.36	57.36	56.15	21.2	22.1	21.8	22.1
4	6/1/2025	5:00	*4.03*	91.2	n/a	0.91	2.1	0.69	n/m	*64*	62.02	57.34	56.29	21.3	21.8	21.7	21
4	6/1/2025	5:30	*4.04*	90.9	n/a	0.93	2.08	0.58	n/m	*63*	61.82	57.09	56.48	21.2	21.7	21.3	21.2
4	6/1/2025	6:00	*4.03*	91.1	n/a	0.95	2.09	0.6	n/m	*63*	61.69	57.18	56.51	21.1	21.3	21.7	22.6
4	6/1/2025	6:30	*4.04*	90.9	n/a	0.94	2.12	0.66	n/m	*63*	61.85	57.44	55.99	21.1	21.8	21.7	21.6
4	6/1/2025	7:00	*4.04*	90.9	n/a	0.98	2.05	0.65	n/m	*64*	61.65	57.13	56.01	21.1	21.6	21.7	21.1
4	6/1/2025	7:30	*4.04*	91	n/a	0.98	2.05	0.63	n/m	*62*	61.94	57.17	55.89	21.1	21.9	21.4	21.5
4	6/1/2025	8:00	*4.04*	91	n/a	1.34	2.07	0.62	n/m	*62*	62.12	57.13	55.67	21.1	21.8	21.3	21.2
5	6/1/2025	10:10	*4.01*	194.6	0.64	n/a	4.97	1.97	n/m	*62*	55.97	46.58	39.92	21.4	21.6	22.1	23
5	6/1/2025	10:40	*4.01*	194.7	0.83	n/a	5.16	1.99	n/m	*62*	55.68	46.21	39.42	21.4	22.1	22.1	23.4
5	6/1/2025	11:10	*4.01*	195.5	1.01	n/a	5.03	2.01	n/m	*62*	55.79	45.96	39.76	21.4	21.9	22.2	23.9
5	6/1/2025	11:40	*4*	194.6	1.18	n/a	5.08	1.98	n/m	*62*	55.88	45.8	39.43	21.3	21.6	22	22.5
5	6/1/2025	12:10	*4.01*	194.8	1.41	n/a	5.07	2	n/m	*63*	56.07	45.57	39.05	21.5	21.8	22.3	24
5	6/1/2025	12:40	*4*	195	1.72	n/a	5.11	2.01	n/m	*62*	56.25	45.56	38.96	21.4	22.1	22.1	23.3
5	6/1/2025	13:10	*4.01*	195.2	2.03	n/a	5.11	2.01	n/m	*62*	56.13	45.04	38.31	21.2	21.6	22.3	22.1
5	6/1/2025	13:40	*4.01*	195.1	2.39	n/a	5.07	1.94	n/m	*62*	56.28	44.58	38.35	21	22.2	22.3	23.9
5	6/1/2025	13:52	*4.01*	195	2.63	n/a	5.11	1.97	n/m	*62*	56.16	44.58	37.94	21.2	22	22.4	22.4
6	6/1/2025	14:06	*4.01*	194.7	n/a	0.61	4.96	1.97	n/m	*61*	56.64	48.98	42.34	21.3	22.1	22.1	23.5
6	6/1/2025	14:36	*4.01*	195.2	n/a	0.86	5.11	2.03	n/m	*62*	56.17	48.13	41.46	21.4	21.9	22.1	22.2
6	6/1/2025	15:06	*4.01*	195.3	n/a	1.01	5.04	2.01	n/m	*62*	56.32	48.21	41.61	21.4	21.6	22.1	22
6	6/1/2025	15:36	*4.01*	195.2	n/a	1.23	5.09	2	n/m	*62*	56.51	48.22	41.59	21.3	22.1	22.1	23

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
6	6/1/2025	16:06	*4.01*	195	n/a	1.47	5.03	2.04	n/m	*63*	56.02	47.49	41.56	21.3	22.1	22.1	24
6	6/1/2025	16:36	*4.01*	194.6	n/a	1.71	5.11	2.03	n/m	*63*	56.45	47.47	40.91	21.4	22	22.1	23.3
6	6/1/2025	17:06	*4.01*	195	n/a	2.09	5.07	2.02	n/m	*63*	55.97	47.06	40.39	21.3	21.9	22.1	22.7
6	6/1/2025	17:36	*4.01*	195.3	n/a	2.45	5.12	2.08	n/m	*63*	56.19	46.46	40.09	21.4	22	22.1	22.5
7	6/1/2025	18:07	*4.01*	196.1	0.7	n/a	4.91	1.98	n/m	*63*	56.4	46.59	40.44	21.3	22	22	22.5
7	6/1/2025	18:37	*4.01*	195	0.89	n/a	5.08	2.07	n/m	*64*	56.37	46.34	39.96	21.4	21.9	22.1	22.3
7	6/1/2025	19:07	*4*	195	1.04	n/a	5.11	2.09	n/m	*63*	55.96	46	39.45	21.2	22.3	22.1	22.3
7	6/1/2025	19:37	*4.01*	194.7	1.24	n/a	5.09	2.01	n/m	*64*	56.93	46.03	39.41	21.6	22.1	22	23
7	6/1/2025	20:07	*4.01*	195	1.48	n/a	5.09	2.08	n/m	*63*	55.86	45.65	39.16	22	22.1	22.1	23.6
7	6/1/2025	20:37	*4.01*	195.3	1.79	n/a	5.1	1.97	n/m	*63*	56.75	45.57	38.76	21.9	22.1	22	23.1
7	6/1/2025	21:07	*4.01*	195.1	2.04	n/a	5.06	1.99	n/m	*63*	55.52	44.83	38.41	22.1	21.6	21.9	21.9
7	6/1/2025	21:37	*4.01*	195.2	2.49	n/a	5.11	2.01	n/m	*63*	56.93	44.39	38.11	21.9	21.6	21.9	22.9
8	6/1/2025	22:09	*4.01*	194.6	n/a	0.76	4.95	2.02	n/m	*63*	56.35	48.34	42.16	22.2	22.1	22.1	23.3
8	6/1/2025	22:39	*4.01*	195.1	n/a	0.98	5.02	2.02	n/m	*63*	56.26	48.44	41.61	22.3	22.2	22.1	23.2
8	6/1/2025	23:09	*4.01*	195.3	n/a	1.15	5.05	2.02	n/m	*63*	55.82	47.77	41.38	22.3	22.1	22.4	23.1
8	6/1/2025	23:39	*4.01*	195.3	n/a	1.4	5.09	2.01	n/m	*63*	56.47	47.9	41.14	22.2	22.1	22.1	23
8	6/2/2025	0:00	*4.01*	195	n/a	1.55	5.1	2.04	n/m	*63*	55.74	47.76	41.14	22.1	22.9	22.1	23
8	6/2/2025	0:30	*4.01*	194.9	n/a	1.83	5.04	2.03	n/m	*62*	55.93	47.6	40.64	22	21.9	22.1	22.8
8	6/2/2025	1:00	*4.01*	194.7	n/a	2.15	5.07	2.08	n/m	*63*	56.09	47.08	40.37	21.3	21.9	21.9	22.6
8	6/2/2025	1:30	*4.01*	195.1	n/a	2.56	5.16	2.06	n/m	*64*	56.06	46.52	39.9	21.3	21.6	22	22.5
8	6/2/2025	1:40	*4.01*	195.1	n/a	2.7	5.11	1.94	n/m	*63*	55.98	46.64	39.79	21	21.5	22	21.9
n/a	6/2/2025	2:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	20.6	20.3	20.9	19.3
n/a	6/2/2025	3:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	18.2	17.6	17.9	18.2
n/a	6/2/2025	4:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	17	22.7	21.4	23.6
n/a	6/2/2025	5:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.7	22.9	22	22.3
n/a	6/2/2025	6:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.8	22.6	21.3	21.4
n/a	6/2/2025	7:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.2	22.7	21.8	22.9
n/a	6/2/2025	8:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.3	23.5	22.3	22.2
n/a	6/2/2025	9:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.2	23.4	22.5	22.5
n/a	6/2/2025	10:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.2	23.9	22.8	23.2
n/a	6/2/2025	11:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.3	24.1	23.7	24.1
n/a	6/2/2025	12:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.3	24.2	23	22.9

			[FM-01]	FM-02	DP-01	DP-02	DP-03	DP-04	DP-05	*[P-01]*	P-02	P-03	P-05	T-01	T-02	T-03	T-AMB
Filter Period	Date	Time	*(gpm)*	(mL min^{-1})	(psid)	(psid)	(psid)	(psid)	(psid)	*(psig)*	(psig)	(psig)	(psig)	(°C)	(°C)	(°C)	(°C)
n/a	6/2/2025	13:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.1	23.4	22.4	22.8
n/a	6/2/2025	14:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.4	23.6	23.1	24.3
n/a	6/2/2025	15:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.2	23.6	22.2	22.7
n/a	6/2/2025	16:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.6	24.3	22.7	23
n/a	6/2/2025	17:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.4	24.1	22.8	23.8
n/a	6/2/2025	18:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.1	23.6	22.5	23.1
n/a	6/2/2025	19:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.3	23.7	22.3	22.3
n/a	6/2/2025	20:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.1	24	22.9	24
n/a	6/2/2025	21:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.3	23.6	22.5	22.2
n/a	6/2/2025	22:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.4	23.7	22.6	23.5
n/a	6/2/2025	23:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.2	24	23	23.6
n/a	6/3/2025	0:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.4	24.1	23.1	23.7
n/a	6/3/2025	1:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.3	24	23.3	23.5
n/a	6/3/2025	2:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.4	23.9	23.1	23.5
n/a	6/3/2025	3:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.5	24.1	23.3	23.7
n/a	6/3/2025	4:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.2	24.1	23.3	22.9
n/a	6/3/2025	5:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.3	23.5	22.4	22.3
n/a	6/3/2025	6:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.2	22.8	22.1	22.2
n/a	6/3/2025	7:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16	22.9	22.1	22.2
9	6/3/2025	7:30	*4.03*	130.1	0.51	n/a	3.08	1.04	n/m	*61*	56.18	49.63	46.89	16.2	17.1	22.2	21.9
9	6/3/2025	8:00	*4.03*	130.7	0.6	n/a	3.25	1.09	n/m	*60*	56.35	49.48	46.52	16.1	17.1	19.8	22.3
9	6/3/2025	8:30	*4.03*	129.8	0.66	n/a	3.21	1.06	n/m	*60*	56.35	49.49	46.44	16	17.4	19.7	22.7
9	6/3/2025	9:00	*4.03*	129.6	0.73	n/a	3.22	1.05	n/m	*60*	56.48	49.44	46.46	16.1	17.3	20	23.3
9	6/3/2025	9:30	*4.03*	129.9	0.8	n/a	3.2	1.05	n/m	*60*	56.41	49.4	46.45	16.2	17.4	19.9	23.8
9	6/3/2025	10:00	*4.03*	131	0.88	n/a	3.22	1.04	n/m	*60*	56.41	49.24	46.35	16.3	17.5	20.1	23.9
9	6/3/2025	10:30	*4.03*	130.2	0.95	n/a	3.24	1.09	n/m	*60*	56.35	49.15	46.16	16.3	17.2	19.9	22.3
9	6/3/2025	11:00	*4.03*	130.3	1.04	n/a	3.23	1.08	n/m	*60*	56.36	49.12	46.11	16.4	17	19.7	24
9	6/3/2025	11:30	*4.03*	130.5	1.12	n/a	3.24	1.1	n/m	*60*	56.33	49.06	46.04	16.2	17.3	19.9	23.5
9	6/3/2025	12:00	*4.03*	129.7	1.2	n/a	3.2	1.06	n/m	*60*	56.37	48.99	45.96	16.2	17	20	21.9
9	6/3/2025	12:30	*4.03*	130.1	1.33	n/a	3.3	1.05	n/m	*61*	60.3	53.35	50.03	16.1	17.3	20.1	23
9	6/3/2025	13:00	*4.03*	129.7	1.44	n/a	3.22	0.99	n/m	*61*	60.61	52.96	49.84	16.1	17.3	20	24.1
9	6/3/2025	13:30	*4.03*	130.4	1.53	n/a	3.16	1.09	n/m	*61*	60.73	52.46	49.67	16.3	17.2	19.9	23.3

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
9	6/3/2025	14:00	*4.03*	130.6	1.74	n/a	3.25	1.08	n/m	*62*	60.47	52.25	49.53	16.3	17.5	19.7	22.2
9	6/3/2025	14:30	*4.03*	130.7	1.89	n/a	3.23	1.12	n/m	*62*	60.22	51.98	49.3	16.4	17.1	20.1	22.1
9	6/3/2025	15:00	*4.03*	129.8	2.02	n/a	3.28	1.11	n/m	*62*	60.63	52.52	49.1	16.4	17.4	20.1	22.6
9	6/3/2025	15:30	*4.01*	130	2.29	n/a	3.16	1.06	n/m	*63*	60.8	52.9	49.08	16.3	17.4	20.1	23.8
9	6/3/2025	16:00	*4.03*	130.8	2.39	n/a	3.29	1.08	n/m	*63*	60.71	51.88	48.75	16.2	17.4	20	24.1
10	6/3/2025	16:30	*4.03*	130	n/a	0.52	3.11	1.02	n/m	*63*	60.62	55.36	52.56	16.4	17.2	20.1	23.3
10	6/3/2025	17:00	*4.03*	130	n/a	0.6	3.19	1.04	n/m	*63*	60.5	54.59	52.02	16.1	17.3	20	22.7
10	6/3/2025	17:30	*4.03*	130.1	n/a	0.69	3.23	1.07	n/m	*63*	60.42	54.95	51.52	16.3	17.1	19.8	22.4
10	6/3/2025	18:00	*4.02*	130.3	n/a	0.75	3.28	1.09	n/m	*63*	60.63	54.87	52.02	16.2	17.4	20	21.9
10	6/3/2025	18:30	*4.03*	129.8	n/a	0.81	3.18	1.08	n/m	*63*	60.42	55	51.56	16.2	17.4	19.9	22.2
10	6/3/2025	19:00	*4.03*	130	n/a	0.9	3.23	1.09	n/m	*63*	60.75	54.39	51.72	16.3	17.4	19.8	22.3
10	6/3/2025	19:30	*4.03*	130.6	n/a	1.18	3.11	1.02	n/m	*63*	60.69	54.28	51.25	16.2	17.5	20	22.6
10	6/3/2025	20:00	*4.03*	130	n/a	1.15	3.29	1.02	n/m	*63*	60.39	54.04	51.06	16.1	17.5	20	22.5
10	6/3/2025	20:30	*4.02*	129.4	n/a	1.25	3.22	1.06	n/m	*64*	60.06	54.38	51.35	15.9	17.4	19.8	23.6
10	6/3/2025	21:00	*4.02*	130.1	n/a	1.35	3.29	1.05	n/m	*63*	60.06	54.3	51.01	16.3	17.1	19.6	22.7
10	6/3/2025	21:30	*4.03*	130.1	n/a	1.53	3.23	1.06	n/m	*63*	60.07	54.14	50.56	16.3	17.4	19.7	21.8
10	6/3/2025	22:00	*4.03*	129.3	n/a	1.56	3.2	1.1	n/m	*63*	60.03	54.02	50.52	16.3	17.3	19.5	23.4
10	6/3/2025	22:30	*4.03*	130.6	n/a	1.84	3.22	1.07	n/m	*63*	60.23	53.34	50.16	16.3	17	19.9	22.6
10	6/3/2025	23:00	*4.03*	130	n/a	2.05	3.23	1.12	n/m	*63*	60.34	53.32	50.42	16.2	17.4	19.6	23.3
10	6/3/2025	23:30	*4.03*	130.3	n/a	2.09	3.25	1.05	n/m	*63*	60.51	53.54	50.52	16.3	17	19.7	23.5
10	6/4/2025	0:00	*4.03*	129.9	n/a	2.49	3.3	1.09	n/m	*63*	60.6	53.17	49.99	16	17.3	19.8	23.6

Table C.8. Initial Differential Pressure Data for DEFs from Run W-03

Filter Period	Date	Active Filter ID	Start Time	ΔP at t = 2 min (psid)	ΔP at t = 4 min (psid)	ΔP at t = 6 min (psid)	ΔP at t = 8 min (psid)	ΔP at t = 10 min (psid)	Target ΔP for Filter Switch (psid)
1	5/28/2025	1	7:53	0.22	0.24	0.25	0.24	0.25	2.25
2	5/29/2025	2	8:02	0.28	0.33	0.37	0.39	0.39	2.39
3	5/30/2025	1	7:58	0.22	0.27	0.32	0.33	0.36	2.36
4	5/31/2025	2	8:02	0.26	0.28	0.31	0.34	0.37	2.37
5	6/1/2025	1	9:53	0.36	0.49	0.53	0.57	0.60	2.60
6	6/1/2025	2	13:55	0.45	0.52	0.54	0.56	0.59	2.59
7	6/1/2025	1	17:52	0.40	0.44	0.53	0.58	0.60	2.60
8	6/1/2025	2	21:54	0.50	0.56	0.58	0.61	0.64	2.64
9	6/3/2025	1	7:01	0.21	0.25	0.30	0.33	0.35	2.35
10	6/3/2025	2	16:02	0.30	0.35	0.39	0.38	0.39	2.39

C.4 W-04 Tabulated Data

Table C.9. Periodically Recorded Data from Run W-04

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
1	8/7/2025	8:04	*4.01*	130.0	0.90	n/a	3.28	1.41	1.97	*63*	60.73	51.47	48.07	22.3	23.0	22.2	23.2
1	8/7/2025	8:34	*4.00*	129.6	0.93	n/a	3.95	1.46	2.53	*63*	60.67	51.12	46.82	22.2	22.8	22.4	24.0
1	8/7/2025	9:00	*4.01*	129.9	0.92	n/a	3.82	1.44	2.45	*63*	60.63	51.26	47.19	22.2	22.7	23	24.2
1	8/7/2025	9:30	*4.01*	129.9	0.89	n/a	3.66	1.42	2.33	*63*	60.63	51.49	47.60	21.8	22.6	23.0	22.3
1	8/7/2025	10:00	*4*	130.0	0.89	n/a	3.61	1.42	2.30	*63*	60.59	51.47	47.66	22.1	22.4	22.8	22.4
1	8/7/2025	10:30	*4.01*	130.1	0.91	n/a	3.6	1.43	2.28	*63*	60.49	51.32	47.53	21.8	22.4	22.7	24
1	8/7/2025	11:00	*4*	130.1	0.91	n/a	3.61	1.45	2.28	*63*	60.51	51.27	47.43	21.8	22.2	22.9	24.0
1	8/7/2025	11:30	*4.01*	130.0	0.90	n/a	3.59	1.46	2.26	*63*	60.55	51.33	47.52	21.7	22.3	22.6	23.4
1	8/7/2025	12:00	*4*	130.0	0.90	n/a	3.61	1.46	2.27	*63*	60.30	51.16	47.37	21.7	22	22.3	22.9
1	8/7/2025	12:30	*4*	130.0	0.90	n/a	3.63	1.47	2.29	*63*	60.32	51.09	47.24	21.9	22.3	22.4	22.3
1	8/7/2025	13:00	*4.01*	129.9	0.90	n/a	3.62	1.46	2.29	*63*	60.53	51.14	47.29	21.6	22.2	22.6	22.6
1	8/7/2025	13:30	*4.01*	130.1	0.90	n/a	3.62	1.46	2.30	*63*	60.41	51.09	47.23	21.5	22.2	22.5	23.2

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
1	8/7/2025	14:00	*4*	130.1	0.91	n/a	3.64	1.47	2.31	*63*	60.40	51.07	47.19	21.4	22	22.5	23.9
1	8/7/2025	14:30	*4*	130.0	0.92	n/a	3.64	1.47	2.32	*63*	60.36	51.04	47.14	21.4	22.1	22.7	24.2
1	8/7/2025	15:00	*4*	130.0	0.92	n/a	3.66	1.47	2.32	*63*	60.42	51.02	47.15	21.5	22.1	22.6	23.9
1	8/7/2025	15:30	*4.01*	130.0	0.92	n/a	3.65	1.47	2.33	*63*	60.40	51.03	47.13	21.4	21.9	22.4	23.9
1	8/7/2025	16:00	*4.01*	130.0	0.92	n/a	3.67	1.48	2.33	*63*	60.34	51.03	47.1	21.5	21.9	22.5	23.9
1	8/7/2025	16:30	*4*	130.1	0.92	n/a	3.67	1.49	2.33	*63*	60.19	50.94	47.04	21.3	21.8	22.4	23.7
1	8/7/2025	17:00	*4*	130.0	0.93	n/a	3.69	1.49	2.34	*68*	60.17	55.5	52.03	21.3	22.2	22.4	23.3
1	8/7/2025	17:30	*4*	130.0	0.93	n/a	3.72	1.48	2.35	*68*	63.93	54.7	50.7	21.3	22.1	22.3	22.8
1	8/7/2025	18:00	*4*	130.0	0.93	n/a	3.68	1.49	2.36	*68*	63.87	54.55	50.54	21.3	22	22.2	22.5
1	8/7/2025	18:30	*4*	130.1	0.95	n/a	3.68	1.49	2.36	*68*	63.96	54.21	50.3	21.2	22.1	22.4	22.5
1	8/7/2025	19:00	*4*	130.0	0.95	n/a	3.72	1.51	2.37	*68*	63.57	54.09	50.16	21.2	21.5	22.1	22.5
1	8/7/2025	19:30	*4*	130.0	0.94	n/a	3.74	1.51	2.38	*68*	63.59	54.01	50.07	21.3	21.4	22.2	22.1
1	8/7/2025	20:00	*4*	130.0	0.96	n/a	3.73	1.5	2.39	*68*	63.47	54.11	50.02	21.2	21.5	22.4	22
1	8/7/2025	20:30	*4*	130.1	0.96	n/a	3.72	1.5	2.39	*68*	63.45	54.03	50.01	21.2	22.1	22.2	23
1	8/7/2025	21:00	*4*	130.0	0.98	n/a	3.74	1.51	2.40	*68*	63.16	53.9	49.84	21.3	21.6	22.4	23.2
1	8/7/2025	21:30	*4*	129.9	0.97	n/a	3.75	1.51	2.40	*68*	63.09	53.83	49.7	21.3	22.3	22	22.1
1	8/7/2025	22:00	*4*	130.0	0.97	n/a	3.74	1.49	2.41	*68*	63.11	53.58	49.57	21.0	21.8	22.4	23.2
1	8/7/2025	22:40	*4*	130.0	0.97	n/a	3.73	1.49	2.38	*68*	62.99	53.55	49.56	21.2	22.0	22.5	23.6
1	8/7/2025	23:00	*4*	130.0	0.97	n/a	3.7	1.49	2.37	*68*	62.71	53.55	49.6	21.3	21.7	22.6	23.5
1	8/7/2025	23:30	*4*	130.0	0.98	n/a	3.71	1.48	2.36	*68*	62.75	53.53	49.6	21.2	21.9	22.4	23.4
1	8/8/2025	0:00	*4*	130.0	0.95	n/a	3.67	1.47	2.36	*68*	63.02	53.47	49.58	21.3	21.6	22.7	23.3
1	8/8/2025	0:30	*4*	130.1	0.95	n/a	3.73	1.47	2.36	*68*	62.64	53.44	49.51	21.4	22.0	22.7	23.1
1	8/8/2025	1:00	*4*	130.1	0.98	n/a	3.71	1.5	2.39	*68*	62.91	53.53	49.47	21.1	21.9	22.5	23.0
1	8/8/2025	1:32	*4*	130.0	0.96	n/a	3.76	1.48	2.40	*68*	63.02	53.37	49.31	21.2	22.0	22.3	22.6
1	8/8/2025	2:00	*4*	130.0	0.98	n/a	3.78	1.48	2.42	*68*	62.62	53.31	49.23	21.0	21.8	22.2	22.3
1	8/8/2025	2:30	*4*	130.0	0.98	n/a	3.79	1.49	2.43	*68*	62.57	53.26	49.19	21.1	22.1	22.1	22.3
1	8/8/2025	3:00	*4*	130.1	0.99	n/a	3.78	1.49	2.42	*68*	62.64	53.35	49.19	21.0	22.1	22.1	22.1
1	8/8/2025	3:30	*4*	129.9	0.97	n/a	3.79	1.46	2.43	*68*	62.69	53.17	49.08	21.3	21.4	21.9	22.3
1	8/8/2025	4:00	*4*	130.0	0.98	n/a	3.76	1.5	2.49	*68*	62.28	53.18	49.06	21.1	21.7	21.6	21.9
1	8/8/2025	4:29	*4*	129.9	0.96	n/a	3.81	1.51	2.43	*68*	62.79	53.14	49.03	21.0	21.6	21.8	21.6
1	8/8/2025	5:00	*4*	130.0	0.99	n/a	3.78	1.52	2.42	*68*	62.51	53.1	48.97	21.1	21.7	21.5	21.4
1	8/8/2025	5:30	*4*	130.1	0.98	n/a	3.85	1.49	2.41	*68*	62.47	53.96	48.94	21.1	21.8	21.4	21.2

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
1	8/8/2025	6:00	*4*	130.0	1.00	n/a	3.8	1.46	2.41	*68*	62.56	53.13	48.89	21.0	21.3	21.5	21.4
1	8/8/2025	6:30	*4.01*	130.0	1.00	n/a	3.81	1.41	2.42	*68*	62.08	52.09	48.82	21.1	21	21.5	20.9
1	8/8/2025	7:00	*4*	130.0	1.00	n/a	3.8	1.49	2.41	*68*	62.57	53.01	48.81	20.9	21.4	21.4	21.1
1	8/8/2025	7:30	*4.01*	130.0	1.00	n/a	3.86	1.5	2.42	*68*	62.23	53.07	48.78	21	21.2	21.4	21.5
1	8/8/2025	8:00	*4*	130.0	0.99	n/a	3.83	1.48	2.43	*68*	62.31	53.04	48.82	21	21	21.6	22
2	8/8/2025	8:12	*4*	129.9	n/a	3.8	3.29	1.25	2.12	*68*	62.18	53.02	49.65	21.0	21.3	21.6	22
2	8/8/2025	8:40	*4*	129.5	n/a	4.38	3.86	1.51	2.46	*68*	62.09	52.05	47.73	21	21.5	21.3	22.4
2	8/8/2025	9:00	*4*	130.0	n/a	4.21	3.74	1.44	2.42	*68*	62.73	52.37	48.42	21.0	21.6	21.9	22.4
2	8/8/2025	9:30	*4*	129.9	n/a	4.28	3.7	1.44	2.41	*68*	62.51	52.45	48.46	21.1	21.7	21.9	23.1
2	8/8/2025	10:00	*4*	130.0	n/a	4.29	3.68	1.46	2.41	*68*	62.46	52.39	48.36	21.1	21.4	22.1	23.5
2	8/8/2025	10:30	*4*	130.0	n/a	4.36	3.70	1.46	2.43	*68*	62.13	52.26	48.21	21.2	21.7	22.1	22.6
2	8/8/2025	11:00	*4*	130.0	n/a	4.29	3.70	1.43	2.44	*68*	62.23	52.30	48.22	21.0	21.3	22.1	22.4
2	8/8/2025	11:30	*4*	130.0	n/a	4.36	3.75	1.44	2.45	*68*	62.12	52.33	48.24	21.1	21.8	22.2	23.8
2	8/8/2025	12:00	*4*	129.9	n/a	4.23	3.74	1.47	2.46	*68*	62.23	52.27	48.18	21.0	21.7	22.3	23.7
2	8/8/2025	12:30	*4*	130.0	n/a	4.38	3.76	1.42	2.45	*68*	62.19	52.07	48.16	21.0	21.4	22.1	23.5
2	8/8/2025	13:00	*4*	130.0	n/a	4.27	3.78	1.44	2.46	*68*	62.33	52.15	48.06	21.1	21.6	22.2	22.9
2	8/8/2025	13:30	*4*	130.0	n/a	4.18	3.77	1.44	2.46	*68*	62.56	52.18	48.08	21.1	21.6	22.2	22.3
2	8/8/2025	14:00	*4*	130.0	n/a	4.36	3.77	1.45	2.46	*68*	62.38	52.07	48.08	21.4	21.6	22.2	22.4
2	8/8/2025	14:30	*4*	130.0	n/a	4.38	3.77	1.46	2.47	*68*	62.46	52.18	48.06	21.2	21.7	22.1	22.1
2	8/8/2025	15:00	*4*	130.0	n/a	4.29	3.72	1.44	2.47	*68*	62.18	52.08	48.02	21.1	21.8	22.2	22.7
2	8/8/2025	15:30	*4*	130.0	n/a	4.34	3.77	1.48	2.48	*68*	62.12	52.07	48.02	21.2	21.6	22.2	22.7
2	8/8/2025	16:00	*4*	130.1	n/a	4.37	3.78	1.47	2.48	*68*	62.31	52.24	48.03	21.3	22.0	22.1	22.6
2	8/8/2025	16:30	*4*	130.2	n/a	4.42	3.77	1.47	2.48	*68*	62.28	52.16	48.07	21.3	22.2	22.4	22.5
2	8/8/2025	17:00	*4*	130.0	n/a	4.39	3.77	1.46	2.48	*68*	62.52	52.17	48.09	21.3	22.3	22.3	23.1
2	8/8/2025	17:30	*4*	129.9	n/a	4.38	3.75	1.45	2.48	*68*	62.18	52.26	48.11	21.1	21.7	22.3	23.3
2	8/8/2025	18:00	*4*	130.0	n/a	4.35	3.77	1.47	2.48	*68*	62.55	52.12	48.11	21.2	21.8	22.5	23.4
2	8/8/2025	18:30	*4*	130.0	n/a	4.38	3.76	1.45	2.48	*68*	62.24	52.24	48.09	21.2	22.0	22.3	24.2
2	8/8/2025	19:00	*4*	130.0	n/a	4.38	3.78	1.45	2.49	*68*	62.25	52.12	48.02	21.4	22	22.2	23.8
2	8/8/2025	19:30	*4*	130.1	n/a	4.37	3.78	1.46	2.49	*68*	62.24	52.13	47.99	21.6	21.6	22.3	23.7
2	8/8/2025	20:00	*4*	130.0	n/a	4.39	3.79	1.47	2.50	*68*	62.45	52.14	48.01	21.9	22.1	22.1	23.8
2	8/8/2025	20:30	*4*	130.0	n/a	4.39	3.78	1.45	2.50	*68*	62.33	52.11	47.98	22.1	21.7	22.3	23.6
2	8/8/2025	21:00	*4*	130.0	n/a	4.42	3.80	1.46	2.50	*68*	62.43	52.09	47.92	22.2	21.5	22.1	23.3

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
2	8/8/2025	21:30	4	130.0	n/a	4.38	3.79	1.48	2.51	68	62.40	52.06	47.92	21.8	21.7	21.8	22.2
2	8/8/2025	22:00	4	130.0	n/a	4.37	3.78	1.46	2.51	68	62.39	52	47.92	21.8	22.1	22.1	21.8
2	8/8/2025	22:30	4	130.0	n/a	4.41	3.78	1.48	2.51	68	62.37	52.09	47.91	22.1	21.9	22.2	23
2	8/8/2025	23:00	4	130.0	n/a	4.41	3.81	1.47	2.52	68	62.22	52.01	47.86	21.9	21.6	22.2	23.4
2	8/8/2025	23:30	4	130.0	n/a	4.46	3.79	1.47	2.52	68	62.33	52.02	47.81	22	21.3	22.1	22
2	8/9/2025	0:00	4	130.0	n/a	4.25	3.8	1.41	2.52	68	62.30	51.82	47.86	22.1	21.6	22.1	23.3
2	8/9/2025	0:30	4	130.1	n/a	4.4	3.81	1.45	2.52	68	62.03	51.96	47.80	21.8	21.8	22.2	21.7
2	8/9/2025	1:00	4	130.1	n/a	4.42	3.80	1.47	2.52	68	62.22	52.02	47.83	21.9	21.3	22	23.2
2	8/9/2025	1:30	3.99	130.0	n/a	4.4	3.76	1.41	2.51	68	62.22	52.03	47.83	22.2	21.6	22.3	22.5
2	8/9/2025	2:00	4	130.0	n/a	4.27	3.72	1.42	2.48	68	62.41	52.01	47.96	22.4	21.9	22.3	23.4
2	8/9/2025	2:30	4	130.0	n/a	4.26	3.77	1.38	2.46	68	62.47	51.96	47.97	22.4	22.4	22.4	23.8
2	8/9/2025	3:00	4.01	129.9	n/a	4.19	3.69	1.42	2.45	68	62.22	52.06	47.98	22.4	22	22.5	23.8
2	8/9/2025	3:30	3.99	130.1	n/a	4.27	3.74	1.39	2.45	68	62.36	52.02	48.06	22.3	22	22.7	23.7
2	8/9/2025	4:00	3.99	130.0	n/a	4.28	3.69	1.42	2.45	68	62.47	51.96	48.05	22.4	22	22.6	23.5
2	8/9/2025	4:30	4	130.0	n/a	4.25	3.75	1.44	2.47	68	61.97	52.06	47.93	22.2	22.2	22.5	23.2
2	8/9/2025	5:00	4	130.0	n/a	4.31	3.75	1.42	2.48	68	62.83	52.03	47.89	22.1	22.4	22.4	23
2	8/9/2025	5:30	4	130.0	n/a	4.41	3.79	1.41	2.49	68	61.87	51.86	47.83	21.9	21.8	22.5	23
2	8/9/2025	6:00	4	130.0	n/a	4.41	3.75	1.44	2.50	68	62.26	51.89	47.78	21.8	21.6	22.3	22.9
2	8/9/2025	6:30	4	130.1	n/a	4.43	3.75	1.45	2.50	68	62.03	51.91	47.73	21.1	22.2	22.1	22.8
2	8/9/2025	7:00	3.99	130.0	n/a	4.26	3.81	1.46	2.52	68	62.27	51.89	47.73	21.1	21.8	22.3	23
2	8/9/2025	7:30	3.99	130.0	n/a	4.3	3.76	1.43	2.50	68	62.52	51.91	47.71	21.2	22	22.2	23
2	8/9/2025	8:00	4	130.0	n/a	4.36	3.74	1.42	2.49	68	62.91	51.75	47.66	21.3	21.8	22.4	23.5
2	8/9/2025	8:30	4	130.0	n/a	4.34	3.73	1.40	2.47	68	62.01	51.76	47.70	21	21.5	22.6	23.8
3	8/9/2025	9:00	4	90.9	0.56	n/a	2.11	0.83	1.44	68	64.24	57.93	56.47	21.0	22.4	22.3	23
3	8/9/2025	9:30	4	90.6	0.62	n/a	2.35	0.88	1.69	68	64.15	57.33	55.48	21.30	22	22.4	22.3
3	8/9/2025	10:00	4.01	91.0	0.59	n/a	2.32	0.85	1.65	68	64.48	58.02	56.42	21.2	21.7	22.4	22.3
3	8/9/2025	10:30	4.01	91.0	0.61	n/a	2.36	0.86	1.68	68	64.35	57.88	56.21	21.1	21.7	22.3	22.3
3	8/9/2025	11:00	4.01	90.9	0.62	n/a	2.39	0.86	1.70	68	64.22	57.79	56.13	21.3	21.8	22.4	22.8
3	8/9/2025	11:30	4.01	91.0	0.63	n/a	2.38	0.87	1.70	68	64.31	57.70	56.09	21.3	21.6	22.4	23.4
3	8/9/2025	12:00	4.01	91.1	0.63	n/a	2.37	0.86	1.70	68	64.28	57.80	56.04	21.2	21.9	22.3	23.6
3	8/9/2025	12:30	4.01	91.0	0.63	n/a	2.39	0.86	1.71	68	64.20	57.81	56.03	21.2	22.2	22.5	23.5
3	8/9/2025	13:00	4	91.0	0.64	n/a	2.39	0.86	1.71	68	64.30	57.73	56.07	21.4	21.9	22.5	23.5

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
3	8/9/2025	13:30	*4*	91.0	0.65	n/a	2.39	0.87	1.71	*68*	64.19	57.73	56.04	21.3	22.1	22.4	24.2
3	8/9/2025	14:00	*4*	91.0	0.65	n/a	2.36	0.85	1.71	*68*	64.20	57.73	56.1	21	22.2	22.4	24.4
3	8/9/2025	14:30	*4.01*	91.0	0.65	n/a	2.38	0.86	1.71	*68*	64.32	57.82	56.1	21.3	22.3	22.5	24.5
3	8/9/2025	15:00	*4.01*	90.9	0.66	n/a	2.4	0.86	1.72	*68*	64.38	57.78	56.04	21.0	22.1	22.7	24
3	8/9/2025	15:30	*4.01*	91.0	0.65	n/a	2.4	0.84	1.72	*68*	64.29	57.68	55.97	21.4	22.2	22.4	23.2
3	8/9/2025	16:00	*4.01*	91.0	0.65	n/a	2.4	0.87	1.72	*68*	64.16	57.75	55.95	21.1	21.6	22.5	23.1
3	8/9/2025	16:30	*4*	90.9	0.65	n/a	2.41	0.88	1.73	*68*	64.20	57.65	55.94	21.3	22.1	22.6	22.8
3	8/9/2025	17:00	*4.01*	91.0	0.66	n/a	2.4	0.86	1.74	*68*	64.19	57.64	55.9	21.3	22.1	22.5	22.5
3	8/9/2025	17:30	*4.01*	91.0	0.66	n/a	2.42	0.86	1.74	*68*	64.27	57.67	55.95	21.1	22.1	22.3	22.5
3	8/9/2025	18:00	*4.01*	91.0	0.66	n/a	2.4	0.86	1.74	*68*	64.30	57.66	55.97	21	21.5	22.4	22.9
3	8/9/2025	18:30	*4.01*	90.9	0.66	n/a	2.4	0.85	1.74	*68*	64.23	57.74	55.95	21.3	21.9	22.5	22.7
3	8/9/2025	19:00	*4.01*	91.0	0.67	n/a	2.4	0.85	1.74	*68*	64.22	57.67	55.95	21.1	21.9	22.6	23.1
3	8/9/2025	19:30	*4*	91.0	0.67	n/a	2.4	0.86	1.74	*68*	64.22	57.65	55.95	21.3	21.6	22.5	23.1
3	8/9/2025	20:00	*4.01*	91.0	0.66	n/a	2.4	0.85	1.74	*68*	64.21	57.65	55.94	21.4	21.8	22.5	23.1
3	8/9/2025	20:30	*4.01*	91.0	0.66	n/a	2.41	0.86	1.75	*68*	64.16	57.62	55.92	21.2	21.8	22.5	23.3
3	8/9/2025	21:00	*4*	91.0	0.68	n/a	2.42	0.86	1.73	*68*	64.24	57.57	55.94	21	22.1	22.1	23.4
3	8/9/2025	21:30	*4*	91.0	0.68	n/a	2.42	0.87	1.73	*68*	64.19	57.58	55.82	21.1	21.3	22.3	22.9
3	8/9/2025	22:00	*4*	91.0	0.68	n/a	2.44	0.88	1.75	*68*	64.18	57.56	55.74	21	21.5	22.3	22.1
3	8/9/2025	22:30	*4.01*	91.0	0.69	n/a	2.42	0.86	1.75	*68*	64.22	57.63	55.84	21	21.9	22.5	23.6
3	8/9/2025	23:00	*4.01*	91.0	0.69	n/a	2.44	0.87	1.74	*68*	64.18	57.5	55.77	21.3	21.7	22.1	22.7
3	8/9/2025	23:30	*4.01*	91.0	0.69	n/a	2.44	0.87	1.77	*68*	64.15	57.53	55.77	21.1	21.5	22.1	22
3	8/10/2025	0:00	*4*	91.0	0.69	n/a	2.43	0.88	1.76	*68*	64.15	57.53	55.78	21	21.7	22.2	23.1
3	8/10/2025	0:30	*4.01*	91.1	0.69	n/a	2.43	0.87	1.76	*68*	64.11	57.5	55.67	21.1	22.3	22.3	21.5
3	8/10/2025	1:00	*4*	91.0	0.69	n/a	2.42	0.87	1.76	*68*	64.12	57.56	55.77	21.1	22.2	22.3	23.7
3	8/10/2025	1:30	*4*	91.0	0.69	n/a	2.46	0.87	1.75	*68*	64.01	57.48	55.65	21.2	21.7	22.1	22.8
3	8/10/2025	2:00	*4.01*	91.0	0.70	n/a	2.42	0.86	1.77	*68*	64.17	57.43	55.71	21.2	21.8	22.1	23.3
3	8/10/2025	2:30	*4.01*	91.0	0.69	n/a	2.4	0.83	1.74	*68*	64.06	57.45	55.77	21.1	21.6	22.4	23.6
3	8/10/2025	3:00	*4.01*	91.0	0.69	n/a	2.38	0.82	1.72	*68*	64.07	57.49	55.87	21.1	22.1	22.6	23.7
3	8/10/2025	3:30	*4.01*	90.9	0.69	n/a	2.36	0.83	1.71	*68*	64.04	57.46	55.84	21.1	22	22.8	23.7
3	8/10/2025	4:00	*4.01*	91.0	0.69	n/a	2.36	0.83	1.71	*68*	64.01	57.51	55.84	21.1	21.8	22.6	23.7
3	8/10/2025	4:30	*4.01*	91.0	0.68	n/a	2.36	0.82	1.71	*68*	64.07	57.52	55.84	21.1	21.6	22.8	23.3
3	8/10/2025	5:00	*4*	91.0	0.69	n/a	2.36	0.83	1.71	*68*	64.20	57.53	55.9	21	22.1	23	23.6

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
3	8/10/2025	5:30	*4*	91.0	0.68	n/a	2.38	0.83	1.72	*68*	64.19	57.56	55.87	21.2	21.9	23.0	23.4
3	8/10/2025	6:00	*4.01*	91.0	0.69	n/a	2.36	0.82	1.73	*68*	64.24	57.52	55.91	21.1	21.6	22.7	23.3
3	8/10/2025	6:30	*4*	91.0	0.69	n/a	2.39	0.84	1.74	*68*	64.25	57.57	55.91	21	21.6	22.7	23.3
3	8/10/2025	7:00	*4*	91.0	0.69	n/a	2.39	0.83	1.74	*68*	64.25	57.61	55.95	21	21.7	22.8	23.4
3	8/10/2025	7:30	*4.01*	90.9	0.70	n/a	2.36	0.83	1.74	*68*	64.10	57.67	55.94	21.1	21.9	22.6	23.7
3	8/10/2025	8:00	*4.01*	91.0	0.69	n/a	2.37	0.84	1.75	*68*	64.17	57.43	55.78	21.2	21.5	22.9	22.5
4	8/10/2025	10:40	*4.01*	91.0	n/a	1.63	2.02	0.53	1.59	*68*	64.70	59.12	58.44	21.2	22.1	23	23.3
4	8/10/2025	11:00	*4*	90.3	n/a	2.53	2.17	0.84	1.51	*68*	64.46	57.17	55.69	21.5	22.1	22.7	23.1
4	8/10/2025	11:30	*4.01*	91.3	n/a	2.46	2.39	0.85	1.71	*68*	64.36	57.25	55.55	21.2	21.5	22.4	22.6
4	8/10/2025	12:00	*4.01*	91.1	n/a	2.56	2.35	0.84	1.72	*68*	64.63	57.44	55.86	21.3	21.9	22.5	22.3
4	8/10/2025	12:30	*4.01*	91.0	n/a	2.48	2.37	0.85	1.74	*68*	64.59	57.47	55.72	21.3	21.9	22.7	22.3
4	8/10/2025	13:00	*4.01*	91.0	n/a	2.57	2.43	0.83	1.74	*68*	64.52	57.45	55.71	21.2	22	22.8	22.8
4	8/10/2025	13:30	*4.01*	91.0	n/a	2.55	2.35	0.79	1.73	*68*	64.35	56.83	55.15	21	21.8	22.8	23.1
4	8/10/2025	14:00	*4.01*	91.0	n/a	2.52	2.36	0.85	1.73	*68*	64.00	56.05	54.5	21.4	21.9	22.8	23.6
4	8/10/2025	14:30	*4.01*	91.0	n/a	2.6	2.35	0.83	1.73	*68*	64.03	56.07	54.5	21.2	22.3	22.9	24.6
4	8/10/2025	15:00	*4.01*	91.0	n/a	2.67	2.44	0.83	1.75	*68*	63.94	56.64	54.9	21.4	22.3	22.7	22.8
4	8/10/2025	15:30	*4.01*	91.0	n/a	2.54	2.42	0.8	1.76	*68*	63.78	56.69	55.03	21.1	22.2	22.7	22.8
4	8/10/2025	16:00	*4.01*	91.0	n/a	2.59	2.42	0.84	1.75	*68*	63.75	56.62	54.97	21.3	22.1	22.8	23.3
4	8/10/2025	16:30	*4.01*	91.0	n/a	2.63	2.42	0.83	1.76	*68*	63.90	56.53	54.86	21.1	22.2	23.3	24.3
4	8/10/2025	17:00	*4.01*	91.0	n/a	2.55	2.44	0.85	1.76	*68*	63.61	56.47	54.85	21.3	22.2	22.7	22.5
4	8/10/2025	17:30	*4.01*	91.0	n/a	2.65	2.44	0.84	1.76	*68*	63.85	56.53	54.95	21.3	22.3	23	23.5
4	8/10/2025	18:00	*4.00*	91.0	n/a	2.53	2.44	0.84	1.77	*68*	63.74	56.73	54.95	21.3	22	22.9	23.9
4	8/10/2025	18:30	*4.01*	91.0	n/a	2.67	2.45	0.85	1.77	*68*	63.92	56.7	54.86	21.2	21.5	22.4	22.9
4	8/10/2025	19:00	*4.01*	91.0	n/a	2.57	2.46	0.85	1.78	*68*	64.15	56.92	55.25	21.2	21.6	22.5	22.6
4	8/10/2025	19:30	*4.00*	91.0	n/a	2.55	2.45	0.85	1.78	*68*	64.21	56.85	55.14	21.2	21.8	22.7	23.0
4	8/10/2025	20:00	*4.00*	91.0	n/a	2.63	2.43	0.84	1.78	*68*	63.65	56.47	54.83	21	21.6	22.7	23.3
4	8/10/2025	20:30	*4.01*	91.0	n/a	2.66	2.45	0.84	1.78	*68*	63.95	56.6	54.79	21.4	22.2	22.5	24.1
4	8/10/2025	21:00	*4.01*	91.0	n/a	2.68	2.45	0.86	1.77	*68*	64.26	56.78	55.17	21.1	21.8	22.5	23.9
4	8/10/2025	21:30	*4*	91.0	n/a	2.64	2.46	0.84	1.76	*68*	63.85	56.58	54.74	21.1	21.6	22.3	23
4	8/10/2025	22:00	*4.01*	91.0	n/a	2.64	2.47	0.84	1.76	*68*	63.64	56.47	54.78	21.2	21.9	22.3	22.7
4	8/10/2025	22:30	*4.01*	91.0	n/a	2.56	2.48	0.86	1.77	*68*	63.64	56.31	54.73	21.3	21.6	22.3	22.5
4	8/10/2025	23:00	*4*	91.0	n/a	2.68	2.46	0.85	1.78	*68*	63.93	56.43	54.72	21.2	21.5	22.1	22.3

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
4	8/10/2025	23:30	*4.01*	91.0	n/a	2.69	2.44	0.85	1.79	*68*	64.07	56.8	55.05	21.3	21.4	22.3	21.9
4	8/11/2025	0:00	*4.01*	91.0	n/a	2.69	2.45	0.84	1.80	*68*	63.92	56.72	54.93	21.2	21.5	22.3	23
4	8/11/2025	0:30	*4*	91.0	n/a	2.61	2.42	0.84	1.80	*68*	63.83	56.48	54.84	21.1	22	22.3	23.7
4	8/11/2025	1:00	*4.02*	91.0	n/a	2.69	2.45	0.83	1.80	*68*	63.67	56.34	54.62	21.1	21.6	22.2	22.5
4	8/11/2025	1:30	*4.01*	91.0	n/a	2.74	2.45	0.83	1.82	*68*	63.84	56.38	54.72	21.1	21.8	22.3	22.1
4	8/11/2025	2:00	*4.01*	91.0	n/a	2.57	2.48	0.84	1.81	*68*	63.59	56.4	54.63	21.1	22	22.1	23.1
4	8/11/2025	2:31	*4.01*	90.9	n/a	2.6	2.46	0.8	1.81	*68*	63.70	56.33	54.6	21	21.5	22.1	22
4	8/11/2025	3:00	*4.01*	91.0	n/a	2.72	2.43	0.79	1.82	*68*	63.57	56.38	54.69	21	21.5	22.1	23.4
4	8/11/2025	3:30	*4*	91.0	n/a	2.63	2.47	0.86	1.81	*68*	63.80	56.33	54.58	21	21.6	22.1	22.1
4	8/11/2025	4:00	*4*	91.0	n/a	2.6	2.45	0.82	1.82	*68*	63.85	56.44	54.63	21.3	21.5	22.2	23.5
4	8/11/2025	4:30	*4*	91.0	n/a	2.56	2.43	0.78	1.83	*68*	63.60	56.41	54.68	21.1	21.5	22.2	22.5
4	8/11/2025	5:00	*4.01*	91.0	n/a	2.77	2.49	0.83	1.82	*68*	62.97	55.83	54.03	21.2	21.3	22.3	22.3
4	8/11/2025	5:30	*4.01*	91.0	n/a	2.7	2.48	0.8	1.84	*68*	63.20	55.82	54.12	21.2	21.5	22	23.3
4	8/11/2025	6:00	*4.01*	91.0	n/a	2.61	2.46	0.8	1.83	*68*	62.70	55.52	53.86	21.1	21.8	22.3	23.6
4	8/11/2025	6:30	*4.01*	91.0	n/a	2.71	2.4	0.76	1.82	*68*	62.67	55.45	53.78	21	21.4	22.6	23.7
4	8/11/2025	7:00	*4.01*	91.0	n/a	2.65	2.42	0.77	1.82	*68*	62.16	54.92	53.21	21	21.7	22.4	21.9
4	8/11/2025	7:30	*4.01*	91.1	n/a	2.67	2.44	0.76	1.85	*68*	62.61	55.13	53.31	21.1	21.6	22.4	23.5
4	8/11/2025	8:00	*4.01*	91.0	n/a	2.66	2.42	0.77	1.85	*68*	62.08	54.72	53.18	21.1	21.6	22.2	21.9
4	8/11/2025	8:30	*4.01*	91.0	n/a	2.63	2.43	0.77	1.85	*68*	61.72	54.52	52.85	21	22	22.3	23.9
4	8/11/2025	9:00	*4*	90.9	n/a	2.68	2.44	0.81	1.85	*68*	61.81	54.56	52.89	21.1	21.5	22.3	22.8
4	8/11/2025	9:30	*4.01*	91.0	n/a	2.72	2.45	0.79	1.84	*69*	61.30	54.02	52.36	21.2	21.6	22.2	21.9
4	8/11/2025	10:00	*4*	91.1	n/a	2.69	2.47	0.79	1.86	*69*	60.88	53.73	51.99	21.1	21.6	22.3	22.4
4	8/11/2025	10:30	*4.01*	91.0	n/a	2.7	2.46	0.77	1.86	*69*	64.58	56.44	54.86	21.1	22.1	22.3	23.3
5	8/11/2025	11:00	*4*	108.9	0.71	n/a	2.77	1	1.96	*69*	62.83	53.85	51.45	21.3	21.3	22.4	24.2
5	8/11/2025	11:30	*4*	110.0	0.68	n/a	2.99	1.01	2.20	*69*	63.31	54.56	51.81	21	21.5	22.6	24
5	8/11/2025	12:00	*4*	110.0	0.70	n/a	3.02	1	2.22	*69*	63.52	54.23	51.17	21	21.7	22.4	23.4
5	8/11/2025	12:30	*4*	110.0	0.72	n/a	3.06	1.02	2.23	*69*	63.33	54.05	51.32	21.2	22.1	22.3	22.6
5	8/11/2025	13:00	*4*	130.0	0.87	n/a	3.75	1.33	2.64	*69*	61.79	51.08	47.08	21	21.9	22.5	22.8
5	8/11/2025	13:30	*4*	130.1	0.88	n/a	3.73	1.3	2.62	*69*	62.33	51.09	47.19	21	21.1	22.6	23.3
5	8/11/2025	14:00	*3.99*	130.0	0.90	n/a	3.75	1.3	2.64	*69*	61.93	50.99	47.04	21.1	22	22.6	24.5
5	8/11/2025	14:30	*3.99*	130.0	0.91	n/a	3.79	1.31	2.65	*69*	61.80	50.28	46.28	21.3	21.5	22.5	23.1
5	8/11/2025	15:00	*3.99*	150.0	1.09	n/a	4.49	1.62	3.05	*69*	60.75	47.37	42.2	21.2	21.6	22.6	23.3

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
5	8/11/2025	15:30	*3.99*	150.1	1.10	n/a	4.48	1.6	3.06	*69*	60.69	48.08	42.81	21.2	22	22.6	24.5
5	8/11/2025	16:00	*3.98*	150.3	1.11	n/a	4.52	1.63	3.06	*68*	60.73	47.31	42.73	21.5	21.9	22.7	23.3
5	8/11/2025	16:30	*4*	150.0	1.11	n/a	4.48	1.61	3.07	*68*	60.52	47.64	42.82	21.3	22.1	22.5	24.1
5	8/11/2025	17:00	*3.99*	168.4	1.29	n/a	5.23	1.95	3.46	*68*	59.40	46.83	39.78	22.1	21.9	22.6	23
5	8/11/2025	17:30	*3.99*	169.4	1.30	n/a	5.26	1.97	3.47	*68*	59.68	46.52	40.1	22.2	22	22.5	23.4
5	8/11/2025	18:00	*3.99*	167.9	1.31	n/a	5.21	1.96	3.46	*68*	59.60	46.48	40.01	22.4	21.7	22.3	22.9
5	8/11/2025	18:30	*3.99*	168.1	1.30	n/a	5.22	1.94	3.46	*68*	59.54	46.42	39.97	22.4	22.1	22.2	23.2
5	8/11/2025	18:53	*3.98*	195.1	1.64	n/a	6.34	2.46	4.07	*68*	57.08	41.37	32.75	22.4	21.5	22.1	22.9
5	8/11/2025	19:00	*3.97*	195.2	1.62	n/a	6.35	2.43	4.07	*68*	57.53	41.57	33.01	22.5	21.9	22.3	24.1
5	8/11/2025	19:30	*3.98*	195.0	1.66	n/a	6.4	2.43	4.09	*68*	57.22	41.4	32.11	21	21.6	22.1	22.6
5	8/11/2025	20:00	*3.97*	195.2	1.67	n/a	6.38	2.45	4.09	*68*	57.27	41.21	32.57	21.3	22.1	22.3	22.6
5	8/11/2025	20:30	*3.98*	195.0	1.67	n/a	6.34	2.45	4.07	*68*	57.15	41.23	32.71	21.2	21.6	22.3	23.6
5	8/11/2025	21:00	*3.99*	170.1	1.43	n/a	5.38	1.98	3.54	*68*	59.34	45.63	38.96	21.1	21.6	22	23.9
5	8/11/2025	21:30	*3.99*	170.0	1.44	n/a	5.34	2.01	3.54	*68*	59.44	45.51	38.12	21.2	21.8	22.1	23.5
5	8/11/2025	22:00	*3.98*	170.1	1.42	n/a	5.38	1.98	3.54	*68*	59.24	45.64	38.96	21.2	21.6	22	22.6
5	8/11/2025	22:30	*3.99*	169.9	1.48	n/a	5.33	2	3.54	*68*	59.07	45.79	36.92	21.3	21.9	22.2	22.1
5	8/11/2025	23:00	*3.99*	149.9	1.29	n/a	4.62	1.66	3.15	*68*	60.44	48.6	43.52	21.1	21.9	22.1	22.5
5	8/11/2025	23:30	*3.99*	150.0	1.29	n/a	4.56	1.66	3.13	*68*	60.35	48.78	43.39	21.3	21.9	22.4	23.3
5	8/12/2025	0:00	*3.99*	150.1	1.29	n/a	4.61	1.66	3.13	*68*	60.45	48.65	43.42	21.1	22.4	22.1	23.7
5	8/12/2025	0:30	*3.98*	149.9	1.29	n/a	4.58	1.61	3.13	*68*	60.27	48.49	43.25	21.1	22	22.2	23.5
5	8/12/2025	1:00	*4*	130.1	1.07	n/a	3.88	1.29	2.69	*68*	61.62	51.74	47.69	21.1	22	22.1	22.6
5	8/12/2025	1:30	*4*	130.0	1.06	n/a	3.86	1.29	2.72	*68*	61.70	51.67	47.69	21.2	21.3	21.7	21.9
5	8/12/2025	2:00	*4*	130.0	1.09	n/a	3.88	1.28	2.72	*68*	61.91	51.67	47.79	21	21.4	22.1	22.8
5	8/12/2025	2:30	*4*	129.8	1.08	n/a	3.86	1.29	2.70	*68*	62.04	51.66	47.65	21.1	21.9	22	23.3
5	8/12/2025	3:00	*4*	110.0	0.89	n/a	3.18	1.07	2.29	*68*	62.93	54.74	51.91	21	21.5	22.2	22
5	8/12/2025	3:30	*4.01*	110.1	0.91	n/a	3.16	1.04	2.39	*68*	63.26	54.81	52.02	21	22	22	23.3
5	8/12/2025	4:00	*4*	110.7	0.90	n/a	3.15	1.05	2.29	*68*	63.12	54.81	52.02	21.1	21.8	22	21.7
5	8/12/2025	4:30	*4*	110.2	0.92	n/a	3.16	1.05	2.29	*68*	63.00	54.72	51.94	21.1	21.4	22.2	23.4
5	8/12/2025	5:00	*4*	91.0	0.75	n/a	2.5	0.78	1.91	*68*	64.51	57.13	55.55	21	21.7	22.3	23.7
5	8/12/2025	5:30	*4.01*	90.6	0.72	n/a	2.46	0.76	1.90	*68*	64.51	57.12	55.35	21.1	21.7	22.3	21.8
5	8/12/2025	6:00	*4.01*	91.0	0.75	n/a	2.52	0.77	1.90	*68*	64.60	57.21	55.42	21.2	21.9	22.2	23
5	8/12/2025	6:30	*4.01*	90.9	0.75	n/a	2.46	0.79	1.90	*68*	63.92	56.96	55.22	21.2	22.1	22.2	23.3

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
5	8/12/2025	7:00	*4*	110.0	0.91	n/a	3.13	0.99	2.29	*68*	62.69	53.83	51.12	20.9	22.1	22.4	23.8
5	8/12/2025	7:30	*4*	110.0	0.91	n/a	3.11	1.04	2.29	*68*	62.22	53.12	50.27	21	22	22.3	22.4
5	8/12/2025	8:00	*4*	110.0	0.92	n/a	3.1	1	2.32	*68*	62.08	53.39	50.64	21.1	22	22.2	24
5	8/12/2025	8:30	*4*	110.0	0.91	n/a	3.14	1.03	2.32	*68*	62.18	53.22	50.34	21.1	21.4	22.1	22.8
5	8/12/2025	9:00	*4*	130.0	1.08	n/a	3.84	1.3	2.74	*68*	60.12	49.48	45.45	21.3	21.8	22	22.1
5	8/12/2025	9:30	*4*	130.0	1.11	n/a	3.86	1.31	2.77	*68*	59.77	49.08	45.09	21	22	22.1	22.5
5	8/12/2025	10:25	*4*	130.1	1.10	n/a	3.82	1.29	2.76	*68*	58.35	47.82	43.85	21.1	22.3	22.3	24
6	8/12/2025	10:37	*4*	109.9	n/a	2.31	2.62	0.67	2.18	*68*	60.15	53.37	51.89	21.1	21.6	22.1	22.8
6	8/12/2025	11:00	*4*	111.4	n/a	3.32	2.92	1.02	2.12	*68*	59.91	51.32	48.86	21	21.4	22	24.1
6	8/12/2025	11:30	*4.01*	110.0	n/a	3.14	3.01	0.98	2.28	*68*	59.86	51.32	48.72	21.1	21.4	22.4	23.1
6	8/12/2025	12:00	*4*	110.0	n/a	3.22	3.09	0.99	2.32	*68*	59.12	50.43	47.77	21.2	21.8	22.6	23.1
6	8/12/2025	12:30	*4*	110.0	n/a	3.29	3.08	0.99	2.32	*68*	58.82	50.16	47.5	21.5	21.9	22.4	22.7
6	8/12/2025	13:00	*4*	129.9	n/a	4.13	3.77	1.29	2.72	*68*	55.98	45.89	41.95	21.3	21.9	22.6	22.8
6	8/12/2025	13:30	*4*	130.0	n/a	4.18	3.77	1.29	2.72	*68*	56.07	45.8	41.94	21.1	22.2	22.4	23.4
6	8/12/2025	14:00	*4*	130.0	n/a	4.21	3.78	1.29	2.73	*68*	56.35	46.25	42.38	21	22	22.7	24.5
6	8/12/2025	14:30	*4*	130.1	n/a	4.23	3.79	1.28	2.74	*68*	56.20	45.88	41.98	21.1	21.6	22.4	24
6	8/12/2025	15:00	*4*	150.0	n/a	5.13	4.52	1.58	3.15	*68*	53.07	41.21	36.05	21.3	21.4	22.4	23
6	8/12/2025	15:30	*4*	150.0	n/a	5.15	4.51	1.58	3.14	*68*	53.09	40.71	35.59	21.4	22	22.5	23.5
6	8/12/2025	16:00	*3.99*	150.1	n/a	5.21	4.52	1.59	3.15	*68*	53.49	40.97	35.75	21	22.1	22.5	24.6
6	8/12/2025	16:30	*3.99*	150.1	n/a	5.18	4.53	1.57	3.15	*68*	57.36	38.66	33.42	21.3	22.1	22.4	23.1
6	8/12/2025	17:00	*3.99*	169.9	n/a	6.26	5.27	1.99	3.57	*68*	50.13	36.38	29.76	21	21.9	22.6	23.5
6	8/12/2025	17:30	*3.99*	169.9	n/a	6.26	5.28	1.92	3.59	*68*	51.56	37.34	30.74	21	21.9	22.4	23.7
6	8/12/2025	18:00	*3.99*	169.9	n/a	6.3	5.3	1.94	3.59	*68*	50.33	36.34	29.66	21.4	22	22.5	23.1
6	8/12/2025	18:30	*3.99*	170.2	n/a	6.22	5.3	1.93	3.59	*68*	55.48	47.54	34.88	21.3	21.9	22.2	23.6
6	8/12/2025	19:00	*3.98*	195.1	n/a	7.76	6.32	2.37	4.13	*68*	51.59	34.67	26.22	21.3	21.8	22.1	23.1
6	8/12/2025	19:30	*3.99*	195.0	n/a	7.71	6.3	2.39	4.13	*68*	51.80	34.77	26.33	21.1	21.8	22.2	22.6
6	8/12/2025	20:00	*3.98*	195.0	n/a	7.77	6.31	2.4	4.14	*68*	51.83	34.67	26.12	21.1	21.9	22.3	23
6	8/12/2025	20:30	*3.99*	195.2	n/a	7.82	6.31	2.36	4.14	*68*	51.98	35.33	26.83	21.2	22.2	22.3	24
6	8/12/2025	21:00	*3.98*	170.2	n/a	6.37	5.35	1.94	3.61	*68*	54.53	40.57	33.84	21.3	21.1	22	23.4
6	8/12/2025	21:30	*3.99*	170.1	n/a	6.31	5.33	1.94	3.61	*68*	55.03	40.31	34.24	21	21.7	22	22.6
6	8/12/2025	22:00	*3.99*	170.0	n/a	6.43	5.35	1.96	3.62	*68*	54.97	40.77	34.11	21.1	21.8	22	22.1
6	8/12/2025	22:30	*3.99*	170.0	n/a	6.36	5.36	1.96	3.62	*68*	55.33	40.52	34.3	21	21.3	22.2	22.2

Filter Period	Date	Time	*[FM-01]* (*gpm*)	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* (*psig*)	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
6	8/12/2025	23:00	*3.99*	150.0	n/a	5.34	4.6	1.63	3.21	*68*	58.18	45.97	40.75	21.3	21.6	22	22.5
6	8/12/2025	23:30	*3.99*	150.0	n/a	5.32	4.57	1.62	3.22	*68*	58.13	45.86	40.56	21.1	21.4	22.1	22.8
6	8/13/2025	0:00	*3.99*	150.0	n/a	5.38	4.57	1.6	3.21	*68*	58.36	46.34	40.79	21.1	21.5	22.2	22.8
6	8/13/2025	0:32	*3.99*	150.2	n/a	5.3	4.6	1.62	3.22	*62*	53.93	41.74	36.45	21	22.1	22	22.3
6	8/13/2025	1:00	*3.99*	150.0	n/a	5.35	4.61	1.6	3.21	*68*	55.72	43.62	38.31	21.1	21.3	22.1	22.5
6	8/13/2025	1:30	*4*	130.0	n/a	4.35	3.84	1.38	2.80	*68*	58.59	48.18	44.1	21	21.5	22	22.3
6	8/13/2025	2:00	*4*	130.0	n/a	4.3	3.86	1.3	2.80	*68*	57.32	46.84	42.87	21.1	21.8	22.2	23.5
6	8/13/2025	2:30	*4*	130.0	n/a	4.32	3.86	1.3	2.78	*68*	59.83	49.46	45.52	21.1	21.4	22.1	23.6
6	8/13/2025	3:00	*4*	130.0	n/a	4.34	3.86	1.3	2.77	*68*	60.46	50.03	46.06	20.9	22.1	22.1	22.6
6	8/13/2025	3:30	*4*	110.0	n/a	3.45	3.16	1.02	2.38	*68*	63.33	54.58	51.75	21	21.7	22	21.8
6	8/13/2025	4:00	*4*	110.0	n/a	3.52	3.18	1.04	2.36	*68*	62.02	53.41	50.6	21.1	22	22	23.2
6	8/13/2025	3:30	*4*	110.0	n/a	3.46	3.12	1	2.38	*68*	62.43	53.4	50.72	20.9	21.9	22.1	21.8
6	8/13/2025	5:00	*4*	110.0	n/a	3.49	3.13	0.98	2.37	*68*	61.58	52.71	49.93	21.1	21.6	22	23.2
6	8/13/2025	5:30	*4.01*	91.0	n/a	2.69	2.52	0.74	1.98	*68*	63.80	56.38	54.76	21	21.7	22.1	21.8
6	8/13/2025	6:00	*4.01*	91.0	n/a	2.78	2.51	0.76	1.95	*68*	63.81	56.18	54.55	21.1	21.7	22.1	22.8
6	8/13/2025	6:30	*4.01*	91.0	n/a	2.77	2.5	0.75	1.97	*68*	63.64	56.21	54.57	21	21.6	22.3	23.3
6	8/13/2025	7:00	*4.01*	91.0	n/a	2.65	2.45	0.75	1.98	*68*	63.92	56.36	54.67	21.1	21.7	22.3	22
6	8/13/2025	7:30	*4.01*	91.0	n/a	2.76	2.52	0.77	1.96	*68*	63.62	56.04	54.48	21	22.2	22.3	23.3
6	8/13/2025	8:00	*4.01*	91.0	n/a	2.71	2.5	0.75	1.97	*68*	63.23	55.87	54.25	21	21.6	22.1	22.1
6	8/13/2025	8:30	*4.01*	90.9	n/a	2.7	2.52	0.75	1.98	*68*	63.37	55.82	54.11	21	21.8	22.3	22.8
6	8/13/2025	9:00	*4.01*	91.0	n/a	2.71	2.5	0.76	1.96	*68*	63.18	55.6	54.1	21.1	22	22.3	23.9
6	8/13/2025	9:30	*4.01*	91.0	n/a	2.7	2.48	0.74	1.96	*68*	62.92	55.39	53.77	21.1	21.7	22.3	23.4
6	8/13/2025	10:00	*4.01*	91.0	n/a	2.72	2.49	0.74	1.97	*69*	63.91	56.41	54.81	21.7	21.6	22.4	22.7
6	8/13/2025	10:30	*4.01*	91.0	n/a	2.74	2.48	0.75	1.99	*69*	65.01	57.37	55.79	21	21.6	22.3	22.5

Table C.10. Initial Differential Pressure Data for DEFs from Run W-04

Filter Period	Date	Active Filter ID	Start Time	ΔP at t = 2 min (psid)	ΔP at t = 4 min (psid)	ΔP at t = 6 min (psid)	ΔP at t = 8 min (psid)	ΔP at t = 10 min (psid)	Target ΔP for Filter Switch (psid)
1	8/7/2025	1	7:53	0.67	0.59	0.62	0.71	0.87	2.87
2	8/8/2025	2	8:02	2.96	2.99	3.04	3.13	3.56	5.56
3	8/9/2025	1	8:38	0.31	0.33	0.34	0.36	0.39	2.39
4	8/10/2025	2	10:30	1.61	1.64	1.73	1.74	1.66	3.66
5	8/11/2025	1	10:32	0.34	0.39	0.38	0.4	0.45	2.45
6	8/12/2025	2	10:27	2.21	2.21	2.23	2.24	2.27	4.27

C.5 W-05 Tabulated Data

Table C.11. Periodically Recorded Data from Run W-05A

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
1	9/2/2025	8:46	*4.00*	129.70	0.92	n/a	2.98	1.47	1.65	*75*	69.99	59.81	57.50	22.20	22.90	22.70	23.00
1	9/2/2025	9:00	*4.00*	132.60	0.99	n/a	3.31	1.55	1.94	*75*	70.18	59.68	56.86	22.10	23.00	22.50	22.40
1	9/2/2025	9:30	*3.99*	130.00	1.08	n/a	3.85	1.57	2.40	*75*	69.79	59.23	55.59	22.10	22.80	22.60	22.90
1	9/2/2025	9:55	*4.00*	130.00	1.08	n/a	3.79	1.52	2.38	*75*	69.95	59.33	56.16	22.00	22.70	22.90	22.20
1	9/2/2025	10:30	*4.00*	130.00	1.26	n/a	3.74	1.48	2.45	*75*	70.19	59.05	55.86	21.70	22.80	22.80	23.30
1	9/2/2025	11:00	*3.99*	130.10	1.36	n/a	3.79	1.49	2.47	*75*	69.75	58.88	56.42	21.90	22.50	22.70	23.90
1	9/2/2025	11:30	*3.99*	130.00	1.44	n/a	3.76	1.49	2.51	*75*	69.83	58.97	55.57	21.70	22.40	22.60	22.60
1	9/2/2025	12:00	*4.00*	129.90	1.56	n/a	3.74	1.47	2.54	*75*	70.06	58.36	55.03	21.60	22.40	22.90	22.60
1	9/2/2025	12:30	*4.00*	130.10	1.68	n/a	3.81	1.44	2.57	*75*	69.95	58.48	55.06	21.90	22.20	22.80	24.00
1	9/2/2025	13:00	*3.99*	130.10	1.85	n/a	3.85	1.45	2.59	*75*	69.85	58.58	55.25	21.80	22.30	22.70	24.30
1	9/2/2025	13:30	*4.00*	130.00	1.95	n/a	3.84	1.40	2.60	*75*	70.13	58.43	55.01	22.00	22.40	22.70	22.60
1	9/2/2025	14:00	*3.99*	130.00	2.08	n/a	3.84	1.41	2.62	*75*	69.88	58.09	54.74	21.60	22.40	22.70	23.00
1	9/2/2025	14:30	*4.00*	130.00	2.25	n/a	3.84	1.43	2.63	*75*	69.71	57.90	54.42	21.50	22.50	22.90	23.70
1	9/2/2025	15:00	*4.00*	130.00	2.39	n/a	3.86	1.43	2.65	*75*	69.66	57.73	54.20	21.60	22.40	22.90	24.00
1	9/2/2025	15:30	*4.00*	130.00	2.53	n/a	3.86	1.40	2.63	*75*	70.00	57.73	54.13	21.80	22.10	22.70	22.80
1	9/2/2025	16:00	*4.00*	130.10	2.71	n/a	3.85	1.39	2.66	*77*	70.00	57.38	53.90	21.40	22.60	22.70	23.60

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min⁻¹)	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
1	9/2/2025	16:30	*4.00*	130.00	2.90	n/a	3.87	1.37	2.69	*78*	70.10	57.33	53.89	21.60	22.30	22.70	23.70
2	9/2/2025	17:00	*4.00*	129.00	n/a	4.37	3.49	1.36	2.36	*77*	69.67	58.59	55.53	21.60	22.10	22.30	22.40
2	9/2/2025	17:30	*4.00*	130.00	n/a	4.39	3.83	1.36	2.68	*78*	69.77	58.84	55.45	21.70	22.00	22.60	23.00
2	9/2/2025	18:00	*4.00*	130.00	n/a	4.45	3.86	1.36	2.70	*77*	69.95	58.95	55.49	21.30	22.30	22.90	24.50
2	9/2/2025	18:30	*4.00*	130.00	n/a	4.53	3.86	1.35	2.71	*78*	69.83	58.61	55.30	21.70	22.10	22.50	22.90
2	9/2/2025	19:00	*4.00*	130.10	n/a	4.62	3.85	1.38	2.72	*78*	69.88	58.34	55.01	21.60	22.00	22.50	22.40
2	9/2/2025	19:30	*4.00*	130.00	n/a	4.80	3.85	1.38	2.72	*77*	69.85	58.57	54.86	21.40	22.10	22.50	22.50
2	9/2/2025	20:00	*4.00*	130.00	n/a	4.87	3.84	1.37	2.72	*77*	70.01	58.37	54.86	21.40	21.90	22.30	22.10
2	9/2/2025	20:30	*4.00*	130.00	n/a	5.02	3.89	1.35	2.74	*77*	70.05	58.19	54.69	21.60	22.00	22.30	22.20
2	9/2/2025	21:00	*4.00*	130.00	n/a	5.18	3.86	1.35	2.75	*78*	69.76	58.02	54.58	21.70	22.30	22.50	23.70
2	9/2/2025	21:30	*4.00*	130.00	n/a	5.30	3.86	1.34	2.75	*78*	69.64	57.56	54.49	21.40	22.10	22.40	23.50
2	9/2/2025	22:00	*4.00*	129.90	n/a	5.38	3.89	1.36	2.75	*77*	69.46	57.77	54.07	21.40	21.80	22.40	22.10
2	9/2/2025	22:30	*4.00*	130.00	n/a	5.68	3.91	1.35	2.75	*77*	69.35	57.23	53.88	21.20	22.20	22.30	23.40
2	9/2/2025	22:48	*4.00*	130.00	n/a	5.82	3.89	1.34	2.77	*77*	69.60	57.38	53.66	21.40	22.40	22.30	22.50
3	9/2/2025	23:00	*4.00*	130.00	0.79	n/a	3.35	1.15	2.44	*77*	69.70	60.29	57.33	21.40	22.30	22.20	23.20
3	9/2/2025	23:30	*4.00*	129.90	1.05	n/a	3.92	1.35	2.76	*77*	69.65	59.39	55.71	21.70	22.10	22.20	22.00
3	9/3/2025	0:00	*4.00*	130.00	1.09	n/a	3.85	1.33	2.75	*78*	69.82	59.65	55.98	21.50	22.10	22.30	23.40
3	9/3/2025	0:30	*4.00*	130.10	1.13	n/a	3.92	1.35	2.75	*71*	69.86	59.41	55.85	21.60	22.00	22.30	21.80
3	9/3/2025	1:00	*3.99*	130.00	1.23	n/a	3.84	1.36	2.78	*75*	69.72	59.21	55.60	21.70	22.30	22.30	23.20
3	9/3/2025	1:30	*4.00*	130.00	1.31	n/a	3.89	1.35	2.75	*77*	69.75	59.17	55.75	21.60	22.30	22.40	23.10
3	9/3/2025	2:00	*4.00*	130.00	1.34	n/a	3.87	1.36	2.77	*74*	69.59	59.00	55.54	21.60	22.00	22.30	22.50
3	9/3/2025	2:30	*3.99*	129.90	1.46	n/a	3.92	1.32	2.77	*75*	69.25	58.87	55.54	21.70	22.30	22.30	23.10
3	9/3/2025	3:00	*3.99*	130.10	1.50	n/a	3.86	1.32	2.76	*73*	69.60	58.90	55.31	21.70	22.20	22.50	23.30
3	9/3/2025	3:30	*3.99*	129.90	1.69	n/a	3.89	1.34	2.76	*75*	69.53	58.54	54.94	21.70	22.30	22.50	23.60
3	9/3/2025	4:00	*4.00*	130.00	1.78	n/a	3.89	1.32	2.75	*76*	69.39	58.22	54.92	21.60	22.30	22.70	23.50
3	9/3/2025	4:30	*3.99*	130.00	1.88	n/a	3.84	1.33	2.73	*73*	69.45	58.15	54.84	21.70	22.40	22.90	23.90
3	9/3/2025	5:00	*4.00*	130.10	2.03	n/a	3.86	1.32	2.75	*76*	69.34	58.26	54.61	21.60	22.50	23.00	23.80
3	9/3/2025	5:30	*3.99*	129.90	2.10	n/a	3.86	1.30	2.76	*74*	69.63	58.01	54.64	22.00	22.40	22.80	23.70
3	9/3/2025	6:00	*3.99*	129.90	2.28	n/a	3.78	1.29	2.77	*71*	69.23	57.81	54.34	21.70	22.20	22.80	23.70
3	9/3/2025	6:30	*4.00*	130.00	2.40	n/a	3.85	1.29	2.74	*75*	69.54	57.62	54.26	21.60	22.30	22.90	23.70
3	9/3/2025	7:00	*3.99*	129.90	2.55	n/a	3.85	1.28	2.76	*75*	69.59	57.53	54.12	21.90	22.40	22.80	23.50
3	9/3/2025	7:30	*4.00*	129.90	2.70	n/a	3.85	1.34	2.78	*74*	69.56	57.52	53.96	22.00	22.40	22.90	23.90

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
4	9/3/2025	8:00	*3.99*	129.70	n/a	4.58	3.56	1.31	2.48	*75*	69.71	58.21	55.07	22.00	22.40	22.60	23.80
4	9/3/2025	8:30	*4.00*	130.00	n/a	4.58	3.81	1.29	2.76	*75*	69.48	58.58	55.03	22.00	22.40	23.00	23.50
4	9/3/2025	9:00	*3.99*	130.10	n/a	4.60	3.91	1.32	2.76	*75*	69.58	58.57	55.04	21.80	22.60	22.40	22.20
4	9/3/2025	9:30	*4.00*	130.00	n/a	4.63	3.88	1.32	2.77	*75*	69.44	58.46	54.89	22.00	22.30	22.40	23.90
4	9/3/2025	10:00	*3.99*	130.10	n/a	4.76	3.91	1.33	2.76	*75*	69.46	58.32	54.88	21.90	22.50	22.60	22.50
4	9/3/2025	10:30	*4.00*	129.90	n/a	4.97	3.91	1.34	2.77	*75*	69.41	58.13	54.49	21.70	22.60	22.70	22.60
4	9/3/2025	11:00	*4.00*	130.20	n/a	4.99	3.88	1.32	2.79	*75*	69.62	57.66	54.40	21.90	22.50	22.70	24.30
4	9/3/2025	11:30	*4.00*	130.00	n/a	5.11	3.91	1.33	2.78	*75*	69.42	57.84	54.42	21.70	22.50	22.80	23.90
4	9/3/2025	12:00	*3.99*	130.10	n/a	5.12	3.89	1.33	2.80	*75*	69.72	57.74	54.33	21.90	22.50	22.50	22.60
4	9/3/2025	12:30	*4.00*	130.00	n/a	5.22	3.90	1.31	2.77	*75*	69.40	57.81	54.11	22.00	22.40	22.60	22.20
4	9/3/2025	13:00	*3.99*	130.10	n/a	5.31	3.86	1.30	2.77	*75*	69.55	57.45	54.05	21.60	22.40	22.90	23.30
4	9/3/2025	13:30	*4.00*	129.90	n/a	5.44	3.88	1.31	2.80	*75*	69.39	57.32	53.98	21.80	22.50	22.80	24.30
4	9/3/2025	14:00	*4.00*	129.80	n/a	5.55	3.88	1.32	2.79	*75*	69.64	57.20	53.94	22.10	22.40	22.60	23.40
4	9/3/2025	14:30	*4.00*	130.10	n/a	5.70	3.89	1.31	2.79	*75*	69.54	57.28	53.85	22.10	22.40	22.60	23.40
5	9/3/2025	15:00	*3.99*	130.20	1.02	n/a	3.56	1.30	2.51	*75*	69.44	59.17	56.32	22.10	22.40	22.30	23.00
5	9/3/2025	15:30	*4.00*	130.00	1.10	n/a	3.85	1.30	2.77	*75*	69.57	58.81	55.08	22.10	22.40	23.00	24.20
5	9/3/2025	16:00	*4.00*	130.00	1.15	n/a	3.88	1.33	2.77	*76*	69.72	59.04	55.47	21.60	22.50	22.70	23.10
5	9/3/2025	16:30	*4.00*	130.00	1.20	n/a	3.88	1.32	2.78	*76*	69.45	58.04	55.67	22.00	22.50	22.50	22.80
5	9/3/2025	17:00	*4.00*	129.90	1.27	n/a	3.88	1.29	2.79	*77*	69.68	58.89	55.42	21.70	22.70	22.60	23.70
5	9/3/2025	17:30	*3.99*	130.10	1.32	n/a	3.89	1.31	2.79	*76*	69.69	58.71	55.23	22.00	22.70	22.60	24.00
5	9/3/2025	18:00	*4.00*	130.00	1.38	n/a	3.88	1.31	2.79	*76*	69.73	58.65	55.21	22.00	22.60	22.40	22.40
5	9/3/2025	18:30	*4.00*	130.00	1.47	n/a	3.89	1.33	2.79	*77*	69.59	58.72	55.18	21.90	22.50	22.50	23.00
5	9/3/2025	19:00	*4.00*	130.10	1.56	n/a	3.89	1.32	2.81	*76*	69.45	58.56	55.07	21.90	23.00	22.70	23.30
5	9/3/2025	19:30	*4.00*	130.10	1.65	n/a	3.88	1.30	2.80	*76*	69.58	58.42	54.85	21.90	22.70	22.70	24.00
5	9/3/2025	20:00	*3.99*	130.00	1.75	n/a	3.89	1.33	2.79	*76*	69.11	58.23	54.74	21.90	22.60	22.70	22.80
5	9/3/2025	20:30	*4.00*	130.10	1.83	n/a	3.88	1.34	2.79	*76*	69.27	57.99	54.74	22.00	22.60	22.40	22.50
5	9/3/2025	21:00	*4.00*	130.00	1.93	n/a	3.86	1.30	2.80	*75*	69.36	57.98	54.53	21.90	22.50	22.70	24.10
5	9/3/2025	21:30	*4.00*	130.10	2.06	n/a	3.89	1.32	2.80	*75*	69.35	57.94	54.35	21.80	22.30	22.70	23.20
5	9/3/2025	22:00	*4.00*	130.00	2.15	n/a	3.89	1.31	2.81	*75*	69.46	57.78	54.43	21.90	22.40	22.70	22.30
5	9/3/2025	22:30	*4.00*	130.10	2.53	n/a	3.86	1.30	2.82	*75*	69.33	57.45	54.03	21.90	22.60	22.40	23.80
5	9/3/2025	23:00	*4.00*	130.10	2.61	n/a	3.88	1.32	2.81	*75*	69.22	57.45	53.89	21.90	22.50	22.40	22.60
5	9/3/2025	23:10	*3.99*	130.10	2.66	n/a	3.91	1.31	2.81	*75*	69.40	57.25	53.59	21.90	22.60	22.60	23.00

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
6	9/3/2025	23:30	*4.00*	130.20	n/a	4.74	3.51	1.35	2.40	*75*	69.15	57.67	54.96	21.90	22.70	22.40	24.00
6	9/4/2025	0:00	*3.99*	130.10	n/a	4.94	3.96	1.34	2.83	*75*	69.20	57.47	53.70	21.90	22.60	22.60	22.50
6	9/4/2025	0:30	*3.99*	129.80	n/a	4.81	3.87	1.29	2.79	*75*	69.60	58.02	54.62	21.90	22.50	22.40	23.90
6	9/4/2025	1:00	*3.99*	130.10	n/a	4.74	3.87	1.35	2.80	*73*	69.54	57.98	54.36	21.60	22.40	22.30	22.40
6	9/4/2025	1:30	*3.99*	129.80	n/a	4.93	3.91	1.29	2.80	*75*	69.38	57.91	54.50	21.60	22.50	22.30	23.70
6	9/4/2025	2:00	*3.99*	130.00	n/a	4.90	3.95	1.33	2.81	*75*	69.43	57.86	54.31	21.90	22.50	22.50	22.30
6	9/4/2025	2:30	*3.99*	129.90	n/a	5.03	3.92	1.30	2.80	*76*	69.55	57.72	54.36	21.70	22.50	22.40	23.70
6	9/4/2025	3:00	*3.99*	130.00	n/a	5.14	3.87	1.33	2.80	*75*	69.18	57.39	54.18	22.00	22.20	22.30	21.90
6	9/4/2025	3:30	*3.99*	130.10	n/a	5.25	3.88	1.34	2.80	*73*	69.35	57.55	54.14	21.90	22.30	22.30	23.40
6	9/4/2025	4:00	*4.00*	130.00	n/a	5.22	3.90	1.30	2.80	*74*	69.28	57.22	53.85	21.80	22.70	22.50	23.60
6	9/4/2025	4:30	*3.99*	130.00	n/a	5.41	3.90	1.33	2.82	*76*	69.03	57.13	53.71	21.70	22.30	22.30	22.10
6	9/4/2025	5:00	*4.00*	130.10	n/a	5.41	3.98	1.29	2.82	*71*	69.32	57.27	53.59	22.00	22.30	22.20	23.30
6	9/4/2025	5:30	*3.99*	129.80	n/a	5.58	3.90	1.29	2.82	*73*	69.36	57.24	53.57	21.80	22.60	22.50	23.60
6	9/4/2025	6:00	*3.99*	130.10	n/a	5.71	3.88	1.26	2.80	*75*	69.14	56.70	53.14	21.70	22.50	22.80	23.70
6	9/4/2025	6:30	*3.99*	130.00	n/a	5.72	3.82	1.30	2.79	*76*	69.24	56.50	53.34	21.80	22.60	22.90	24.00
6	9/4/2025	7:00	*3.99*	130.10	n/a	5.70	3.86	1.30	2.79	*73*	69.22	56.71	53.15	22.00	22.40	22.60	24.00
6	9/4/2025	7:30	*3.99*	130.10	n/a	6.15	3.92	1.26	2.76	*75*	69.02	56.25	53.07	21.60	22.60	22.90	24.20
7	9/4/2025	9:00	*3.99*	130.00	0.83	n/a	3.34	1.22	2.40	*78*	69.38	59.68	57.11	22.00	22.00	22.90	22.50
7	9/4/2025	9:30	*3.99*	131.00	1.04	n/a	3.91	1.32	2.72	*78*	69.64	59.26	55.59	21.90	22.50	22.30	24.00
7	9/4/2025	10:00	*4.00*	130.00	1.09	n/a	3.89	1.30	2.72	*78*	69.05	59.12	55.58	21.70	22.90	22.70	23.10
7	9/4/2025	10:30	*4.00*	129.90	1.15	n/a	3.89	1.37	2.75	*78*	69.45	58.96	55.42	21.90	22.50	22.70	22.30
7	9/4/2025	11:00	*4.00*	130.00	1.19	n/a	3.91	1.35	2.78	*78*	69.49	58.79	55.50	21.70	22.70	22.60	24.30
7	9/4/2025	11:30	*4.00*	130.00	1.26	n/a	3.92	1.36	2.77	*78*	69.38	58.75	55.20	22.10	22.60	22.80	22.80
7	9/4/2025	12:00	*4.00*	130.00	1.33	n/a	3.87	1.32	2.78	*78*	68.99	58.78	55.27	21.70	22.50	22.70	22.60
7	9/4/2025	12:30	*4.00*	130.10	1.38	n/a	3.88	1.34	2.78	*78*	69.23	58.77	55.44	21.90	22.70	22.60	24.00
7	9/4/2025	13:00	*3.99*	130.00	1.45	n/a	3.90	1.31	2.75	*78*	69.25	58.58	55.05	22.00	22.50	22.70	23.30
7	9/4/2025	13:30	*3.99*	130.00	1.50	n/a	3.88	1.32	2.76	*78*	69.27	58.49	55.09	21.70	22.40	22.50	22.40
7	9/4/2025	14:00	*4.00*	129.80	1.58	n/a	3.94	1.36	2.79	*78*	69.29	58.44	54.86	21.80	22.40	22.80	23.80
7	9/4/2025	14:30	*4.00*	129.80	1.71	n/a	3.87	1.31	2.77	*78*	69.31	58.33	55.11	21.70	22.30	22.60	24.00
7	9/4/2025	15:00	*3.99*	130.00	1.74	n/a	3.93	1.38	2.79	*78*	69.29	57.91	54.42	21.80	22.40	22.60	22.30
7	9/4/2025	15:30	*3.99*	130.10	1.84	n/a	3.95	1.33	2.81	*78*	69.27	58.06	54.70	21.80	22.60	22.70	23.00
7	9/4/2025	16:00	*4.00*	130.00	1.99	n/a	3.93	1.36	2.78	*78*	69.00	57.92	54.67	21.80	22.60	22.70	24.20

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
7	9/4/2025	16:30	*4.00*	130.10	2.05	n/a	3.91	1.30	2.79	*78*	69.34	57.91	54.15	21.70	22.90	22.70	23.30
7	9/4/2025	17:00	*4.00*	130.10	2.15	n/a	3.88	1.30	2.77	*78*	69.42	57.88	54.26	21.70	22.70	22.50	22.30
7	9/4/2025	17:30	*4.00*	130.00	2.23	n/a	3.92	1.33	2.78	*78*	69.25	57.34	54.15	21.80	22.40	22.70	23.50
7	9/4/2025	18:00	*4.00*	130.10	2.37	n/a	3.88	1.34	2.76	*77*	69.22	57.57	54.09	21.70	22.50	22.80	23.70
7	9/4/2025	18:30	*4.00*	130.00	2.50	n/a	3.96	1.35	2.78	*77*	68.74	57.32	53.72	21.60	22.70	22.70	22.70
7	9/4/2025	19:00	*3.99*	130.10	2.59	n/a	3.94	1.32	2.81	*78*	68.97	57.10	53.65	21.70	22.70	22.60	23.10
7	9/4/2025	19:05	*4.00*	130.00	2.64	n/a	3.90	1.34	2.80	*78*	68.99	56.85	53.65	22.00	22.50	22.50	22.20
8	9/4/2025	19:30	*3.99*	131.00	n/a	4.52	3.60	1.36	2.43	*78*	69.77	57.73	54.61	21.80	22.90	22.60	24.00
8	9/4/2025	20:00	*3.99*	130.00	n/a	4.28	3.87	1.31	2.77	*78*	69.25	58.23	54.66	21.80	22.50	22.50	22.20
8	9/4/2025	20:30	*4.00*	130.00	n/a	4.40	3.88	1.36	2.80	*78*	69.50	57.89	54.60	21.80	22.50	22.70	24.10
8	9/4/2025	21:00	*3.99*	130.00	n/a	4.54	3.88	1.33	2.79	*78*	69.21	58.00	54.36	21.80	22.40	22.60	22.70
8	9/4/2025	21:30	*3.99*	130.10	n/a	4.60	3.90	1.36	2.81	*78*	69.02	57.73	54.20	21.70	22.40	22.70	23.60
8	9/4/2025	22:00	*4.00*	130.10	n/a	4.67	3.90	1.35	2.80	*77*	69.33	57.45	54.32	21.90	22.40	22.50	22.80
8	9/4/2025	22:30	*3.99*	130.10	n/a	4.81	3.95	1.35	2.82	*78*	68.87	57.49	54.10	21.90	22.60	22.40	23.60
8	9/4/2025	23:00	*4.00*	129.90	n/a	4.81	3.96	1.34	2.80	*78*	69.18	57.45	54.03	21.60	22.30	22.50	22.50
8	9/4/2025	23:30	*3.99*	129.90	n/a	4.92	3.93	1.36	2.80	*78*	69.39	57.04	54.02	21.60	22.30	22.30	23.40
8	9/5/2025	0:00	*4.00*	129.90	n/a	5.02	3.96	1.35	2.82	*75*	68.73	57.36	53.44	21.70	22.30	22.50	21.80
8	9/5/2025	0:30	*3.99*	129.70	n/a	5.03	3.97	1.36	2.79	*75*	69.29	57.28	53.47	21.70	22.00	22.30	22.90
8	9/5/2025	1:00	*4.00*	129.90	n/a	5.08	3.92	1.36	2.80	*73*	69.04	57.06	53.87	21.70	22.30	22.30	23.70
8	9/5/2025	1:30	*3.99*	130.00	n/a	5.26	3.96	1.38	2.81	*76*	69.22	56.94	53.73	22.00	22.30	22.70	23.70
8	9/5/2025	2:00	*3.99*	129.70	n/a	5.26	3.98	1.34	2.77	*73*	69.17	57.00	53.53	21.70	22.20	22.60	23.60
8	9/5/2025	2:30	*3.99*	130.10	n/a	5.49	3.91	1.33	2.77	*73*	68.62	56.89	53.55	21.90	22.50	22.70	23.80
8	9/5/2025	3:00	*3.99*	130.10	n/a	5.54	3.91	1.36	2.78	*74*	68.99	56.39	53.08	21.70	22.30	22.70	23.80
8	9/5/2025	3:30	*3.99*	130.10	n/a	5.69	3.95	1.35	2.79	*73*	69.03	56.62	53.29	21.70	22.30	22.70	23.70
8	9/5/2025	4:00	*3.99*	129.90	n/a	5.80	3.88	1.36	2.78	*75*	69.01	56.52	53.17	21.50	22.70	22.90	23.50
8	9/5/2025	4:30	*3.99*	130.00	n/a	5.86	3.87	1.33	2.80	*74*	68.92	56.34	53.06	21.70	22.60	22.90	23.50
8	9/5/2025	5:00	*3.99*	130.10	n/a	6.02	3.90	1.32	2.81	*75*	68.64	56.23	52.83	21.60	22.60	22.90	23.30
9	9/5/2025	5:30	*3.99*	129.20	1.02	n/a	3.75	1.39	2.55	*75*	69.18	58.08	55.16	22.20	22.40	22.60	23.00
9	9/5/2025	6:00	*4.00*	129.90	1.04	n/a	3.89	1.37	2.79	*75*	68.83	58.42	55.26	21.70	22.40	22.70	23.00
9	9/5/2025	6:30	*3.99*	130.10	1.07	n/a	3.88	1.33	2.81	*75*	69.08	58.47	55.00	21.60	22.40	22.70	22.60
9	9/5/2025	7:00	*3.99*	130.00	1.13	n/a	3.90	1.35	2.81	*76*	68.87	58.27	55.70	22.00	22.40	22.60	22.50
9	9/5/2025	7:30	*3.99*	130.00	1.19	n/a	3.98	1.35	2.84	*75*	68.88	58.16	54.62	22.00	22.40	22.40	22.70

			[FM-01]	FM-02	DP-01	DP-02	DP-03	DP-04	DP-05	*[P-01]*	P-02	P-03	P-05	T-01	T-02	T-03	T-AMB
Filter Period	Date	Time	*(gpm)*	(mL min^{-1})	(psid)	(psid)	(psid)	(psid)	(psid)	*(psig)*	(psig)	(psig)	(psig)	(°C)	(°C)	(°C)	(°C)
9	9/5/2025	8:00	*3.99*	130.00	1.25	n/a	3.95	1.36	2.84	*75*	68.77	58.28	54.66	21.60	22.40	22.60	22.80
9	9/5/2025	8:33	*3.99*	130.00	1.33	n/a	3.91	1.35	2.81	*75*	69.03	58.01	54.74	21.70	22.20	22.60	23.20
9	9/5/2025	9:00	*3.99*	130.10	1.37	n/a	3.96	1.35	2.82	*75*	69.10	58.10	54.55	21.60	22.50	22.60	23.60
9	9/5/2025	9:33	*4.00*	130.10	1.42	n/a	3.94	1.35	2.82	*75*	68.91	57.87	54.47	21.80	22.40	22.70	23.00
9	9/5/2025	10:00	*3.99*	130.10	1.52	n/a	3.95	1.35	2.81	*75*	69.04	57.75	54.45	21.70	22.40	22.60	22.50
9	9/5/2025	10:30	*3.99*	130.20	1.75	n/a	3.95	1.32	2.84	*75*	68.95	57.76	54.12	21.70	22.50	22.60	23.80
9	9/5/2025	11:00	*3.99*	130.10	1.77	n/a	3.93	1.35	2.82	*75*	68.98	57.50	54.17	21.90	22.30	22.60	23.30
9	9/5/2025	11:30	*3.99*	129.90	1.83	n/a	3.97	1.38	2.84	*75*	68.97	57.55	54.09	22.00	22.30	22.60	22.30
9	9/5/2025	12:00	*3.99*	130.10	1.94	n/a	3.92	1.40	2.81	*75*	69.14	54.22	54.16	21.50	22.20	22.60	24.00
9	9/5/2025	12:30	*3.99*	129.80	1.98	n/a	3.91	1.37	2.83	*75*	68.90	57.23	53.84	21.80	22.70	22.70	23.90
9	9/5/2025	13:00	*3.99*	130.00	2.09	n/a	4.00	1.36	2.80	*75*	68.96	57.09	53.79	21.60	22.20	22.60	22.50
9	9/5/2025	13:30	*3.99*	129.90	2.15	n/a	3.94	1.36	2.84	*75*	69.18	57.17	53.74	21.80	22.20	22.50	22.90
9	9/5/2025	14:00	*3.99*	129.90	2.22	n/a	3.99	1.37	2.85	*75*	69.14	57.18	53.73	21.60	22.30	22.70	24.50
9	9/5/2025	14:30	*3.99*	130.00	2.36	n/a	3.91	1.37	2.82	*75*	69.00	57.10	53.31	21.60	22.40	22.50	23.30
9	9/5/2025	15:00	*3.99*	129.90	2.49	n/a	3.98	1.34	2.83	*75*	68.77	56.63	53.42	21.60	22.20	22.60	22.40
9	9/5/2025	15:30	*3.99*	130.00	2.62	n/a	3.93	1.35	2.82	*75*	68.83	56.71	53.31	22.00	22.40	22.70	23.50
10	9/5/2025	16:00	*3.99*	129.60	n/a	4.45	3.51	1.36	2.42	*75*	68.98	57.61	54.65	21.60	22.60	22.90	23.70
10	9/5/2025	16:30	*3.99*	130.00	n/a	4.36	3.92	1.35	2.81	*75*	68.96	57.76	54.30	21.60	22.30	22.70	22.30
10	9/5/2025	17:00	*3.99*	130.00	n/a	4.45	3.95	1.37	2.81	*75*	68.77	57.68	54.31	21.50	22.50	22.60	23.10
10	9/5/2025	17:30	*3.99*	130.10	n/a	4.53	3.95	1.37	2.82	*75*	68.93	57.39	54.07	21.70	22.20	22.40	23.50
10	9/5/2025	18:00	*3.99*	130.10	n/a	4.59	3.94	1.37	2.83	*75*	68.84	57.25	54.01	21.70	22.40	22.40	22.30
10	9/5/2025	18:30	*3.99*	130.00	n/a	4.66	3.98	1.35	2.82	*75*	68.85	57.29	53.97	21.60	22.40	22.60	23.00
10	9/5/2025	19:00	*3.99*	130.00	n/a	4.72	3.95	1.35	2.83	*75*	68.96	57.41	53.90	21.50	22.20	22.50	24.00
10	9/5/2025	19:30	*3.99*	130.00	n/a	4.74	3.94	1.37	2.85	*75*	68.95	57.26	53.80	21.60	22.20	22.30	22.80
10	9/5/2025	20:00	*3.99*	130.00	n/a	4.81	3.92	1.36	2.83	*75*	68.71	57.10	53.84	21.60	22.20	22.60	22.40
10	9/5/2025	20:30	*3.99*	130.00	n/a	4.90	3.94	1.34	2.83	*75*	68.93	57.20	53.70	21.50	22.20	22.50	23.70
10	9/5/2025	21:00	*3.99*	130.00	n/a	4.96	3.97	1.36	2.85	*75*	68.54	56.80	53.39	21.60	22.10	22.30	22.60
10	9/5/2025	21:30	*3.99*	130.10	n/a	5.08	3.94	1.35	2.84	*75*	68.58	56.92	53.49	21.60	22.10	22.40	23.90
10	9/5/2025	22:00	*3.99*	130.10	n/a	5.18	3.98	1.37	2.84	*75*	68.52	56.73	53.18	21.70	22.00	22.40	22.70
10	9/5/2025	22:30	*3.99*	130.00	n/a	5.39	3.96	1.34	2.83	*75*	69.10	56.70	53.26	21.50	22.50	22.60	23.80
10	9/5/2025	23:00	*3.99*	130.00	n/a	5.55	3.99	1.36	2.85	*75*	69.11	56.52	53.13	21.60	22.40	22.50	22.40
10	9/5/2025	23:30	*3.99*	130.00	n/a	5.58	3.99	1.36	2.85	*75*	68.99	56.34	53.08	21.50	22.50	22.40	23.60

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
10	9/6/2025	0:00	*3.99*	130.10	n/a	5.70	3.95	1.39	2.85	*74*	68.47	56.05	52.87	21.60	22.40	22.50	22.40
10	9/6/2025	0:30	*3.99*	130.00	n/a	5.76	3.91	1.37	2.84	*73*	68.64	56.26	52.84	21.70	22.50	22.30	23.30
10	9/6/2025	1:00	*3.99*	130.00	n/a	5.86	3.99	1.37	2.84	*75*	68.98	56.21	52.77	21.50	22.00	22.30	21.70
10	9/6/2025	1:30	*3.99*	130.10	n/a	5.95	4.00	1.39	2.82	*75*	68.80	56.07	52.52	21.80	22.30	22.10	22.60
10	9/6/2025	2:00	*3.99*	128.70	1.02	n/a	3.68	1.39	2.60	*75*	68.70	58.43	55.20	21.50	22.40	22.10	23.30
11	9/6/2025	2:30	*3.99*	129.90	1.04	n/a	3.93	1.30	2.80	*75*	68.79	58.70	55.28	21.60	22.10	22.50	23.70
11	9/6/2025	3:00	*3.99*	130.00	1.08	n/a	3.96	1.32	2.80	*73*	68.62	58.44	55.16	21.60	22.60	22.80	23.70
11	9/6/2025	3:30	*3.99*	130.00	1.10	n/a	3.96	1.34	2.80	*75*	68.77	58.34	54.09	21.80	22.40	22.80	23.80
11	9/6/2025	4:00	*3.99*	129.90	1.16	n/a	3.93	1.36	2.79	*74*	69.09	58.48	54.97	21.80	22.40	22.90	24.00
11	9/6/2025	4:30	*3.99*	130.10	1.24	n/a	3.92	1.35	2.77	*74*	68.97	58.34	55.15	21.50	22.50	23.00	24.00
11	9/6/2025	5:00	*3.99*	130.10	1.29	n/a	3.85	1.35	2.81	*75*	69.04	58.44	55.07	21.50	22.20	23.00	23.80
11	9/6/2025	5:30	*3.99*	130.00	1.35	n/a	3.90	1.33	2.80	*73*	69.00	58.36	54.96	21.60	22.40	23.00	23.80
11	9/6/2025	6:00	*3.99*	130.10	1.39	n/a	3.91	1.34	2.80	*74*	69.12	58.24	54.89	21.60	22.50	23.00	23.90
11	9/6/2025	6:30	*3.99*	130.10	1.50	n/a	3.86	1.34	2.80	*73*	69.05	58.17	54.79	21.60	22.40	23.00	23.90
11	9/6/2025	7:00	*3.99*	130.00	1.56	n/a	3.91	1.36	2.80	*74*	68.85	58.04	54.58	21.60	22.00	23.00	22.70
11	9/6/2025	7:30	*3.99*	130.00	1.60	n/a	3.96	1.38	2.80	*73*	68.70	57.92	54.50	21.60	22.10	22.40	22.30
11	9/6/2025	8:00	*3.99*	130.10	1.71	n/a	3.97	1.33	2.83	*73*	68.81	57.96	54.48	21.50	22.10	22.40	23.40
11	9/6/2025	8:30	*3.99*	130.10	1.76	n/a	3.98	1.33	2.80	*75*	68.79	57.68	54.45	21.60	22.40	22.70	23.60
11	9/6/2025	9:00	*3.99*	130.00	1.84	n/a	3.99	1.33	2.78	*75*	68.86	57.50	54.15	21.70	22.70	22.80	23.90
11	9/6/2025	9:30	*3.99*	130.10	1.93	n/a	3.93	1.36	2.79	*75*	68.78	57.52	54.20	21.70	22.50	22.80	24.00
11	9/6/2025	10:00	*3.99*	130.10	2.04	n/a	4.00	1.37	2.80	*75*	68.68	57.47	53.83	21.50	22.10	22.40	22.20
11	9/6/2025	10:30	*3.99*	129.90	2.46	n/a	4.00	1.36	2.82	*75*	68.72	56.96	53.66	21.40	22.00	22.10	23.00
11	9/6/2025	11:00	*3.99*	130.00	2.53	n/a	3.92	1.32	2.83	*75*	68.68	56.99	53.62	21.50	22.50	22.50	23.70
11	9/6/2025	11:30	*3.99*	130.00	2.58	n/a	3.99	1.38	2.84	*75*	68.60	56.85	53.48	21.50	22.00	22.30	22.20
12	9/6/2025	12:00	*3.99*	130.00	2.71	n/a	3.96	1.39	2.84	*75*	68.61	56.85	53.33	21.60	21.90	22.20	23.30
12	9/6/2025	12:33	*3.99*	131.10	n/a	4.45	3.82	1.39	2.70	*75*	68.50	57.70	54.67	21.70	22.10	21.90	22.00
12	9/6/2025	13:00	*3.99*	130.00	n/a	4.47	3.91	1.36	2.79	*75*	68.94	57.37	54.28	21.40	22.10	22.30	23.00
12	9/6/2025	13:30	*3.99*	129.90	n/a	4.46	3.94	1.37	2.84	*78*	68.57	57.53	54.12	21.60	22.10	22.20	23.90
12	9/6/2025	14:00	*3.99*	130.00	n/a	4.54	3.99	1.38	2.85	*75*	68.67	57.21	53.77	21.60	22.10	22.40	22.40
12	9/6/2025	14:30	*3.99*	130.10	n/a	4.51	3.99	1.35	2.84	*75*	68.62	57.23	53.66	21.40	22.40	22.20	23.50
12	9/6/2025	15:00	*3.99*	130.00	n/a	4.60	3.95	1.36	2.86	*75*	68.77	57.05	53.76	21.50	22.20	22.30	21.80
12	9/6/2025	15:30	*3.99*	130.00	n/a	4.60	3.99	1.33	2.86	*75*	68.53	57.03	53.65	21.50	22.30	22.30	22.90

			[FM-01]	FM-02	DP-01	DP-02	DP-03	DP-04	DP-05	*[P-01]*	P-02	P-03	P-05	T-01	T-02	T-03	T-AMB
Filter Period	Date	Time	*(gpm)*	(mL min^{-1})	(psid)	(psid)	(psid)	(psid)	(psid)	*(psig)*	(psig)	(psig)	(psig)	(°C)	(°C)	(°C)	(°C)
12	9/6/2025	16:00	*3.99*	130.10	n/a	4.78	3.95	1.35	2.86	*75*	68.67	56.90	53.46	21.30	22.30	22.40	23.60
12	9/6/2025	16:30	*3.99*	130.00	n/a	4.82	4.04	1.39	2.86	*75*	68.22	56.66	53.34	21.40	22.30	22.30	22.60
12	9/6/2025	17:00	*3.99*	130.00	n/a	4.92	3.99	1.38	2.86	*75*	68.24	56.69	53.45	21.50	22.40	22.30	23.70
12	9/6/2025	17:30	*3.99*	129.90	n/a	4.97	3.98	1.37	2.85	*78*	68.52	56.29	53.10	21.60	21.90	22.40	22.40
12	9/6/2025	18:00	*3.99*	129.90	n/a	5.03	3.94	1.34	2.87	*78*	68.43	56.69	53.34	21.30	22.30	22.20	22.70
12	9/6/2025	18:30	*3.99*	130.00	n/a	5.15	3.96	1.38	2.84	*78*	68.78	56.46	53.37	21.60	22.30	22.30	22.90
12	9/6/2025	19:00	*3.99*	130.00	n/a	5.16	3.97	1.34	2.88	*75*	68.46	56.55	53.20	21.40	22.10	22.20	22.10
12	9/6/2025	19:30	*3.99*	130.00	n/a	5.34	4.01	1.38	2.87	*78*	68.72	56.98	53.11	21.50	22.30	22.10	22.90
12	9/6/2025	20:00	*3.99*	130.00	n/a	5.45	4.01	1.37	2.83	*75*	68.55	56.38	53.12	21.60	22.30	22.40	23.70
13	9/6/2025	20:31	*3.99*	130.40	1.03	n/a	3.74	1.37	2.59	*78*	68.65	56.14	55.36	21.60	22.20	22.50	23.60
13	9/6/2025	21:00	*3.99*	130.10	1.08	n/a	3.95	1.36	2.84	*78*	68.87	58.39	55.05	21.60	22.10	22.50	22.20
13	9/6/2025	21:30	*3.99*	130.00	1.10	n/a	3.97	1.40	2.85	*75*	68.89	58.30	54.88	21.60	22.30	22.00	22.90
13	9/6/2025	22:00	*3.99*	130.10	1.14	n/a	3.98	1.37	2.85	*75*	68.55	58.28	54.84	21.60	22.10	22.40	23.30
13	9/6/2025	22:30	*3.99*	130.00	1.25	n/a	3.98	1.35	2.82	*77*	68.70	58.18	54.54	21.70	22.30	22.40	23.50
13	9/6/2025	23:00	*3.99*	129.90	1.28	n/a	3.99	1.37	2.83	*75*	68.52	57.99	54.60	21.60	22.20	22.50	23.30
13	9/6/2025	23:30	*3.99*	130.00	1.31	n/a	4.00	1.37	2.83	*75*	68.77	58.09	54.56	21.40	22.20	22.60	23.10
13	9/7/2025	0:00	*3.99*	130.10	1.29	n/a	4.01	1.36	2.84	*74*	68.43	57.77	54.44	21.50	22.20	22.50	23.30
13	9/7/2025	0:30	*3.99*	130.10	1.36	n/a	3.99	1.35	2.84	*74*	68.80	57.80	54.24	21.40	22.00	22.50	23.00
13	9/7/2025	1:00	*3.99*	130.00	1.47	n/a	3.98	1.33	2.83	*73*	68.74	57.76	54.40	21.60	22.40	22.30	23.00
13	9/7/2025	1:30	*3.99*	130.00	1.50	n/a	3.95	1.38	2.85	*74*	68.74	57.75	54.37	21.60	22.10	22.60	23.00
13	9/7/2025	2:00	*3.99*	130.00	1.55	n/a	3.99	1.38	2.84	*74*	68.63	57.79	54.28	21.60	22.00	22.50	23.00
13	9/7/2025	2:30	*3.99*	129.90	1.60	n/a	4.00	1.38	2.85	*73*	68.40	57.54	54.16	21.60	22.20	22.60	23.10
13	9/7/2025	3:00	*3.99*	129.90	1.73	n/a	4.00	1.38	2.85	*74*	68.28	57.58	54.21	21.60	22.10	22.40	23.10
13	9/7/2025	3:30	*3.99*	130.00	1.77	n/a	3.99	1.37	2.86	*73*	68.67	57.25	53.95	21.60	22.20	22.60	23.20
13	9/7/2025	4:00	*3.99*	130.00	1.88	n/a	3.99	1.38	2.86	*74*	68.84	57.31	53.86	21.40	22.10	22.40	23.10
13	9/7/2025	4:30	*3.99*	130.10	1.95	n/a	4.00	1.35	2.86	*74*	68.87	57.15	53.59	21.60	22.30	22.60	23.00

Table C.12. Initial Differential Pressure Data for DEFs from Run W-05A

Filter Period	Date	Active Filter ID	Start Time	ΔP at t = 2 min (psid)	ΔP at t = 4 min (psid)	ΔP at t = 6 min (psid)	ΔP at t = 8 min (psid)	ΔP at t = 10 min (psid)	Target ΔP for Filter Switch (psid)
1	9/2/2025	1	8:36	0.55	0.60	0.63	0.75	0.90	2.90
2	9/2/2025	2	16:33	3.06	3.13	3.15	3.20	3.82	5.82
3	9/2/2025	1	22:50	0.43	0.47	0.50	0.53	0.66	2.66
4	9/3/2025	2	7:31	2.87	2.99	3.04	3.09	3.76	5.76
5	9/3/2025	1	14:31	0.45	0.48	0.50	0.53	0.66	2.66
6	9/3/2025	2	23:12	2.88	2.91	2.95	2.99	4.69	6.69
7	9/4/2025	1	8:50	0.43	0.47	0.51	0.52	0.66	2.66
8	9/4/2025	2	19:10	2.93	2.93	2.94	3.31	4.01	6.01
9	9/5/2025	1	5:01	0.42	0.45	0.47	0.51	0.67	2.67
10	9/5/2025	2	15:40	2.88	2.86	2.92	3.02	3.95	5.95
11	9/6/2025	1	1:31	0.40	0.45	0.48	0.50	0.71	2.71
12	9/6/2025	2	12:02	2.86	2.91	2.94	2.96	3.45	5.45
13	9/6/2025	1	20:03	0.44	0.47	0.51	0.54	0.61	2.61

Table C.13. Periodically Recorded Data from Run W-05B

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
1	9/7/2025	9:11	*4.00*	129.80	n/a	3.78	3.42	1.18	2.38	*75*	68.90	58.82	56.42	22.2	22.8	23.3	24.0
1	9/7/2025	9:31	*4.00*	128.00	n/a	4.41	3.84	1.41	2.62	*75*	69.32	58.29	55.09	22.1	22.7	22.4	22.1
1	9/7/2025	10:00	*4.00*	129.80	n/a	4.40	3.98	1.36	2.79	*75*	69.71	58.12	54.86	22.1	23.0	22.6	23.7
1	9/7/2025	10:30	*4.00*	129.80	n/a	4.42	4.04	1.38	2.77	*75*	69.32	58.23	54.82	22.0	22.4	22.7	22.7
1	9/7/2025	11:00	*4.00*	130.20	n/a	4.36	3.98	1.35	2.80	*75*	69.40	57.94	54.74	21.9	22.7	22.8	23.6
1	9/7/2025	11:31	*4.00*	130.10	n/a	4.53	3.95	1.40	2.83	*75*	69.76	57.86	54.54	22.1	22.8	23.0	24.1
1	9/7/2025	12:03	*4.00*	130.00	n/a	4.44	4.01	1.42	2.83	*75*	69.16	57.68	54.57	21.9	22.3	22.6	23.4
1	9/7/2025	12:30	*4.00*	130.00	n/a	4.45	3.97	1.39	2.80	*75*	69.60	57.85	54.55	22.0	22.5	23.0	23.3
1	9/7/2025	13:00	*4.00*	129.80	n/a	4.47	4.02	1.39	2.81	*75*	69.31	57.88	54.38	21.8	22.7	23.0	25.0
1	9/7/2025	13:30	*4.00*	129.80	n/a	4.52	3.99	1.41	2.83	*75*	69.19	57.71	54.43	21.9	22.6	23.0	24.5
1	9/7/2025	14:00	*4.00*	129.80	n/a	4.56	4.01	1.42	2.82	*75*	68.86	57.49	54.46	21.8	22.3	23.0	23.3

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
1	9/7/2025	14:30	*4.00*	130.10	n/a	4.61	3.94	1.38	2.82	*75*	69.50	57.79	54.43	21.8	22.3	23.0	23.3
1	9/7/2025	15:00	*4.00*	129.80	n/a	4.45	4.01	1.36	2.81	*75*	69.47	57.90	54.42	21.6	22.3	23.1	24.7
1	9/7/2025	15:30	*4.00*	130.10	n/a	4.50	4.00	1.39	2.81	*75*	69.08	57.85	54.31	21.9	22.7	23.2	25.4
1	9/7/2025	16:00	*4.00*	129.80	n/a	4.50	4.00	1.40	2.84	*75*	69.05	57.60	54.37	21.6	22.4	23.1	23.4
1	9/7/2025	16:30	*3.99*	129.80	n/a	4.60	4.02	1.35	2.78	*75*	69.39	57.78	54.59	21.8	22.4	23.0	23.6
1	9/7/2025	17:00	*4.00*	130.00	n/a	4.67	3.99	1.41	2.82	*75*	69.67	57.85	54.64	21.9	22.7	22.9	24.1
1	9/7/2025	17:30	*3.99*	130.10	n/a	4.62	3.95	1.41	2.83	*78*	69.27	57.48	54.53	21.9	22.8	23.0	25.5
1	9/7/2025	18:00	*3.99*	130.20	n/a	4.70	4.03	1.40	2.83	*75*	69.37	57.84	54.34	21.9	22.7	23.1	24.1
1	9/7/2025	18:30	*3.99*	130.00	n/a	4.66	3.97	1.40	2.82	*75*	69.49	57.71	54.41	21.9	22.6	23.0	23.6
1	9/7/2025	19:00	*4.00*	129.90	n/a	4.72	3.97	1.40	2.83	*75*	68.99	57.57	54.35	21.9	22.4	23.0	23.2
1	9/7/2025	19:30	*4.00*	130.00	n/a	4.72	4.00	1.41	2.84	*75*	69.06	57.72	54.42	21.8	22.5	23.0	24.1
1	9/7/2025	20:00	*4.00*	129.70	n/a	4.77	4.03	1.40	2.83	*75*	69.39	57.58	54.19	21.6	22.4	23.0	24.6
1	9/7/2025	20:30	*3.99*	130.00	n/a	4.78	4.04	1.41	2.81	*75*	69.13	57.65	54.08	21.7	22.2	22.9	22.6
1	9/7/2025	21:00	*4.00*	130.10	n/a	4.93	4.05	1.44	2.84	*75*	69.44	57.41	53.91	21.6	22.2	22.3	22.3
1	9/7/2025	21:30	*4.00*	130.10	n/a	4.97	4.07	1.45	2.89	*75*	69.49	57.25	53.94	21.6	22.5	22.3	23.3
1	9/7/2025	22:00	*4.00*	130.70	n/a	4.96	4.07	1.44	2.86	*75*	69.44	57.55	53.95	21.6	22.2	22.4	23.4
1	9/7/2025	22:30	*4.00*	129.80	n/a	5.04	4.10	1.46	2.83	*75*	69.25	56.98	53.77	21.6	22.4	22.3	22.1
1	9/7/2025	23:00	*4.00*	130.10	n/a	5.02	4.07	1.44	2.87	*75*	69.09	57.31	53.79	21.7	22.5	22.2	23.8
1	9/7/2025	23:30	*4.00*	130.10	n/a	5.07	4.12	1.45	2.87	*75*	69.10	57.30	53.87	21.7	22.6	22.4	22.3
1	9/8/2025	0:00	*4.00*	129.60	n/a	5.02	4.04	1.42	2.88	*75*	69.15	57.44	53.81	21.7	22.4	22.1	23.5
1	9/8/2025	0:30	*4.00*	130.40	n/a	5.05	4.05	1.42	2.90	*75*	69.15	57.00	53.81	21.5	22.3	22.4	22.0
1	9/8/2025	1:00	*4.00*	129.90	n/a	5.11	4.09	1.42	2.85	*75*	69.25	57.14	53.66	21.8	22.1	22.1	22.7
1	9/8/2025	1:30	*4.00*	129.90	n/a	5.10	4.11	1.39	2.90	*75*	69.11	57.34	53.75	21.7	22.3	22.3	23.3
1	9/8/2025	2:00	*4.00*	130.50	n/a	5.12	4.00	1.40	2.88	*75*	69.44	56.96	53.63	21.6	22.6	22.4	23.6
2	9/8/2025	2:30	*3.99*	130.30	0.85	n/a	3.50	1.37	2.42	*75*	69.58	59.39	56.25	21.6	22.2	22.4	22.0
2	9/8/2025	3:00	*3.99*	131.00	0.97	n/a	3.99	1.39	2.82	*75*	69.02	58.77	55.51	21.5	22.3	22.1	22.6
2	9/8/2025	3:30	*3.99*	130.20	1.03	n/a	4.11	1.39	2.86	*75*	69.08	58.44	55.32	21.7	22.5	22.5	23.2
2	9/8/2025	4:00	*4.00*	131.00	1.02	n/a	4.00	1.42	2.90	*75*	69.03	58.75	55.21	21.7	22.4	22.4	22.9
2	9/8/2025	4:30	*4.00*	129.80	1.09	n/a	4.03	1.41	2.90	*75*	69.17	58.53	55.11	21.8	22.4	22.5	23.0
2	9/8/2025	5:00	*4.00*	129.50	1.10	n/a	4.05	1.40	2.88	*75*	69.04	58.46	55.06	21.6	22.3	22.6	23.1
2	9/8/2025	5:30	*4.00*	130.50	1.06	n/a	4.00	1.40	2.88	*75*	69.44	58.66	55.15	21.4	22.5	22.4	23.0
2	9/8/2025	6:00	*3.99*	129.60	1.12	n/a	4.11	1.40	2.89	*75*	68.74	58.55	55.25	21.8	22.3	22.6	22.9

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min⁻¹)	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
2	9/8/2025	6:30	*3.99*	130.00	1.13	n/a	4.04	1.41	2.91	*75*	69.06	58.43	55.20	21.6	22.3	22.7	22.8
2	9/8/2025	7:00	*4.00*	130.10	1.15	n/a	4.12	1.45	2.92	*75*	69.11	58.54	55.01	21.5	22.4	22.3	22.7
2	9/8/2025	7:30	*4.00*	130.50	1.13	n/a	4.06	1.41	2.91	*75*	69.39	58.32	55.20	21.6	22.3	22.3	22.9
2	9/8/2025	8:00	*4.00*	130.00	1.15	n/a	4.03	1.41	2.91	*75*	69.08	58.62	54.98	21.7	22.3	22.4	23.2
2	9/8/2025	8:30	*4.00*	130.60	1.19	n/a	4.06	1.42	2.91	*75*	68.99	58.51	55.20	21.9	22.3	22.6	23.5
2	9/8/2025	9:00	*4.00*	130.10	1.22	n/a	4.03	1.41	2.90	*75*	68.88	58.31	55.04	21.8	22.1	22.6	23.5
2	9/8/2025	9:30	*4.00*	130.00	1.22	n/a	4.04	1.41	2.88	*75*	69.38	58.39	55.18	21.6	22.5	22.9	24.0
2	9/8/2025	10:00	*4.00*	130.40	1.20	n/a	4.06	1.41	2.89	*75*	69.47	58.34	54.69	21.9	22.1	22.4	22.2
2	9/8/2025	10:30	*4.00*	130.20	1.24	n/a	4.09	1.43	2.91	*75*	69.01	58.17	54.91	21.6	22.6	22.3	23.9
2	9/8/2025	11:00	*4.00*	130.20	1.24	n/a	4.10	1.41	2.89	*75*	68.95	58.15	54.70	21.4	22.3	22.5	22.1
2	9/8/2025	11:30	*4.00*	129.70	1.27	n/a	4.08	1.42	2.89	*75*	69.05	58.17	54.88	21.8	22.4	22.4	23.9
2	9/8/2025	12:00	*4.00*	130.60	1.31	n/a	4.07	1.39	2.88	*75*	69.03	58.02	54.70	21.5	22.1	22.4	23.7
2	9/8/2025	12:30	*4.00*	129.40	1.29	n/a	4.08	1.39	2.87	*75*	68.73	58.33	54.67	21.5	22.2	22.5	22.5
2	9/8/2025	13:00	*4.00*	130.60	1.28	n/a	4.12	1.42	2.91	*75*	68.86	58.31	54.88	21.7	22.3	22.3	22.3
2	9/8/2025	13:30	*4.00*	130.40	1.32	n/a	4.02	1.37	2.91	*75*	69.33	58.12	54.98	21.5	22.5	22.5	24.1
2	9/8/2025	14:00	*4.00*	130.60	1.34	n/a	4.06	1.41	2.89	*75*	69.37	58.30	54.66	21.7	22.3	22.4	24.2
2	9/8/2025	14:30	*4.00*	130.20	1.36	n/a	4.06	1.39	2.89	*75*	69.09	58.23	54.65	21.4	22.3	22.7	23.3
2	9/8/2025	15:00	*4.00*	130.30	1.36	n/a	4.07	1.38	2.91	*75*	69.05	58.26	54.82	21.5	22.3	22.4	22.7
2	9/8/2025	15:30	*4.00*	129.70	1.40	n/a	4.07	1.41	2.91	*75*	69.17	58.41	54.90	21.5	22.2	22.4	22.4
2	9/8/2025	16:00	*4.00*	130.10	1.44	n/a	4.02	1.39	2.91	*75*	68.97	58.02	54.80	21.5	22.4	22.7	23.3
2	9/8/2025	16:30	*3.99*	129.50	1.42	n/a	4.03	1.43	2.92	*75*	69.36	57.84	54.56	21.4	22.6	22.5	23.3
2	9/8/2025	17:00	*3.99*	130.40	1.40	n/a	4.06	1.38	2.89	*75*	68.94	57.21	54.52	21.6	22.5	22.6	23.7
2	9/8/2025	17:31	*3.99*	129.60	1.48	n/a	4.03	1.42	2.91	*78*	69.13	57.64	54.83	21.9	22.3	22.3	23.7
2	9/8/2025	18:01	*3.99*	129.80	1.51	n/a	4.01	1.39	2.88	*75*	69.09	58.23	54.86	21.6	22.1	22.5	25.0
2	9/8/2025	18:30	*3.99*	130.40	1.48	n/a	4.04	1.36	2.88	*75*	68.88	58.20	54.72	21.7	22.3	22.8	24.7
2	9/8/2025	19:00	*3.99*	130.20	1.51	n/a	4.06	1.37	2.88	*75*	68.84	58.02	54.28	21.6	22.5	22.9	23.1
2	9/8/2025	19:30	*3.99*	130.40	1.52	n/a	4.04	1.36	2.86	*75*	68.77	58.12	54.77	21.7	22.3	22.7	22.6
2	9/8/2025	20:00	*3.99*	130.70	1.56	n/a	4.06	1.39	2.90	*75*	68.91	57.80	54.56	21.7	22.2	22.5	23.2
2	9/8/2025	20:30	*4.00*	131.40	1.57	n/a	4.06	1.39	2.87	*75*	69.33	58.03	54.61	21.6	22.2	22.4	23.8
2	9/8/2025	21:01	*3.99*	130.50	1.84	n/a	4.06	1.36	2.88	*75*	68.85	57.65	54.07	21.6	22.3	22.6	22.9
2	9/8/2025	21:30	*4.00*	130.20	1.88	n/a	4.07	1.41	2.93	*75*	69.31	57.67	53.87	21.3	22.2	22.5	22.3
2	9/8/2025	22:00	*3.99*	130.50	1.93	n/a	4.07	1.39	2.90	*75*	69.21	57.37	53.90	21.7	22.3	22.4	23.9

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
2	9/8/2025	22:30	*3.99*	130.10	1.86	n/a	4.12	1.43	2.90	*75*	69.34	57.63	54.18	21.9	22.0	22.2	22.0
2	9/8/2025	23:00	*3.99*	130.80	1.91	n/a	4.03	1.43	2.91	*75*	69.31	57.63	54.11	21.5	22.4	22.4	23.3
2	9/8/2025	23:30	*3.99*	130.40	1.92	n/a	4.09	1.42	2.89	*75*	69.14	57.68	53.95	21.7	22.1	22.2	22.7
2	9/9/2025	0:00	*3.99*	130.70	1.99	n/a	4.05	1.43	2.92	*75*	69.18	57.51	54.24	21.8	22.4	22.3	23.4
2	9/9/2025	0:30	*4.00*	130.60	1.97	n/a	4.07	1.42	2.87	*75*	69.12	57.40	53.92	21.7	22.2	22.5	22.8
2	9/9/2025	1:00	*3.99*	129.90	2.01	n/a	4.11	1.43	2.95	*75*	69.11	57.68	54.07	21.6	22.3	22.3	23.5
2	9/9/2025	1:30	*4.00*	130.40	2.04	n/a	4.08	1.41	2.92	*75*	69.09	57.49	53.86	21.5	22.3	22.6	21.8
2	9/9/2025	2:00	*3.99*	131.40	2.05	n/a	4.09	1.43	2.91	*75*	69.27	57.50	53.56	21.4	21.8	22.2	22.9
2	9/9/2025	2:30	*3.99*	131.10	2.05	n/a	4.10	1.41	2.93	*75*	69.22	57.60	53.97	21.5	22.2	22.3	23.5
2	9/9/2025	3:00	*3.99*	130.80	2.06	n/a	4.09	1.40	2.90	*75*	69.50	57.66	54.16	21.6	22.2	22.6	23.9
2	9/9/2025	3:30	*3.99*	131.60	2.11	n/a	4.05	1.45	2.92	*75*	68.95	57.55	53.73	21.7	22.3	22.4	22.6
2	9/9/2025	4:00	*3.99*	131.10	2.15	n/a	4.13	1.42	2.87	*75*	69.16	57.47	53.88	21.6	22.0	22.3	22.4
2	9/9/2025	4:30	*3.99*	130.00	2.16	n/a	4.09	1.44	2.92	*75*	68.93	57.44	54.03	21.8	22.6	22.2	23.0
2	9/9/2025	5:00	*3.99*	129.70	2.17	n/a	4.04	1.41	2.91	*75*	69.22	57.37	53.90	21.7	22.0	22.4	23.1
2	9/9/2025	5:30	*3.99*	130.10	2.22	n/a	4.10	1.41	2.91	*75*	69.08	57.42	53.92	21.5	22.0	22.6	23.3
2	9/9/2025	6:00	*3.99*	130.00	2.24	n/a	4.09	1.43	2.93	*75*	69.24	57.10	53.74	21.6	22.1	22.5	23.0
2	9/9/2025	6:30	*3.99*	130.00	2.25	n/a	4.07	1.42	2.92	*75*	69.31	57.29	53.69	21.6	22.3	22.4	23.1
2	9/9/2025	7:00	*3.99*	130.20	2.32	n/a	4.09	1.41	2.92	*75*	69.11	57.18	53.76	21.7	22.3	22.3	23.1
3	9/9/2025	7:30	*3.99*	130.30	n/a	4.22	3.67	1.35	2.52	*75*	68.89	58.06	55.02	21.4	22.3	22.3	23.1
3	9/9/2025	8:00	*3.99*	129.80	n/a	4.39	3.99	1.38	2.88	*75*	69.16	57.98	54.68	21.4	22.1	22.4	23.0
3	9/9/2025	8:30	*3.99*	130.10	n/a	4.45	4.05	1.39	2.89	*75*	69.25	57.67	54.25	21.5	22.3	22.6	23.3
3	9/9/2025	9:00	*3.99*	130.00	n/a	4.54	4.03	1.40	2.91	*75*	69.18	57.67	54.10	21.7	22.3	22.8	23.8
3	9/9/2025	9:30	*3.99*	129.90	n/a	4.56	4.08	1.42	2.92	*75*	68.91	57.57	53.96	21.8	22.3	22.5	22.1
3	9/9/2025	10:00	*3.99*	130.20	n/a	4.53	4.07	1.43	2.94	*75*	69.16	57.62	53.94	21.5	22.1	22.3	23.0
3	9/9/2025	10:30	*3.99*	130.10	n/a	4.56	4.05	1.39	2.91	*75*	69.13	57.62	54.14	21.7	22.3	22.4	23.9
3	9/9/2025	11:00	*3.99*	130.10	n/a	4.53	4.08	1.39	2.91	*75*	68.98	57.38	54.14	21.5	22.0	22.4	22.6
3	9/9/2025	11:30	*3.99*	130.20	n/a	4.58	4.08	1.42	2.92	*75*	68.89	57.50	54.02	21.4	22.4	22.5	23.4
3	9/9/2025	12:00	*3.99*	130.50	n/a	4.61	4.10	1.41	2.91	*75*	68.96	57.45	54.05	21.7	22.3	22.5	23.5
3	9/9/2025	12:30	*3.99*	130.10	n/a	4.65	4.14	1.40	2.91	*75*	69.06	57.32	53.81	21.4	22.2	22.5	22.4
3	9/9/2025	13:00	*3.99*	129.80	n/a	4.64	4.07	1.41	2.93	*75*	68.88	57.40	54.04	21.6	22.3	22.4	22.6
3	9/9/2025	13:30	*3.99*	130.30	n/a	4.63	4.08	1.42	2.92	*75*	69.05	57.34	54.06	21.5	22.4	22.3	23.7
3	9/9/2025	14:00	*3.99*	130.00	n/a	4.66	4.09	1.43	2.91	*75*	68.94	57.22	53.93	21.6	22.5	22.7	24.0

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
3	9/9/2025	14:30	*3.99*	129.80	n/a	4.67	4.10	1.41	2.91	*75*	69.04	57.44	53.86	21.7	22.3	22.4	23.7
3	9/9/2025	15:00	*3.99*	129.50	n/a	4.75	4.07	1.42	2.92	*75*	68.96	57.25	53.80	21.5	22.3	22.3	22.7
3	9/9/2025	15:30	*3.99*	129.90	n/a	4.79	4.09	1.42	2.91	*75*	69.05	57.13	53.91	21.7	22.3	22.5	22.3
3	9/9/2025	16:00	*3.99*	130.30	n/a	4.76	4.11	1.42	2.92	*75*	69.95	57.23	53.75	21.7	22.2	22.6	22.4
3	9/9/2025	16:30	*3.99*	129.30	n/a	4.78	4.06	1.43	2.91	*75*	68.97	57.64	53.35	21.6	22.4	22.3	22.5
3	9/9/2025	17:00	*3.99*	130.60	n/a	4.76	4.06	1.43	2.94	*75*	69.06	57.25	53.76	21.6	22.3	22.5	23.0
3	9/9/2025	17:30	*3.99*	130.10	n/a	4.85	4.07	1.37	2.94	*75*	69.05	57.41	54.03	21.7	22.5	22.8	23.3
3	9/9/2025	18:00	*3.99*	131.10	n/a	4.84	4.06	1.40	2.91	*75*	69.25	57.44	53.83	21.6	22.5	22.6	23.9
3	9/9/2025	18:30	*3.99*	129.80	n/a	4.76	4.08	1.43	2.93	*75*	69.05	57.32	53.70	21.6	22.5	22.4	23.7
3	9/9/2025	19:00	*3.99*	130.60	n/a	4.86	4.10	1.39	2.93	*75*	69.22	57.71	53.71	21.6	22.4	22.4	23.4
3	9/9/2025	19:30	*3.99*	129.70	n/a	4.92	4.07	1.43	2.90	*75*	68.65	57.34	53.61	21.6	22.1	22.3	23.0
3	9/9/2025	20:00	*3.99*	130.40	n/a	4.98	4.10	1.41	2.91	*75*	69.02	57.64	53.60	21.3	22.2	22.3	22.4
3	9/9/2025	20:30	*3.99*	130.40	n/a	4.85	4.13	1.44	2.92	*75*	68.76	57.15	53.57	21.6	22.3	22.4	22.0
3	9/9/2025	21:00	*3.99*	130.50	n/a	5.23	4.11	1.43	2.90	*75*	68.89	57.34	53.48	21.5	22.1	22.3	23.1
3	9/9/2025	21:30	*3.99*	130.40	n/a	5.22	4.09	1.45	2.91	*75*	68.78	57.48	53.38	21.5	22.4	22.2	23.6
3	9/9/2025	22:00	*3.99*	129.60	n/a	5.27	4.14	1.41	2.91	*75*	68.79	58.72	53.28	21.6	22.4	22.1	22.5
3	9/9/2025	22:30	*3.99*	129.90	n/a	5.30	4.11	1.44	2.93	*75*	68.71	58.46	53.29	21.6	22.5	22.3	22.5
3	9/9/2025	23:00	*3.99*	129.60	n/a	5.27	4.12	1.44	2.88	*75*	69.06	58.74	53.28	21.3	22.1	22.4	23.1
3	9/9/2025	23:30	*3.99*	129.80	n/a	5.30	4.12	1.44	2.94	*75*	69.22	58.57	53.21	21.6	22.3	22.3	21.7
3	9/10/2025	0:00	*3.99*	129.70	n/a	5.33	4.09	1.42	2.92	*75*	68.44	56.86	53.41	21.6	22.1	22.2	23.0
3	9/10/2025	0:30	*3.99*	130.50	n/a	5.33	4.14	1.42	2.93	*75*	68.91	56.69	53.20	21.4	22.5	22.2	23.2
3	9/10/2025	1:00	*3.99*	129.00	n/a	5.38	4.13	1.46	2.93	*75*	68.88	56.66	53.01	21.6	22.1	22.3	22.7
3	9/10/2025	1:30	*3.99*	130.10	n/a	5.39	4.11	1.40	2.93	*75*	69.04	56.66	52.99	21.4	22.1	22.3	23.3
3	9/10/2025	2:00	*3.99*	131.10	n/a	5.39	4.09	1.42	2.89	*75*	68.98	56.35	53.00	21.7	22.1	22.5	22.4
3	9/10/2025	2:30	*3.99*	130.60	n/a	5.44	4.05	1.41	2.94	*75*	69.09	56.56	52.83	21.4	22.2	22.2	23.5
3	9/10/2025	3:00	*3.99*	130.10	n/a	5.47	4.00	1.44	2.91	*75*	68.97	56.72	53.28	21.5	22.2	22.4	23.7
3	9/10/2025	3:30	*3.99*	129.00	n/a	5.47	4.05	1.38	2.89	*75*	68.46	56.50	53.24	21.6	22.2	22.6	22.3
3	9/10/2025	4:00	*3.99*	129.90	n/a	5.57	4.14	1.46	2.95	*75*	69.02	56.60	53.00	21.6	21.1	22.1	22.6
3	9/10/2025	4:30	*3.99*	131.70	n/a	5.59	4.06	1.43	2.95	*75*	68.86	56.39	52.83	21.4	22.0	22.1	23.5
3	9/10/2025	5:00	*3.99*	130.00	n/a	5.63	4.13	1.39	2.95	*75*	69.07	56.38	52.61	21.4	22.0	22.3	21.9
3	9/10/2025	5:30	*3.99*	130.40	n/a	5.62	4.09	1.44	2.94	*75*	68.72	56.50	52.80	21.4	22.2	22.1	23.0
3	9/10/2025	6:00	*3.99*	130.00	n/a	5.68	4.11	1.46	2.96	*75*	68.7	56.24	52.90	21.6	22.3	22.4	23.5

Filter Period	Date	Time	*[FM-01]* (*gpm*)	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* (*psig*)	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
3	9/10/2025	6:30	*3.99*	130.90	n/a	5.69	4.10	1.44	2.93	*75*	69.05	56.11	52.91	21.6	22.1	22.3	23.4
3	9/10/2025	7:00	*3.99*	129.70	n/a	5.76	4.04	1.42	2.90	*75*	68.73	56.16	52.71	21.6	22.4	22.5	23.2
3	9/10/2025	7:30	*3.99*	131.50	n/a	5.72	4.12	1.42	2.88	*75*	68.85	56.36	52.82	21.6	22.5	22.7	23.7
3	9/10/2025	8:00	*3.99*	130.70	n/a	5.76	4.09	1.39	2.88	*75*	68.82	56.23	52.95	21.5	22.4	22.9	23.7
3	9/10/2025	8:30	*3.99*	130.10	n/a	5.73	4.10	1.40	2.88	*73*	68.63	56.03	52.82	21.7	22.5	22.6	24.0
3	9/10/2025	9:00	*3.99*	130.10	n/a	5.92	4.11	1.41	2.91	*73*	68.64	56.11	52.58	21.7	22.1	22.1	22.0
n/a	9/10/2025	10:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	20.4	n/m	n/m	23.3
n/a	9/10/2025	11:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	19.5	n/m	n/m	22.7
n/a	9/10/2025	12:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	18.7	n/m	n/m	22.4
n/a	9/10/2025	13:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	17.6	n/m	n/m	23.4
n/a	9/10/2025	14:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	17.0	n/m	n/m	24.2
n/a	9/10/2025	15:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.5	n/m	n/m	22.3
n/a	9/10/2025	16:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.9	24.0	22.6	23.9
n/a	9/10/2025	17:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.2	23.5	22.6	22.3
n/a	9/10/2025	18:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.3	23.6	23.0	24.0
n/a	9/10/2025	19:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.4	23.1	22.3	22.5
n/a	9/10/2025	20:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.8	23.6	23.0	23.6
n/a	9/10/2025	21:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.4	24.8	22.8	22.2
n/a	9/10/2025	22:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.7	24.7	22.7	22.2
n/a	9/10/2025	23:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.8	22.6	22.1	22.6
n/a	9/11/2025	0:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.2	22.6	22.3	23.0
n/a	9/11/2025	1:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.6	22.5	22.1	22.1
n/a	9/11/2025	2:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.0	23.9	22.5	22.0
n/a	9/11/2025	3:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.3	24.1	22.9	22.4
n/a	9/11/2025	4:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.6	23.3	22.7	23.0
n/a	9/11/2025	5:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.9	23.6	23.3	23.9
n/a	9/11/2025	6:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.3	24.2	23.9	24.0
n/a	9/11/2025	7:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.7	24.0	23.9	23.8
n/a	9/11/2025	8:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.2	25.6	24.1	24.3
n/a	9/11/2025	9:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.5	23.8	23.0	22.3
n/a	9/11/2025	10:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.2	24.2	23.1	23.8
n/a	9/11/2025	11:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.3	22.7	22.3	22.2

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
n/a	9/11/2025	12:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	15.7	22.6	22.3	22.1
n/a	9/11/2025	13:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.0	22.7	22.0	22.4
n/a	9/11/2025	14:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.4	22.6	22.2	22.2
n/a	9/11/2025	15:00	*n/m*	n/m	n/m	n/m	n/m	n/m	n/m	*n/m*	n/m	n/m	n/m	16.5	22.4	22.5	22.8
4	9/11/2025	15:15	*4.01*	129.8	0.80	n/a	3.50	1.32	2.34	*78*	70.91	60.65	57.97	16.7	17.8	22.8	24.1
4	9/11/2025	15:30	*4.01*	128.7	0.99	n/a	4.07	1.44	2.77	*78*	70.19	59.75	56.34	16.6	17.3	22.4	22.0
4	9/11/2025	16:00	*4.01*	130.8	1.06	n/a	4.35	1.41	3.05	*75*	70.34	55.69	55.85	15.9	17.2	20.7	24.3
4	9/11/2025	16:30	*4.01*	130.3	1.10	n/a	4.42	1.52	3.07	*75*	69.92	59.14	55.35	15.7	16.6	20.6	22.6
4	9/11/2025	17:00	*4.01*	130.4	1.12	n/a	4.35	1.52	3.12	*75*	70.27	59.04	55.46	15.6	16.5	20.2	22.6
4	9/11/2025	17:30	*4.01*	129.7	1.13	n/a	4.42	1.53	3.11	*75*	70.20	59.21	55.20	15.3	16.6	20.0	23.5
4	9/11/2025	18:09	*4.01*	129.3	1.18	n/a	4.42	1.52	3.13	*75*	70.14	59.23	55.04	15.5	16.6	19.7	22.8
4	9/11/2025	18:30	*4.01*	129.7	1.17	n/a	4.42	1.55	3.16	*75*	70.10	58.97	54.74	15.8	16.9	19.5	22.9
4	9/11/2025	19:00	*4.01*	129.5	1.20	n/a	4.47	1.52	3.14	*75*	69.74	59.17	54.88	15.7	16.9	19.7	23.2
4	9/11/2025	19:30	*4.01*	129.8	1.25	n/a	4.46	1.50	3.14	*75*	70.34	59.07	55.16	16.0	16.9	19.8	22.2
4	9/11/2025	20:00	*4.01*	131.5	1.23	n/a	4.43	1.51	3.13	*75*	70.02	59.13	55.19	16.0	17.0	19.7	23.8
4	9/11/2025	20:30	*4.01*	130.0	1.28	n/a	4.45	1.52	3.14	*74*	69.84	58.84	54.90	16.0	17.0	19.8	22.3
4	9/11/2025	21:00	*4.01*	130.40	1.29	n/a	4.40	1.53	3.13	*74*	69.93	58.83	55.08	16.3	17.2	19.9	23.2
4	9/11/2025	21:30	*4.01*	130.00	1.25	n/a	4.42	1.48	3.10	*74*	69.92	58.88	54.90	16.2	17.1	20.0	22.3
4	9/11/2025	22:00	*4.01*	129.90	1.34	n/a	4.38	1.50	3.13	*74*	69.49	58.76	54.78	16.3	17.2	19.7	23.3
4	9/11/2025	22:30	*4.01*	129.40	1.33	n/a	4.40	1.53	3.14	*74*	69.61	58.91	54.84	16.1	17.3	19.7	21.6
4	9/11/2025	23:00	*4.01*	130.30	1.36	n/a	4.43	1.50	3.13	*74*	69.99	58.84	54.64	16.2	17.1	19.7	22.8
4	9/11/2025	23:30	*4.01*	129.90	1.36	n/a	4.38	1.51	3.13	*74*	69.77	58.65	54.50	16.4	17.3	20.0	23.2
4	9/12/2025	0:00	*4.01*	130.20	1.42	n/a	4.33	1.50	3.11	*75*	69.83	58.66	54.81	16.3	17.4	20.0	23.4
4	9/12/2025	0:30	*4.01*	130.30	1.42	n/a	4.36	1.52	3.12	*75*	69.76	58.61	54.67	16.3	17.4	20.1	23.4
4	9/12/2025	1:00	*4.01*	129.20	1.48	n/a	4.40	1.49	3.09	*75*	69.64	58.42	54.51	16.5	17.5	20.1	23.4
4	9/12/2025	1:30	*4.00*	130.30	1.49	n/a	4.31	1.50	3.08	*75*	69.64	58.62	54.61	16.2	17.4	20.2	23.6
4	9/12/2025	2:00	*4.01*	130.60	1.49	n/a	4.36	1.46	3.07	*75*	69.95	58.63	54.65	16.4	17.5	20.5	23.8
4	9/12/2025	2:30	*NA*	130.20	1.49	n/a	4.30	1.49	3.08	*NA*	NA	NA	NA	16.3	17.6	20.6	23.6
4	9/12/2025	3:00	*4.00*	130.70	1.56	n/a	4.34	1.46	3.07	*75*	70.04	58.53	54.65	16.3	17.6	20.4	23.2
4	9/12/2025	3:30	*4.00*	130.10	1.70	n/a	4.40	1.50	3.11	*75*	69.86	58.23	54.58	16.3	17.3	20.5	23.1
4	9/12/2025	4:00	*4.01*	130.30	1.71	n/a	4.33	1.47	3.11	*75*	69.84	58.13	54.57	16.2	17.5	20.2	23.2
4	9/12/2025	4:30	*4.01*	129.30	1.77	n/a	4.35	1.45	3.12	*75*	69.98	58.44	54.36	16.1	17.4	20.1	22.9

			[FM-01]	FM-02	DP-01	DP-02	DP-03	DP-04	DP-05	*[P-01]*	P-02	P-03	P-05	T-01	T-02	T-03	T-AMB
Filter Period	Date	Time	*(gpm)*	(mL min^{-1})	(psid)	(psid)	(psid)	(psid)	(psid)	*(psig)*	(psig)	(psig)	(psig)	(°C)	(°C)	(°C)	(°C)
4	9/12/2025	5:00	*4.01*	130.20	1.79	n/a	4.38	1.51	3.13	*75*	69.77	58.10	54.40	16.0	17.4	20.2	22.9
4	9/12/2025	5:30	*4.01*	129.30	1.79	n/a	4.45	1.50	3.10	*75*	70.04	58.01	54.19	16.2	17.4	20.3	22.7
4	9/12/2025	6:00	*4.01*	130.20	1.83	n/a	4.41	1.49	3.11	*75*	69.40	57.98	54.09	16.1	17.3	20.0	22.6
4	9/12/2025	6:30	*4.01*	130.00	1.88	n/a	4.41	1.50	3.13	*75*	69.95	58.08	54.25	16.0	17.3	19.8	22.3
4	9/12/2025	7:00	*4.01*	130.00	1.85	n/a	4.36	1.47	3.11	*75*	69.61	58.10	54.16	16.2	17.1	19.9	22.3
4	9/12/2025	7:30	*4.00*	130.20	1.88	n/a	4.45	1.51	3.13	*75*	69.52	58.03	54.02	16.1	17.2	19.7	22.5
4	9/12/2025	8:00	*4.01*	129.80	1.92	n/a	4.38	1.49	3.14	*78*	69.60	58.01	55.02	16.0	17.1	19.9	22.6
4	9/12/2025	8:30	*4.01*	129.50	1.98	n/a	4.41	1.48	3.13	*78*	69.33	57.96	53.88	16.3	17.1	19.6	22.9
4	9/12/2025	9:00	*4.00*	130.10	2.00	n/a	4.35	1.40	3.11	*78*	69.58	57.94	53.83	16.1	17.0	20.1	23.3
4	9/12/2025	9:30	*4.01*	130.50	2.02	n/a	4.34	1.49	3.13	*78*	69.65	57.83	53.86	16.0	17.4	20.0	23.4
4	9/12/2025	10:00	*4.00*	130.20	2.01	n/a	4.42	1.49	3.10	*78*	69.65	57.83	53.90	16.1	17.5	20.1	23.9
4	9/12/2025	10:30	*4.01*	131.20	2.06	n/a	4.37	1.55	3.13	*78*	69.52	57.99	53.75	16.3	17.2	19.7	22.1
4	9/12/2025	11:00	*4.01*	129.30	2.10	n/a	4.40	1.47	3.15	*78*	69.83	57.94	53.94	16.2	17.1	19.9	23.9
4	9/12/2025	11:30	*4.00*	129.80	2.12	n/a	4.37	1.51	3.13	*75*	69.70	57.76	53.60	16.1	17.1	20.1	22.2
4	9/12/2025	12:00	*4.01*	130.30	2.13	n/a	4.43	1.49	3.12	*78*	69.87	57.57	53.85	16.2	17.3	20.1	23.9
4	9/12/2025	12:30	*4.01*	131.20	2.19	n/a	4.44	1.49	3.14	*78*	69.86	57.80	53.61	16.2	17.4	20.1	23.5
4	9/12/2025	13:00	*4.01*	130.00	2.23	n/a	4.44	1.53	3.13	*78*	69.66	57.64	53.79	16.3	17.2	19.7	22.2
4	9/12/2025	13:30	*4.01*	129.60	2.23	n/a	4.41	1.50	3.10	*78*	69.57	57.79	53.88	16.2	17.4	20.1	23.1
4	9/12/2025	14:00	*4.01*	131.20	2.30	n/a	4.44	1.47	3.13	*78*	69.66	57.53	53.59	16.2	17.4	20.0	24.4
4	9/12/2025	14:30	*4.01*	130.10	2.30	n/a	4.39	1.48	3.14	*78*	69.82	57.51	53.39	16.3	17.0	20.1	23.2
4	9/12/2025	15:00	*4.01*	130.00	2.37	n/a	4.42	1.54	3.12	*78*	69.40	57.32	53.64	16.1	17.2	20.0	22.2
5	9/12/2025	15:11	*4.01*	130.00	n/a	3.54	3.56	1.11	2.72	*78*	69.13	59.84	57.55	16.0	17.3	20.1	23.7
5	9/12/2025	15:30	*4.01*	129.80	n/a	4.33	3.81	1.41	2.68	*78*	69.89	58.48	55.57	16.3	17.1	19.9	22.6
5	9/12/2025	16:00	*4.01*	130.00	n/a	4.65	4.35	1.50	3.10	*74*	66.53	54.70	50.82	16.2	17.2	20.9	23.0
5	9/12/2025	16:30	*4.01*	130.00	n/a	4.66	4.36	1.50	3.12	*74*	66.65	54.77	50.86	16.0	17.3	20.2	23.6
5	9/12/2025	17:00	*4.01*	130.00	n/a	4.69	4.35	1.50	3.13	*74*	66.77	54.82	50.95	16.3	17.3	20.2	23.9
5	9/12/2025	17:30	*4.01*	130.00	n/a	4.74	4.39	1.50	3.12	*73*	66.80	54.85	50.89	16.1	17.3	20.0	23.9
5	9/12/2025	18:00	*4.01*	129.90	n/a	4.73	4.40	1.51	3.13	*74*	66.73	54.86	50.87	16.3	17.2	20.2	23.5
5	9/12/2025	18:30	*4.01*	129.90	n/a	4.79	4.39	1.49	3.14	*74*	66.80	54.85	50.85	16.3	17.1	20.0	23.1
5	9/12/2025	19:00	*4.01*	130.00	n/a	4.78	4.44	1.49	3.14	*74*	66.79	54.86	50.83	16.0	17.1	19.8	23.0
5	9/12/2025	19:30	*4.01*	130.00	n/a	4.84	4.42	1.50	3.15	*73*	66.91	54.86	50.83	16.0	17.0	20.0	22.2
5	9/12/2025	20:00	*4.01*	130.10	n/a	4.84	4.42	1.49	3.15	*73*	66.88	54.83	50.79	16.1	17.4	19.9	22.0

Filter Period	Date	Time	*[FM-01]* (*gpm*)	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* (*psig*)	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
5	9/12/2025	20:30	*4.01*	130.00	n/a	4.83	4.42	1.51	3.15	*75*	66.91	54.78	50.81	16.3	17.3	19.5	23.3
5	9/12/2025	21:00	*4.01*	130.00	n/a	4.86	4.42	1.49	3.13	*75*	66.89	54.65	50.79	16.3	17.0	19.7	22.1
5	9/12/2025	21:30	*4.01*	130.00	n/a	4.88	4.43	1.52	3.15	*75*	66.89	54.83	50.79	16.2	17.2	19.8	23.3
5	9/12/2025	22:00	*4.01*	130.00	n/a	4.92	4.42	1.51	3.15	*75*	66.91	54.66	50.77	16.4	17.2	20.0	21.8
5	9/12/2025	22:30	*4.01*	130.00	n/a	4.92	4.44	1.53	3.14	*75*	66.98	54.81	50.83	16.1	17.2	19.8	22.9
5	9/12/2025	23:00	*4.01*	130.00	n/a	4.97	4.43	1.51	3.15	*75*	66.87	54.81	50.72	16.1	17.2	19.6	23.2
5	9/12/2025	23:30	*4.01*	130.00	n/a	4.99	4.43	1.52	3.15	*75*	66.94	54.80	50.57	16.3	17.0	19.9	23.4

Table C.14. Initial Differential Pressure Data for DEFs from Run W-05B

Filter Period	Date	Active Filter ID	Start Time	ΔP at t = 2 min (psid)	ΔP at t = 4 min (psid)	ΔP at t = 6 min (psid)	ΔP at t = 8 min (psid)	ΔP at t = 10 min (psid)	Target ΔP for Filter Switch (psid)
1	9/7/2025	2	9:00	2.86	2.85	2.86	2.91	3.17	5.17
2	9/8/2025	1	02:13	0.47	0.50	0.53	0.61	0.77	2.77
3	9/9/2025	2	07:19	2.89	2.96	3.03	3.07	3.84	5.84
4	9/11/2025	1	15:03	1.44	0.48	0.63	0.75	0.83	2.83
5	9/12/2025	2	15:01	2.89	2.96	2.88	3.02	3.15	5.15

C.6 W-06 Tabulated Data

Table C.15. Periodically Recorded Data from Run W-06

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
1	9/22/2025	8:03	*3.99*	129.80	1.10	n/a	3.35	1.57	1.90	*62*	56.54	46.30	43.29	22.10	22.30	21.20	22.60
1	9/22/2025	8:30	*3.98*	130.10	1.31	n/a	5.92	2.18	3.78	*62*	56.06	44.07	37.30	22.10	22.50	21.30	22.50
1	9/22/2025	9:00	*3.98*	129.90	1.29	n/a	5.98	2.19	3.84	*62*	55.84	44.29	37.60	22.30	22.30	21.80	21.90
1	9/22/2025	9:30	*3.98*	129.90	1.34	n/a	6.08	2.27	3.90	*62*	55.68	44.10	37.24	22.30	23.70	22.10	21.90
1	9/22/2025	10:00	*3.98*	130.00	1.29	n/a	6.02	2.22	3.90	*62*	55.89	44.19	37.33	22.30	23.10	21.70	22.00
1	9/22/2025	10:30	*3.98*	130.10	1.34	n/a	6.03	2.22	3.90	*62*	55.99	44.17	37.25	22.40	23.00	22.10	22.20
1	9/22/2025	11:00	*3.98*	130.10	1.38	n/a	5.93	2.23	3.92	*62*	55.49	43.96	37.25	22.60	23.10	22.30	22.60
1	9/22/2025	11:34	*3.98*	130.00	1.32	n/a	5.87	2.18	3.85	*62*	55.82	44.02	37.45	22.70	23.40	22.60	23.30
1	9/22/2025	12:00	*3.99*	130.00	1.30	n/a	5.91	2.14	3.85	*62*	55.90	44.11	37.51	23.00	23.30	22.90	23.60
1	9/22/2025	12:30	*3.98*	130.00	1.36	n/a	5.79	2.16	3.82	*62*	55.75	44.07	37.50	22.90	23.30	23.30	23.20
1	9/22/2025	13:00	*3.98*	130.00	1.36	n/a	5.92	2.17	3.85	*62*	55.51	44.11	37.62	23.00	23.50	23.00	23.50
1	9/22/2025	13:30	*3.98*	129.90	1.37	n/a	5.92	2.17	3.86	*62*	55.78	44.21	37.62	23.20	22.60	23.00	22.20
1	9/22/2025	14:00	*3.98*	130.10	1.35	n/a	5.86	2.15	3.84	*62*	55.76	44.17	37.53	23.40	23.70	23.00	23.80
1	9/22/2025	14:30	*3.98*	130.00	1.35	n/a	5.88	2.17	3.86	*62*	55.60	43.95	37.57	22.60	23.70	23.20	23.70
1	9/22/2025	15:00	*3.98*	130.00	1.38	n/a	5.88	2.12	3.86	*62*	55.75	44.10	37.66	23.50	24.30	23.10	23.10
1	9/22/2025	15:30	*3.98*	130.00	1.31	n/a	5.86	2.18	3.86	*62*	55.36	44.12	37.54	23.50	24.00	23.00	22.60
1	9/22/2025	16:00	*3.98*	130.00	1.36	n/a	5.84	2.12	3.87	*65*	55.69	44.38	37.47	23.60	24.00	23.20	21.80
1	9/22/2025	16:30	*3.98*	130.00	1.36	n/a	5.78	2.16	3.86	*62*	55.61	44.03	37.57	24.00	24.30	23.40	22.10
1	9/22/2025	17:00	*3.99*	129.90	1.36	n/a	5.87	2.16	3.84	*62*	55.64	43.70	37.36	23.90	24.30	23.50	23.20
1	9/22/2025	17:30	*3.98*	130.00	1.37	n/a	5.86	2.16	3.86	*62*	55.45	43.73	37.17	24.00	24.70	23.60	23.50
1	9/22/2025	18:00	*3.98*	130.00	1.35	n/a	5.73	2.14	3.83	*62*	55.14	43.80	37.23	24.10	24.40	23.50	22.30
1	9/22/2025	18:30	*3.98*	130.10	1.34	n/a	5.74	2.13	3.81	*62*	55.27	43.61	37.14	24.20	24.40	23.60	23.00
1	9/22/2025	19:00	*3.98*	130.10	1.36	n/a	5.85	2.14	3.83	*62*	55.50	43.50	37.12	24.30	24.30	23.60	22.80
1	9/22/2025	19:30	*3.99*	130.00	1.36	n/a	5.81	2.11	3.85	*62*	55.55	43.63	37.28	24.40	24.90	23.70	23.10
1	9/22/2025	20:00	*3.98*	130.00	1.32	n/a	5.76	2.09	3.83	*62*	55.65	44.18	37.57	24.30	24.10	23.80	22.10
1	9/22/2025	20:30	*3.98*	130.00	1.34	n/a	5.78	2.12	3.83	*62*	55.38	44.12	37.70	24.70	24.90	24.00	23.00
1	9/22/2025	21:00	*3.98*	130.00	1.30	n/a	5.79	2.13	3.85	*62*	55.11	43.90	37.53	24.60	25.10	23.90	22.80
1	9/22/2025	21:30	*3.98*	130.00	1.31	n/a	5.81	2.11	3.81	*62*	55.54	43.95	37.71	24.60	25.00	23.90	22.50

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
1	9/22/2025	22:00	*3.98*	130.00	1.35	n/a	5.82	2.12	3.86	*62*	55.13	43.45	37.51	24.90	24.90	23.70	22.40
1	9/22/2025	22:30	*3.98*	130.00	1.34	n/a	5.83	2.10	3.84	*62*	55.02	43.41	37.45	24.60	24.80	23.70	22.00
1	9/22/2025	23:00	*3.98*	130.00	1.32	n/a	5.85	2.08	3.84	*62*	55.01	43.89	37.45	24.90	25.20	23.30	21.80
1	9/22/2025	23:30	*3.98*	130.00	1.30	n/a	5.87	2.08	3.83	*62*	55.11	44.01	37.35	24.90	25.00	23.30	21.40
1	9/23/2025	0:00	*3.98*	130.00	1.34	n/a	5.84	2.07	3.83	*61*	55.46	44.01	37.37	25.00	25.20	23.30	21.60
1	9/23/2025	0:30	*3.98*	130.10	1.34	n/a	5.81	2.07	3.76	*61*	55.60	44.72	37.74	24.70	25.00	23.50	23.10
1	9/23/2025	1:00	*3.98*	130.00	1.35	n/a	5.80	2.08	3.86	*61*	55.68	44.25	37.52	24.30	24.70	23.80	21.40
1	9/23/2025	1:30	*3.98*	129.90	1.38	n/a	5.82	2.11	3.89	*61*	55.43	43.95	37.48	23.60	24.20	23.00	21.70
1	9/23/2025	2:00	*3.98*	129.90	1.38	n/a	5.81	2.05	3.91	*61*	55.43	44.18	37.44	23.40	23.90	23.10	23.10
1	9/23/2025	2:30	*3.98*	130.00	1.38	n/a	5.83	2.09	3.94	*61*	55.16	44.14	37.32	23.00	23.40	23.20	21.60
1	9/23/2025	3:00	*3.98*	130.10	1.38	n/a	5.98	2.15	4.00	*61*	55.58	43.93	37.13	22.60	23.30	22.70	21.50
1	9/23/2025	3:30	*3.98*	130.00	1.38	n/a	5.90	2.09	3.99	*61*	55.43	44.09	37.45	22.70	23.00	22.60	23.00
1	9/23/2025	4:00	*3.98*	129.90	1.37	n/a	5.98	2.17	4.03	*61*	55.61	43.89	37.23	22.30	22.70	22.80	21.60
1	9/23/2025	4:30	*3.98*	129.90	1.41	n/a	6.01	2.10	4.04	*61*	55.25	43.97	37.08	22.00	22.60	22.40	22.20
1	9/23/2025	5:00	*3.98*	130.00	1.40	n/a	5.95	2.15	4.00	*61*	55.21	43.86	37.03	21.90	22.90	22.10	23.00
1	9/23/2025	5:30	*3.98*	130.00	1.40	n/a	6.02	2.15	4.08	*61*	55.58	43.72	36.81	21.70	22.30	22.30	21.00
1	9/23/2025	6:05	*3.98*	129.90	1.38	n/a	6.15	2.18	4.06	*61*	55.23	43.65	36.73	21.90	22.00	22.00	22.50
1	9/23/2025	6:30	*3.98*	130.00	1.42	n/a	6.15	2.18	4.10	*61*	55.20	43.77	36.69	21.60	22.30	21.70	21.60
1	9/23/2025	7:00	*3.98*	130.00	1.40	n/a	6.07	2.15	4.07	*61*	55.25	43.62	36.66	21.40	22.10	21.80	21.90
1	9/23/2025	7:30	*3.98*	130.00	1.43	n/a	6.15	2.19	4.13	*61*	55.44	43.73	36.69	21.60	21.60	22.00	22.80
1	9/23/2025	8:00	*3.98*	129.90	1.45	n/a	6.09	2.18	4.09	*62*	55.45	43.79	36.73	21.40	21.80	21.90	21.60
2	9/23/2025	8:15	*3.98*	129.30	n/a	4.90	4.64	1.80	3.01	*61*	55.20	44.17	39.06	21.40	21.90	21.80	22.40
2	9/23/2025	8:30	*3.98*	129.90	n/a	5.47	5.39	2.23	3.38	*61*	54.94	42.17	36.16	21.30	22.10	22.30	23.40
2	9/23/2025	9:00	*3.98*	129.90	n/a	5.54	6.14	2.18	4.14	*62*	55.24	42.59	35.56	21.40	21.90	22.10	22.20
2	9/23/2025	9:30	*3.98*	129.90	n/a	5.52	6.14	2.20	4.17	*62*	55.30	42.63	35.31	21.40	21.80	22.00	21.80
2	9/23/2025	10:00	*3.98*	130.00	n/a	5.56	6.12	2.14	4.17	*62*	55.60	42.47	35.52	21.20	21.80	21.90	22.10
2	9/23/2025	10:30	*3.98*	130.00	n/a	5.59	6.21	2.19	4.17	*62*	55.49	42.61	35.38	21.20	21.80	21.80	22.30
2	9/23/2025	11:00	*3.98*	130.00	n/a	5.58	6.17	2.19	4.17	*62*	55.61	42.48	35.42	21.00	21.90	22.10	22.60
2	9/23/2025	11:30	*3.98*	130.00	n/a	5.53	6.15	2.12	4.14	*62*	55.61	42.54	35.56	21.30	21.50	22.10	23.30
2	9/23/2025	12:00	*3.98*	130.00	n/a	5.56	6.13	2.12	4.11	*62*	55.16	42.63	35.74	21.30	22.10	22.30	23.60
2	9/23/2025	12:30	*3.98*	130.00	n/a	5.56	6.11	2.16	4.09	*62*	55.12	42.53	35.59	21.20	21.90	22.40	23.40
2	9/23/2025	13:00	*3.98*	130.00	n/a	5.46	6.10	2.10	4.13	*62*	55.44	42.63	35.58	21.20	21.90	22.20	23.50

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
2	9/23/2025	13:30	*3.98*	130.00	n/a	5.49	6.13	2.14	4.10	*62*	55.30	42.62	35.56	21.30	21.70	22.30	22.40
2	9/23/2025	14:00	*3.98*	130.00	n/a	5.46	6.12	2.15	4.15	*62*	55.21	42.42	35.44	21.20	21.60	22.30	22.00
2	9/23/2025	14:30	*3.98*	130.00	n/a	5.58	6.14	2.17	4.17	*62*	55.55	42.42	35.48	21.10	22.20	22.00	22.20
2	9/23/2025	15:00	*3.98*	130.00	n/a	5.56	6.12	2.14	4.16	*62*	55.18	42.43	35.61	21.20	21.60	22.30	22.60
2	9/23/2025	15:30	*3.98*	129.90	n/a	5.55	6.12	2.17	4.15	*62*	55.42	42.55	35.51	21.20	21.70	22.10	22.50
2	9/23/2025	16:00	*3.98*	130.00	n/a	5.55	6.12	2.15	4.14	*62*	55.50	42.58	35.59	21.30	22.40	22.00	22.80
2	9/23/2025	16:30	*3.98*	130.00	n/a	5.57	6.06	2.09	4.14	*62*	55.55	42.39	35.55	21.30	22.00	22.10	22.80
2	9/23/2025	17:00	*3.98*	129.90	n/a	5.55	6.13	2.15	4.14	*62*	55.30	42.65	35.66	21.20	21.90	22.10	23.20
2	9/23/2025	17:30	*3.98*	130.00	n/a	5.67	6.13	2.15	4.18	*62*	55.20	42.60	35.50	21.70	21.90	22.10	23.50
2	9/23/2025	18:00	*3.98*	130.00	n/a	5.59	6.06	2.12	4.18	*62*	55.34	42.38	35.54	21.90	22.10	22.10	23.60
2	9/23/2025	18:30	*3.98*	130.10	n/a	5.61	6.01	2.17	4.19	*62*	55.18	42.40	35.53	21.80	21.50	22.00	23.40
2	9/23/2025	19:00	*3.98*	130.00	n/a	5.45	6.17	2.18	4.20	*62*	55.45	42.45	35.40	21.90	21.40	21.70	22.80
2	9/23/2025	19:30	*3.98*	129.90	n/a	5.59	6.11	2.15	4.18	*62*	55.33	42.47	35.55	22.10	22.10	22.10	22.90
2	9/23/2025	20:00	*3.98*	132.00	n/a	5.65	6.20	2.16	4.22	*62*	55.12	42.17	35.22	21.30	21.60	22.10	23.00
2	9/23/2025	20:30	*3.98*	130.00	n/a	5.63	6.12	2.12	4.18	*62*	55.50	42.51	35.43	21.40	22.10	22.10	23.30
2	9/23/2025	21:00	*3.98*	130.00	n/a	5.63	6.11	2.13	4.15	*62*	55.45	42.54	35.45	21.00	21.90	22.30	23.50
2	9/23/2025	21:30	*3.98*	130.00	n/a	5.62	6.00	2.17	4.13	*62*	55.13	42.57	35.55	21.20	22.00	22.50	23.50
2	9/23/2025	22:00	*3.98*	130.00	n/a	5.62	6.03	2.12	4.14	*62*	55.51	42.35	35.39	21.20	21.90	22.40	23.00
2	9/23/2025	22:30	*3.98*	130.00	n/a	5.61	6.12	2.12	4.18	*62*	55.37	42.40	35.37	21.40	22.30	22.30	22.80
2	9/23/2025	23:00	*3.98*	130.00	n/a	5.64	6.15	2.13	4.18	*62*	55.53	42.33	35.41	21.30	22.00	22.30	22.50
2	9/23/2025	23:30	*3.98*	130.00	n/a	5.65	6.17	2.14	4.24	*62*	55.16	42.15	35.60	21.30	21.80	21.90	22.10
2	9/24/2025	0:00	*3.98*	130.00	n/a	5.58	6.19	2.14	4.24	*61*	55.07	42.19	35.13	21.20	22.10	21.80	22.10
2	9/24/2025	0:30	*3.98*	129.90	n/a	5.49	6.22	2.14	4.24	*61*	55.02	42.14	35.04	21.30	21.50	22.00	21.50
2	9/24/2025	1:00	*3.98*	130.00	n/a	5.53	6.15	2.17	4.24	*61*	55.15	42.27	35.16	21.10	21.60	21.50	21.60
2	9/24/2025	1:30	*3.98*	129.90	n/a	5.62	6.25	2.16	4.23	*61*	54.92	42.27	34.95	21.10	21.20	21.50	21.20
2	9/24/2025	2:00	*3.98*	130.00	n/a	5.66	6.22	2.12	4.21	*61*	55.33	42.07	34.98	21.00	21.40	21.00	21.00
2	9/24/2025	2:30	*3.98*	130.00	n/a	5.53	6.27	2.12	4.22	*61*	55.14	42.17	35.10	21.20	21.40	21.20	22.20
2	9/24/2025	3:00	*3.98*	129.90	n/a	5.56	6.22	2.07	4.24	*61*	54.88	42.23	35.10	21.10	21.60	21.70	22.50
2	9/24/2025	3:30	*3.98*	130.00	n/a	5.49	6.28	2.08	4.22	*61*	55.35	42.16	35.02	20.90	21.20	21.40	21.30
2	9/24/2025	4:00	*3.98*	130.00	n/a	5.64	6.23	2.16	4.21	*61*	55.15	42.26	34.30	21.00	21.60	21.40	21.00
2	9/24/2025	4:30	*3.98*	130.00	n/a	5.56	6.27	2.10	4.19	*61*	55.33	42.16	34.84	21.00	21.90	21.00	21.20
2	9/24/2025	5:00	*3.98*	130.00	n/a	5.61	6.15	2.14	4.25	*61*	54.85	42.04	35.04	21.10	21.70	21.40	23.00

Filter Period	Date	Time	*[FM-01]* (*gpm*)	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* (*psig*)	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
2	9/24/2025	5:30	*3.98*	129.80	n/a	5.57	6.25	2.08	4.25	*61*	54.99	42.02	35.01	21.40	21.50	21.50	21.40
2	9/24/2025	6:00	*3.98*	130.00	n/a	5.58	6.26	2.11	4.21	*61*	55.01	42.18	34.96	21.00	21.40	21.30	21.20
2	9/24/2025	6:30	*3.98*	130.00	n/a	5.54	6.19	2.14	4.22	*61*	55.08	42.22	34.35	21.20	21.70	21.60	22.60
2	9/24/2025	7:00	*3.98*	130.00	n/a	5.68	6.22	2.13	4.24	*61*	55.07	42.02	34.89	21.20	22.00	21.50	21.50
2	9/24/2025	7:30	*3.98*	130.00	n/a	5.63	6.16	2.07	4.23	*61*	54.90	42.21	34.94	21.10	21.60	21.40	21.50
2	9/24/2025	8:00	*3.98*	130.60	n/a	5.69	6.16	2.13	4.23	*61*	55.03	42.00	34.94	21.20	21.70	21.40	23.10
3	9/24/2025	8:11	*3.98*	129.40	0.89	n/a	4.53	1.48	3.22	*61*	54.74	45.63	41.25	21.20	22.00	21.60	22.50
3	9/24/2025	8:30	*3.98*	129.10	1.06	n/a	5.63	2.19	3.57	*61*	54.63	43.08	36.94	21.30	21.60	22.10	21.90
3	9/24/2025	9:00	*3.98*	130.00	1.17	n/a	6.23	2.13	4.25	*61*	55.13	43.53	36.44	21.30	21.70	21.60	21.80
3	9/24/2025	9:30	*3.98*	130.00	1.21	n/a	6.23	2.14	4.25	*62*	55.15	43.52	36.41	21.20	21.80	21.90	22.00
3	9/24/2025	10:00	*3.98*	130.00	1.24	n/a	6.21	2.13	4.23	*62*	54.87	43.47	36.47	21.30	21.80	21.80	22.10
3	9/24/2025	10:30	*3.98*	130.00	1.23	n/a	6.21	2.12	4.23	*62*	55.16	43.67	36.44	21.20	21.80	21.90	22.60
3	9/24/2025	11:00	*3.98*	130.00	1.27	n/a	6.14	2.11	4.19	*62*	55.16	43.63	36.65	21.40	21.90	22.00	23.20
3	9/24/2025	11:30	*3.98*	130.00	1.29	n/a	6.11	2.09	4.14	*62*	55.14	54.57	36.76	21.20	22.00	22.40	23.90
3	9/24/2025	12:00	*3.98*	130.00	1.26	n/a	6.11	2.10	4.15	*62*	54.90	43.65	36.62	21.40	21.90	22.30	22.10
3	9/24/2025	12:30	*3.98*	130.00	1.29	n/a	6.10	2.09	4.17	*62*	54.94	43.54	36.78	21.30	22.10	22.40	23.90
3	9/24/2025	13:00	*3.98*	130.10	1.28	n/a	6.11	2.10	4.19	*62*	55.19	43.55	36.75	21.70	21.80	22.50	23.90
3	9/24/2025	13:30	*3.98*	130.00	1.29	n/a	6.12	2.09	4.18	*62*	54.75	43.58	36.57	21.40	22.10	22.30	23.30
3	9/24/2025	14:00	*3.98*	130.10	1.30	n/a	6.14	2.11	4.19	*62*	55.12	43.62	36.66	21.40	21.60	22.20	22.70
3	9/24/2025	14:30	*3.98*	130.10	1.30	n/a	6.13	2.12	4.20	*62*	55.17	43.62	36.64	21.30	22.20	22.10	22.80
3	9/24/2025	15:00	*3.98*	130.10	1.29	n/a	6.11	2.11	4.17	*62*	54.65	43.34	36.44	21.50	22.00	22.50	22.50
3	9/24/2025	15:30	*3.98*	130.00	1.30	n/a	6.12	2.10	4.20	*62*	54.97	43.42	36.51	21.70	22.10	22.20	22.10
3	9/24/2025	16:00	*3.98*	130.00	1.28	n/a	6.13	2.11	4.19	*62*	54.67	43.52	36.58	21.80	22.10	22.30	22.10
3	9/24/2025	16:30	*3.98*	130.00	1.30	n/a	6.11	2.11	4.20	*62*	54.67	43.55	36.56	21.40	22.10	22.50	22.00
3	9/24/2025	17:00	*3.98*	129.90	1.31	n/a	6.12	2.07	4.20	*62*	54.59	43.54	36.55	21.60	22.30	22.20	22.00
3	9/24/2025	17:30	*3.98*	130.00	1.30	n/a	6.07	2.10	4.20	*62*	54.73	43.40	36.45	21.50	22.10	22.20	22.30
3	9/24/2025	18:00	*3.98*	129.90	1.31	n/a	6.12	2.11	4.20	*62*	54.92	43.53	36.54	21.40	22.40	22.30	22.60
3	9/24/2025	18:30	*3.98*	130.00	1.32	n/a	6.12	2.09	4.18	*62*	55.00	43.62	36.64	21.40	22.30	22.30	23.30
3	9/24/2025	19:00	*3.98*	130.00	1.32	n/a	6.11	2.10	4.20	*62*	55.05	43.62	36.68	21.50	21.30	22.20	23.70
3	9/24/2025	19:30	*3.98*	130.00	1.32	n/a	6.11	2.09	4.21	*62*	54.81	43.56	36.53	21.60	22.10	22.30	23.40
3	9/24/2025	20:00	*3.98*	130.00	1.33	n/a	6.15	2.11	4.22	*62*	54.54	43.23	36.33	21.60	22.20	22.40	22.10
3	9/24/2025	20:30	*3.98*	130.00	1.34	n/a	6.04	2.07	4.20	*62*	54.89	43.33	36.56	21.40	21.00	22.00	23.50

Filter Period	Date	Time	*[FM-01]* *(gpm)*	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* *(psig)*	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
3	9/24/2025	21:00	*3.98*	130.00	1.33	n/a	6.15	2.05	4.21	*62*	54.54	43.31	36.33	21.40	22.30	22.30	22.00
3	9/24/2025	21:30	*3.98*	130.00	1.35	n/a	6.14	2.08	4.22	*62*	54.92	43.25	36.46	21.40	22.10	22.10	23.10
3	9/24/2025	22:00	*3.98*	130.00	1.34	n/a	6.11	2.08	4.19	*62*	55.02	43.29	36.50	21.50	22.20	22.30	23.10
3	9/24/2025	22:30	*3.98*	130.00	1.35	n/a	6.12	2.09	4.17	*62*	54.66	43.42	36.50	21.50	22.00	22.60	23.40
3	9/24/2025	23:00	*3.98*	130.00	1.36	n/a	6.11	2.09	4.18	*62*	54.86	43.49	36.42	21.30	22.00	22.40	23.30
3	9/24/2025	23:30	*3.98*	130.00	1.36	n/a	6.11	2.18	4.19	*62*	55.01	43.45	36.55	21.40	22.20	22.30	23.00
3	9/25/2025	0:00	*3.98*	129.90	1.35	n/a	6.06	2.10	4.19	*61*	55.03	43.46	36.37	21.40	22.40	22.40	22.60
3	9/25/2025	0:30	*3.98*	130.00	1.28	n/a	6.04	2.09	4.21	*61*	54.65	43.36	36.38	21.30	22.10	22.20	22.30
3	9/25/2025	1:00	*3.98*	129.90	1.33	n/a	6.17	2.08	4.23	*61*	54.51	43.26	36.29	21.40	22.20	22.00	22.10
3	9/25/2025	1:30	*3.98*	130.00	1.31	n/a	6.18	2.12	4.24	*61*	54.85	43.11	36.06	21.30	22.00	22.00	22.10
3	9/25/2025	2:00	*3.98*	130.00	1.31	n/a	6.15	2.14	4.22	*61*	54.66	43.26	36.17	21.20	21.50	21.80	22.00
3	9/25/2025	2:30	*3.98*	129.90	1.35	n/a	6.24	2.12	4.24	*61*	54.57	43.23	36.16	21.40	22.30	21.90	21.70
3	9/25/2025	3:00	*3.98*	130.00	1.26	n/a	6.16	2.13	4.23	*61*	54.47	43.26	36.11	21.20	21.60	21.60	21.40
3	9/25/2025	3:30	*3.97*	130.00	1.28	n/a	6.15	2.14	4.20	*61*	54.85	43.08	35.98	21.50	21.80	21.40	21.40
3	9/25/2025	4:00	*3.98*	130.10	1.35	n/a	6.17	2.10	4.24	*61*	54.88	43.21	35.90	21.00	21.70	21.50	21.30
3	9/25/2025	4:30	*3.98*	129.90	1.35	n/a	6.28	2.15	4.20	*61*	54.83	43.20	35.89	21.10	21.70	21.40	21.00
3	9/25/2025	5:00	*3.97*	130.00	1.35	n/a	6.27	2.15	4.24	*61*	54.43	43.04	35.96	21.20	21.60	21.00	20.90
3	9/25/2025	5:30	*3.98*	130.00	1.34	n/a	6.27	2.14	4.20	*61*	54.49	43.10	35.92	21.30	21.90	21.40	22.20
3	9/25/2025	6:00	*3.98*	130.00	1.36	n/a	6.15	2.09	4.21	*61*	54.91	43.01	36.09	21.30	21.80	21.70	21.50
3	9/25/2025	6:30	*3.98*	130.00	1.36	n/a	6.25	2.11	4.25	*61*	54.45	43.27	35.93	21.20	22.20	21.30	21.40
3	9/25/2025	7:00	*3.98*	130.00	1.35	n/a	6.29	2.13	4.20	*61*	54.63	43.23	35.84	21.20	21.60	21.50	21.30
3	9/25/2025	7:32	*3.98*	130.00	1.30	n/a	6.27	2.13	4.25	*61*	54.53	42.92	35.98	21.30	21.60	21.60	22.60
3	9/25/2025	8:00	*3.98*	130.00	1.34	n/a	6.25	2.15	4.22	*61*	54.48	43.00	35.88	21.20	21.70	22.00	22.00
4	9/25/2025	8:30	*3.98*	130.30	n/a	5.38	5.36	2.15	3.46	*60*	54.45	41.43	34.84	21.40	21.70	22.10	22.10
4	9/25/2025	9:00	*3.97*	130.00	n/a	5.43	6.26	2.15	4.26	*60*	54.66	41.81	34.51	21.40	21.90	21.60	22.40
4	9/25/2025	9:30	*3.97*	130.00	n/a	5.37	6.23	2.13	4.22	*60*	54.73	41.64	34.48	21.20	21.40	21.80	22.70
4	9/25/2025	10:00	*3.98*	130.00	n/a	5.40	6.13	2.11	4.21	*60*	54.80	41.82	34.75	21.30	22.20	21.90	23.30
4	9/25/2025	10:30	*3.98*	130.00	n/a	5.41	6.15	2.11	4.15	*60*	54.39	41.84	34.87	21.30	22.10	22.30	23.90
5	9/25/2025	10:44	*3.98*	129.80	0.91	n/a	4.67	1.81	3.06	*60*	54.42	44.17	39.00	21.40	22.00	22.60	24.00
5	9/25/2025	11:00	*3.98*	130.20	0.98	n/a	5.42	2.12	3.46	*60*	54.26	43.35	37.02	21.50	22.10	22.90	22.40
5	9/25/2025	11:30	*3.97*	130.00	1.12	n/a	6.08	2.10	4.21	*60*	54.64	43.23	36.24	21.50	22.10	22.40	24.20
5	9/25/2025	12:00	*3.97*	130.00	1.18	n/a	6.15	2.10	4.20	*60*	54.65	43.08	36.07	21.40	22.30	22.60	23.60

Filter Period	Date	Time	*[FM-01]* (*gpm*)	FM-02 (mL min^{-1})	DP-01 (psid)	DP-02 (psid)	DP-03 (psid)	DP-04 (psid)	DP-05 (psid)	*[P-01]* (*psig*)	P-02 (psig)	P-03 (psig)	P-05 (psig)	T-01 (°C)	T-02 (°C)	T-03 (°C)	T-AMB (°C)
5	9/25/2025	12:30	*3.98*	130.00	1.18	n/a	6.14	2.11	4.23	*60*	54.70	43.24	36.12	21.50	22.00	22.30	23.00
5	9/25/2025	13:00	*3.98*	130.00	1.24	n/a	6.15	2.11	4.21	*60*	54.57	43.17	36.08	21.30	22.10	22.40	23.00
5	9/25/2025	13:30	*3.98*	130.00	1.24	n/a	6.14	2.12	4.20	*60*	54.46	43.05	36.06	21.70	22.40	22.30	23.00
5	9/25/2025	14:00	*3.98*	130.00	1.23	n/a	6.15	2.08	4.23	*60*	54.43	43.05	36.06	21.50	22.10	22.40	22.80
5	9/25/2025	14:30	*3.98*	130.00	1.25	n/a	6.16	2.11	4.22	*60*	54.36	43.22	36.10	21.30	22.00	22.20	22.80
5	9/25/2025	15:00	*3.98*	130.10	1.26	n/a	6.17	2.10	4.21	*60*	54.55	43.23	36.08	21.30	21.80	22.30	22.50
5	9/25/2025	15:30	*3.98*	130.00	1.25	n/a	6.12	2.11	4.23	*60*	54.72	43.07	36.17	21.60	22.10	22.40	22.70
5	9/25/2025	16:00	*3.98*	130.00	1.26	n/a	6.11	2.13	4.23	*62*	54.46	43.84	36.02	21.40	21.70	22.40	22.20
5	9/25/2025	16:30	*3.98*	130.00	1.25	n/a	6.07	2.13	4.24	*62*	54.51	43.32	36.11	21.50	22.10	22.20	22.50
5	9/25/2025	17:00	*3.98*	130.00	1.22	n/a	6.11	2.10	4.24	*62*	54.31	43.25	36.12	21.30	22.20	22.40	22.30
5	9/25/2025	17:30	*3.98*	130.00	1.29	n/a	6.15	2.11	4.24	*62*	54.54	43.62	36.15	21.60	22.00	22.30	22.60
5	9/25/2025	18:00	*3.98*	130.00	1.28	n/a	6.16	2.10	4.24	*62*	54.78	43.23	36.14	21.50	22.00	22.30	22.80
5	9/25/2025	18:30	*3.98*	130.00	1.29	n/a	6.14	2.12	4.23	*62*	54.28	43.44	36.16	21.30	22.10	22.40	23.00
5	9/25/2025	19:00	*3.98*	130.00	1.27	n/a	6.15	2.11	4.24	*62*	54.63	43.09	36.10	21.60	22.10	22.50	23.90
5	9/25/2025	19:30	*3.98*	130.00	1.28	n/a	6.18	2.09	4.25	*62*	54.45	43.17	36.05	21.40	21.70	22.20	23.40
5	9/25/2025	20:00	*3.98*	130.00	1.32	n/a	6.19	2.13	4.25	*62*	54.46	42.59	35.95	21.30	22.40	22.10	22.20
5	9/25/2025	20:30	*3.98*	130.00	1.32	n/a	6.18	2.11	4.23	*62*	54.25	43.28	36.13	21.40	22.20	22.30	23.50
5	9/25/2025	21:00	*3.98*	130.00	1.31	n/a	6.17	2.13	4.23	*62*	54.36	43.12	35.95	21.40	22.00	22.10	22.30
5	9/25/2025	21:30	*3.98*	130.00	1.32	n/a	6.16	2.11	4.25	*62*	54.64	43.13	35.91	21.30	22.40	22.40	23.60
5	9/25/2025	22:00	*3.98*	130.00	1.32	n/a	6.15	2.11	4.22	*62*	54.30	43.29	36.05	21.30	21.80	22.50	23.70
5	9/25/2025	22:30	*3.98*	130.00	1.34	n/a	6.14	2.09	4.21	*62*	54.67	43.27	36.19	21.50	22.00	22.60	23.60
5	9/25/2025	23:00	*3.98*	130.00	1.26	n/a	6.11	2.10	4.21	*62*	54.73	43.21	35.89	21.30	22.10	22.40	23.40
5	9/25/2025	23:30	*3.98*	130.00	1.32	n/a	6.11	2.09	4.21	*62*	54.56	43.27	35.98	21.30	22.10	22.30	23.10
5	9/26/2025	0:00	*3.98*	130.00	1.28	n/a	6.11	2.08	4.20	*50*	40.42	29.14	21.98	21.40	21.90	22.50	22.80
5	9/26/2025	0:30	*3.98*	130.10	1.28	n/a	6.12	2.10	4.24	*68*	59.28	47.96	40.76	21.40	22.40	22.30	22.90
5	9/26/2025	1:00	*3.98*	130.00	1.29	n/a	6.16	2.09	4.23	*68*	59.49	48.20	41.03	21.40	22.10	22.00	22.50
5	9/26/2025	1:30	*3.97*	129.90	1.30	n/a	6.15	2.10	4.25	*68*	59.62	48.33	41.10	21.50	21.90	22.10	22.30
5	9/26/2025	2:00	*3.98*	130.00	1.29	n/a	6.18	2.10	4.25	*68*	59.67	48.32	41.09	21.40	21.90	22.10	22.30
5	9/26/2025	2:30	*3.98*	130.00	1.32	n/a	6.19	2.10	4.25	*68*	59.86	48.41	41.22	21.20	22.00	21.80	22.20
5	9/26/2025	3:00	*3.98*	130.00	1.30	n/a	6.20	2.12	4.25	*68*	59.85	48.44	41.22	21.10	22.20	21.90	22.00
5	9/26/2025	3:30	*3.97*	129.90	1.29	n/a	6.24	2.13	4.25	*68*	59.90	48.45	41.25	21.20	21.90	21.60	21.40
5	9/26/2025	4:00	*3.98*	130.00	1.30	n/a	6.25	2.11	4.23	*68*	60.00	48.59	41.25	21.30	21.90	21.40	21.40

			[FM-01]	FM-02	DP-01	DP-02	DP-03	DP-04	DP-05	*[P-01]*	P-02	P-03	P-05	T-01	T-02	T-03	T-AMB
Filter Period	Date	Time	*(gpm)*	(mL min^{-1})	(psid)	(psid)	(psid)	(psid)	(psid)	*(psig)*	(psig)	(psig)	(psig)	(°C)	(°C)	(°C)	(°C)
5	9/26/2025	4:30	*3.98*	130.00	1.29	n/a	6.21	2.11	4.24	*68*	59.99	48.61	41.35	21.40	22.20	21.90	23.00
5	9/26/2025	5:00	*3.98*	130.00	1.30	n/a	6.22	2.12	4.26	*68*	60.05	48.66	41.35	21.20	21.60	21.80	21.70
5	9/26/2025	5:30	*3.98*	130.10	1.30	n/a	6.24	2.13	4.25	*68*	60.04	48.65	41.39	21.30	21.50	22.00	21.40
5	9/26/2025	6:00	*3.98*	130.00	1.32	n/a	6.23	2.13	4.26	*68*	59.98	48.70	41.40	21.30	21.90	21.60	23.00
5	9/26/2025	6:30	*3.98*	130.00	1.31	n/a	6.23	2.12	4.26	*68*	60.13	48.74	41.40	21.30	21.50	21.90	21.60
5	9/26/2025	7:00	*3.98*	130.10	1.30	n/a	6.24	2.10	4.27	*68*	60.08	48.71	41.43	21.20	21.50	21.40	21.90
5	9/26/2025	7:30	*3.97*	130.00	1.32	n/a	6.20	2.10	4.26	*68*	60.16	48.75	41.49	21.20	21.90	21.40	22.80
5	9/26/2025	8:00	*3.98*	130.00	1.32	n/a	6.24	2.12	4.27	*68*	60.18	48.81	41.48	21.30	22.10	21.80	21.40
5	9/26/2025	8:30	*3.98*	130.00	1.33	n/a	6.22	2.12	4.27	*68*	60.26	48.60	41.66	21.30	22.10	21.90	22.90
5	9/26/2025	9:00	*3.98*	130.00	1.32	n/a	6.16	2.10	4.23	*68*	60.24	48.93	41.71	21.50	22.10	21.90	22.60
5	9/26/2025	9:30	*3.98*	130.00	1.32	n/a	6.18	2.11	4.24	*68*	60.25	49.01	41.73	21.40	22.10	22.10	22.40
5	9/26/2025	10:00	*3.98*	130.10	1.33	n/a	6.17	2.10	4.25	*68*	60.36	48.89	41.68	21.20	21.60	22.10	22.70
5	9/26/2025	10:30	*3.98*	130.00	1.33	n/a	6.15	2.11	4.24	*68*	60.35	48.97	41.73	21.60	22.10	22.00	23.00
5	9/26/2025	11:00	*3.98*	130.00	1.34	n/a	6.14	2.08	4.23	*68*	60.44	48.92	41.75	21.30	22.10	22.30	23.30
6	9/26/2025	11:14	*3.98*	129.80	n/a	4.85	4.78	1.88	3.07	*68*	60.35	48.69	43.16	21.40	22.10	22.50	23.50
6	9/26/2025	11:30	*3.98*	129.10	n/a	5.18	5.48	2.16	3.54	*68*	60.25	47.49	40.86	21.60	22.00	22.80	23.70
6	9/26/2025	12:00	*3.98*	130.00	n/a	5.16	6.12	2.09	4.20	*68*	60.38	47.95	40.68	21.70	22.20	22.70	23.90
6	9/26/2025	12:30	*3.98*	130.00	n/a	5.14	6.14	2.10	4.23	*68*	60.41	47.88	40.78	21.30	22.00	22.40	22.90
6	9/26/2025	13:00	*3.98*	130.00	n/a	5.15	6.14	2.08	4.21	*68*	60.34	48.02	40.88	21.60	22.30	22.40	23.10
6	9/26/2025	13:30	*3.98*	130.00	n/a	5.16	6.15	2.10	4.24	*68*	60.37	47.92	40.85	21.40	21.70	22.50	23.10
6	9/26/2025	14:00	*3.98*	130.00	n/a	5.19	6.15	2.10	4.24	*68*	60.40	47.92	40.76	21.50	22.10	22.20	22.10

Table C.16. Initial Differential Pressure Data for DEFs from Run W-06

Filter Period	Date	Active Filter ID	Start Time	ΔP at t = 2 min (psid)	ΔP at t = 4 min (psid)	ΔP at t = 6 min (psid)	ΔP at t = 8 min (psid)	ΔP at t = 10 min (psid)	Target ΔP for Filter Switch (psid)
1	9/22/2025	1	7:53	0.52	0.60	0.68	0.77	0.96	2.96
2	9/23/2025	2	8:03	2.90	3.03	3.07	3.24	4.06	6.06
3	9/24/2025	1	8:02	0.37	0.42	0.49	0.64	0.77	2.77
4	9/25/2025	2	8:04	2.84	2.90	2.94	2.96	3.12	5.12
5	9/25/2025	1	10:33	0.40	0.45	0.47	0.51	0.73	2.73
6	9/26/2025	2	11:04	2.82	2.86	2.89	3.02	4.27	6.27

Appendix D – Time Series of Experimental Data

In this appendix, time traces of data collected are presented for runs W-01, W-02, W-03, W-04, W-05, and W-06. Each test has the same seven time series plots presented in the same order: (1) system temperatures versus elapsed time, (2) flow rate versus elapsed time, (3) system pressures versus elapsed time, (4) filter differential pressures versus elapsed time, (5) 0.1 M NaOH filter soak time, (6) 0.1 M NaOH filter contact time, and (7) rate of differential pressure change for like-filter periods, in psid·h^{-1}. The first five plots for each run capture manually recorded data which is also presented in tabular form in Appendix B; therefore, the time series data are presented in the remainder of this appendix without any additional description.

D.1 W-01A Time Series and Supplemental Graphs

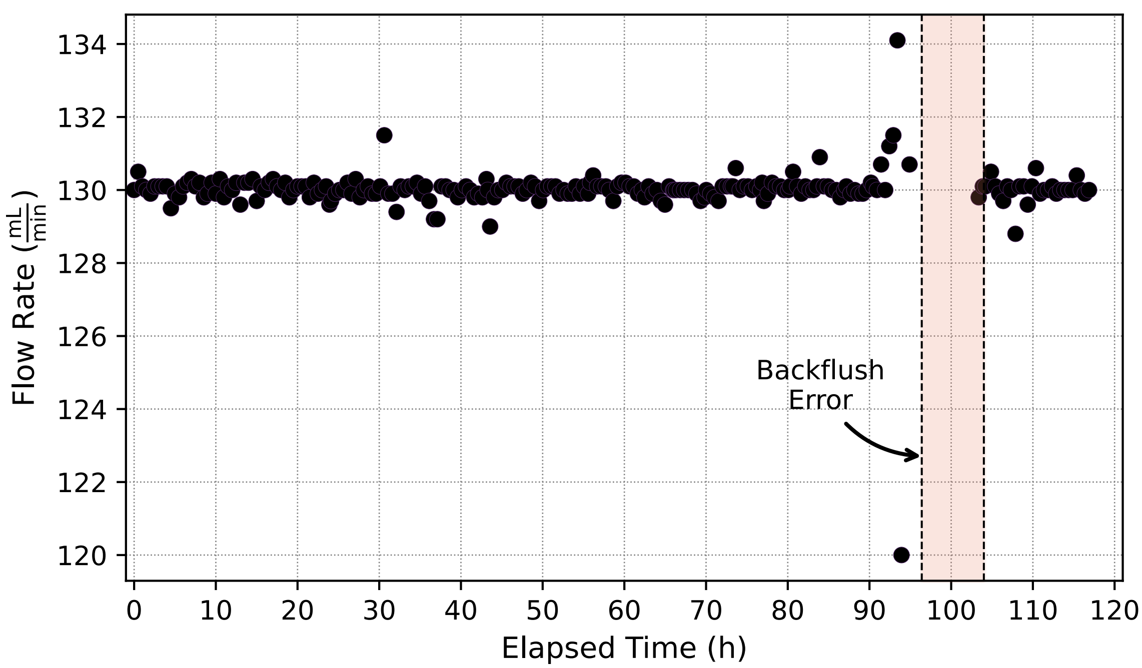


Figure D.1. W-01A time series of flow rate (mL·min^{-1}).

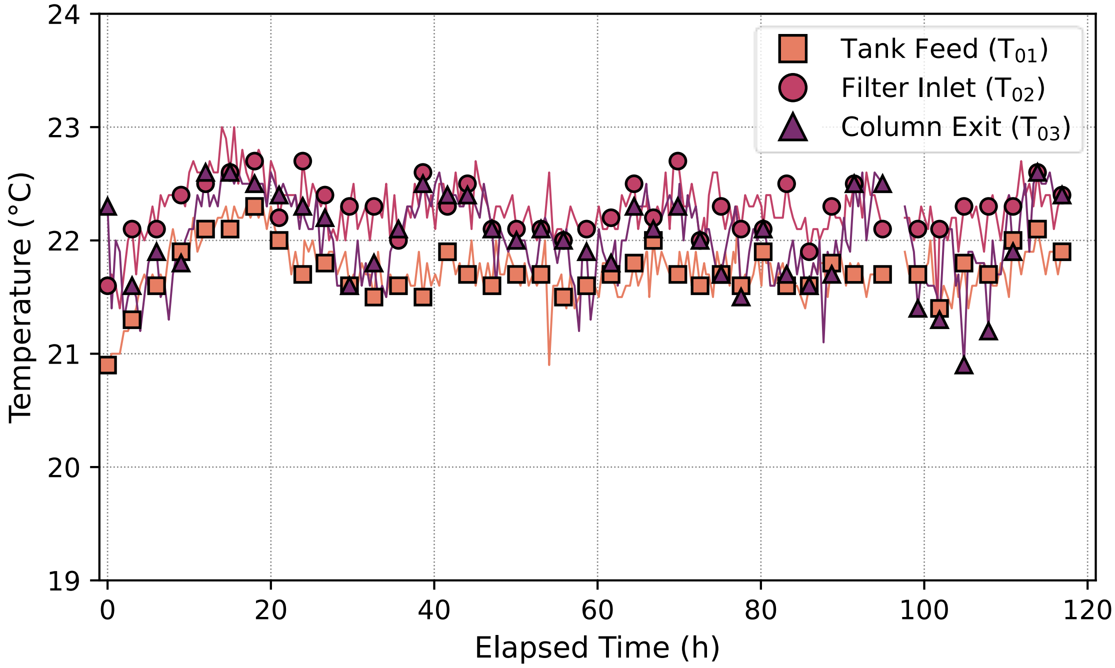


Figure D.2. W-01A time series of temperature (°C). Graph does not contain ambient temperature data.

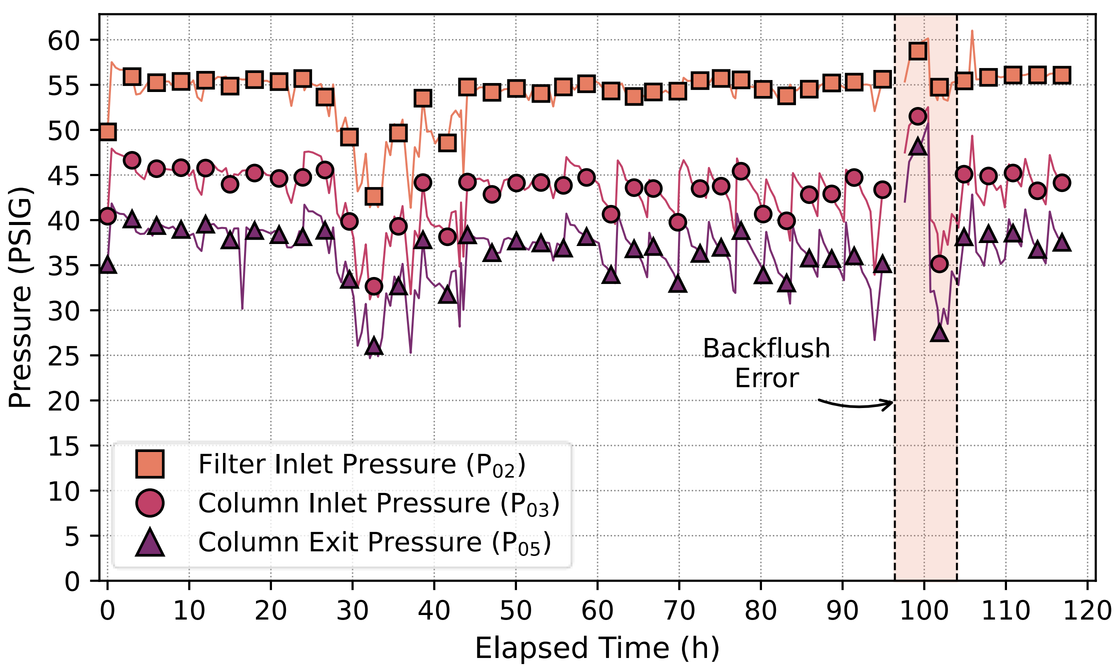


Figure D.3. W-01A time series of line pressure (psig).

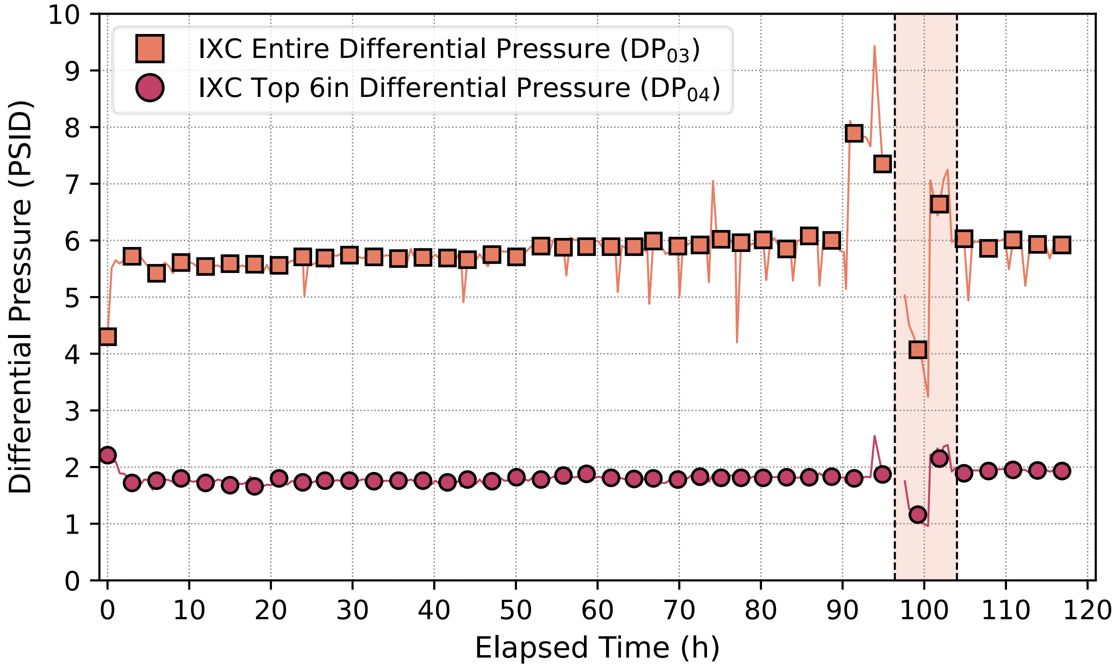


Figure D.4. W-01A time series of IXC differential pressure (psid).

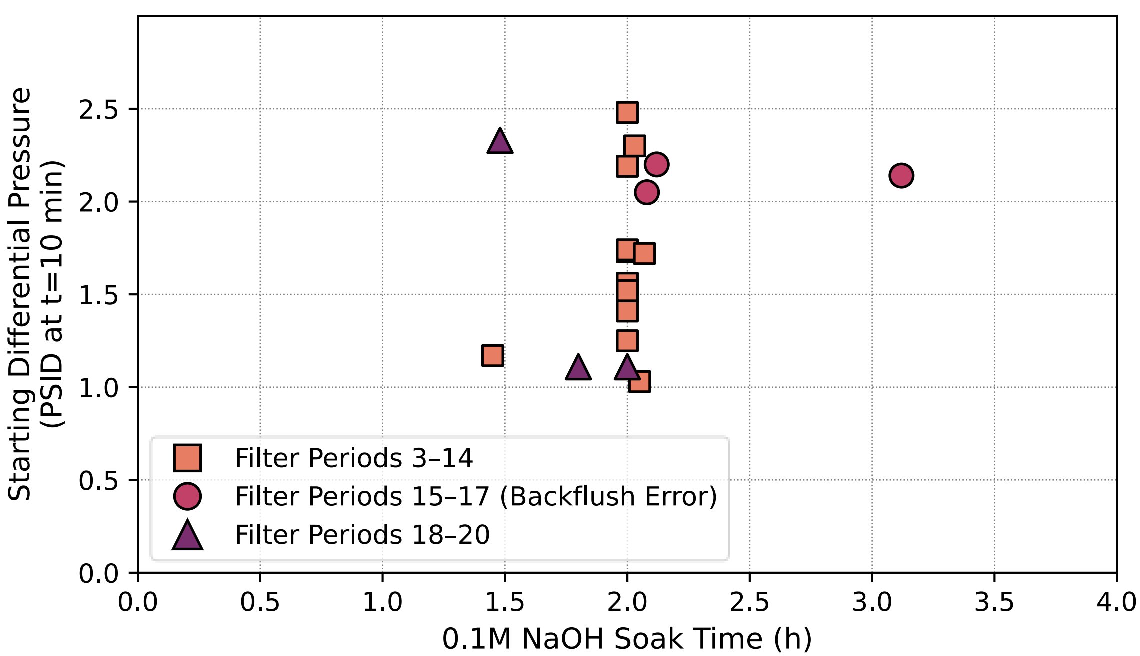


Figure D.5. W-01A starting differential pressure (psid) with varying sodium hydroxide soak time (h).
Soak time is the time between pressurized filter flushes.

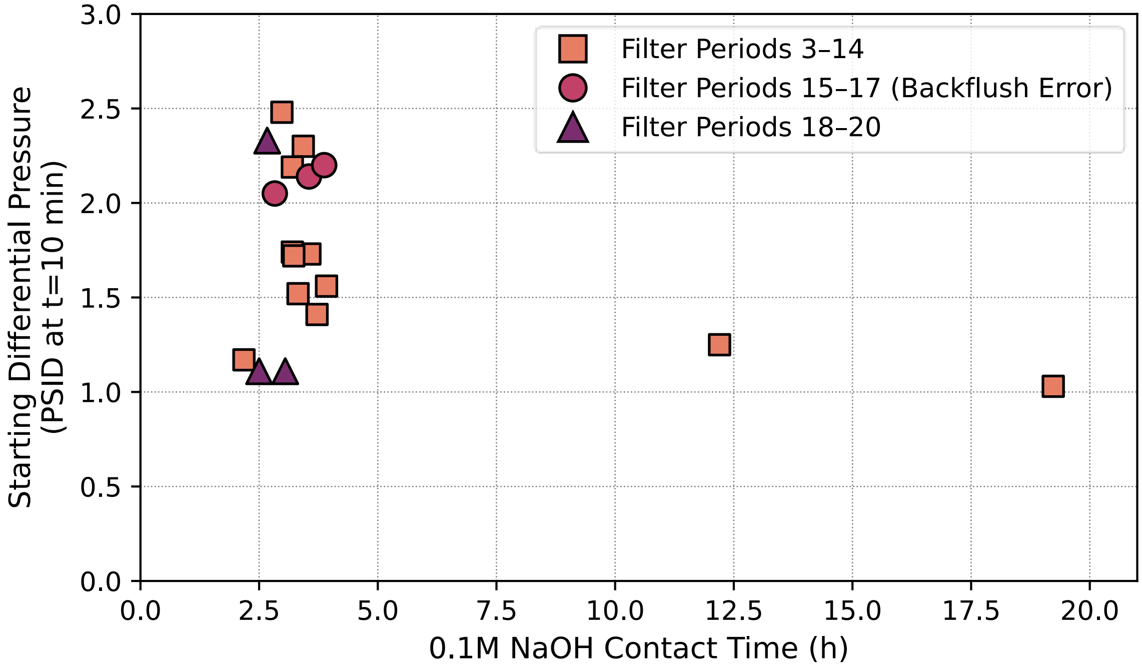


Figure D.6. W-01A starting differential pressure (psid) with varying sodium hydroxide total contact time (h). Contact time is the soak time plus any additional contact time with clean sodium hydroxide while waiting for filter swapping.

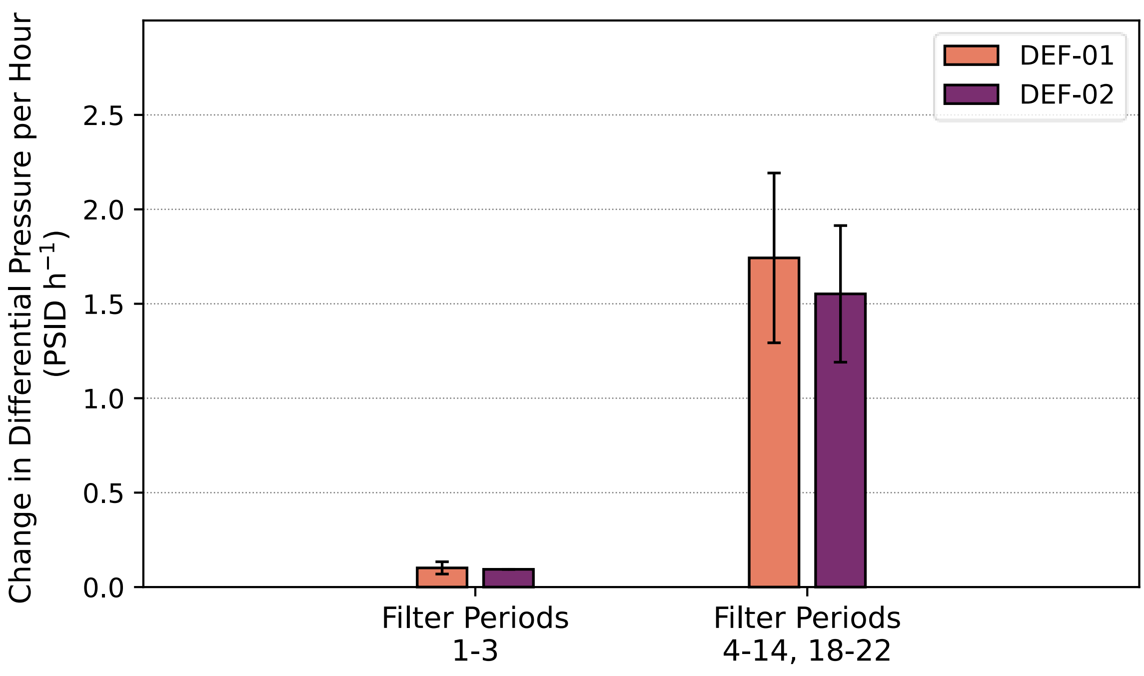


Figure D.7. W-01A filter differential pressure rate of change (psid·h^{-1}) grouped by filter and filter period.

D.2 W-01B Time Series and Supplemental Graphs

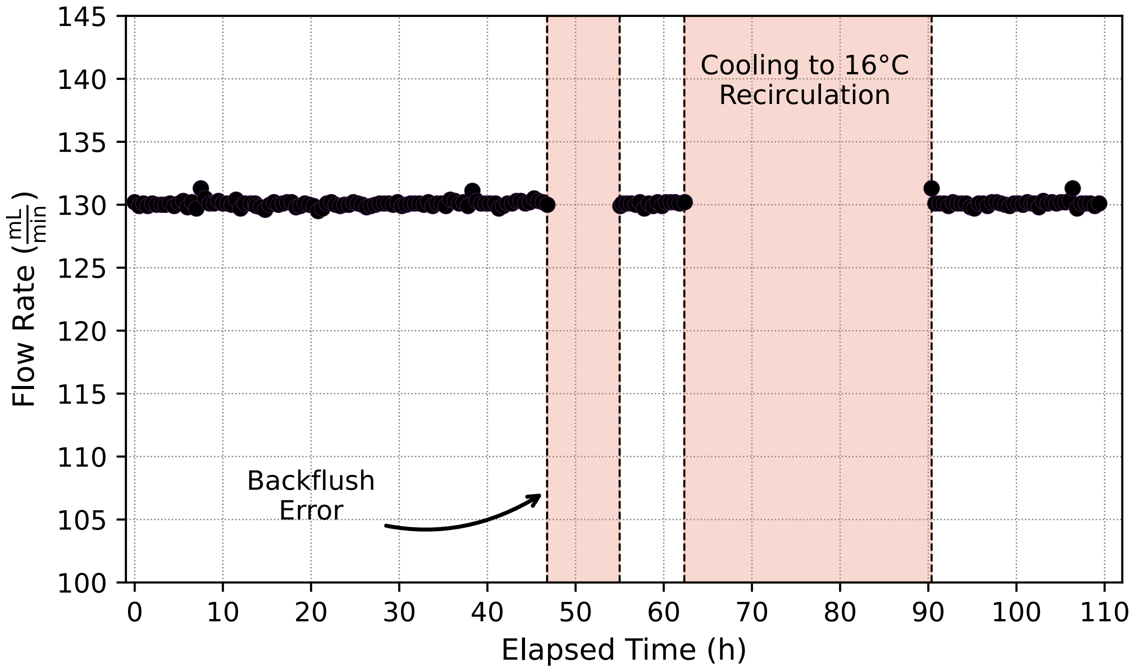


Figure D.8. W-01B time series of flow rate (mL·min^{-1}).

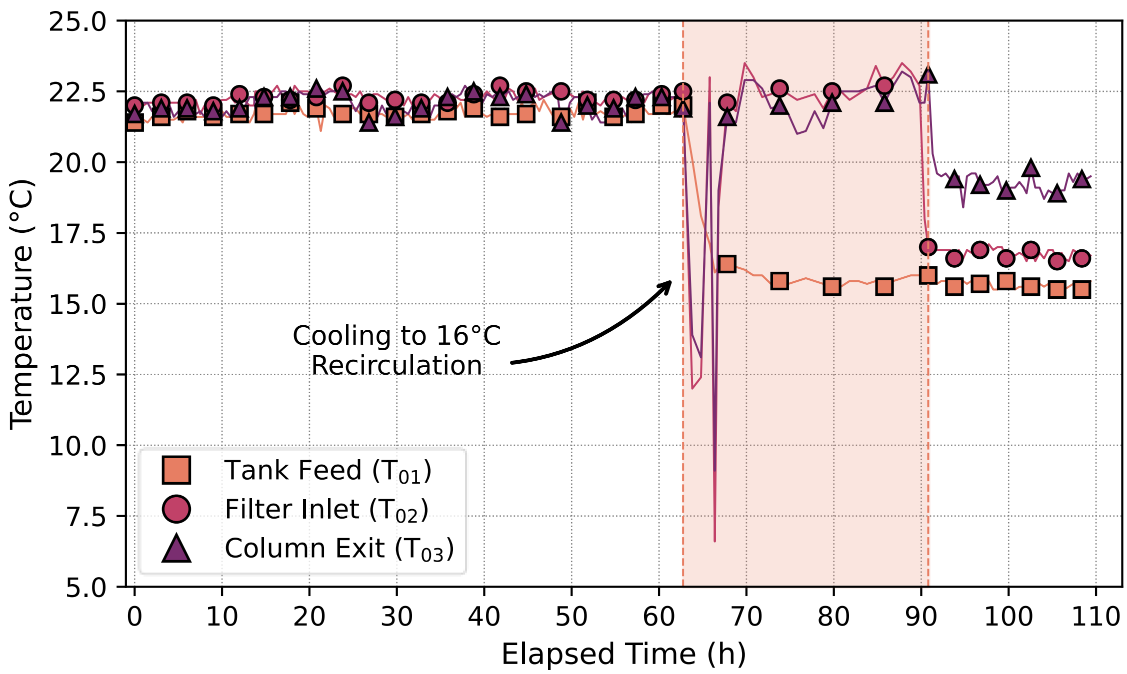


Figure D.9. W-01B time series of temperature (°C). Graph does not contain ambient temperature data.

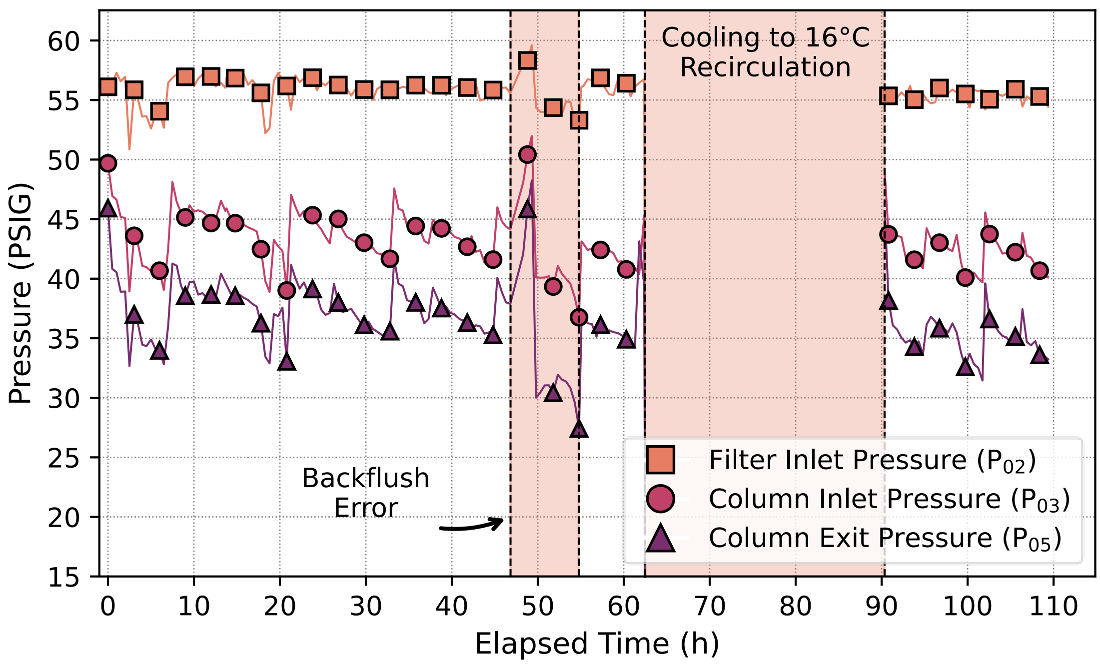


Figure D.10. W-01B time series of line pressure (psig).

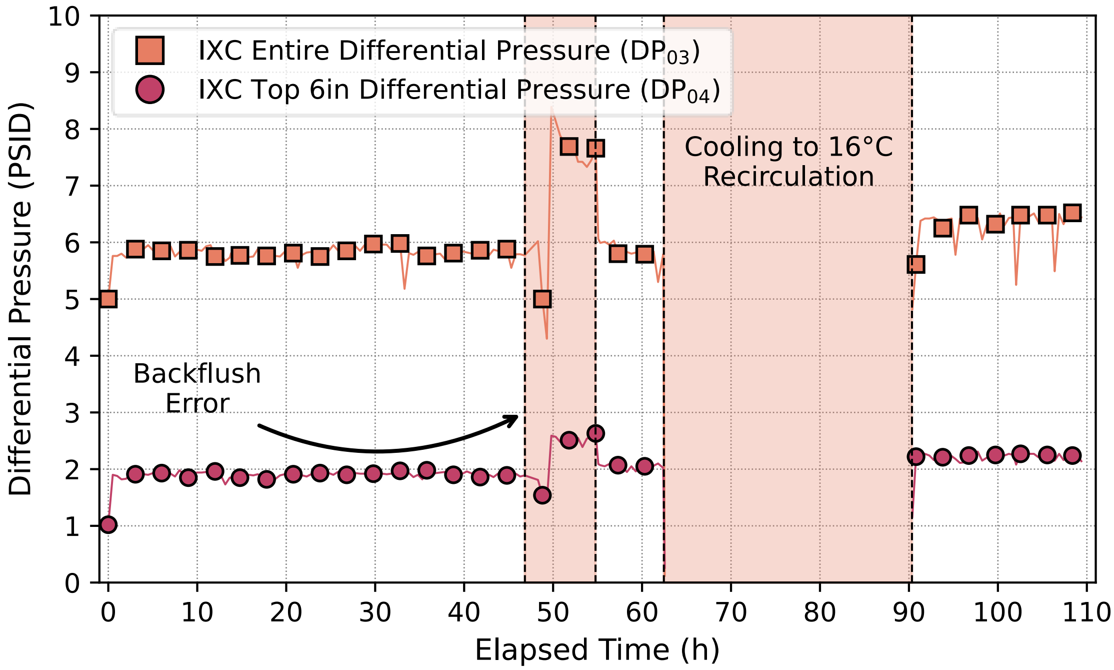


Figure D.11. W-01B time series of IXC differential pressure (psid).

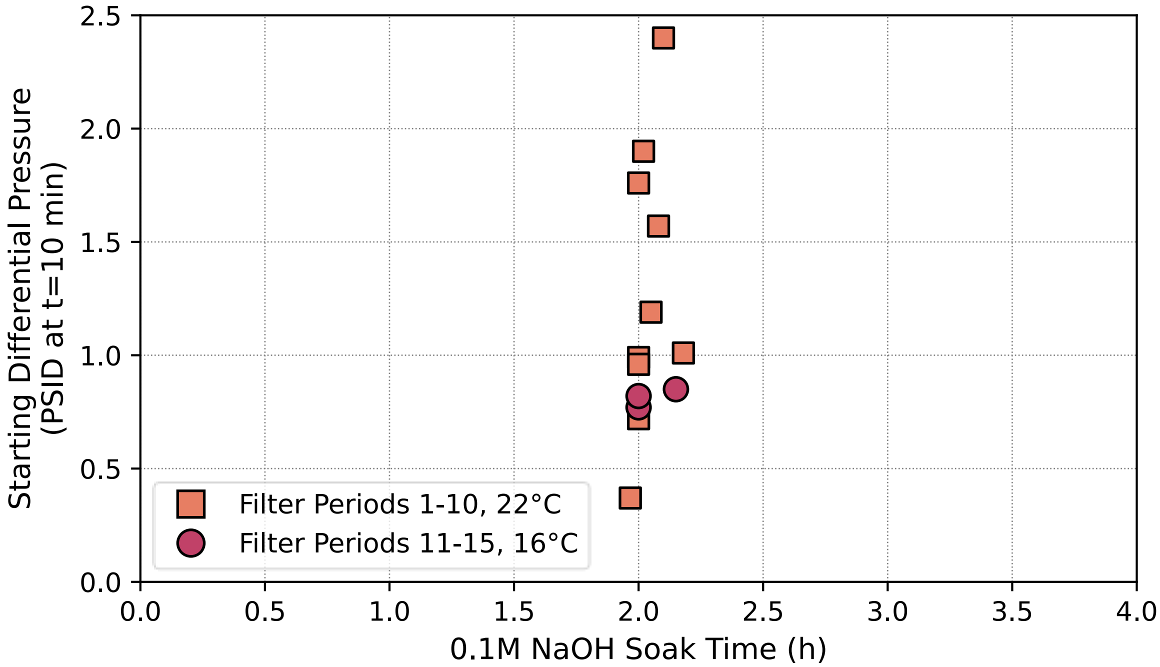


Figure D.12. W-01B starting differential pressure (psid) with varying sodium hydroxide soak time (h). Soak time is the time between pressurized filter flushes.

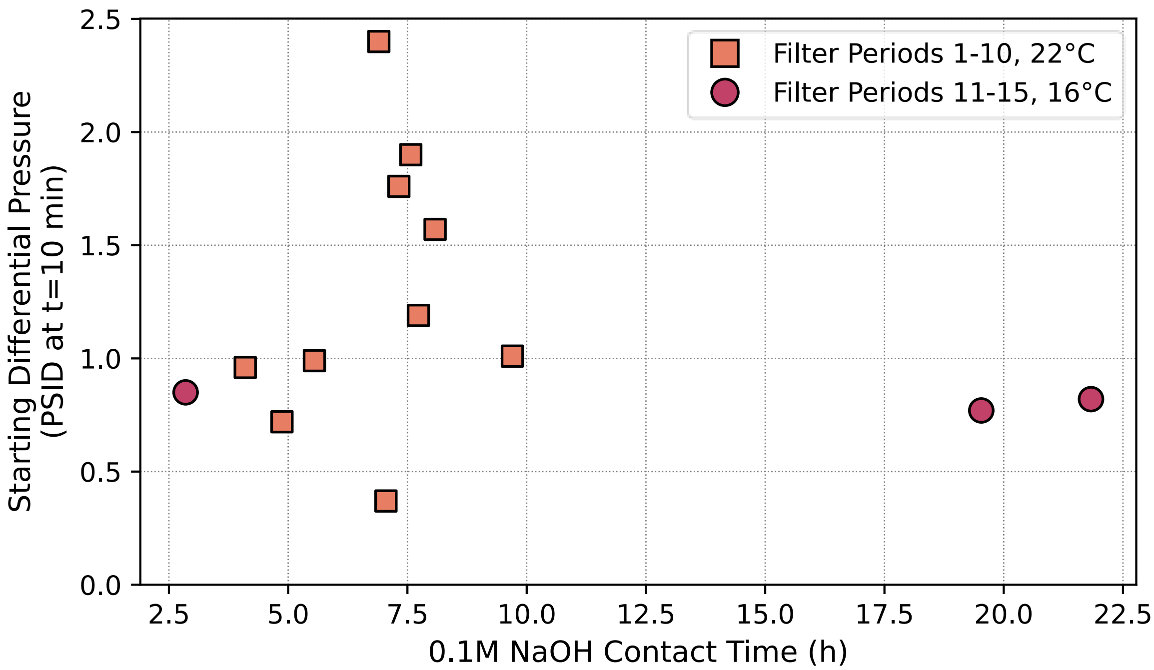


Figure D.13. W-01B starting differential pressure (psid) with varying sodium hydroxide total contact time (h). Contact time is the soak time plus any additional contact time with clean sodium hydroxide while waiting for filter swapping.

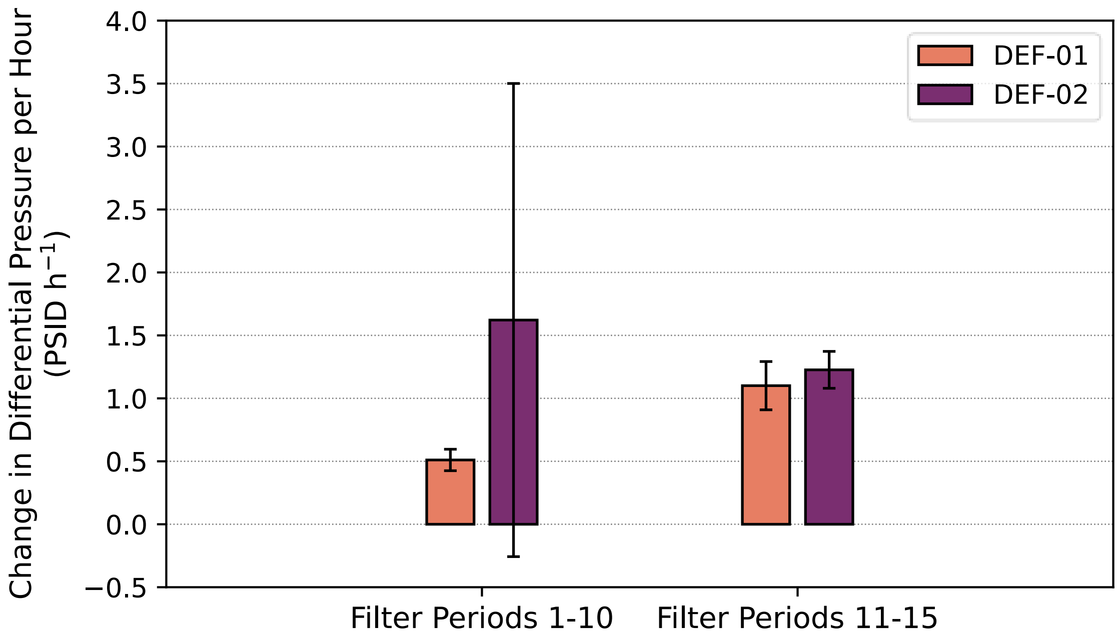


Figure D.14. W-01B filter differential pressure rate of change (psid·h^{-1}) grouped by filter and filter period. Temperature was maintained at 22 °C for filter periods 1-10, and 16 °C during periods 11-15.

D.3 W-02 Time Series and Supplemental Graphs

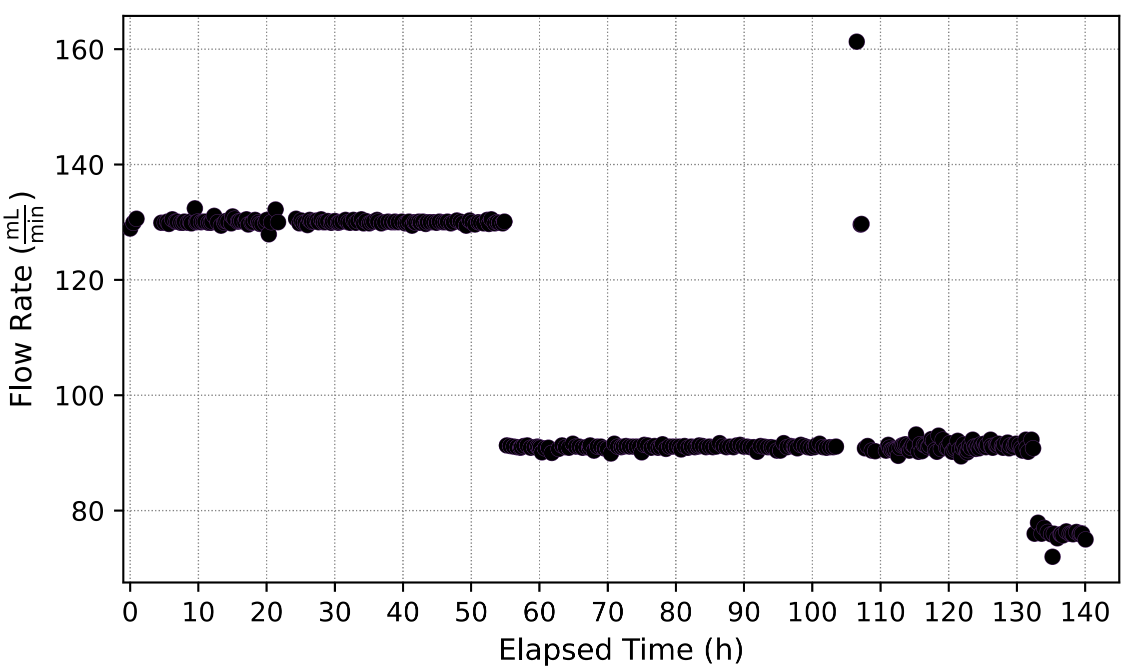


Figure D.15. W-02 time series of flow rate (mL·min^{-1}).

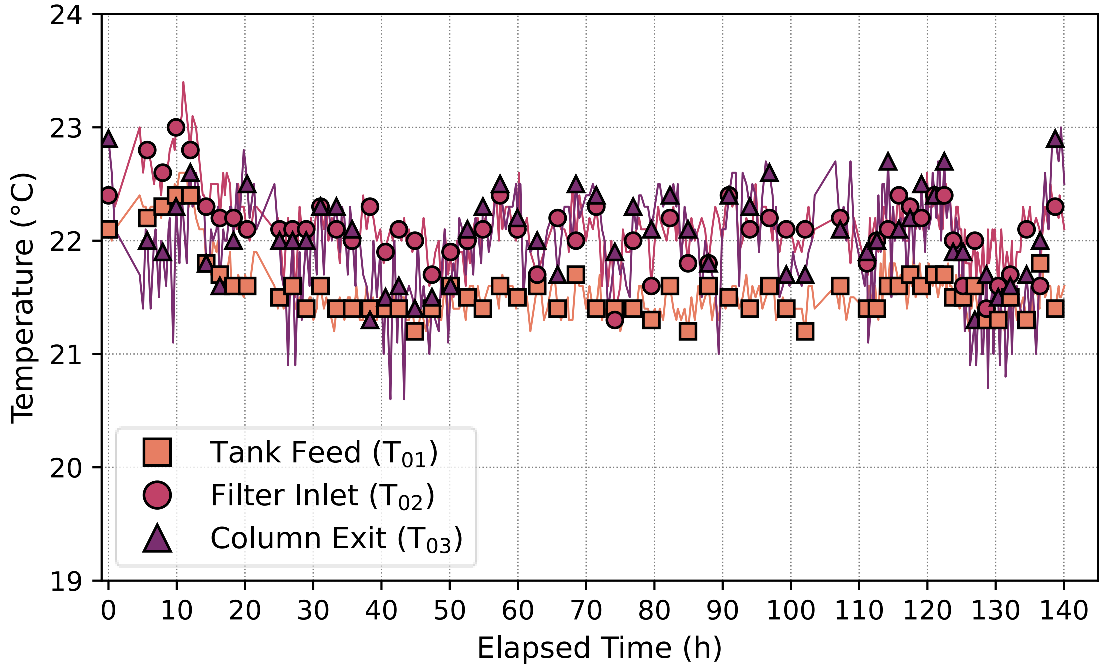


Figure D.16. W-02 time series of temperature (°C). Graph does not contain ambient temperature data.

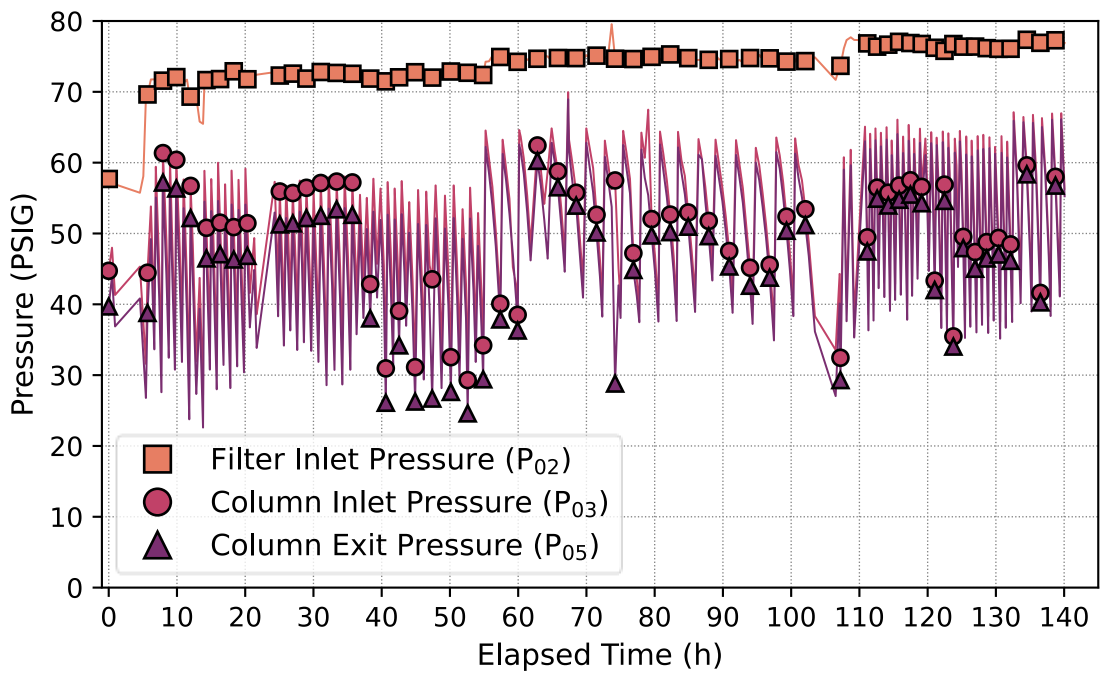


Figure D.17. W-02 time series of line pressure (psig). Note the erraticism of P-03 and P-05 due to frequent filter swaps.

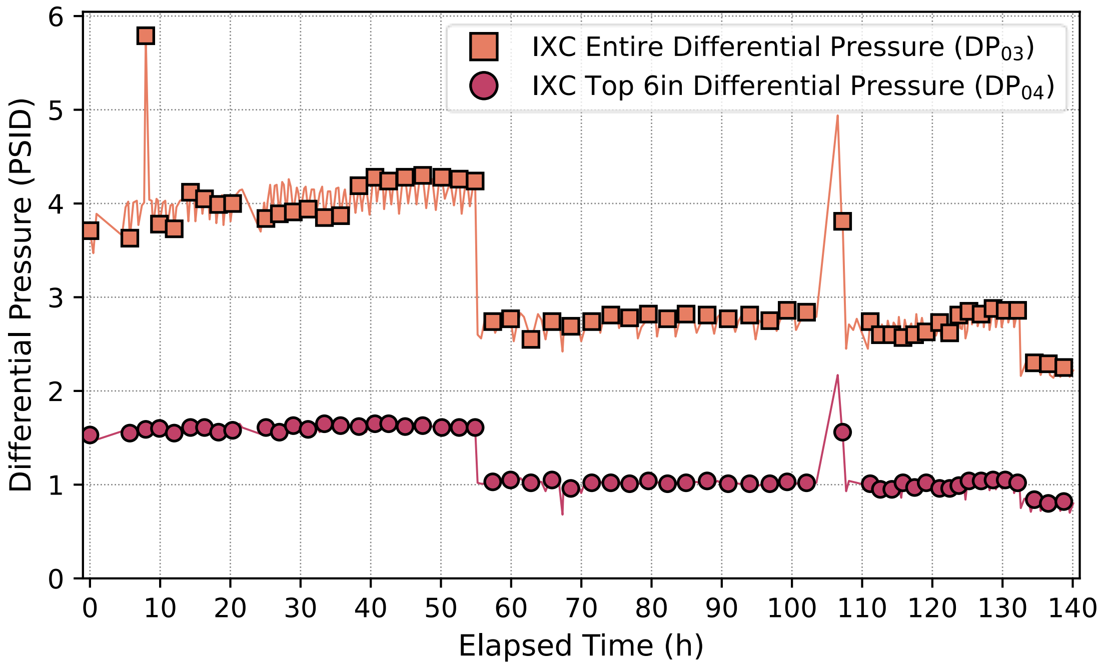


Figure D.18. W-02 time series of IXC differential pressure (psid).

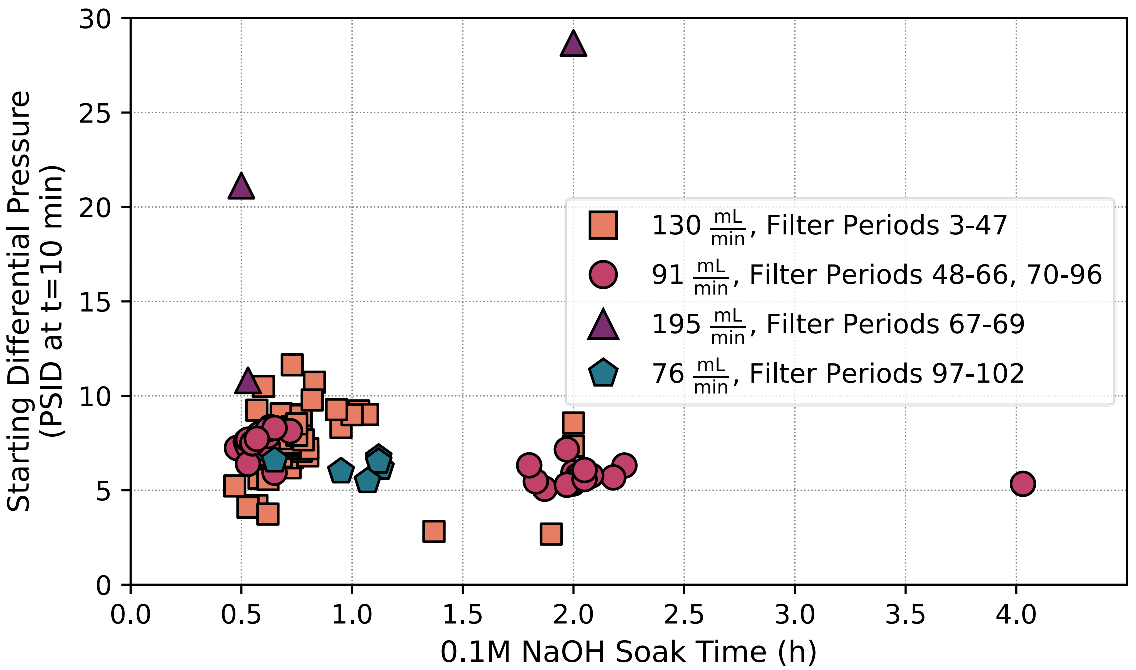


Figure D.19. W-02 starting differential pressure (psid) with varying sodium hydroxide soak time (h). Soak time is the time between pressurized filter flushes.

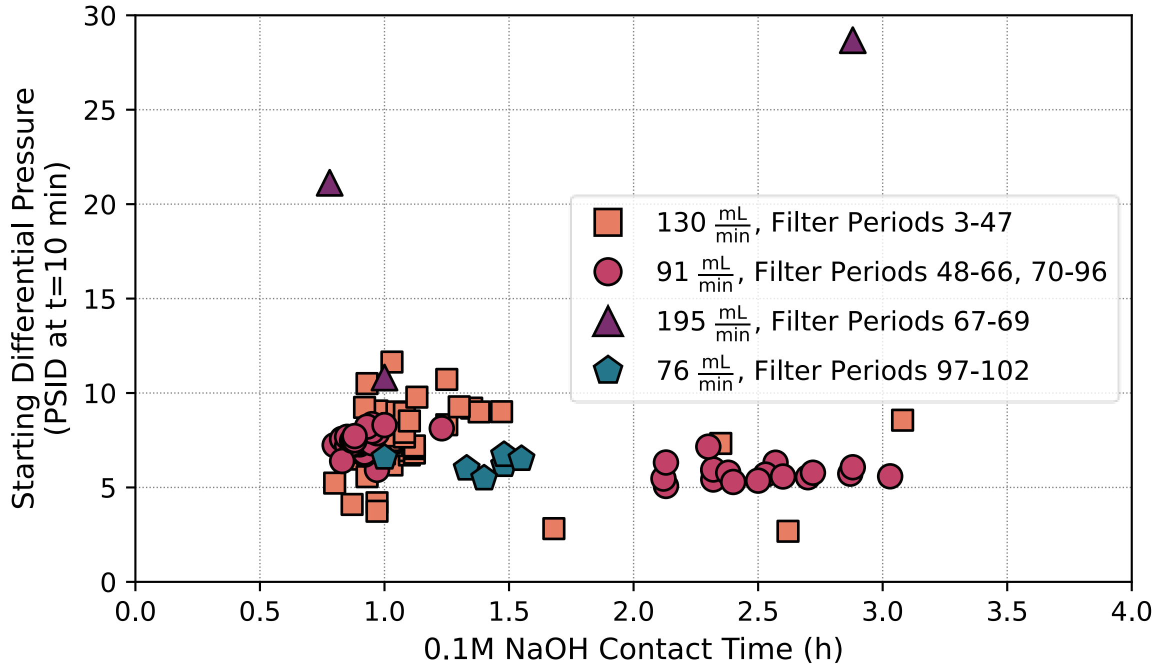


Figure D.20. W-02 starting differential pressure (psid) with varying sodium hydroxide total contact time (h). Contact time is the soak time plus any additional contact time with clean sodium hydroxide while waiting for filter swapping.

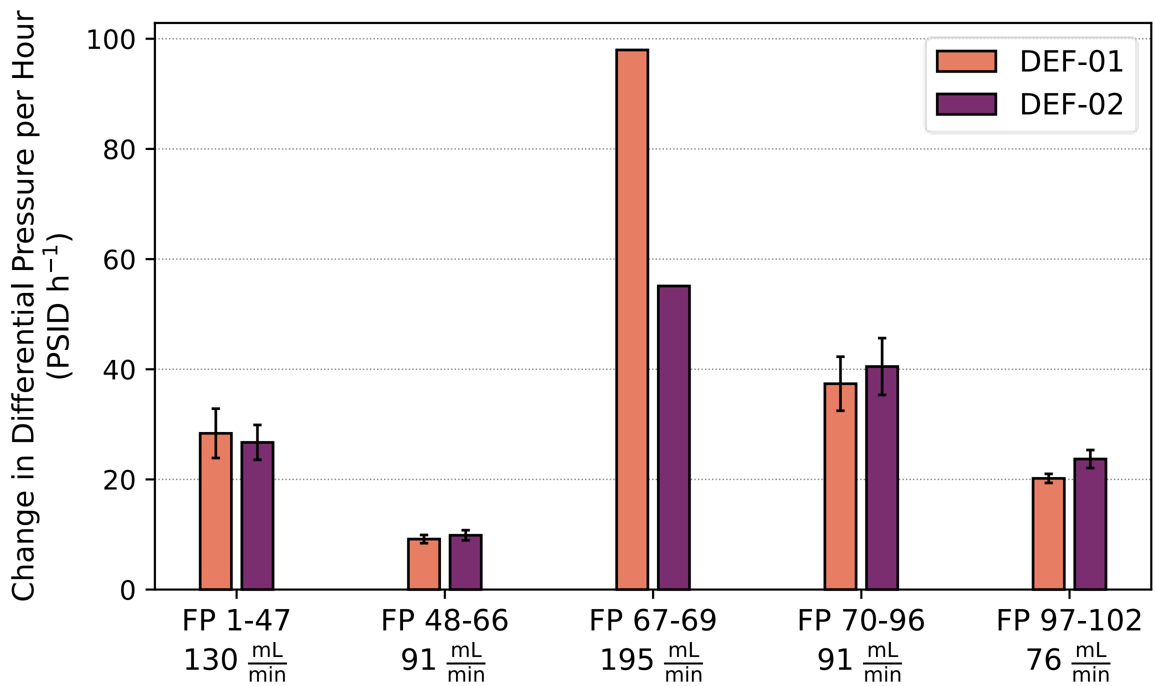


Figure D.21. W-02 filter differential pressure rate of change (psid·h^{-1}) grouped by filter and flow rate. Note that values are listed in chronological order from left to right; the first 91 mL·min^{-1} bars are filter periods

D.4 W-03 Time Series and Supplemental Graphs

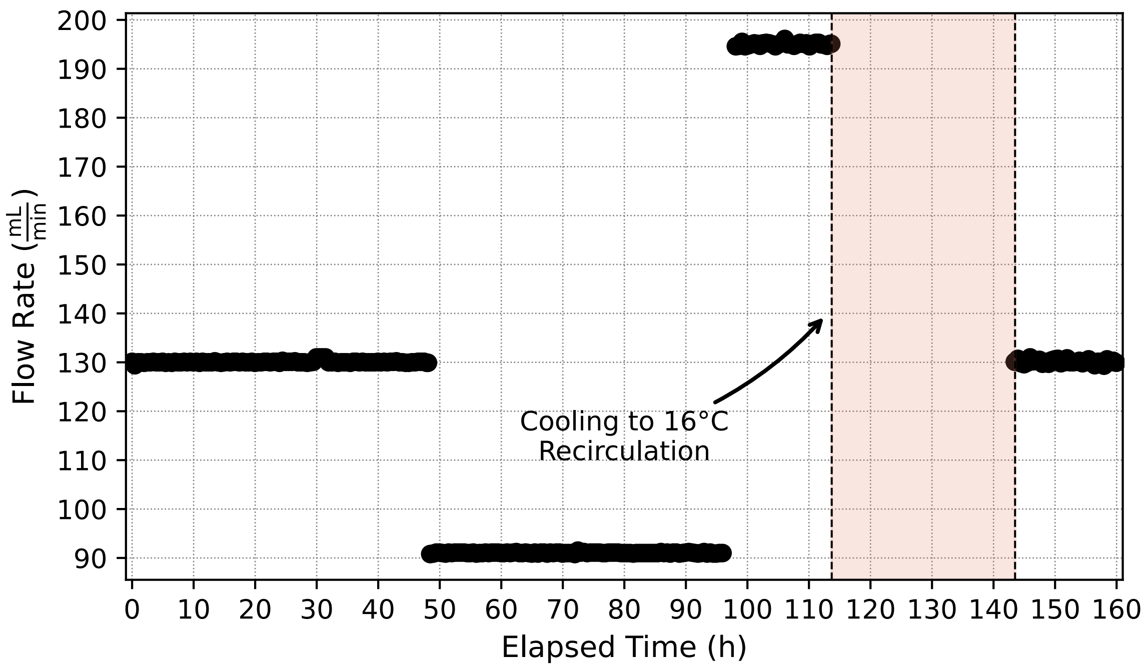


Figure D.22. W-03 time series of flow rate (mL·min^-1).

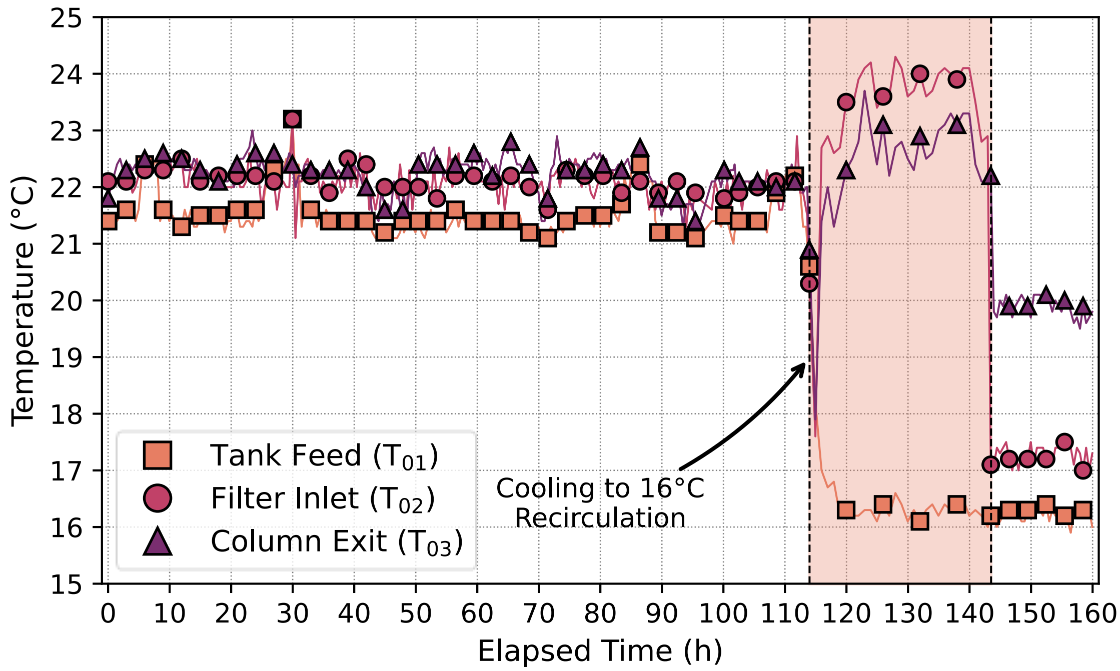


Figure D.23. W-03 time series of temperature (°C). Graph does not contain ambient temperature data.

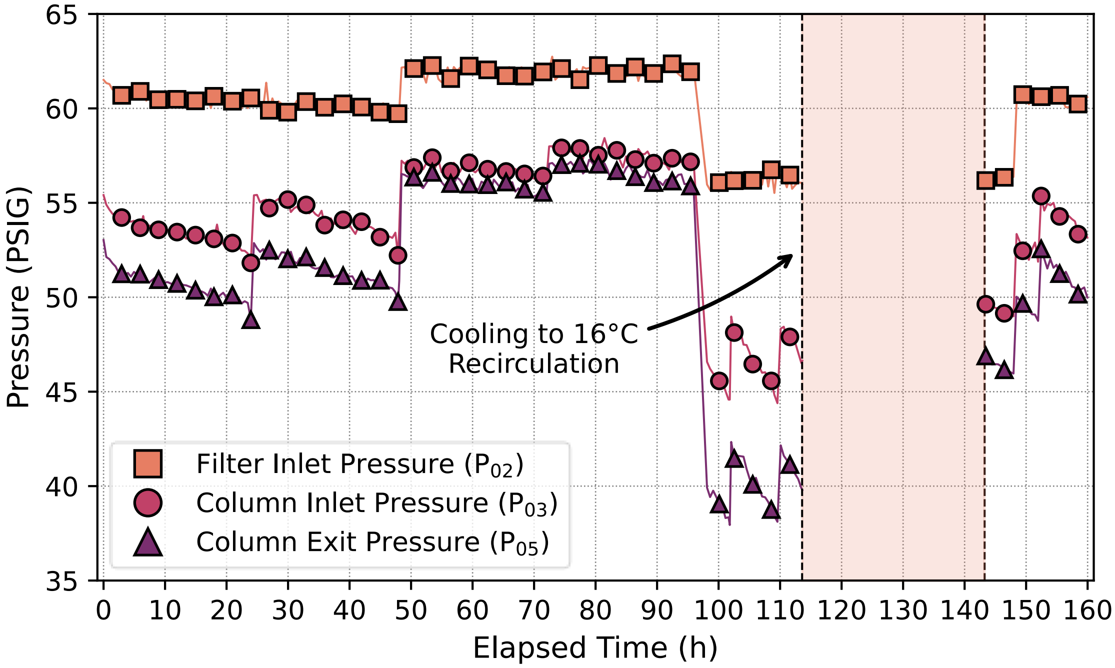


Figure D.24. W-03 time series of line pressure (psig).

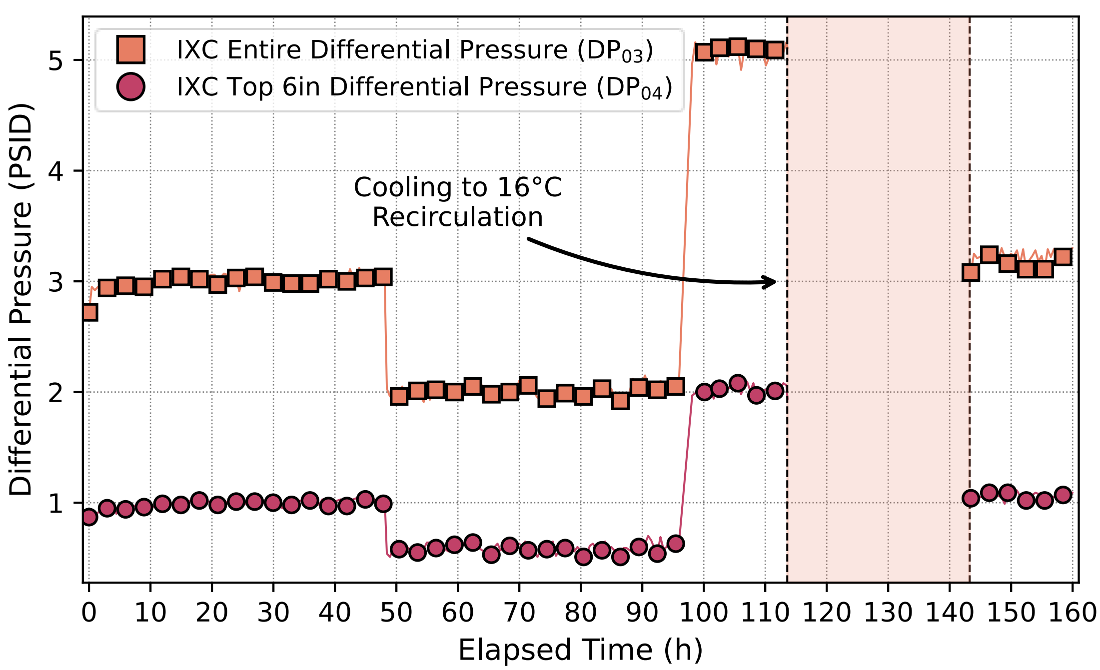


Figure D.25. W-03 time series of IXC differential pressure (psid).

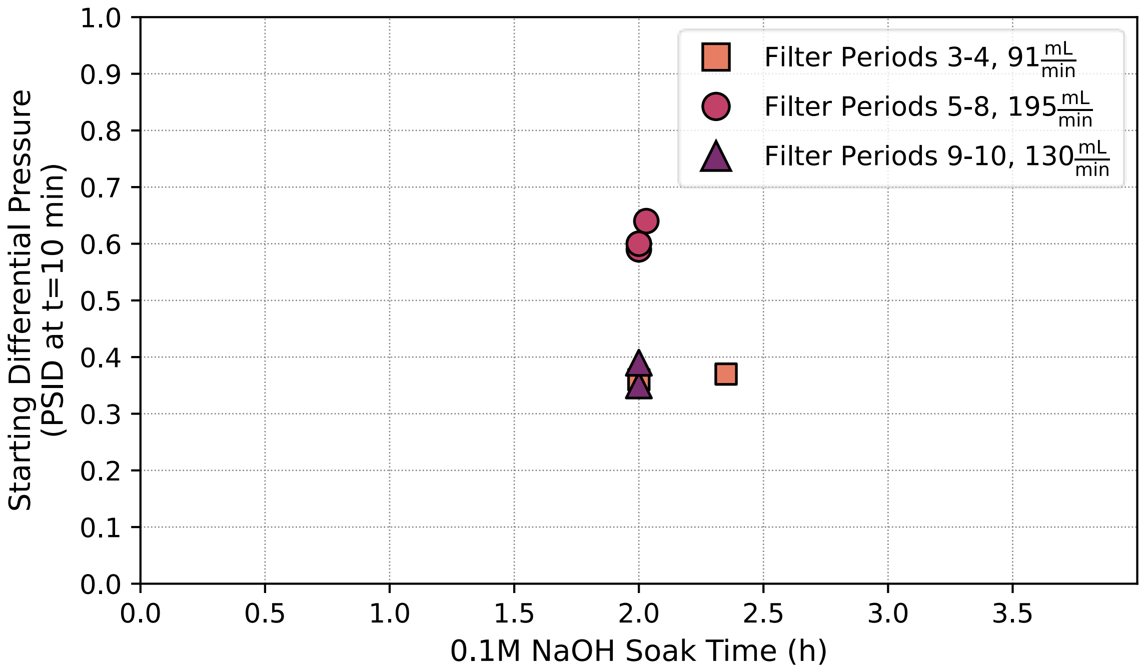


Figure D.26. W-03 starting differential pressure (psid) with varying sodium hydroxide soak time (h). Soak time is the time between pressurized filter flushes.

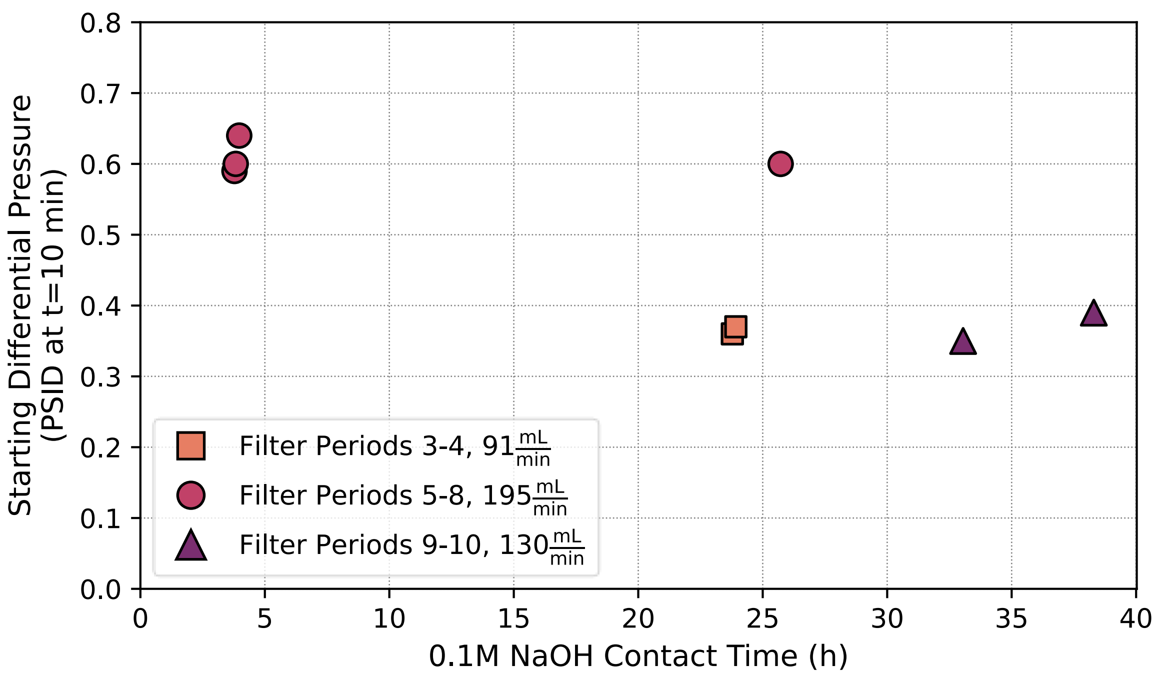


Figure D.27. W-03 starting differential pressure (psid) with varying sodium hydroxide total contact time (h). Contact time is the soak time plus any additional contact time with clean sodium hydroxide while waiting for filter swapping.

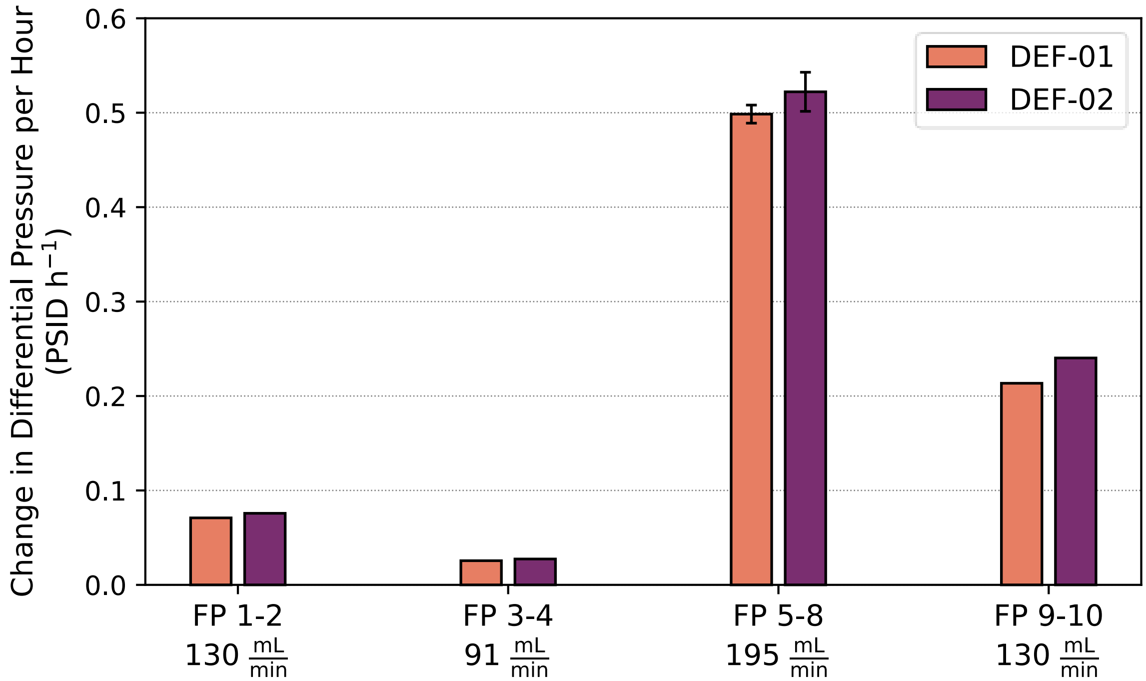


Figure D.28. W-03 filter differential pressure rate of change (psid·h^{-1}) grouped by filter and flow rate. Temperature was controlled to 22 °C for periods 1-8 are at 22 °C, and 16 °C for periods 9-10.

D.5 W-04 Time Series and Supplemental Graphs

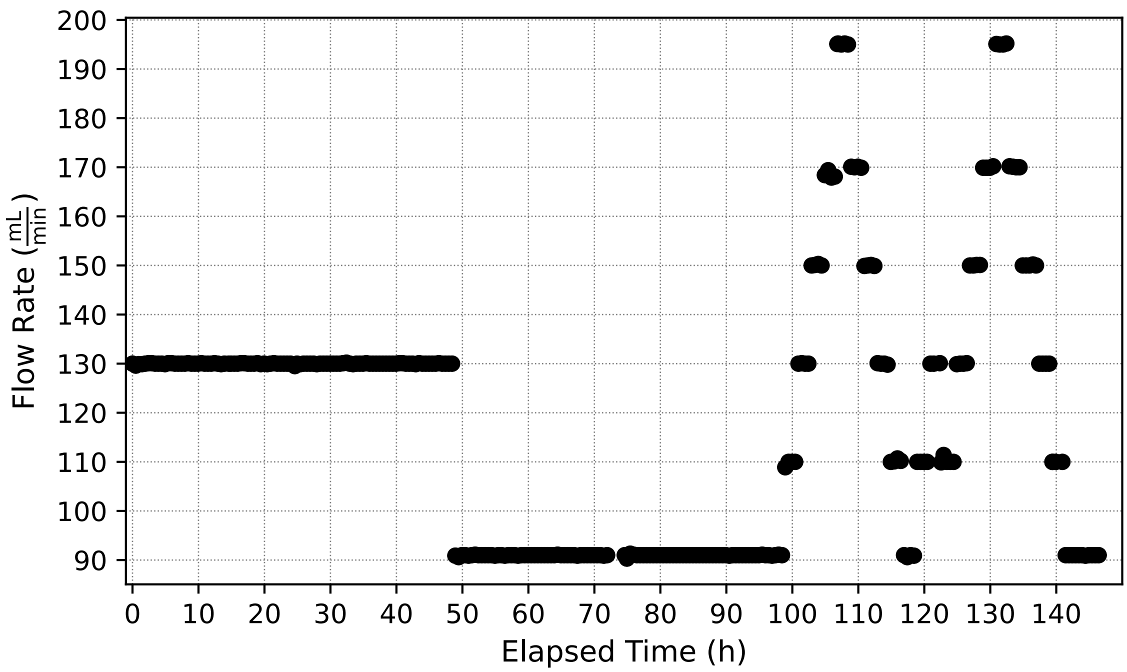


Figure D.29. W-04 time series of flow rate (mL·min^{-1}).

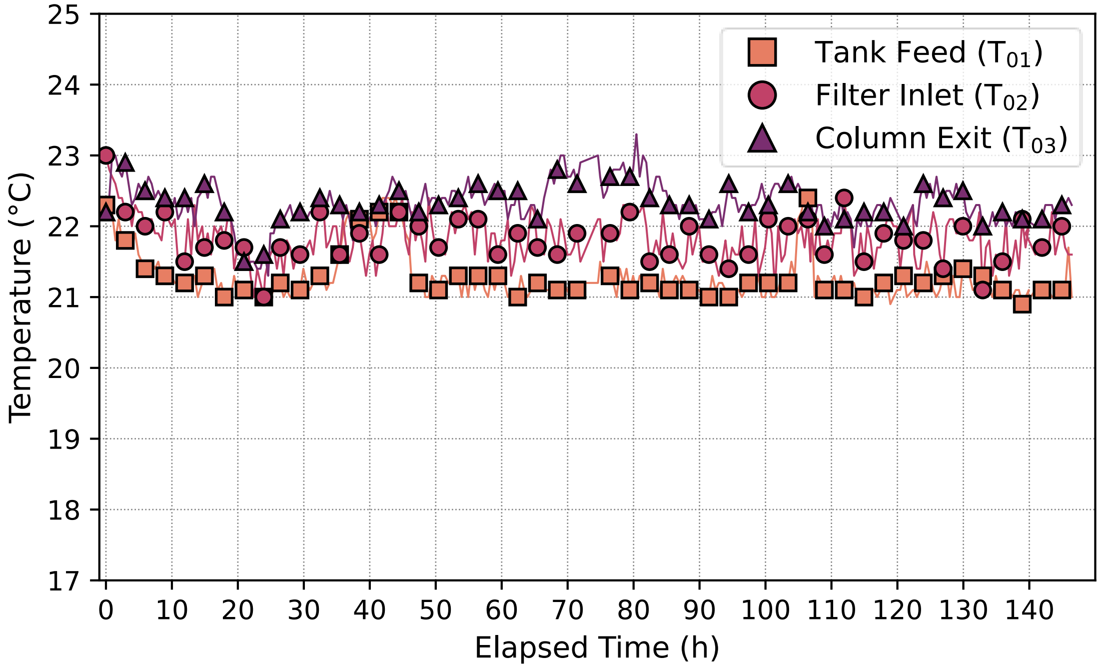


Figure D.30. W-04 time series of temperature (°C). Graph does not contain ambient temperature data.

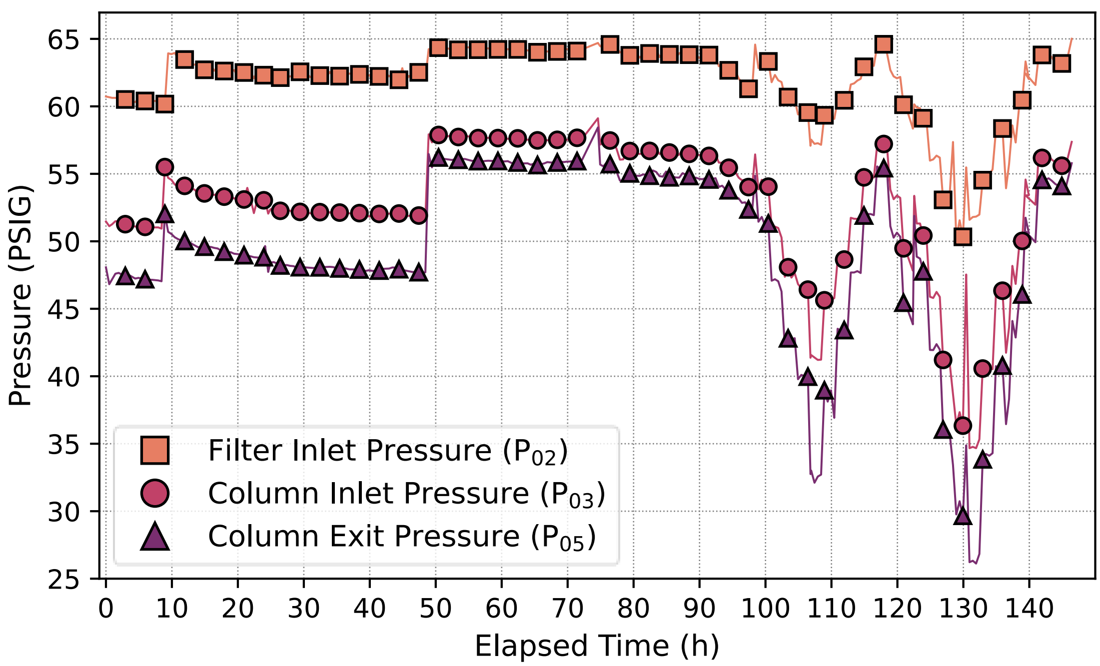


Figure D.31. W-04 time series of line pressure (psig).

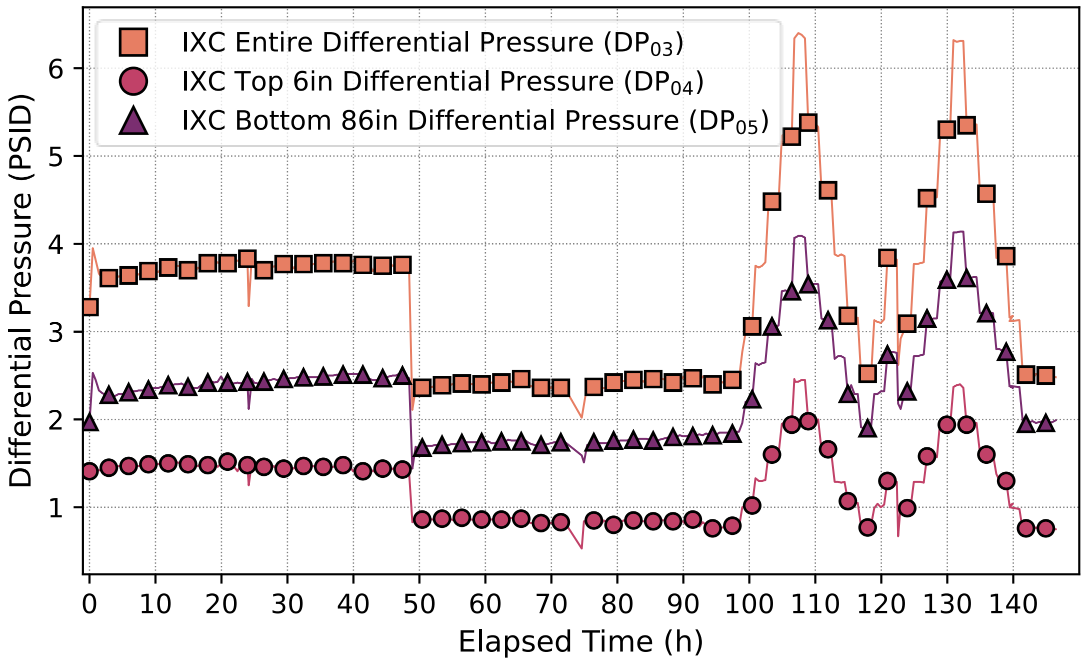


Figure D.32. W-04 time series of IXC differential pressure (psid).

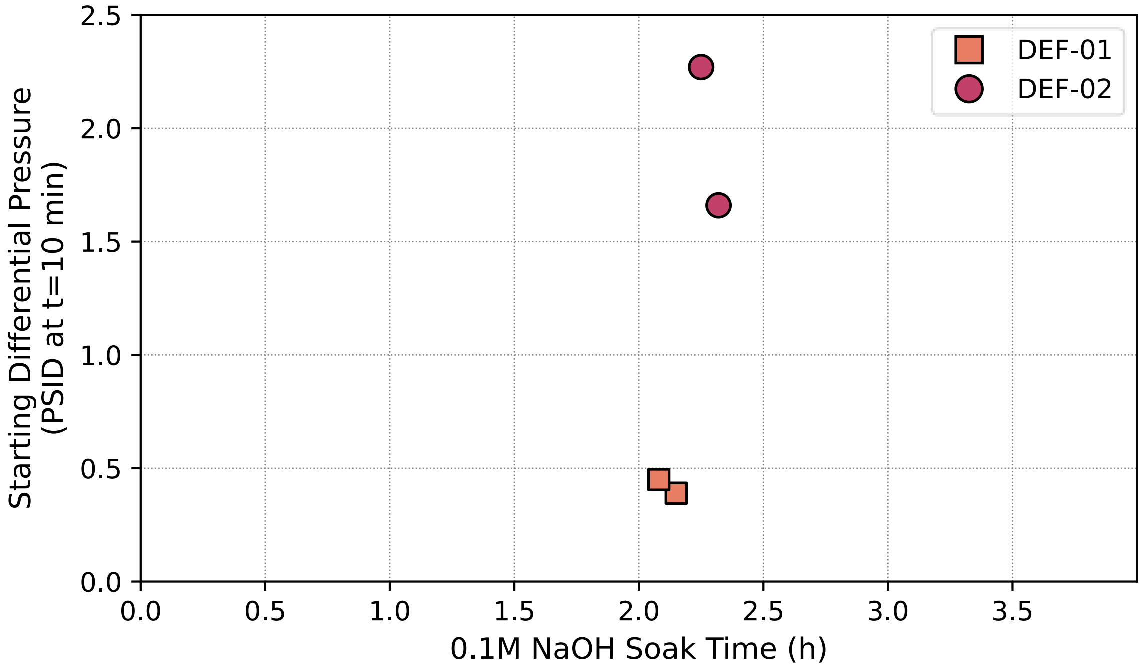


Figure D.33. W-04 starting differential pressure (psid) with varying sodium hydroxide soak time (h). Soak time is the time between pressurized filter flushes.

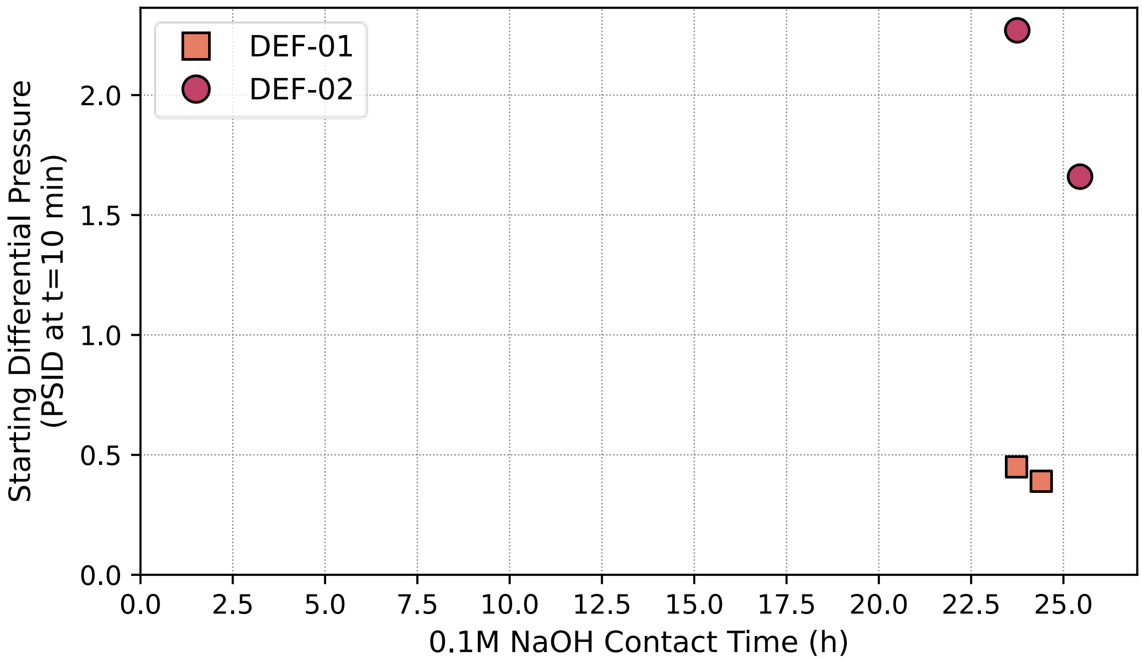


Figure D.34. W-04 starting differential pressure (psid) with varying sodium hydroxide total contact time (h). Contact time is the soak time plus any additional contact time with clean sodium hydroxide while waiting for filter swapping.

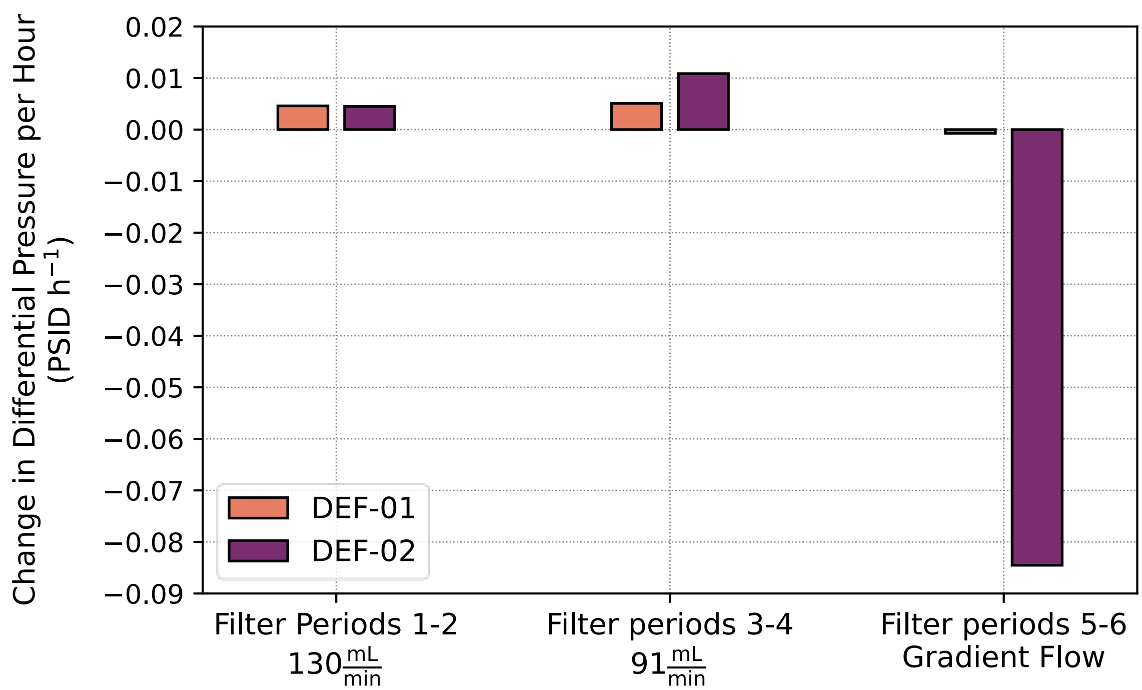


Figure D.35. W-04 filter differential pressure rate of change (psid·h^{-1}) grouped by filter, filter period, and flow conditions. Filter periods 5 and 6 have a negative rate due to gradient flow; flow was stepped up from 76 mL·min^{-1} to 195 mL·min^{-1} and back down again, causing a negative rate of change.

D.6 W-05A Time Series and Supplemental Graphs

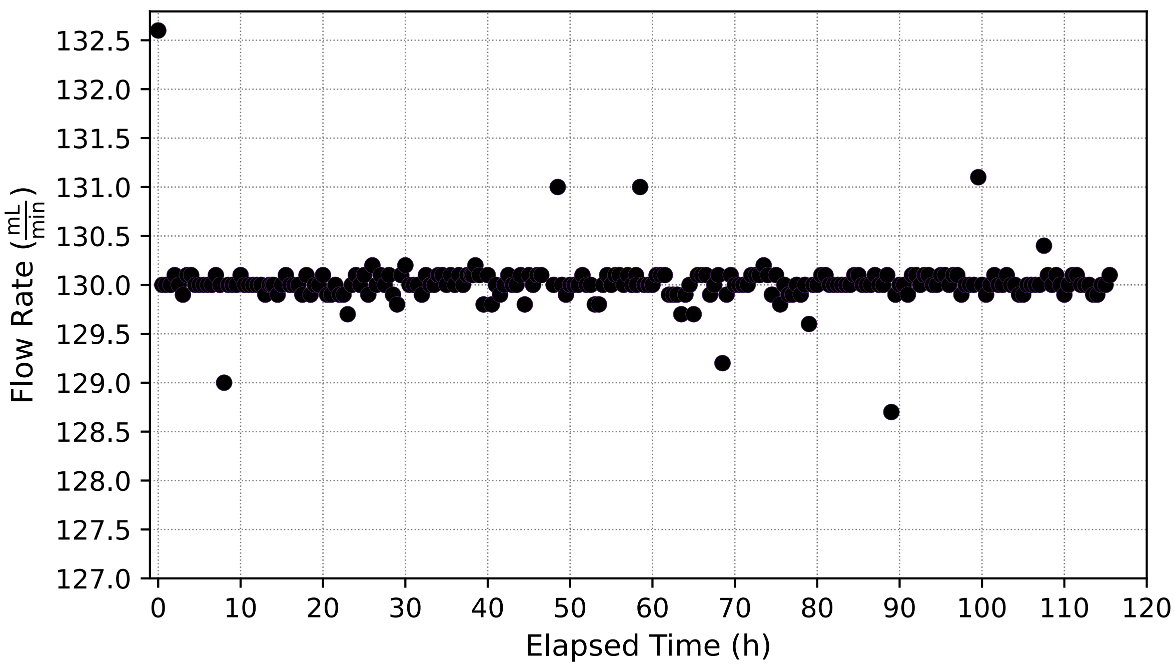


Figure D.36. W-05A time series of flow rate (mL·min^{-1}).

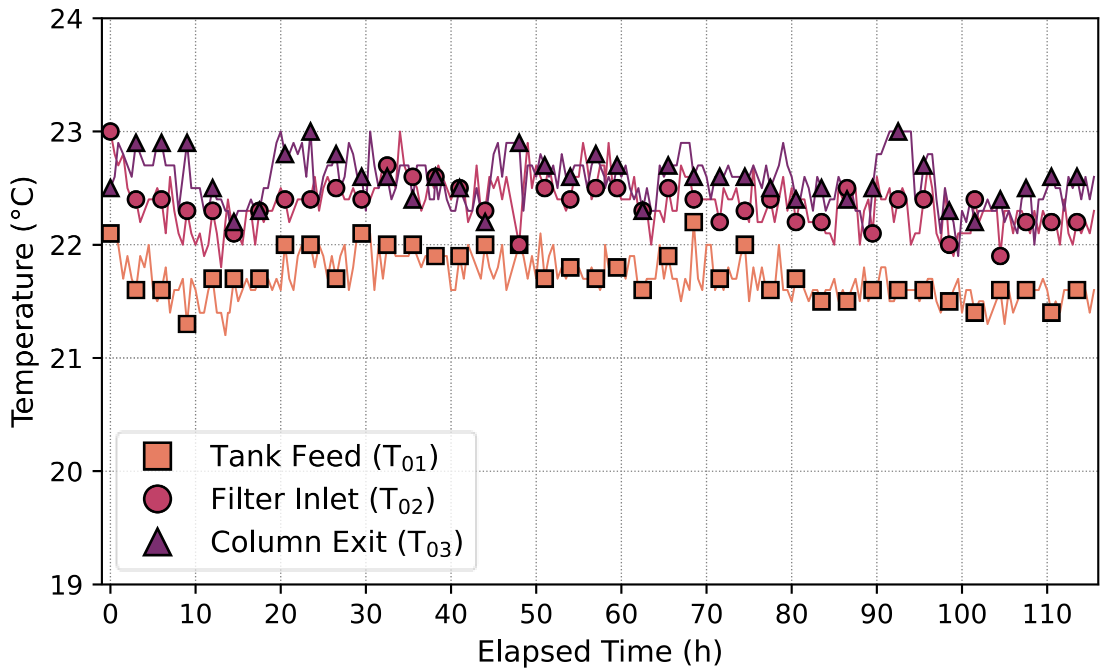


Figure D.37. W-05A time series of temperature (°C). Graph does not contain ambient temperature data.

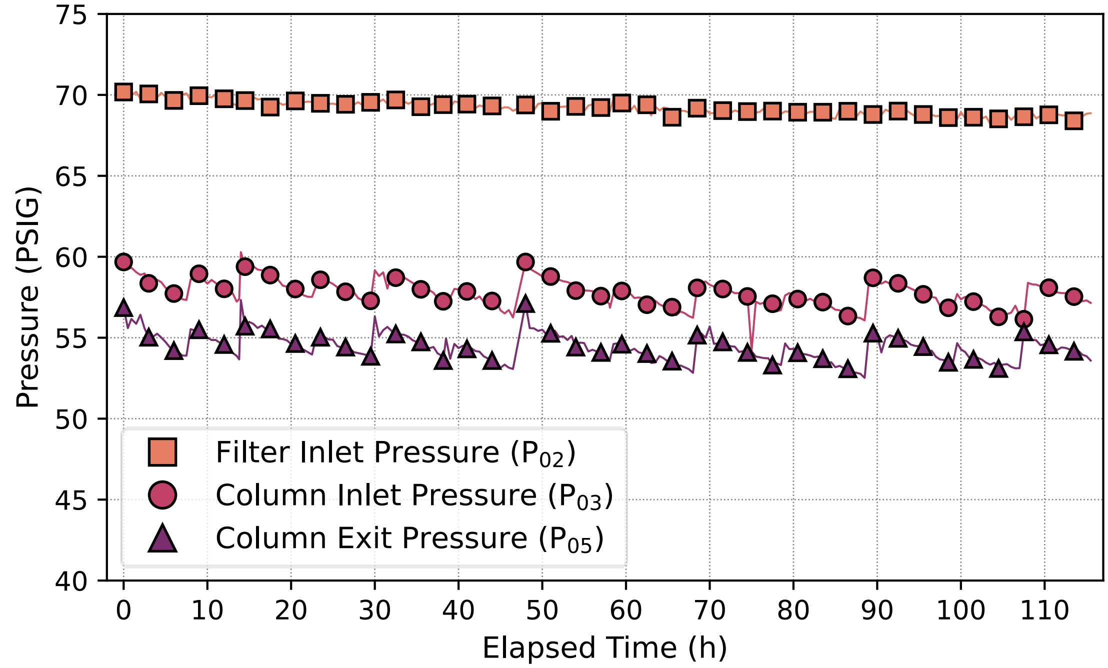


Figure D.38. W-05A time series of line pressure (psig).

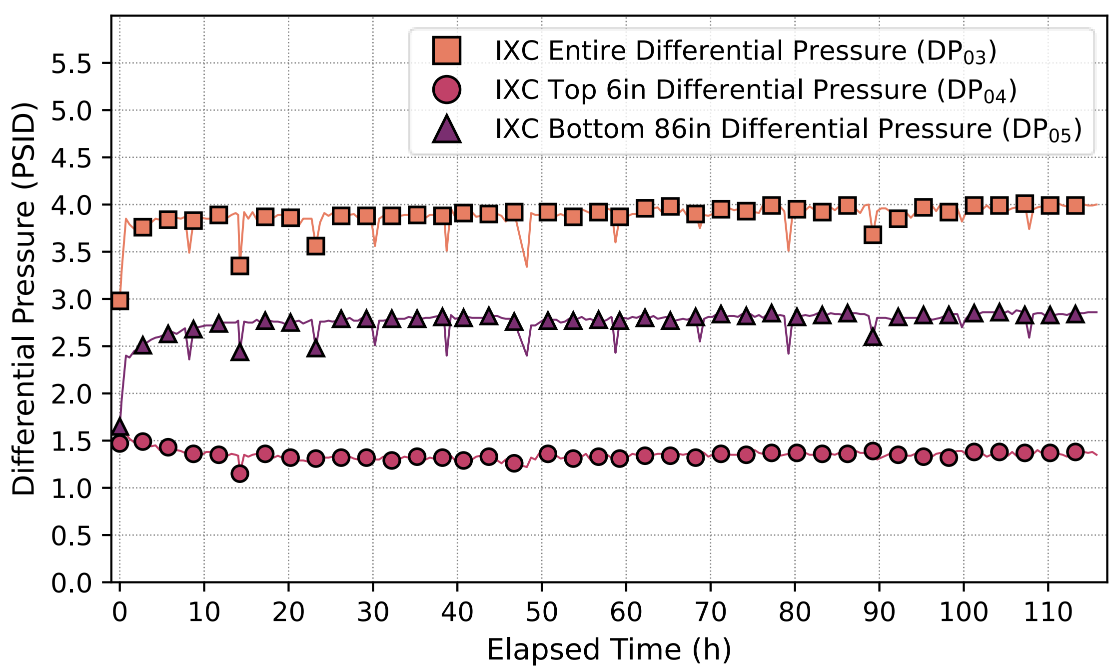


Figure D.39. W-05A time series of IXC differential pressure (psid).

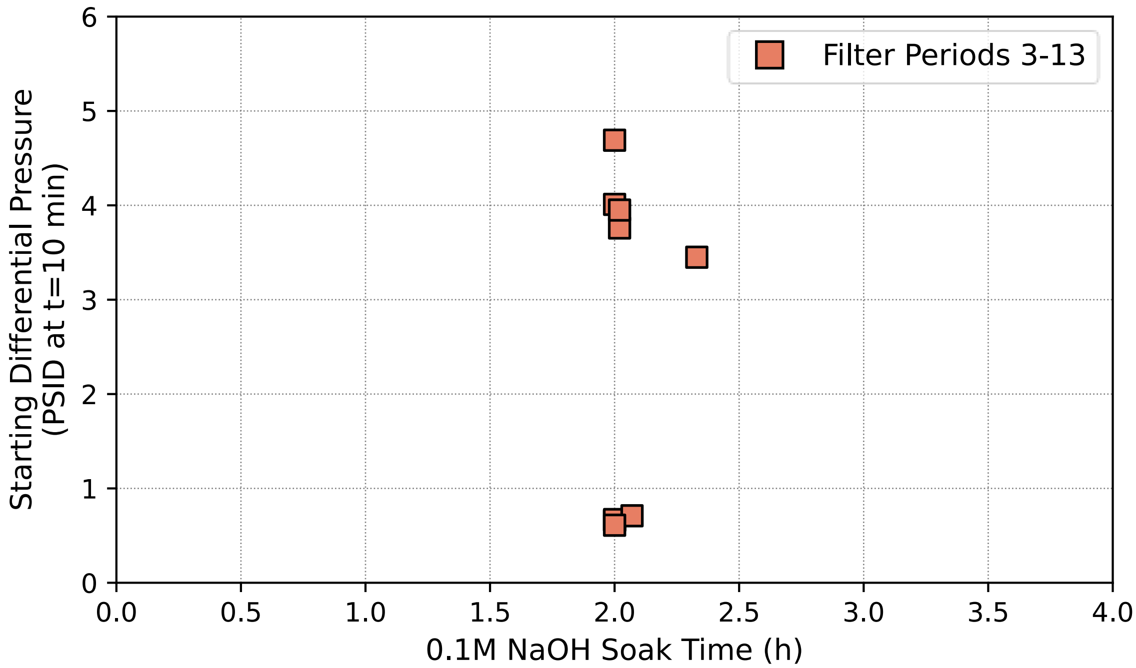


Figure D.40. W-05A starting differential pressure (psid) with varying sodium hydroxide soak time (h). Soak time is the time between pressurized filter flushes.

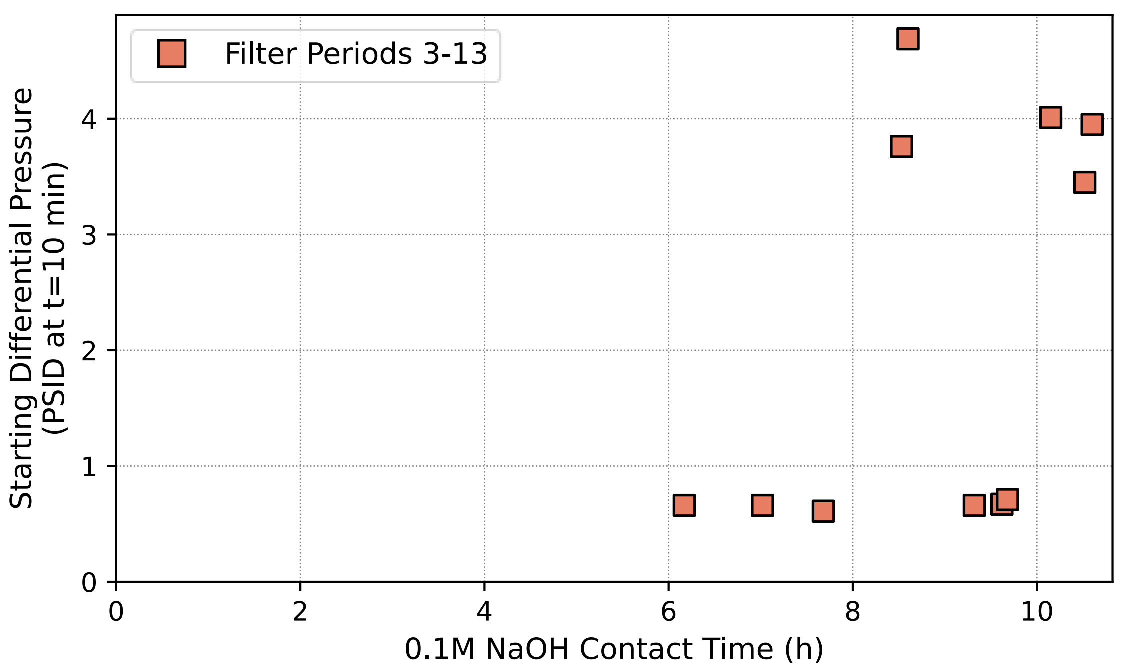


Figure D.41. W-05A starting differential pressure (psid) with varying sodium hydroxide total contact time (h). Contact time is the soak time plus any additional contact time with clean sodium hydroxide while waiting for filter swapping.

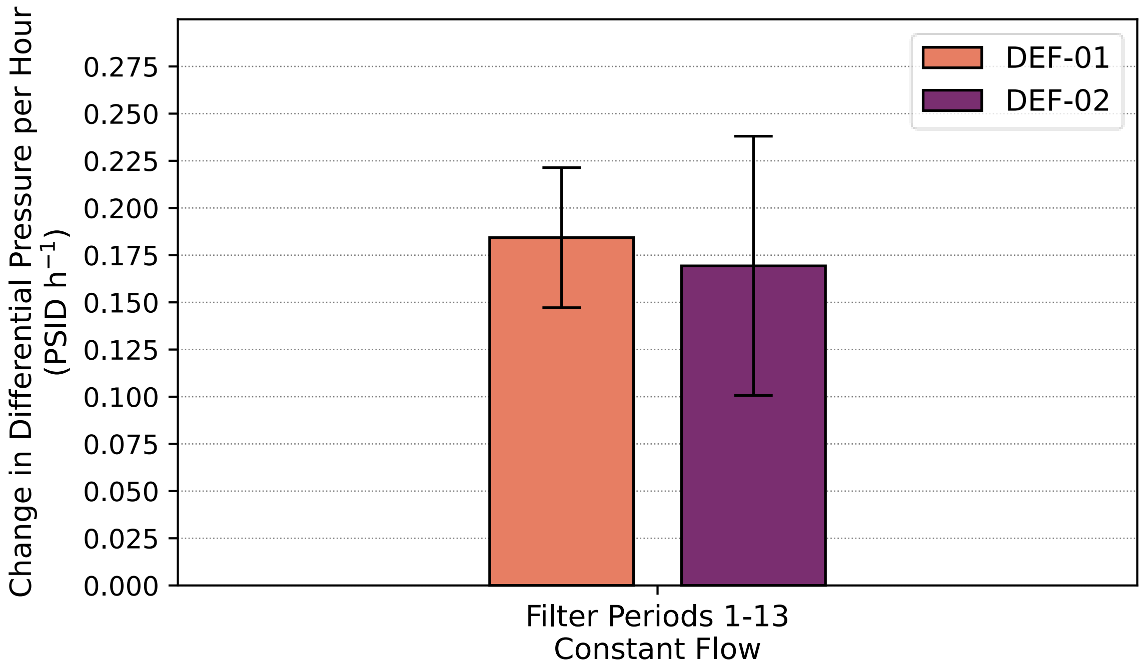


Figure D.42. W-05A filter differential pressure rate of change (psid·h^{-1}) grouped by filter.

D.7 W-05B Time Series and Supplemental Graphs

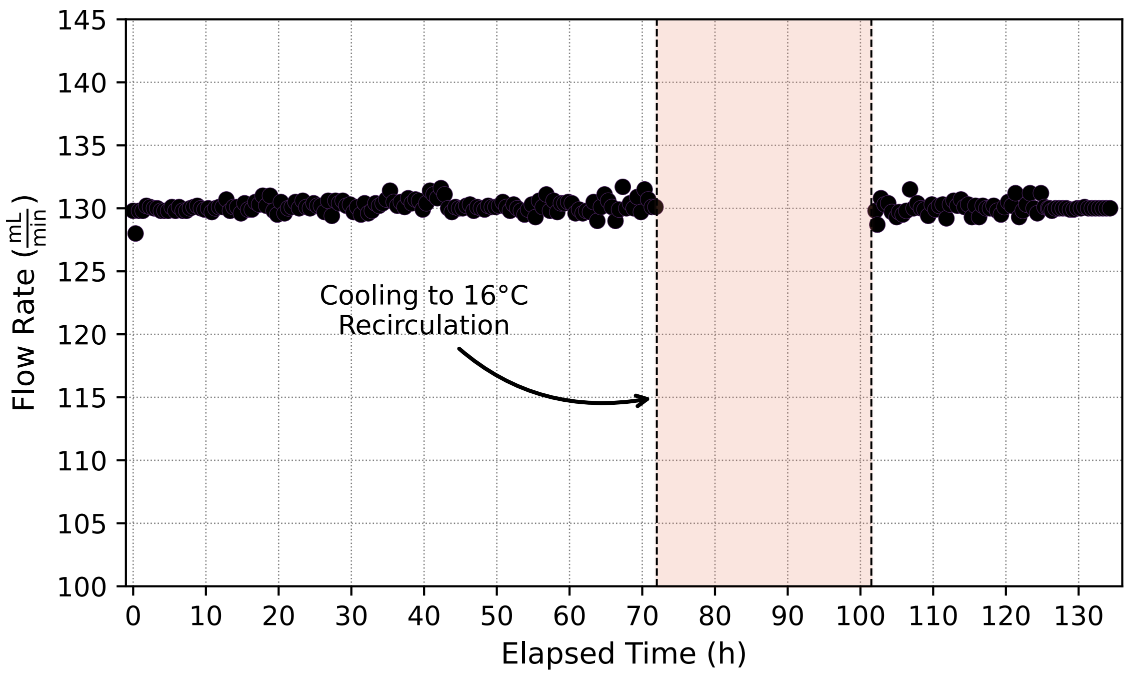


Figure D.43. W-05B time series of flow rate (mL·min^{-1}).

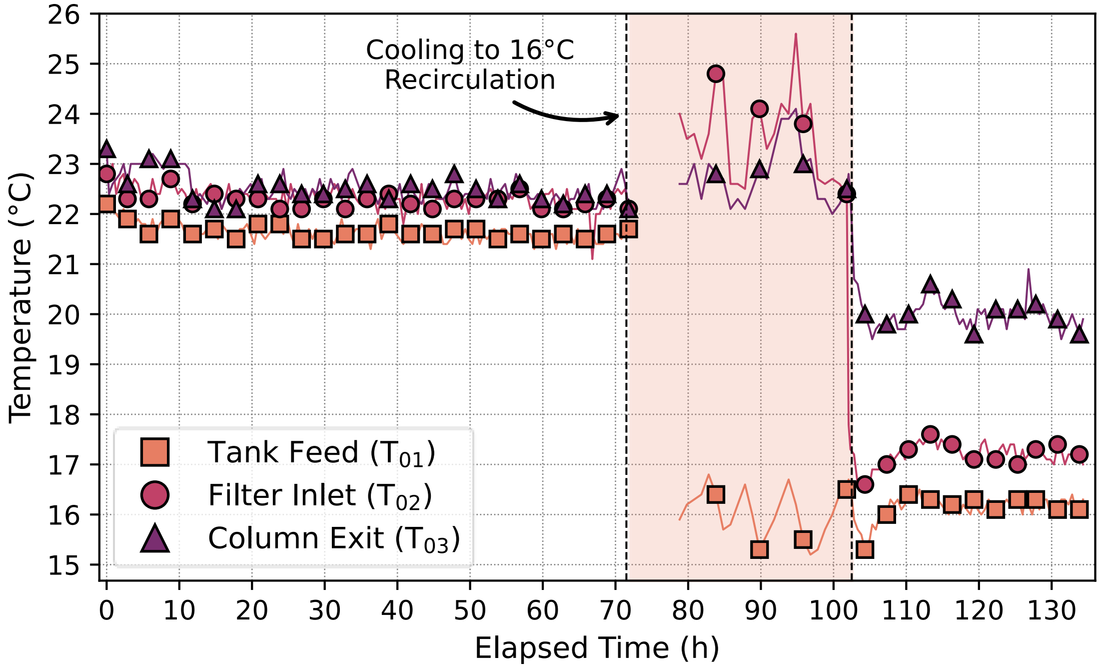


Figure D.44. W-05B time series of temperature (°C). Graph does not contain ambient temperature data.

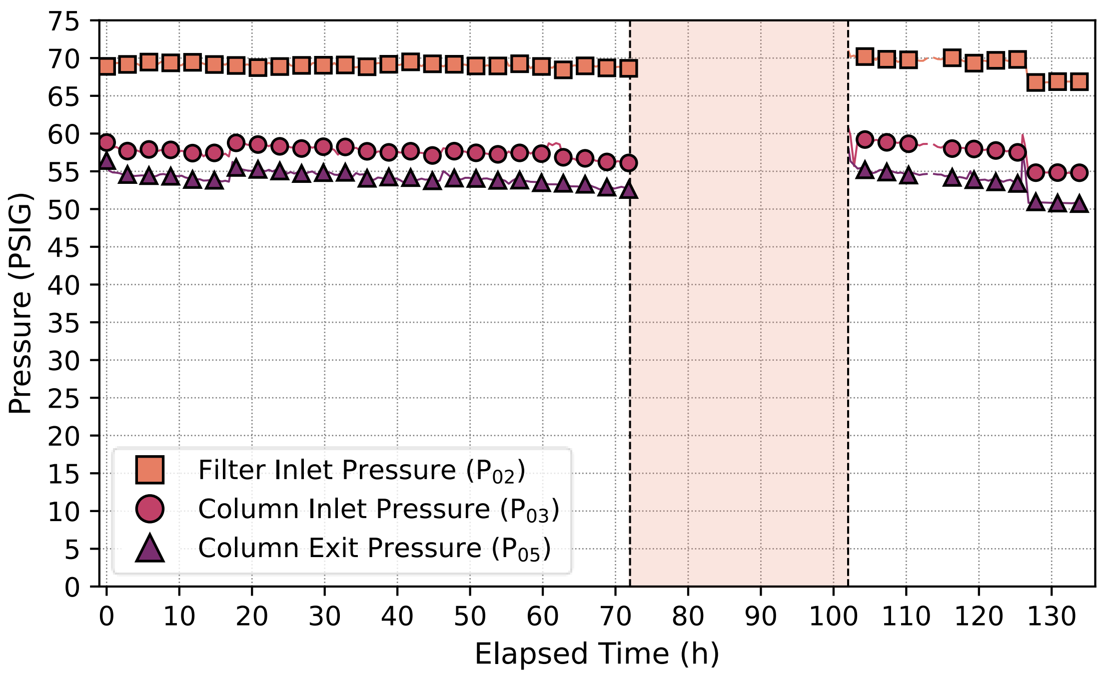


Figure D.45. W-05B time series of line pressure (psig).

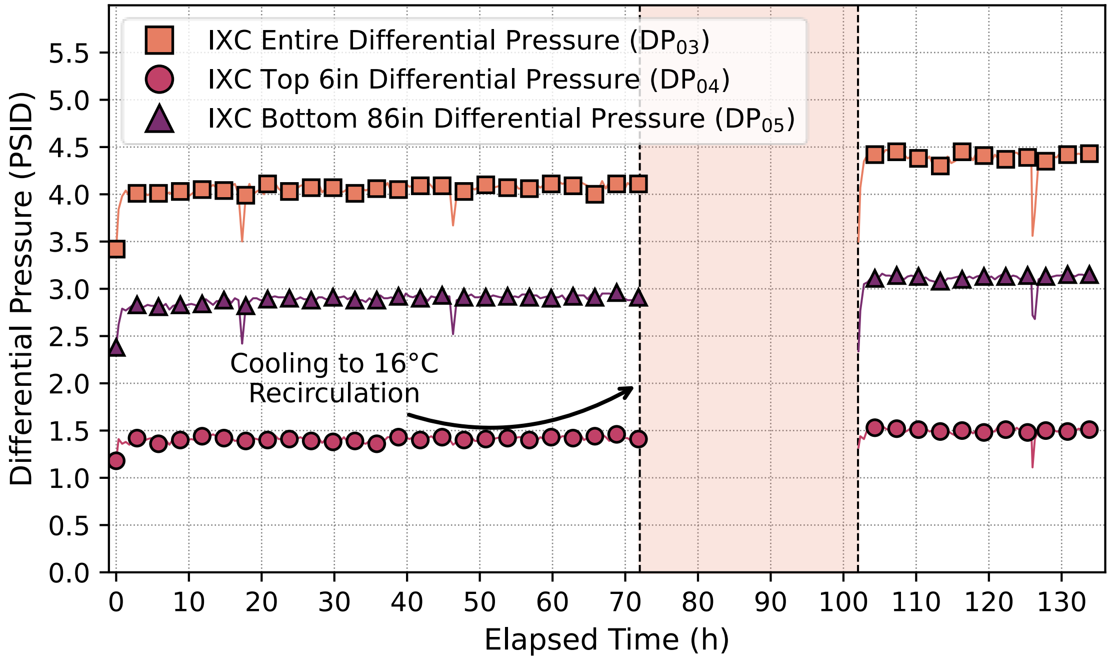


Figure D.46. W-05B time series of IXC differential pressure (psid).

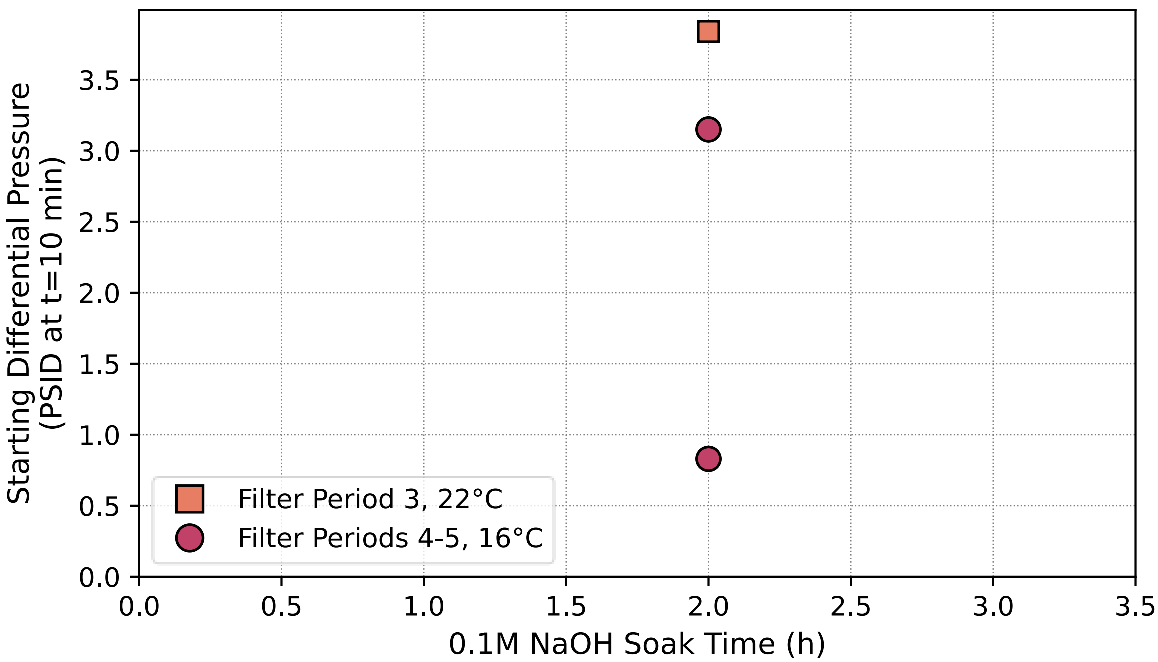


Figure D.47. W-05B starting differential pressure (psid) with varying sodium hydroxide soak time (h). Soak time is the time between pressurized filter flushes.

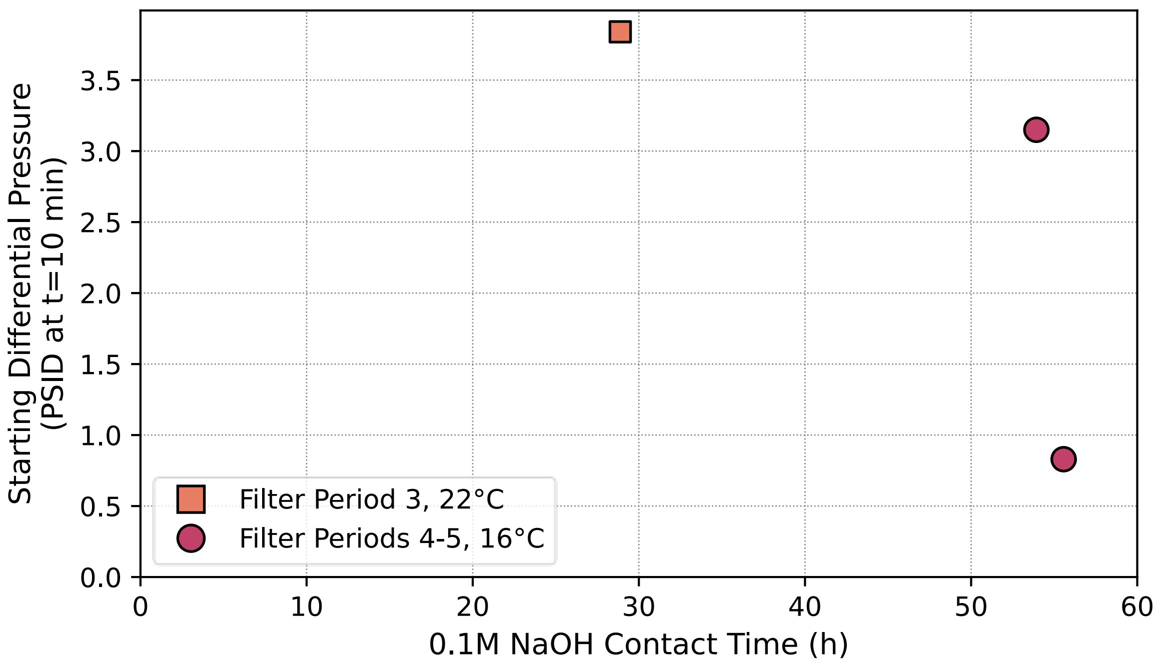


Figure D.48. W-05B starting differential pressure (psid) with varying sodium hydroxide total contact time (h). Contact time is the soak time plus any additional contact time with clean sodium hydroxide while waiting for filter swapping.

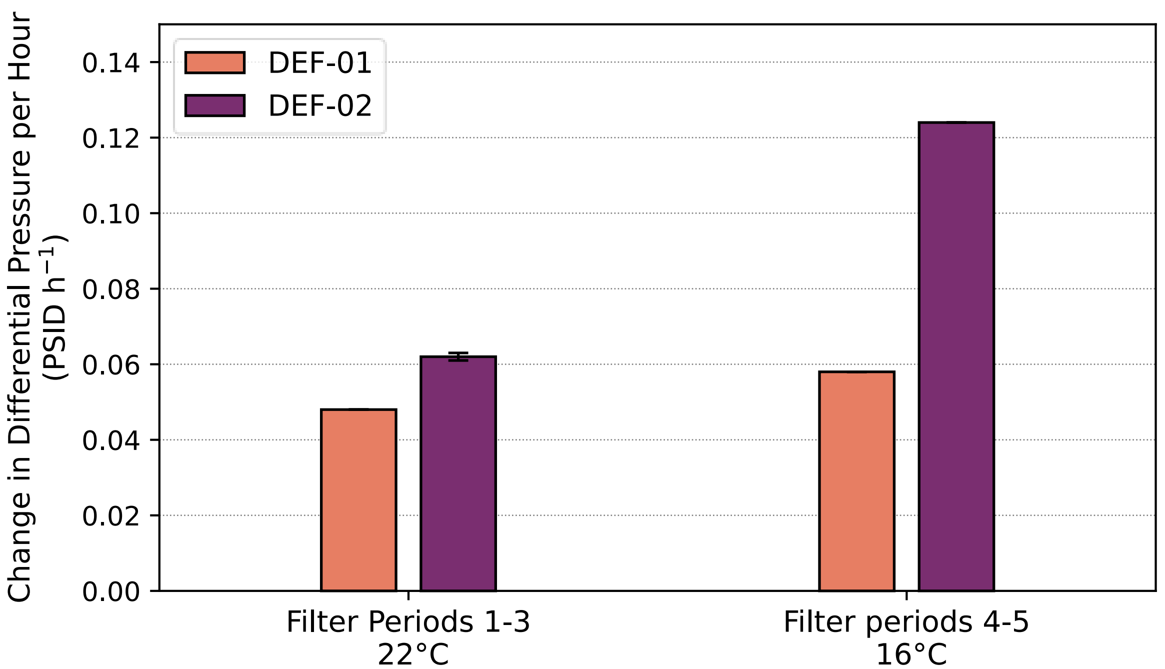


Figure D.49. W-05B filter differential pressure rate of change (psid·h^{-1}) grouped by filter and temperature period.

D.8 W-06 Time Series and Supplemental Graphs

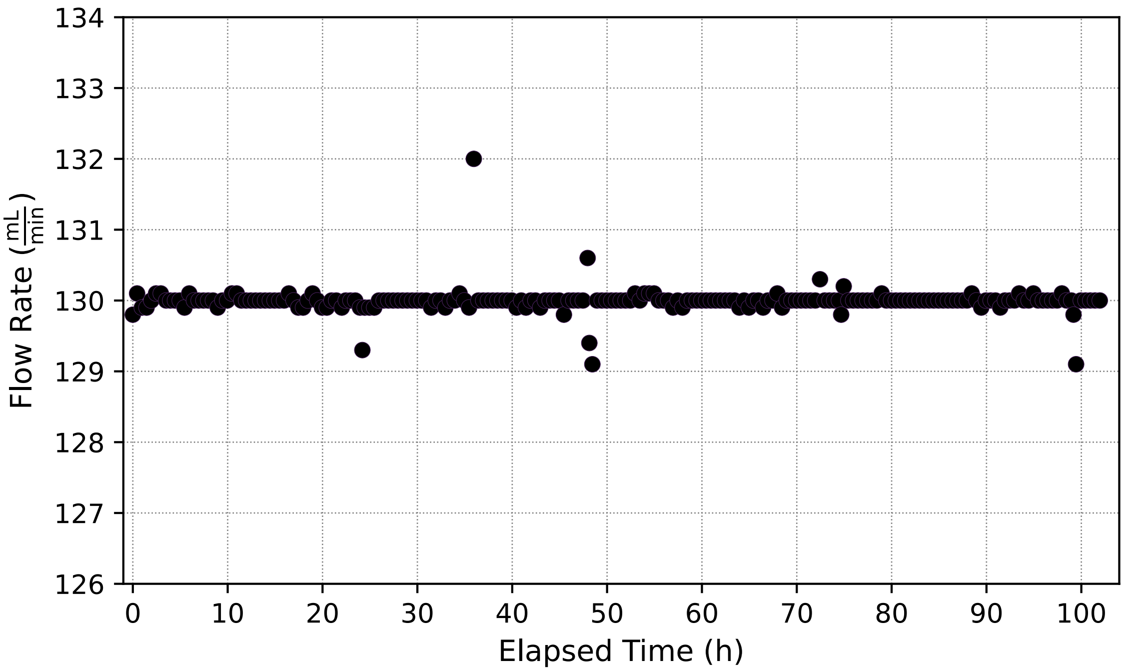


Figure D.50. W-06 time series of flow rate (mL·min[-1]).

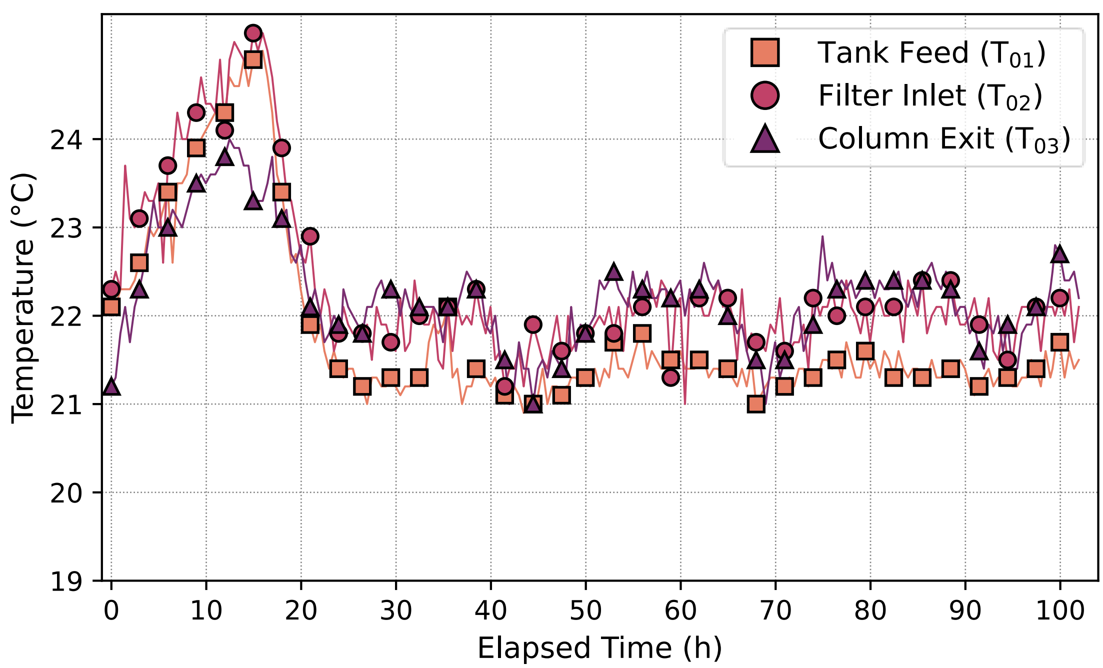


Figure D.51. W-06 time series of temperature (°C). Graph does not contain ambient temperature data.

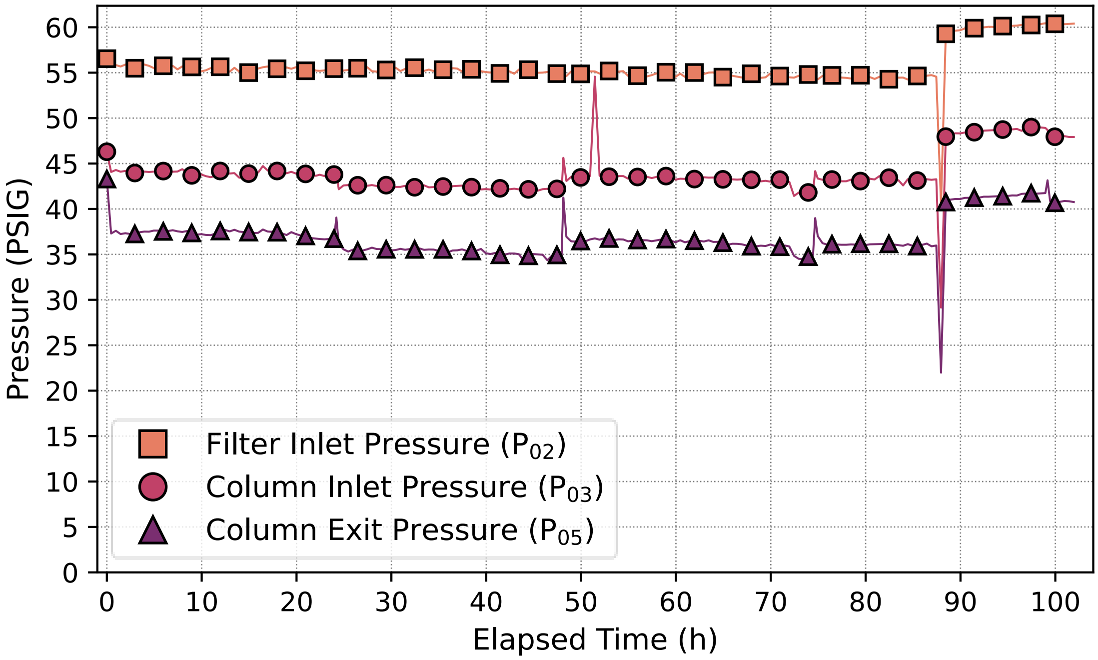


Figure D.52. W-06 time series of line pressure (psig).

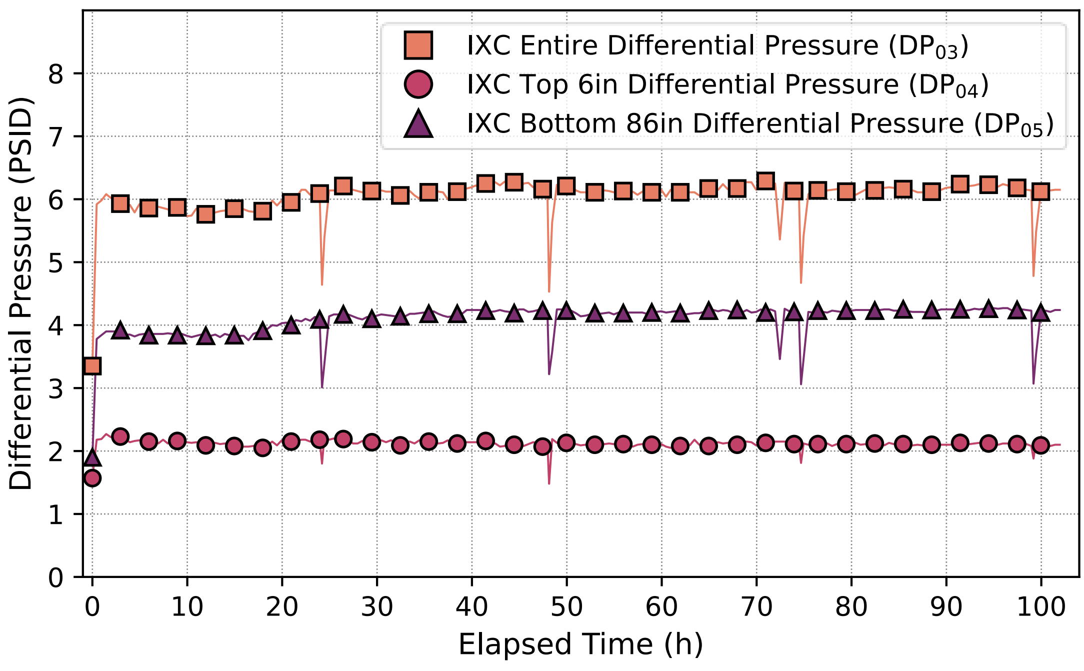


Figure D.53. W-02 time series of IXC differential pressure (psid).

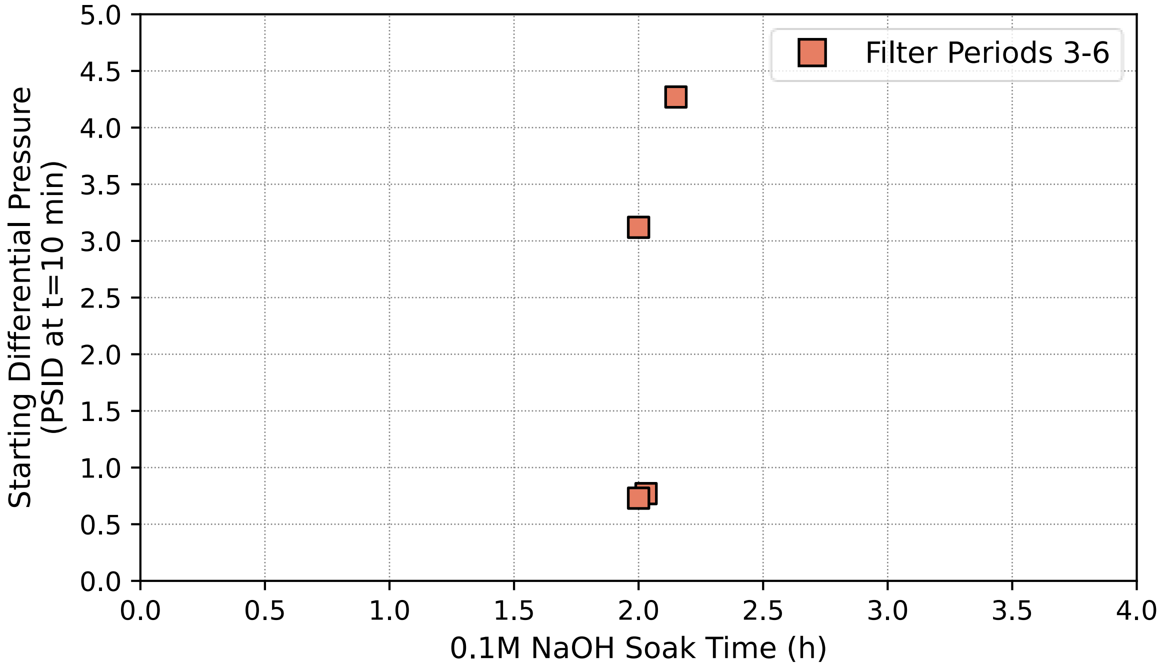


Figure D.54. W-06 starting differential pressure (psid) with varying sodium hydroxide soak time (h). Soak time is the time between pressurized filter flushes.

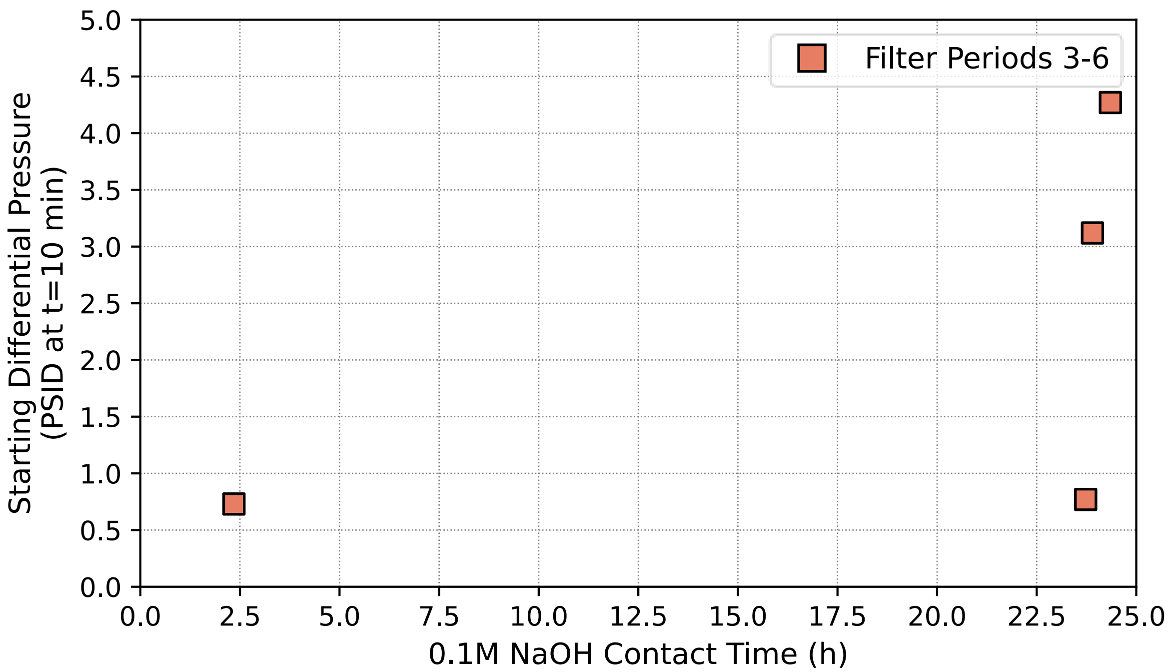


Figure D.55. W-06 starting differential pressure (psid) with varying sodium hydroxide total contact time (h). Contact time is the soak time plus any additional contact time with clean sodium hydroxide while waiting for filter swapping.

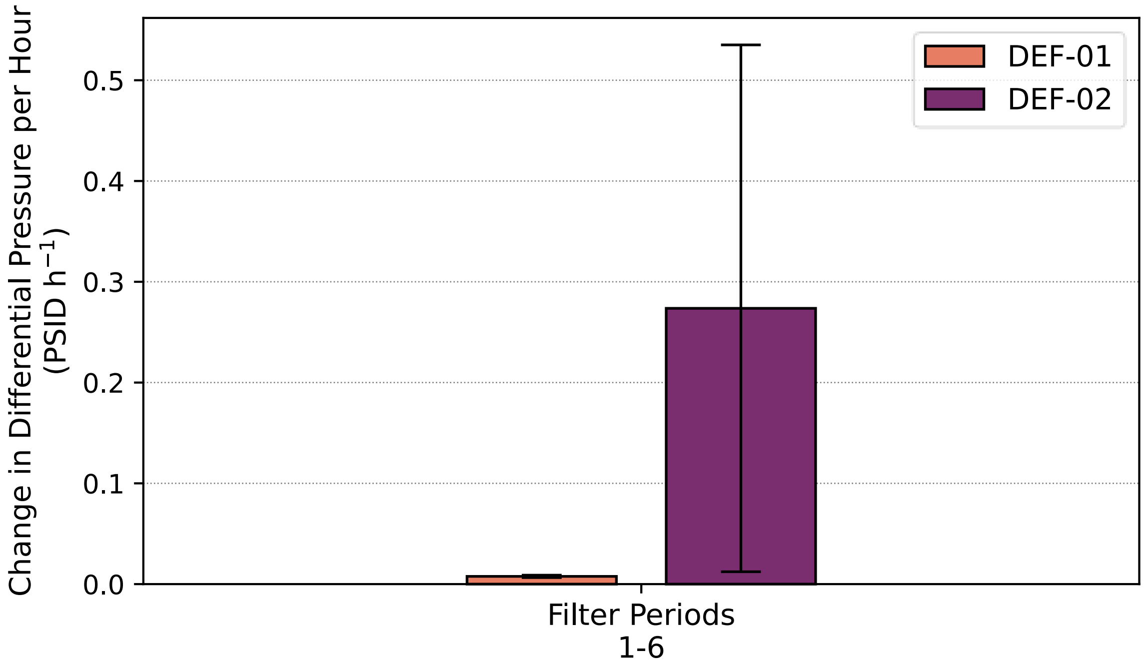


Figure D.56. W-06 filter differential pressure rate of change (psid·h^{-1}) grouped by filter and filter period.

Appendix E – Comparison Data

In this appendix, resistances and rate of change values (psid·h^{-1}) for each DEF, and at a nominal operating flow rate of 130 mL·min^{-1} are tabulated for comparison in Section E.1. Tabulated resistance data for each run are in Section E.2. Sections E.3 and E.4 provide data regarding the baseline resistance of DEFs and baseline permeability of the IXC for the LS1 ("smaller filter") and LS2 ("larger filter") system configurations.

E.1 Tabulated Rate Data

Table E.1. DEF-01 Tabulated Rate Data

Run	Flow Rate (mL·min^{-1})	Temperature (°C)	Filter Period Range(s)	Average Rate (psid·h^{-1})	Standard Deviation
W-01A	130	22	1-3	0.1015	0.0325
W-01A	130	22	4-15, 17-22	1.7429	0.4495
W-01B	130	22	1-10	0.5106	0.0853
W-01B	130	16	11-15	1.1001	0.1917
W-02	91	22	48-66	9.1644	0.7463
W-02	76	22	97-102	20.1855	0.8191
W-02	91	22	70-96	37.3733	4.9046
W-02	130	22	1-47	28.3646	4.4832
W-02	195	22	67-69	97.9714	--
W-03	130	22	1	0.0710	--
W-03	130	16	9	0.2135	--
W-04	130	22	1	0.0046	--
W-04	91	22	3	0.0051	--
W-05A	130	22	1-13	0.1843	0.03710
W-05B	130	22	1-3	0.0480	--
W-05B	130	16	4-5	0.0580	--
W-06	130	22	1-6	0.0077	0.0012

Table E.2. DEF-02 Tabulated Rate Data

Run	Flow Rate ($mL \cdot min^{-1}$)	Temperature (°C)	Filter Period Range(s)	Average Rate ($psid \cdot h^{-1}$)	Standard Deviation
W-01A	130	22	1-3	0.0940	--
W-01A	130	22	4-15, 17-22	1.5524	0.3617
W-01B	130	22	1-10	1.6218	1.8790
W-01B	130	16	11-15	1.2265	0.1465
W-02	91	22	48-66	9.8580	0.9204
W-02	76	22	97-102	23.7036	1.6370
W-02	91	22	70-96	40.4962	5.1562
W-02	130	22	1-47	26.7193	3.1705
W-02	195	22	67-69	55.1151	--
W-03	130	22	2	0.0758	--
W-03	130	16	10	0.2403	--
W-04	130	22	2	0.0045	--
W-04	91	22	4	0.0109	--
W-05A	130	22	1-13	0.1693	0.0687
W-05B	130	22	1-3	0.0620	0.0010
W-05B	130	16	4-5	0.1240	--
W-06	130	22	1-6	0.2737	0.2614

Table E.3. Rate Comparison at 130 mL·min^{-1}

Run	DEF-0X	Temperature (°C)	Filter Period Range(s)	Average Rate (psid·h^{-1})	Standard Deviation
W-01A	DEF-01	22	1-3	0.1015	0.0325
W-01A	DEF-02	22	1-3	0.0940	--
W-01A	DEF-01	22	4-15, 17-22	1.7429	0.4495
W-01A	DEF-02	22	4-15, 17-22	1.5524	0.3617
W-01B	DEF-01	22	1-10	0.5106	0.0853
W-01B	DEF-02	22	1-10	1.6218	1.8790
W-01B	DEF-01	16	11-15	1.1001	0.1917
W-01B	DEF-02	16	11-15	1.2265	0.1465
W-02	DEF-01	22	1-47	28.3646	4.4832
W-02	DEF-02	22	1-47	26.7193	3.1705
W-03	DEF-01	22	1	0.0710	--
W-03	DEF-02	22	2	0.0758	--
W-03	DEF-01	16	9	0.2135	--
W-03	DEF-02	16	10	0.2403	--
W-04	DEF-01	22	1	0.0046	--
W-04	DEF-02	22	2	0.0045	--
W-05A	DEF-01	22	1-13	0.1843	0.03710
W-05A	DEF-02	22	1-13	0.1693	0.0687
W-05B	DEF-01	22	1-3	0.0480	--
W-05B	DEF-02	22	1-3	0.0620	0.0010
W-05B	DEF-01	16	4-5	0.0580	--
W-05B	DEF-02	16	4-5	0.1240	--
W-06	DEF-01	22	1-6	0.0077	0.0012
W-06	DEF-02	22	1-6	0.2737	0.2614

E.2 Tabulated Resistance Data

Table E.4. Tabulated Resistance From W-01A

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W01A	1	7.133304424	1.883488
W01A	1	14.24474431	1.940461
W01A	1	21.35071807	1.914035
W01A	1	28.45122569	1.960023
W01A	1	35.56266558	2.003762
W01A	1	42.67410547	2.039933
W01A	1	49.78554536	2.058019
W01A	1	56.89698525	2.112276
W01A	1	63.97562833	2.171939
W01A	1	71.07613595	2.186444
W01A	1	78.17117744	2.142039
W01A	1	85.28261733	2.193663
W01A	1	92.39952335	2.255997
W01A	1	99.52189551	2.227946
W01A	1	106.6333354	2.31122
W01A	1	113.7502414	2.274069
W01A	1	121.3182857	2.35957
W01A	1	127.9454261	2.376637
W01A	1	135.0623321	2.391537
W01A	1	142.1628398	2.440035
W01A	1	149.2852119	2.489788
W01A	1	156.3802534	2.522718
W01A	1	163.4916933	2.510164
W01A	1	170.5976671	2.511326
W01A	1	177.7145731	2.680687
W01A	1	184.7986823	2.688468
W01A	1	191.9155883	2.671651
W01A	1	199.0324943	2.789119
W01A	1	206.1548665	2.7426
W01A	1	213.2444419	2.777874
W01A	1	220.3558817	2.917094
W01A	1	227.4618555	2.828071
W01A	1	234.5787615	2.85237
W01A	1	241.7011337	2.859978
W01A	1	248.8125736	2.953266
W01A	1	255.9185473	3.009068
W01A	1	263.0354533	2.951766
W01A	1	270.1304948	2.994036
W01A	1	277.2364686	3.009068

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W01A	1	284.3479085	3.161253
W01A	1	291.4593484	3.097952
W01A	1	298.5707883	3.233596
W01A	1	305.6658297	3.057482
W01A	1	312.7827358	3.204772
W01A	1	319.8832434	3.300433
W01A	1	326.9892171	3.298663
W01A	1	334.100657	3.251682
W01A	1	339.7679444	3.37838
W01A	2	342.6037745	1.96289
W01A	2	349.9409658	2.114552
W01A	2	357.0469395	2.190208
W01A	2	364.1529133	2.309229
W01A	2	371.2698193	2.332683
W01A	2	378.3703269	2.361285
W01A	2	385.4926991	2.33166
W01A	2	392.5877406	2.473023
W01A	2	399.6937143	2.504763
W01A	2	406.8051542	2.537586
W01A	2	413.9056618	2.565477
W01A	2	421.0061694	2.608018
W01A	2	428.1176093	2.66501
W01A	2	435.3055751	2.672497
W01A	2	442.4060827	2.735638
W01A	2	449.5065903	2.778178
W01A	2	456.5797673	2.802131
W01A	2	463.6912072	2.843404
W01A	2	470.7971809	2.861825
W01A	2	477.9086208	2.894374
W01A	2	485.0200607	2.953839
W01A	2	492.1369667	2.960826
W01A	2	499.2374744	3.033419
W01A	2	506.3489142	3.064273
W01A	2	513.4384896	3.028033
W01A	2	521.6777751	3.19841
W01A	2	527.562979	3.30106
W01A	2	534.6744189	3.234172
W01A	2	541.7858587	3.268152
W01A	2	548.8918325	3.269896
W01A	2	555.9978063	3.320905
W01A	2	563.0928477	3.392598
W01A	2	570.1988215	3.422923

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W01A	2	577.3102614	3.378586
W01A	2	584.4162351	3.456929
W01A	2	591.5112766	3.511802
W01A	2	598.6117843	3.552409
W01A	2	605.7068257	3.571404
W01A	2	612.8291979	3.553055
W01A	2	615.1978558	3.643962
W01A	3	619.1935995	1.930241
W01A	3	626.288641	2.087656
W01A	3	633.3946148	2.104082
W01A	3	640.5005885	2.104082
W01A	3	647.6174945	2.409609
W01A	3	654.7289344	2.338349
W01A	3	661.8403743	2.410692
W01A	3	668.9518142	2.464949
W01A	3	676.0523218	2.530603
W01A	3	683.1582956	2.710422
W01A	3	690.2752016	2.825262
W01A	3	697.3866415	2.754322
W01A	3	704.4762169	2.786945
W01A	3	711.5821906	2.900469
W01A	3	718.6936305	2.87188
W01A	3	725.8050704	2.93518
W01A	3	732.9165103	2.989438
W01A	3	740.0170179	2.947217
W01A	3	747.1229917	3.090516
W01A	3	754.2234993	3.074012
W01A	3	761.3240069	3.128353
W01A	3	768.4354468	3.125081
W01A	3	775.5359544	3.237035
W01A	3	782.6473943	3.43254
W01A	3	789.7479019	3.53591
W01A	3	793.3063549	3.765002
W01A	4	798.5334363	2.313688
W01A	4	805.6448762	2.66501
W01A	4	812.7563161	3.021798
W01A	4	820.5789	3.370091
W01A	4	826.5005448	3.771484
W01A	5	833.5901201	2.342476
W01A	5	840.70156	2.627722
W01A	5	847.8184661	3.005981
W01A	5	854.9353721	3.385492

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W01A	5	862.046812	4.816103
W01A	5	869.1582519	5.213991
W01A	5	876.2587595	5.618979
W01A	5	883.3647332	6.393713
W01A	6	887.8582595	2.473023
W01A	6	894.9696994	3.055778
W01A	6	902.070207	3.37374
W01A	6	909.1761808	3.907508
W01A	6	916.2657561	4.323248
W01A	6	923.3498654	4.888642
W01A	6	930.4613052	5.680717
W01A	6	937.567279	6.406944
W01A	6	938.9884737	6.559971
W01A	7	942.7783264	2.321279
W01A	7	949.8843002	2.819021
W01A	7	956.9902739	3.217214
W01A	7	964.0962477	3.687807
W01A	7	971.2022214	4.266997
W01A	7	978.3027291	4.985001
W01A	7	985.3923044	5.898225
W01A	7	992.4873459	6.818959
W01A	8	995.3297354	2.538769
W01A	8	1002.430243	3.118499
W01A	8	1009.525285	3.571404
W01A	8	1016.61486	5.294659
W01A	8	1023.7263	5.442859
W01A	8	1031.074788	5.816637
W01A	8	1038.186228	6.351819
W01A	8	1041.504899	6.725596
W01A	9	1046.502039	2.639507
W01A	9	1053.608013	3.226264
W01A	9	1060.719453	3.758084
W01A	9	1067.830892	4.300658
W01A	9	1074.936866	4.819038
W01A	9	1082.522402	5.657093
W01A	9	1089.154644	6.475162
W01A	9	1092.475867	6.927585
W01A	10	1095.311697	3.00247
W01A	10	1102.412205	3.841682
W01A	10	1109.529111	4.369905
W01A	10	1116.640551	4.839717
W01A	10	1123.751991	5.417374

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W01A	10	1130.857964	6.015876
W01A	10	1137.963938	6.934036
W01A	10	1141.045562	7.252283
W01A	11	1146.276652	2.965309
W01A	11	1153.388092	3.62244
W01A	11	1160.488599	4.197058
W01A	11	1167.600039	4.698545
W01A	11	1175.179745	5.416329
W01A	11	1181.811987	6.140317
W01A	11	1187.738187	8.948707
W01A	12	1192.746805	3.288062
W01A	12	1199.858245	4.058182
W01A	12	1206.969685	4.661323
W01A	12	1214.075659	5.131722
W01A	12	1221.181632	5.590802
W01A	12	1228.276674	6.236469
W01A	12	1235.382648	7.027553
W01A	13	1238.938368	2.59155
W01A	13	1246.038875	3.33666
W01A	13	1253.144849	4.013601
W01A	13	1260.245357	4.668012
W01A	13	1267.345864	5.437842
W01A	13	1274.451838	6.176517
W01A	13	1281.568744	6.981801
W01A	14	1285.124464	3.208687
W01A	14	1292.230438	3.813991
W01A	14	1299.374674	4.382381
W01A	14	1306.480648	4.89368
W01A	14	1313.652215	5.531965
W01A	14	1320.840181	6.2192
W01A	14	1328.170266	6.958647
W01A	15	1334.729627	4.460815
W01A	15	1348.779959	4.375519
W01A	17	1355.875	6.619555
W01A	17	1362.98644	7.203428
W01A	17	1367.490352	7.547058
W01A	18	1377.239202	4.285938
W01A	18	1384.824738	5.035101
W01A	18	1391.451878	5.517764
W01A	18	1398.541453	6.129732
W01A	18	1405.652893	6.751081
W01A	18	1412.04827	7.418621

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W01A	19	1419.792688	3.292677
W01A	19	1426.904128	4.011285
W01A	19	1434.015568	4.689502
W01A	19	1441.099677	6.029093
W01A	19	1448.211117	6.425739
W01A	20	1455.349887	3.64874
W01A	20	1462.450395	4.62442
W01A	20	1469.556369	5.276247
W01A	20	1476.662342	5.888354
W01A	21	1483.773782	1.795775
W01A	21	1490.87429	3.481569
W01A	21	1497.980264	4.294147
W01A	21	1505.086237	4.936687
W01A	21	1512.192211	5.579226
W01A	21	1519.298185	6.257965
W01A	22	1526.426023	3.110376
W01A	22	1533.531997	4.553621
W01A	22	1540.632505	5.279539
W01A	22	1547.738478	5.786336

Table E.5. Tabulated Resistance From W-01B

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W01B	1	7.100507622	2.023421
W01B	1	14.21194751	3.188381
W01B	1	21.07577154	3.680819
W01B	1	28.42425943	4.1198
W01B	1	35.53023319	4.285097
W01B	1	43.34680432	4.475144
W01B	1	49.5053149	4.574692
W01B	1	56.85380279	4.843232
W01B	1	63.71762682	4.966888
W01B	1	71.3031627	5.232076
W01B	1	78.18812246	5.333929
W01B	1	85.28316394	5.613473
W01B	1	92.40006997	5.761947
W01B	1	99.48964532	5.861942
W01B	2	106.6666788	3.104328
W01B	2	113.7999832	3.845554
W01B	2	120.9114231	4.287546
W01B	2	128.022863	4.618849
W01B	2	135.1452352	4.859269

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W01B	2	142.2566751	4.992627
W01B	2	149.3681149	5.264465
W01B	2	156.4740887	5.403769
W01B	2	163.601927	5.568244
W01B	2	170.6915023	5.780364
W01B	2	177.8029422	5.859111
W01B	3	187.0478141	2.87188
W01B	3	194.159254	3.468711
W01B	3	196.2894063	3.608364
W01B	3	203.3844478	3.900416
W01B	3	210.468557	3.95028
W01B	3	218.0482623	4.303197
W01B	3	224.6907079	4.50595
W01B	3	231.7966817	4.656141
W01B	3	238.9081216	4.852275
W01B	3	246.0250276	4.993891
W01B	3	253.1419336	5.120394
W01B	3	260.2369751	5.22373
W01B	3	267.3374827	5.446899
W01B	3	274.4489226	5.738479
W01B	3	281.5548964	5.886921
W01B	3	288.655404	6.09899
W01B	3	295.7340471	6.360029
W01B	4	302.8236224	3.675641
W01B	4	309.9350623	4.33002
W01B	4	317.0519684	4.633046
W01B	4	324.1579421	4.978695
W01B	4	331.2584497	5.211474
W01B	4	338.3644235	5.437775
W01B	4	345.4703972	5.514288
W01B	4	352.5873033	6.347708
W01B	4	359.6987432	6.453758
W01B	4	366.8047169	6.534466
W01B	5	373.8997584	3.030291
W01B	5	381.000266	3.635535
W01B	5	388.1062398	4.013601
W01B	5	395.2176797	4.327786
W01B	5	402.3291196	4.490559
W01B	5	409.4405594	4.662374
W01B	5	416.5465332	4.800939
W01B	5	423.6634392	5.156538
W01B	5	430.7639468	5.220479

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W01B	5	437.8699206	5.461578
W01B	5	444.9813605	5.49432
W01B	5	452.0928004	5.801779
W01B	5	459.2042403	5.928379
W01B	5	466.310214	6.131267
W01B	6	473.42712	3.147572
W01B	6	480.5276277	4.394704
W01B	6	487.6390676	4.754768
W01B	6	494.7505074	5.069081
W01B	6	501.8510151	5.322079
W01B	6	508.9788534	5.568244
W01B	6	516.1012255	5.741388
W01B	6	523.2126654	6.589677
W01B	6	530.3295714	6.746664
W01B	7	537.430079	3.128353
W01B	7	544.5961803	3.790889
W01B	7	551.7185524	3.898315
W01B	7	558.8299923	4.354915
W01B	7	565.9414322	4.580988
W01B	7	573.0528721	4.689502
W01B	7	581.823648	4.879403
W01B	7	587.2589891	5.136279
W01B	7	594.3594967	5.202365
W01B	7	601.4709366	5.36772
W01B	7	608.5823765	5.584749
W01B	7	615.7047486	5.722176
W01B	7	622.8271208	5.984018
W01B	7	629.9385607	6.11828
W01B	7	637.0554667	6.412536
W01B	8	644.1887711	4.099622
W01B	8	651.3111433	4.672667
W01B	8	658.4280493	4.998048
W01B	8	665.534023	5.344259
W01B	9	669.557644	5.600865
W01B	9	672.639268	5.476235
W01B	9	679.7507079	5.666135
W01B	9	686.8621478	5.77465
W01B	9	694.4418531	5.932171
W01B	9	701.0842987	6.042062
W01B	9	708.1738741	6.251986
W01B	9	715.285314	6.308181
W01B	9	722.3858216	6.488433

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W01B	9	729.5027276	6.69265
W01B	9	736.6032352	6.89599
W01B	9	743.7201412	7.090232
W01B	9	750.8370473	7.261915
W01B	9	757.9539533	7.551066
W01B	10	765.0653932	1.620131
W01B	10	773.3684502	4.174671
W01B	11	781.7416559	1.121772
W01B	11	787.6678559	2.920243
W01B	11	794.7792957	3.52704
W01B	11	801.8907356	4.072389
W01B	11	808.9912433	4.415603
W01B	11	816.1081493	4.676361
W01B	11	823.2195892	4.832806
W01B	11	830.3310291	4.901935
W01B	11	837.4424689	5.117002
W01B	11	844.5375104	5.272793
W01B	12	850.6818091	3.475329
W01B	12	857.793249	4.218135
W01B	12	864.9046888	4.499542
W01B	12	872.0051965	4.866263
W01B	12	879.1221025	4.922245
W01B	12	886.2390085	4.979925
W01B	13	893.3504484	3.250525
W01B	13	900.4564222	3.790338
W01B	13	907.5569298	4.323289
W01B	13	914.6683697	4.556291
W01B	13	921.7798096	4.732953
W01B	13	928.8857833	5.012552
W01B	13	936.0026893	4.998714
W01B	13	943.1141292	5.431922
W01B	14	947.6180412	2.464757
W01B	14	954.7130826	4.240038
W01B	14	961.8354548	4.587829
W01B	14	968.9468947	4.853104
W01B	14	976.0638007	5.080865
W01B	14	983.1752406	5.249959
W01B	14	990.2921466	5.484625
W01B	14	997.4090526	5.599985
W01B	14	1004.531425	5.79818
W01B	15	1009.316114	2.940747
W01B	15	1016.405689	4.120388

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W01B	15	1023.517129	4.571653
W01B	15	1030.628569	4.955701
W01B	15	1037.740009	5.17845
W01B	15	1044.840516	5.384896
W01B	15	1051.951956	5.600903

Table E.6. Tabulated Resistance From W-02

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W02	2	6.863824034	4.165661
W02	2	13.28871754	9.046661
W02	3	64.88573959	4.077541
W02	3	71.98624721	12.25083
W02	3	77.43835112	27.707
W02	4	80.74681962	3.786234
W02	4	87.88012404	10.06341
W02	4	94.99156393	23.49272
W02	5	98.07318789	5.422293
W02	5	105.1736955	17.30092
W02	5	109.6706837	29.93071
W02	6	112.9893556	4.75943
W02	6	120.0898632	14.87775
W02	6	125.0678712	24.3388
W02	7	127.6693864	4.78363
W02	7	134.9065473	19.23306
W02	7	137.9858026	27.42642
W02	8	140.8303786	5.693301
W02	8	147.9363523	15.96941
W02	8	152.6773123	25.33652
W02	9	155.9959842	6.908548
W02	9	163.0964918	20.35106
W02	9	167.8301636	31.36446
W02	10	170.6747395	6.595245
W02	10	175.2132703	12.76257
W02	10	182.5561099	26.01824
W02	11	189.3935143	13.59608
W02	11	196.4940219	29.30059
W02	12	199.3407843	6.822242
W02	12	203.6076482	13.08445
W02	12	210.7026897	25.72878
W02	13	213.5669437	6.895121

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W02	13	217.8502061	13.79826
W02	13	225.198694	29.75858
W02	14	227.8082262	6.638801
W02	14	232.0783698	12.76412
W02	14	239.1843435	25.08365
W02	15	242.5132189	7.726734
W02	15	246.2914105	14.90387
W02	15	253.3919181	29.89418
W02	16	255.9974418	7.158705
W02	16	260.5117394	13.34333
W02	16	267.6177132	25.69074
W02	17	270.4535433	7.603593
W02	17	274.7072885	14.96632
W02	17	281.8077962	28.36911
W02	18	284.8965261	6.916837
W02	18	288.8581976	13.04874
W02	18	294.069245	21.04175
W02	19	303.222468	14.51377
W02	19	308.4335154	24.75275
W02	20	346.0310404	8.863782
W02	20	353.1260818	20.30461
W02	21	356.6872679	9.466845
W02	21	360.4742053	15.27358
W02	21	365.2078771	24.56099
W02	22	369.9269725	9.002748
W02	22	374.44127	15.38197
W02	22	378.471086	21.85645
W02	23	383.9231899	9.261025
W02	23	389.6210876	17.84265
W02	23	392.9372087	24.99
W02	24	398.4060754	8.129776
W02	24	402.9065255	14.22804
W02	24	406.9332439	22.72721
W02	25	412.1523083	8.188679
W02	25	419.252816	19.5657
W02	25	422.0973919	25.23599
W02	26	427.0792261	9.868949
W02	26	434.1797338	19.57028
W02	26	437.2589891	25.29933
W02	27	441.999949	8.148614
W02	27	449.1277873	19.13972
W02	27	454.1019689	29.6712

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W02	28	458.5989571	8.106749
W02	28	465.7267954	16.75169
W02	28	470.6971507	25.48591
W02	29	475.2045245	7.787789
W02	29	482.3378289	18.79858
W02	29	487.0678566	29.34981
W02	30	491.8124606	7.930861
W02	30	498.9075021	17.38452
W02	30	503.6448179	25.87446
W02	31	507.9116819	7.975369
W02	31	515.0395201	19.03965
W02	31	516.6988561	22.66468
W02	32	523.7938976	9.720275
W02	32	530.8998714	19.91545
W02	33	538.0113113	9.72605
W02	33	545.117285	20.65556
W02	34	551.7495272	8.14921
W02	34	552.2236232	8.718405
W02	34	559.3295969	17.75072
W02	35	566.6780848	8.321858
W02	35	573.5366249	18.38277
W02	35	577.5602459	31.53797
W02	36	581.3530138	8.383169
W02	36	587.7188731	16.46414
W02	36	592.9299205	25.24341
W02	37	596.0068072	8.607096
W02	37	601.9330071	17.40352
W02	37	605.2465773	24.37835
W02	38	610.6986812	8.423078
W02	38	616.3703415	15.19538
W02	38	619.9233284	21.06572
W02	39	626.3187047	10.37152
W02	39	633.4246785	20.51868
W02	39	638.6317174	31.90326
W02	40	644.7949653	9.49264
W02	40	651.9009391	18.17408
W02	40	656.6382549	27.08863
W02	41	661.6162628	8.987482
W02	41	668.7113043	19.95471
W02	41	674.1592175	31.55098
W02	42	681.2815897	8.738436
W02	42	688.3930296	18.04115

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W02	42	693.59606	27.90485
W02	43	700.669237	9.754919
W02	43	707.7916091	19.63616
W02	43	713.0026565	30.20958
W02	44	718.9060809	9.012598
W02	44	726.0120546	18.1581
W02	44	730.98241	26.92485
W02	45	737.3679473	11.44611
W02	45	744.4957856	21.40491
W02	45	748.0405733	32.75578
W02	46	753.0338864	9.084656
W02	46	760.1289279	17.93653
W02	46	764.8662437	26.17001
W02	47	769.5999155	4.753321
W02	47	776.6949569	22.73303
W02	47	780.2506769	29.23885
W02	48	783.7440829	5.964036
W02	48	788.7291968	9.128184
W02	48	793.7088446	12.74637
W02	48	798.6830262	17.54437
W02	48	803.6517417	23.19206
W02	48	805.3098022	25.95897
W02	49	808.6332115	8.512843
W02	49	813.6237915	13.46302
W02	49	818.592507	18.46138
W02	49	823.5666887	25.61708
W02	49	828.5463364	33.22103
W02	49	830.5360091	38.58566
W02	50	832.854743	5.717034
W02	50	834.9889037	6.53974
W02	50	839.4558282	9.196615
W02	50	844.4245437	13.28547
W02	50	849.344064	18.7156
W02	51	859.2596304	10.1485
W02	51	864.2502104	13.23155
W02	51	869.2243921	19.23668
W02	51	874.1931076	25.93783
W02	52	880.0345824	5.19591
W02	52	884.5162654	7.942147
W02	52	889.1639366	10.34832
W02	52	894.1326521	14.71932
W02	52	899.1068338	20.40892

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W02	52	904.0755493	1.162937
W02	53	905.4063706	8.370603
W02	53	910.8418939	13.50097
W02	53	915.8215417	17.45849
W02	53	920.8011894	24.8819
W02	53	925.7644388	32.77624
W02	54	930.5569626	5.604963
W02	54	935.4710167	8.347836
W02	54	940.4779952	11.17043
W02	54	945.4576429	15.21758
W02	54	950.4318246	20.98671
W02	54	953.7515897	25.63893
W02	55	957.5735104	8.732374
W02	55	962.5531581	12.98979
W02	55	967.5328059	16.81138
W02	55	972.5124537	23.31908
W02	55	977.4921014	30.52272
W02	55	980.4470933	36.59084
W02	56	984.2773954	5.966707
W02	56	989.2679754	8.446054
W02	56	994.2366909	11.36281
W02	56	999.2218048	19.85479
W02	56	1004.19052	22.73583
W02	56	1007.838253	26.09732
W02	57	1010.839161	7.843932
W02	57	1015.796944	12.12291
W02	57	1020.776592	15.72473
W02	57	1025.75624	22.01265
W02	57	1030.735887	28.52035
W02	57	1035.715535	36.93274
W02	58	1038.026616	5.969694
W02	58	1043.01173	8.486699
W02	58	1047.980446	11.67239
W02	58	1052.960094	15.45332
W02	58	1057.934275	20.30312
W02	58	1062.24997	25.59829
W02	59	1064.246202	7.395978
W02	59	1069.231316	11.58628
W02	59	1074.205497	14.99531
W02	59	1079.185145	20.6696
W02	59	1084.159327	27.31607
W02	59	1089.138975	35.24782

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W02	60	1094.151419	6.515764
W02	60	1099.136533	8.738421
W02	60	1104.110715	11.96177
W02	60	1109.090362	16.14429
W02	60	1114.396156	21.2634
W02	61	1119.054031	8.906647
W02	61	1124.050077	12.06206
W02	61	1129.029725	16.54277
W02	61	1134.009373	21.28008
W02	61	1138.983554	27.70721
W02	61	1143.957736	35.56658
W02	62	1148.888188	6.837372
W02	62	1153.873302	9.371786
W02	62	1158.85295	13.0634
W02	62	1164.32455	16.93403
W02	62	1169.464538	21.35291
W02	62	1173.108262	26.07604
W02	63	1177.720221	10.32651
W02	63	1182.661606	13.40254
W02	63	1187.674051	17.14459
W02	63	1192.648232	22.61022
W02	63	1197.965687	29.29512
W02	63	1202.613359	37.10367
W02	63	1204.271419	39.88129
W02	64	1207.580252	6.284981
W02	64	1212.576298	8.640465
W02	64	1217.561412	11.74284
W02	64	1222.535594	15.32272
W02	64	1227.338685	19.84369
W02	64	1232.478673	25.21842
W02	65	1235.140316	8.711722
W02	65	1240.147294	11.94077
W02	65	1245.121476	15.45978
W02	65	1250.090191	20.5171
W02	65	1255.064373	26.02044
W02	65	1260.038554	33.07309
W02	65	1264.022273	38.66649
W02	67	1317.511306	18.44459
W02	68	1325.7761	21.52172
W02	68	1327.430334	30.78019
W02	69	1332.393583	10.18347
W02	69	1336.381675	28.25094

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W02	70	1342.476049	14.34995
W02	70	1347.411968	43.77947
W02	71	1348.97674	7.537155
W02	71	1352.307437	19.96748
W02	71	1353.963676	28.56898
W02	72	1356.437101	10.43911
W02	72	1358.91326	20.34846
W02	72	1361.386685	39.99778
W02	73	1364.192998	7.163075
W02	73	1366.639093	14.13959
W02	73	1368.792203	23.90898
W02	74	1372.119256	10.14929
W02	74	1374.61728	18.60925
W02	74	1377.118036	34.56323
W02	75	1380.445089	7.269935
W02	75	1382.915781	14.27911
W02	75	1385.400139	26.89073
W02	76	1387.898162	10.94247
W02	76	1390.390719	19.23328
W02	76	1392.937938	35.25188
W02	77	1396.224906	6.804532
W02	77	1398.725662	13.77954
W02	77	1401.193621	25.02892
W02	78	1404.524319	10.61389
W02	78	1407.019609	19.48133
W02	78	1410.501536	39.39237
W02	79	1412.664121	6.791376
W02	79	1415.189474	12.9578
W02	79	1417.706629	23.72306
W02	80	1420.67474	10.79553
W02	80	1423.139966	18.99149
W02	80	1425.681718	31.03186
W02	81	1429.152166	7.360401
W02	81	1431.842962	13.95762
W02	82	1437.142925	10.58112
W02	82	1439.624549	18.56636
W02	82	1442.130772	30.9239
W02	83	1445.582089	7.535229
W02	83	1448.058247	13.66128
W02	83	1450.705313	24.17073
W02	84	1453.558089	10.13021
W02	84	1456.034247	17.30378

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W02	84	1458.477609	30.73574
W02	84	1460.299471	40.82956
W02	85	1462.466793	7.563781
W02	85	1464.942952	14.10266
W02	85	1467.405445	23.9891
W02	85	1468.55971	28.63356
W02	86	1470.555942	10.30767
W02	86	1473.0403	17.42128
W02	86	1475.562921	29.35559
W02	86	1477.886756	43.39159
W02	87	1480.035129	7.997257
W02	87	1482.527686	14.28443
W02	87	1484.678427	21.58533
W02	88	1487.345901	9.436393
W02	88	1489.835724	15.60263
W02	88	1492.339214	26.28155
W02	88	1494.826304	41.71474
W02	89	1496.658188	8.105714
W02	89	1501.703429	22.86347
W02	89	1502.700452	27.43081
W02	90	1504.687938	10.65454
W02	90	1509.683985	29.02633
W02	90	1511.680217	40.54542
W02	91	1513.516109	7.823407
W02	91	1518.501223	22.36389
W02	91	1519.826213	26.85
W02	92	1521.660101	10.26301
W02	92	1526.678012	27.75314
W02	92	1528.828753	39.74644
W02	93	1530.658633	7.756605
W02	93	1535.632814	21.27154
W02	93	1536.966551	26.77761
W02	94	1538.969342	10.48362
W02	94	1543.965388	26.93317
W02	94	1546.281571	40.51818
W02	95	1548.258125	8.020478
W02	95	1553.303367	21.22672
W02	95	1554.628358	27.14328
W02	96	1556.600539	10.56916
W02	96	1561.64578	27.28285
W02	96	1563.961963	39.59944
W02	97	1565.762143	7.59674

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W02	97	1570.020261	15.49729
W02	97	1574.312998	32.71697
W02	98	1577.820434	10.04278
W02	98	1581.991094	19.93664
W02	98	1586.139889	36.6109
W02	98	1587.714136	51.05309
W02	99	1589.37584	7.694181
W02	99	1593.486373	16.2246
W02	99	1597.635168	29.97804
W02	99	1598.326634	32.54411
W02	100	1600.257637	10.02175
W02	100	1604.433763	20.1448
W02	100	1608.588025	37.04701
W02	100	1610.803631	48.7407
W02	101	1612.601442	7.468835
W02	101	1616.772102	15.86923
W02	101	1620.920898	27.80225
W02	101	1622.030158	31.97464
W02	102	1623.691863	9.239734
W02	102	1627.791463	23.79455

Table E.7. Tabulated Resistance From W-03

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W03	1	6.365859258	3.853388
W03	1	13.47183301	3.953827
W03	1	20.57780677	4.067436
W03	1	27.67831439	4.297189
W03	1	34.78428815	4.408262
W03	1	41.8902619	4.635479
W03	1	49.00170179	4.859728
W03	1	56.10767554	6.226001
W03	1	63.2136493	5.544349
W03	1	70.32508919	5.654377
W03	1	77.42559681	5.661543
W03	1	84.53157057	6.226001
W03	1	91.63207819	6.343721
W03	1	98.74351808	6.562549
W03	1	105.8494918	6.907654
W03	1	112.9554656	7.362089
W03	1	120.0669055	7.697763
W03	1	127.1728792	7.930132
W03	1	134.2843191	8.378891
W03	1	141.3902929	8.725393

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W03	1	148.5017328	9.060019
W03	1	155.6022404	9.413518
W03	1	162.7136803	9.741148
W03	1	169.819654	12.13365
W03	1	176.9256278	12.24726
W03	1	184.0316015	12.47448
W03	1	191.1485076	12.57029
W03	1	198.2544813	12.81531
W03	1	205.3549889	13.0518
W03	1	212.4609627	13.38335
W03	1	219.5724026	13.60088
W03	1	226.6783763	14.065
W03	1	233.7898162	14.282
W03	1	240.9012561	14.39553
W03	1	248.0072299	15.20109
W03	1	255.1186698	15.53074
W03	1	262.2246435	16.10996
W03	1	269.3306173	16.5644
W03	1	276.4420572	16.77947
W03	1	283.5425648	17.59964
W03	1	290.6485385	17.9277
W03	1	297.7545123	18.04131
W03	1	304.8659522	18.59582
W03	1	311.9773921	19.27695
W03	1	319.0833658	19.74544
W03	1	326.1948057	20.18512
W03	1	333.3062456	20.52568
W03	1	340.4067532	31.58427
W03	2	347.5291254	2.663928
W03	2	354.6405653	2.929615
W03	2	361.7520052	2.841905
W03	2	368.863445	2.79805
W03	2	375.9803511	3.103418
W03	2	383.0863248	3.23832
W03	2	390.1922986	3.150542
W03	2	397.2982723	3.150542
W03	2	404.39878	3.37181
W03	2	411.5047537	3.413874
W03	2	418.6161936	3.631293
W03	2	425.7768287	3.482555
W03	2	432.9374638	3.78743
W03	2	440.0980989	4.005198
W03	2	447.258734	4.005198
W03	2	454.3647077	4.116092
W03	2	461.4706815	4.379424
W03	2	468.5821214	4.420681
W03	2	475.682629	4.601637
W03	2	482.7886027	4.686644

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W03	2	489.8945765	4.906087
W03	2	497.0005503	5.037753
W03	2	504.1010579	5.128706
W03	2	511.2124978	6.218731
W03	2	518.3239377	6.306441
W03	2	525.4299114	6.3983
W03	2	532.5413513	6.56957
W03	2	539.6473251	6.573855
W03	2	546.7532988	6.70552
W03	2	553.8592726	6.749409
W03	2	560.9652463	6.881075
W03	2	568.0766862	7.051974
W03	2	575.18266	7.144407
W03	2	582.2940999	7.402813
W03	2	589.4000736	7.451627
W03	2	596.5115135	7.490523
W03	2	603.6229534	7.797507
W03	2	610.7398594	8.011392
W03	2	617.8458332	8.197733
W03	2	624.9518069	8.417177
W03	2	632.0523145	8.510731
W03	2	639.1528222	8.642498
W03	2	646.2587959	8.812174
W03	2	653.3647697	9.119394
W03	2	660.4762096	9.332428
W03	2	667.5876495	9.463993
W03	2	674.6990893	9.639412
W03	2	680.8528626	13.43004
W03	3	683.6930657	5.206759
W03	3	687.3327819	6.602348
W03	3	692.3014974	6.760779
W03	3	697.2811451	7.076596
W03	3	702.2607929	7.076596
W03	3	707.2349745	7.4121
W03	3	712.20369	7.583747
W03	3	717.1833378	8.06199
W03	3	722.1575194	7.905338
W03	3	727.1371672	7.897758
W03	3	732.1168149	8.226223
W03	3	737.0964627	8.06199
W03	3	742.0761104	8.226223
W03	3	747.0502921	8.727402
W03	3	752.0244737	8.398577
W03	3	757.0041215	8.883152
W03	3	761.972837	8.735903
W03	3	766.9470186	9.056228
W03	3	771.9212002	9.549466
W03	3	776.900848	9.540082

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W03	3	781.8750296	9.385053
W03	3	786.8546774	9.868546
W03	3	791.8343251	10.03278
W03	3	796.8139729	10.19701
W03	3	801.7881545	12.01566
W03	3	806.7623362	12.01566
W03	3	811.7419839	11.6751
W03	3	816.7161655	12.01566
W03	3	821.6958133	12.6605
W03	3	826.6809272	12.48366
W03	3	831.6551088	12.5089
W03	3	836.6292905	12.67331
W03	3	841.6089382	12.98896
W03	3	846.5831199	12.5089
W03	3	851.5518353	12.85075
W03	3	856.5314831	12.49626
W03	3	861.5001986	12.19237
W03	3	866.4798464	13.64589
W03	3	871.4594941	13.64589
W03	3	876.4282096	13.50912
W03	3	881.4078574	14.13859
W03	3	886.382039	14.97509
W03	3	891.3616868	14.30282
W03	3	896.3413345	13.64589
W03	3	901.31005	14.49668
W03	3	906.2842317	14.81068
W03	3	911.2584133	15.30391
W03	3	916.2325949	15.63274
W03	3	921.1958443	22.91507
W03	4	926.1973566	3.249022
W03	4	931.1770043	3.258897
W03	4	936.1621182	3.366489
W03	4	941.1362999	3.482002
W03	4	946.2819359	3.534372
W03	4	951.0955954	3.644562
W03	4	956.0752432	3.644562
W03	4	961.0548909	3.589467
W03	4	966.0290725	3.592313
W03	4	971.0032542	3.75778
W03	4	975.9829019	3.809847
W03	4	980.9625497	3.864942
W03	4	985.9421975	3.864942
W03	4	990.9218452	3.920038
W03	4	995.8960268	3.868091
W03	4	1000.870208	4.033558
W03	4	1005.84439	4.033558
W03	4	1010.818572	4.033558
W03	4	1015.787287	3.926462

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W03	4	1020.761469	4.143869
W03	4	1025.73565	4.088713
W03	4	1030.709832	4.309335
W03	4	1035.684014	4.364491
W03	4	1040.658195	5.026358
W03	4	1045.632377	5.136669
W03	4	1050.606559	5.136669
W03	4	1055.58074	4.916047
W03	4	1060.565854	4.962494
W03	4	1065.540036	5.136669
W03	4	1070.519684	5.187224
W03	4	1075.488399	5.196436
W03	4	1080.468047	5.187224
W03	4	1085.447695	5.407604
W03	4	1090.41641	5.472518
W03	4	1095.390592	5.246981
W03	4	1100.370239	5.683079
W03	4	1105.355353	5.788013
W03	4	1110.335001	5.738174
W03	4	1115.309183	5.577914
W03	4	1120.277898	5.859032
W03	4	1125.25208	5.964003
W03	4	1130.237194	6.008152
W03	4	1135.205909	6.135113
W03	4	1140.185557	6.23403
W03	4	1145.154273	6.190329
W03	4	1150.122988	6.411194
W03	4	1155.09717	6.405248
W03	4	1160.071351	8.390849
W03	5	1206.165434	3.692368
W03	5	1216.807997	4.489871
W03	5	1227.494288	5.229333
W03	5	1238.131384	5.964053
W03	5	1248.779412	6.925533
W03	5	1259.438373	8.220896
W03	5	1270.108266	9.513605
W03	5	1280.772693	11.02854
W03	5	1285.036277	12.04125
W03	6	1290.002806	3.527115
W03	6	1300.672699	4.553692
W03	6	1311.348058	5.171385
W03	6	1322.017951	6.082606
W03	6	1332.676911	7.080564
W03	6	1343.314008	8.087848
W03	6	1353.972968	9.645155
W03	6	1364.648327	11.11871
W03	7	1375.724718	3.922252
W03	7	1386.383679	4.736394

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W03	7	1397.042639	5.366123
W03	7	1407.685202	6.213784
W03	7	1418.344162	7.213329
W03	7	1429.019521	8.503227
W03	7	1439.683948	9.559929
W03	7	1450.353841	11.4428
W03	8	1461.700077	4.150155
W03	8	1472.364504	5.051631
W03	8	1483.039863	5.749596
W03	8	1493.715222	6.782117
W03	8	1501.176494	7.411479
W03	8	1511.829989	8.573565
W03	8	1522.472551	9.907044
W03	8	1533.136978	11.58385
W03	8	1536.691787	12.16266
W03	9	1543.803226	6.206373
W03	9	1550.947463	7.097026
W03	9	1558.042505	7.753231
W03	9	1565.126614	8.48101
W03	9	1572.227121	9.179433
W03	9	1579.387757	9.921826
W03	9	1586.504663	10.6907
W03	9	1593.627035	11.60062
W03	9	1600.760339	12.39856
W03	9	1607.849915	13.28807
W03	9	1614.961354	14.5774
W03	9	1622.05093	15.74568
W03	9	1629.178768	16.58318
W03	9	1636.317539	18.69491
W03	9	1643.461775	20.20563
W03	9	1650.556817	21.66898
W03	9	1657.662791	24.39562
W03	9	1664.812493	25.26792
W03	10	1671.918467	3.052308
W03	10	1679.024441	3.368048
W03	10	1686.135881	3.721162
W03	10	1693.258253	3.953245
W03	10	1700.353294	4.201791
W03	10	1707.459268	4.552072
W03	10	1714.598039	5.635765
W03	10	1721.704013	5.538759
W03	10	1728.777189	5.956309
W03	10	1735.888629	6.324013
W03	10	1743.000069	7.033881
W03	10	1750.06778	7.190257
W03	10	1757.206551	8.228651
W03	10	1764.312524	9.090831
W03	10	1771.434897	9.229709

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W03	10	1778.535404	10.83496

Table E.8. Tabulated Resistance From W-04

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W04	1	4.197109565	1.731857
W04	1	7.843024648	1.722316
W04	1	12.04984974	1.698762
W04	1	16.25991335	1.698224
W04	1	20.47321547	1.713366
W04	1	24.68651758	1.713366
W04	1	28.89658119	1.70607
W04	1	33.1066448	1.70607
W04	1	37.3167084	1.70607
W04	1	41.5235335	1.706613
W04	1	45.73683562	1.705527
W04	1	49.95013773	1.713366
W04	1	54.16020134	1.72176
W04	1	58.37026495	1.72176
W04	1	62.58032855	1.72176
W04	1	66.79039216	1.72176
W04	1	71.00369428	1.721205
W04	1	75.21375788	1.729605
W04	1	79.42382149	1.729605
W04	1	83.6338851	1.729605
W04	1	87.84718721	1.744723
W04	1	92.05725082	1.745296
W04	1	96.26731443	1.737451
W04	1	100.477378	1.753141
W04	1	104.6906801	1.752562
W04	1	108.9007438	1.768831
W04	1	113.1075689	1.761572
W04	1	117.3176325	1.760986
W04	1	122.9310506	1.760986
W04	1	125.7377597	1.760986
W04	1	129.9478233	1.768831
W04	1	134.1578869	1.745296
W04	1	138.371189	1.744723
W04	1	142.5844911	1.76824
W04	1	147.0752256	1.753141
W04	1	151.0046183	1.768831
W04	1	155.2146819	1.768831
W04	1	159.4279841	1.77608
W04	1	163.6348092	1.761572
W04	1	167.8448728	1.768831
W04	1	171.9114704	1.753721
W04	1	176.2618694	1.776677

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W04	1	180.4751715	1.76824
W04	1	184.6852351	1.784522
W04	1	188.8952987	1.784522
W04	1	193.1053623	1.784522
W04	1	197.315426	1.784522
W04	1	201.5254896	1.776677
W04	2	203.2082196	1.554075
W04	2	207.1224992	1.640616
W04	2	209.9292083	1.613384
W04	2	214.1360334	1.624063
W04	2	218.346097	1.62504
W04	2	222.5561606	1.635239
W04	2	226.7662242	1.62504
W04	2	230.9762878	1.635239
W04	2	235.1831129	1.616772
W04	2	239.3931765	1.638153
W04	2	243.6032402	1.622126
W04	2	247.8133038	1.609013
W04	2	252.0233674	1.635239
W04	2	256.233431	1.638153
W04	2	260.4434946	1.62504
W04	2	264.6535582	1.632325
W04	2	268.8668603	1.636206
W04	2	273.0834009	1.642991
W04	2	277.2934645	1.639609
W04	2	281.5002896	1.638644
W04	2	285.7103532	1.633782
W04	2	289.9204168	1.638153
W04	2	294.1304805	1.638153
W04	2	298.3437826	1.636206
W04	2	302.5538462	1.639609
W04	2	306.7639098	1.639609
W04	2	310.9739734	1.64398
W04	2	315.184037	1.638153
W04	2	319.3941006	1.636696
W04	2	323.6041642	1.642523
W04	2	327.8142278	1.642523
W04	2	332.0242914	1.649808
W04	2	336.234355	1.619212
W04	2	340.4476571	1.640574
W04	2	344.6609593	1.643485
W04	2	348.8710229	1.641066
W04	2	353.0810865	1.622126
W04	2	357.2911501	1.620669
W04	2	361.4979752	1.61094
W04	2	365.7112773	1.621648
W04	2	369.9213409	1.623583
W04	2	374.1314045	1.619212

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W04	2	378.3414681	1.627954
W04	2	382.5515317	1.642523
W04	2	386.7615953	1.642523
W04	2	390.9748974	1.644941
W04	2	395.184961	1.620669
W04	2	399.3950247	1.626497
W04	2	403.6050883	1.635239
W04	2	407.8151519	1.632325
W04	3	410.7589579	1.628308
W04	3	413.6930484	1.69793
W04	3	416.6400929	1.66124
W04	3	419.5871374	1.683655
W04	3	422.5309434	1.695627
W04	3	425.477988	1.70607
W04	3	428.428271	1.705295
W04	3	431.3753155	1.70607
W04	3	434.32236	1.717277
W04	3	437.2694046	1.728485
W04	3	440.2164491	1.728485
W04	3	443.1634936	1.728485
W04	3	446.1072996	1.740506
W04	3	449.0543441	1.728485
W04	3	452.0013887	1.728485
W04	3	454.9451947	1.729286
W04	3	457.8922392	1.739692
W04	3	460.8392837	1.739692
W04	3	463.7863283	1.739692
W04	3	466.7301343	1.740506
W04	3	469.6771788	1.7509
W04	3	472.6242233	1.7509
W04	3	475.5712678	1.739692
W04	3	478.5183124	1.739692
W04	3	481.4653569	1.762107
W04	3	484.4124014	1.762107
W04	3	487.3594459	1.762107
W04	3	490.3064905	1.773314
W04	3	493.253535	1.773314
W04	3	496.2005795	1.773314
W04	3	499.147624	1.773314
W04	3	502.0979071	1.772466
W04	3	505.0449516	1.773314
W04	3	507.9919961	1.773314
W04	3	510.9390407	1.784522
W04	3	513.8860852	1.773314
W04	3	516.8331297	1.773314
W04	3	519.7769357	1.774165
W04	3	522.7239802	1.773314
W04	3	525.6710248	1.762107

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W04	3	528.6180693	1.773314
W04	3	531.5651138	1.762107
W04	3	534.5121583	1.773314
W04	3	537.4592029	1.773314
W04	3	540.4062474	1.773314
W04	3	543.3500534	1.785385
W04	3	546.2970979	1.773314
W04	4	562.0146687	1.339266
W04	4	563.964252	1.530672
W04	4	566.9210121	1.510338
W04	4	569.8712951	1.53225
W04	4	572.8183396	1.516183
W04	4	575.7653842	1.534916
W04	4	578.7124287	1.530753
W04	4	581.6594732	1.524509
W04	4	584.6065177	1.54116
W04	4	587.5535623	1.55573
W04	4	590.5006068	1.528672
W04	4	593.4476513	1.539079
W04	4	596.3946958	1.547404
W04	4	599.3417404	1.530753
W04	4	602.2887849	1.551567
W04	4	605.2358294	1.52659
W04	4	608.1828739	1.55573
W04	4	611.1299185	1.534916
W04	4	614.076963	1.530753
W04	4	617.0240075	1.547404
W04	4	619.971052	1.553648
W04	4	622.9180966	1.557811
W04	4	625.8651411	1.549486
W04	4	628.8121856	1.549486
W04	4	631.7592301	1.532834
W04	4	634.7062747	1.557811
W04	4	637.6533192	1.559892
W04	4	640.6003637	1.559892
W04	4	643.5474082	1.543241
W04	4	646.4944528	1.559892
W04	4	649.4414973	1.570299
W04	4	652.3885418	1.534916
W04	4	655.4304747	1.541755
W04	4	658.2792844	1.566137
W04	4	661.2263289	1.547404
W04	4	664.1733734	1.54116
W04	4	667.120418	1.532834
W04	4	670.0674625	1.576544
W04	4	673.014507	1.561974
W04	4	675.9615515	1.543241
W04	4	678.9085961	1.564055

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W04	4	681.8556406	1.551567
W04	4	684.8059236	1.55512
W04	4	687.7529681	1.553648
W04	4	690.7000127	1.547404
W04	4	693.6438187	1.558425
W04	4	696.5908632	1.566137
W04	4	699.5411462	1.559278
W04	4	702.4881908	1.561974
W04	5	706.0149287	1.664935
W04	5	709.5772902	1.63047
W04	5	713.1396517	1.649014
W04	5	716.7020132	1.667557
W04	5	720.9120768	1.682534
W04	5	725.1253789	1.689849
W04	5	729.3354425	1.70607
W04	5	733.5455061	1.713915
W04	5	738.4032718	1.741112
W04	5	743.2642761	1.747413
W04	5	748.1317573	1.753204
W04	5	752.989523	1.75471
W04	5	758.4431746	1.781261
W04	5	763.9292113	1.782669
W04	5	769.3666704	1.795736
W04	5	774.8106065	1.788722
W04	5	779.6546625	1.857304
W04	5	781.1296961	1.846416
W04	5	787.4447915	1.868204
W04	5	793.7663639	1.872539
W04	5	800.0814593	1.873434
W04	5	805.5901656	1.857393
W04	5	811.0956334	1.863897
W04	5	816.6043397	1.851398
W04	5	822.106569	1.888417
W04	5	826.9610962	1.877681
W04	5	831.8188619	1.877095
W04	5	836.6798661	1.876511
W04	5	841.5343933	1.877681
W04	5	845.7476954	1.838793
W04	5	849.957759	1.831593
W04	5	854.1678226	1.855129
W04	5	858.3714092	1.848589
W04	5	861.9337707	1.825174
W04	5	865.4993708	1.842951
W04	5	869.0844018	1.829169
W04	5	872.6532404	1.851441
W04	5	875.6002849	1.840559
W04	5	878.5343754	1.810499
W04	5	881.4814199	1.840559

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W04	5	884.4252259	1.841484
W04	5	887.9875874	1.843718
W04	5	891.549949	1.843718
W04	5	895.1123105	1.852989
W04	5	898.674672	1.843718
W04	5	902.8847356	1.847284
W04	5	907.0947992	1.870819
W04	5	914.8191864	1.862311
W04	6	916.2428356	1.398115
W04	6	919.0087394	1.564477
W04	6	922.571101	1.540668
W04	6	926.1334625	1.554443
W04	6	929.695824	1.566496
W04	6	933.9026491	1.602192
W04	6	938.1127127	1.609013
W04	6	942.3227763	1.613384
W04	6	946.5360784	1.615824
W04	6	951.3938441	1.647769
W04	6	956.2516098	1.650294
W04	6	961.112614	1.657432
W04	6	965.9736182	1.653646
W04	6	971.4758475	1.69787
W04	6	976.9780768	1.69787
W04	6	982.4803061	1.702329
W04	6	987.9922509	1.692189
W04	6	994.3105848	1.753352
W04	6	1000.62568	1.748882
W04	6	1006.940776	1.75471
W04	6	1013.262348	1.758788
W04	6	1018.774293	1.708881
W04	6	1024.282999	1.702617
W04	6	1029.788467	1.7164
W04	6	1035.293935	1.708601
W04	6	1040.1517	1.674285
W04	6	1045.009466	1.67176
W04	6	1049.867232	1.679336
W04	6	1055.055757	1.668343
W04	6	1059.589672	1.675548
W04	6	1063.799736	1.633782
W04	6	1068.009799	1.626497
W04	6	1072.219863	1.629411
W04	6	1076.429927	1.632325
W04	6	1079.992288	1.594046
W04	6	1083.55465	1.606099
W04	6	1087.117011	1.595768
W04	6	1090.679373	1.600934
W04	6	1093.626417	1.559892
W04	6	1096.573462	1.578625

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W04	6	1099.520506	1.576544
W04	6	1102.467551	1.551567
W04	6	1105.414595	1.574462
W04	6	1108.36164	1.564055
W04	6	1111.305446	1.562592
W04	6	1114.25249	1.564055
W04	6	1117.199535	1.561974
W04	6	1120.146579	1.566137
W04	6	1123.093624	1.570299

Table E.9. Tabulated Resistance From W-05A

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W05A	1	2.003990277	1.978638
W05A	1	6.214053883	2.088957
W05A	1	9.722440222	2.088957
W05A	1	14.6341811	2.27045
W05A	1	18.84748321	2.370225
W05A	1	23.05754682	2.451942
W05A	1	27.26437192	2.574148
W05A	1	31.47767403	2.692631
W05A	1	35.69097615	2.863909
W05A	1	39.90103976	2.966172
W05A	1	44.11110336	3.09725
W05A	1	48.32116697	3.26866
W05A	1	52.53123058	3.409821
W05A	1	56.74129418	3.550982
W05A	1	60.9545963	3.730375
W05A	1	65.16465991	3.924051
W05A	2	69.34233841	1.670144
W05A	2	73.55240201	1.668032
W05A	2	77.76246562	1.677163
W05A	2	81.97252923	1.689336
W05A	2	86.18583134	1.702492
W05A	2	90.39589495	1.730423
W05A	2	94.60595856	1.741075
W05A	2	98.81602216	1.7639
W05A	2	103.0260858	1.788248
W05A	2	107.2361494	1.806508
W05A	2	111.4429745	1.819312
W05A	2	115.6530381	1.864334
W05A	2	118.1790762	1.885638
W05A	3	119.8631017	1.796552

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W05A	3	124.0699268	2.059523
W05A	3	128.2799904	2.09904
W05A	3	132.4932925	2.138496
W05A	3	136.7033561	2.240201
W05A	3	140.9134197	2.320864
W05A	3	145.1234833	2.351113
W05A	3	149.3303084	2.473242
W05A	3	153.5436105	2.511277
W05A	3	157.7504356	2.705327
W05A	3	161.9604992	2.794762
W05A	3	166.1705628	2.895591
W05A	3	170.383865	3.045262
W05A	3	174.5906901	3.119046
W05A	3	178.7975152	3.300679
W05A	3	183.0075788	3.419904
W05A	3	187.2144039	3.573127
W05A	3	191.421229	3.724488
W05A	4	195.621577	1.698557
W05A	4	199.8316406	1.696945
W05A	4	204.0449428	1.69945
W05A	4	208.2550064	1.704554
W05A	4	212.4683085	1.723779
W05A	4	216.6751336	1.756874
W05A	4	220.8916742	1.758169
W05A	4	225.1017378	1.777596
W05A	4	229.3150399	1.778519
W05A	4	233.5251035	1.794335
W05A	4	237.7384056	1.807409
W05A	4	241.9452307	1.82845
W05A	4	246.1488173	1.845853
W05A	4	250.3621194	1.86671
W05A	5	254.5786601	2.026879
W05A	5	258.7887237	2.109123
W05A	5	262.9987873	2.159537
W05A	5	267.2088509	2.209952
W05A	5	271.415676	2.281518
W05A	5	275.6289781	2.329924
W05A	5	279.8390417	2.391445
W05A	5	284.0491053	2.482191
W05A	5	288.2624074	2.571729
W05A	5	292.4757096	2.662405
W05A	5	296.6857732	2.764513

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W05A	5	300.8990753	2.843758
W05A	5	305.1091389	2.946006
W05A	5	309.322441	3.075488
W05A	5	313.5325046	3.167831
W05A	5	317.7458067	3.549021
W05A	5	321.9591088	3.629623
W05A	5	323.3635429	3.679999
W05A	6	326.17457	1.720185
W05A	6	330.3878721	1.751149
W05A	6	334.5914587	1.733072
W05A	6	338.8047608	1.720738
W05A	6	343.0083474	1.751361
W05A	6	347.218411	1.74564
W05A	6	351.4252361	1.766011
W05A	6	355.6352997	1.782161
W05A	6	359.8486018	1.798286
W05A	6	364.0586654	1.794335
W05A	6	368.268729	1.823247
W05A	6	372.4820311	1.822615
W05A	6	376.6856177	1.850425
W05A	6	380.8989198	1.868231
W05A	6	385.1089834	1.87042
W05A	6	389.3222856	1.86671
W05A	6	393.5355877	1.935135
W05A	7	406.1657785	1.836883
W05A	7	410.4082272	2.04062
W05A	7	414.6182908	2.09904
W05A	7	418.8251159	2.16043
W05A	7	423.0351795	2.199869
W05A	7	427.2452431	2.27045
W05A	7	431.4553067	2.34103
W05A	7	435.6686088	2.390375
W05A	7	439.8786724	2.462025
W05A	7	444.0887361	2.51244
W05A	7	448.2923226	2.595558
W05A	7	452.4959092	2.726838
W05A	7	456.7059728	2.75443
W05A	7	460.9192749	2.853834
W05A	7	465.1293386	3.006504
W05A	7	469.3426407	3.065413
W05A	7	473.5559428	3.166164
W05A	7	477.7660064	3.248494

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W05A	7	481.9793085	3.387818
W05A	7	486.1893721	3.520733
W05A	7	490.4026742	3.609472
W05A	7	491.1043515	3.661894
W05A	8	494.6397254	1.682564
W05A	8	498.849789	1.651294
W05A	8	503.0598526	1.669554
W05A	8	507.2699162	1.690858
W05A	8	511.4832184	1.69945
W05A	8	515.6965205	1.710094
W05A	8	519.9098226	1.731382
W05A	8	524.1166477	1.732508
W05A	8	528.3234728	1.74926
W05A	8	532.5302979	1.764489
W05A	8	536.730646	1.767193
W05A	8	540.9374711	1.773626
W05A	8	545.1475347	1.800422
W05A	8	549.3478827	1.802273
W05A	8	553.5611849	1.834779
W05A	8	557.774487	1.842382
W05A	8	561.9877891	1.86519
W05A	8	566.1946142	1.883274
W05A	8	570.4046778	1.891724
W05A	8	574.6179799	1.915368
W05A	9	578.8021354	2.034827
W05A	9	583.0089605	2.049432
W05A	9	587.2222626	2.078045
W05A	9	591.4323263	2.139371
W05A	9	595.6423899	2.199869
W05A	9	599.8524535	2.260367
W05A	9	604.4835234	2.34103
W05A	9	608.2754953	2.3803
W05A	9	612.9101277	2.430676
W05A	9	616.7020996	2.531428
W05A	9	620.9186402	2.761803
W05A	9	625.1319423	2.783307
W05A	9	629.3387674	2.846597
W05A	9	633.5520695	2.954586
W05A	9	637.7556561	2.999497
W05A	9	641.9657197	3.107333
W05A	9	646.1725448	3.169499
W05A	9	650.3793699	3.240134

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W05A	9	654.5894335	3.379572
W05A	9	658.7962586	3.512583
W05A	9	663.0063222	3.641728
W05A	10	667.2034318	1.679253
W05A	10	671.4134954	1.663467
W05A	10	675.623559	1.677163
W05A	10	679.8368611	1.688807
W05A	10	684.0501632	1.69793
W05A	10	688.2602268	1.709119
W05A	10	692.4702904	1.718249
W05A	10	696.6803541	1.721292
W05A	10	700.8904177	1.731944
W05A	10	705.1004813	1.74564
W05A	10	709.3105449	1.75477
W05A	10	713.523847	1.772437
W05A	10	717.7371491	1.787642
W05A	10	721.9472127	1.820204
W05A	10	726.1572763	1.844551
W05A	10	730.3673399	1.849116
W05A	10	734.580642	1.86671
W05A	10	738.7907056	1.876507
W05A	10	743.0007693	1.891724
W05A	10	747.2140714	1.904724
W05A	11	751.4208965	2.049432
W05A	11	755.6309601	2.088957
W05A	11	759.8410237	2.109123
W05A	11	764.0478488	2.170521
W05A	11	768.2611509	2.249323
W05A	11	772.474453	2.299699
W05A	11	776.6845166	2.361196
W05A	11	780.8978187	2.40045
W05A	11	785.1111209	2.511277
W05A	11	789.3211845	2.572938
W05A	11	793.5312481	2.613269
W05A	11	797.7445502	2.722856
W05A	11	801.9578523	2.773232
W05A	11	806.1679159	2.85526
W05A	11	810.381218	2.94451
W05A	11	814.5945201	3.055337
W05A	11	818.8013452	3.482311
W05A	11	823.0114088	3.550982
W05A	11	827.2214724	3.601397

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W05A	12	831.8917284	1.671481
W05A	12	835.6807856	1.680206
W05A	12	839.8876107	1.679207
W05A	12	844.0976743	1.690858
W05A	12	848.3109765	1.685766
W05A	12	852.5210401	1.699988
W05A	12	856.7311037	1.699988
W05A	12	860.9444058	1.72682
W05A	12	865.1544694	1.733466
W05A	12	869.364533	1.748683
W05A	12	873.5713581	1.756874
W05A	12	877.7781832	1.766011
W05A	12	881.9882468	1.783683
W05A	12	886.1983104	1.785204
W05A	12	890.408374	1.812595
W05A	12	894.6184376	1.829334
W05A	13	898.9822225	2.035356
W05A	13	903.0550812	2.08812
W05A	13	907.2651448	2.109123
W05A	13	911.478447	2.148571
W05A	13	915.6885106	2.260367
W05A	13	919.8953357	2.291609
W05A	13	924.1053993	2.320864
W05A	13	928.3187014	2.299699
W05A	13	932.5320035	2.370225
W05A	13	936.7420671	2.482191
W05A	13	940.9521307	2.51244
W05A	13	945.1621943	2.562855
W05A	13	949.3690194	2.614511
W05A	13	953.5758445	2.74569
W05A	13	957.7859081	2.784679
W05A	13	961.9959717	2.895591
W05A	13	966.2092738	2.964661

Table E.10. Tabulated Resistance From W-05B

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W05B	1	2.763528931	1.681561
W05B	1	6.826995964	1.670586
W05B	1	11.03058255	1.673634
W05B	1	15.24712318	1.662448
W05B	1	19.6008687	1.688807
W05B	1	24.09160321	1.675641
W05B	1	27.88066046	1.677163
W05B	1	32.08424704	1.681254
W05B	1	36.28783363	1.688875
W05B	1	40.49142021	1.694971
W05B	1	44.70472233	1.700971
W05B	1	48.90830892	1.678206
W05B	1	53.12161103	1.684245
W05B	1	57.32519762	1.685826
W05B	1	61.5287842	1.701067
W05B	1	65.73884781	1.71064
W05B	1	69.95214993	1.702492
W05B	1	74.16869056	1.714107
W05B	1	78.37875416	1.709119
W05B	1	82.58557926	1.718802
W05B	1	86.79564286	1.718249
W05B	1	90.99599094	1.727537
W05B	1	95.20605455	1.727379
W05B	1	99.41935666	1.749628
W05B	1	103.6326588	1.755711
W05B	1	107.865392	1.750728
W05B	1	112.0689785	1.768126
W05B	1	116.2822807	1.763313
W05B	1	120.4955828	1.770916
W05B	1	124.6926923	1.766258
W05B	1	128.91571	1.766108
W05B	1	133.1225351	1.778195
W05B	1	137.3293602	1.776672
W05B	1	141.5556163	1.776132
W05B	2	145.7753955	1.855076
W05B	2	150.0178442	1.970579
W05B	2	154.2343848	2.036947
W05B	2	158.4768335	2.020608
W05B	2	162.6804201	2.100733
W05B	2	166.8742912	2.113405
W05B	2	171.1005473	2.064696

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W05B	2	175.2976569	2.132774
W05B	2	179.5077205	2.139371
W05B	2	183.7210226	2.158646
W05B	2	187.9472788	2.135006
W05B	2	192.1573424	2.159537
W05B	2	196.3868371	2.194357
W05B	2	200.6001392	2.229172
W05B	2	204.8102028	2.230118
W05B	2	209.0332204	2.20624
W05B	2	213.2497611	2.248363
W05B	2	217.4663017	2.248363
W05B	2	221.6666498	2.283494
W05B	2	225.8961444	2.314796
W05B	2	230.086777	2.306729
W05B	2	234.3162716	2.284686
W05B	2	238.5392893	2.326865
W05B	2	242.768784	2.344906
W05B	2	246.9853246	2.369172
W05B	2	251.2051037	2.368122
W05B	2	255.4054518	2.414876
W05B	2	259.6187539	2.450826
W05B	2	263.812625	2.437305
W05B	2	268.0356426	2.407281
W05B	2	272.3726558	2.49688
W05B	2	276.5762424	2.524869
W05B	2	280.6584928	2.487697
W05B	2	284.8750334	2.520184
W05B	2	289.0980511	2.527905
W05B	2	293.3307843	2.564513
W05B	2	297.586187	2.566154
W05B	2	301.9533184	2.848151
W05B	2	306.0293077	2.89268
W05B	2	310.2555638	2.93855
W05B	2	314.4688659	2.873984
W05B	2	318.7048376	2.914061
W05B	2	322.9278553	2.929985
W05B	2	327.1605885	2.995757
W05B	2	331.3900831	2.977212
W05B	2	335.5969082	3.02823
W05B	2	339.8199259	3.050609
W05B	2	344.0753286	3.044978
W05B	2	348.3210158	3.049658

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W05B	2	352.5569875	3.06438
W05B	2	356.8188673	3.101633
W05B	2	361.0645545	3.149641
W05B	2	365.2746181	3.177914
W05B	2	369.4749662	3.193057
W05B	2	373.6882683	3.236691
W05B	2	377.8983319	3.258577
W05B	2	382.1083955	3.26866
W05B	2	386.3249362	3.335647
W05B	3	390.5447153	1.640685
W05B	3	394.7483019	1.669062
W05B	3	398.961604	1.676642
W05B	3	403.1716676	1.690858
W05B	3	407.3784927	1.694436
W05B	3	411.5950333	1.688278
W05B	3	415.8083355	1.693368
W05B	3	420.0216376	1.688807
W05B	3	424.2381782	1.695874
W05B	3	428.4644344	1.698822
W05B	3	432.6777365	1.707053
W05B	3	436.8813231	1.707163
W05B	3	441.1011022	1.702931
W05B	3	445.3111658	1.709119
W05B	3	449.5147524	1.711735
W05B	3	453.7086234	1.725605
W05B	3	457.9154485	1.729462
W05B	3	462.1352277	1.722668
W05B	3	466.3226217	1.731317
W05B	3	470.5521164	1.721008
W05B	3	474.7654185	1.737464
W05B	3	479.0111057	1.73033
W05B	3	483.2146923	1.725452
W05B	3	487.444187	1.736155
W05B	3	491.644535	1.750415
W05B	3	495.8675527	1.755489
W05B	3	500.0905703	1.735767
W05B	3	504.3168265	1.792807
W05B	3	508.5398441	1.791898
W05B	3	512.7369537	1.804418
W05B	3	516.9437788	1.807129
W05B	3	521.1408884	1.804418
W05B	3	525.344475	1.807751

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W05B	3	529.544823	1.81295
W05B	3	533.7710792	1.807966
W05B	3	537.9487577	1.825029
W05B	3	542.1620598	1.819573
W05B	3	546.407747	1.813322
W05B	3	550.6372417	1.824009
W05B	3	554.8505438	1.831738
W05B	3	559.0282223	1.83883
W05B	3	563.2350474	1.848247
W05B	3	567.5001657	1.839658
W05B	3	571.7102293	1.856725
W05B	3	575.933247	1.85258
W05B	3	580.1433106	1.864334
W05B	3	584.3825208	1.859902
W05B	3	588.5828688	1.878535
W05B	3	592.8415101	1.860492
W05B	3	597.0742433	1.871813
W05B	3	601.2875454	1.871272
W05B	3	605.5008475	1.900162
W05B	4	607.6026408	1.695106
W05B	4	609.6866223	1.867546
W05B	4	613.922594	1.913974
W05B	4	618.1423731	1.952103
W05B	4	622.3653908	1.968671
W05B	4	626.5657388	1.982594
W05B	4	632.0093511	2.029246
W05B	4	634.9495947	2.017376
W05B	4	639.1434658	2.045074
W05B	4	643.3470524	2.086103
W05B	4	647.6056936	2.054909
W05B	4	651.8157573	2.110459
W05B	4	656.0387749	2.115701
W05B	4	660.2488385	2.084432
W05B	4	664.4556636	2.163406
W05B	4	668.6462961	2.159186
W05B	4	672.8660753	2.177146
W05B	4	677.0729004	2.180771
W05B	4	681.289441	2.230023
W05B	4	685.5092201	2.229079
W05B	4	689.6933757	2.291918
W05B	4	693.9131548	2.289667
W05B	4	698.1426495	2.286705

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W05B	4	702.3591901	2.290658
W05B	4	706.5919233	2.346123
W05B	4	710.8052254	2.473694
W05B	4	715.0250045	2.480088
W05B	4	719.2123986	2.543869
W05B	4	723.4289392	2.550521
W05B	4	727.6163332	2.561314
W05B	4	731.8328739	2.58517
W05B	4	736.0429375	2.630986
W05B	4	740.2530011	2.60496
W05B	4	744.4695417	2.628481
W05B	4	748.6731283	2.668254
W05B	4	752.8669993	2.724373
W05B	4	757.0803015	2.733758
W05B	4	761.3065576	2.745728
W05B	4	765.5230982	2.741088
W05B	4	769.772024	2.770798
W05B	4	773.959418	2.831709
W05B	4	778.1630046	2.842031
W05B	4	782.3827837	2.843618
W05B	4	786.6317095	2.882548
W05B	4	790.8417731	2.934627
W05B	4	795.0388826	2.940598
W05B	4	799.2878084	2.977105
W05B	4	803.5011105	2.993822
W05B	4	807.7111741	3.056083
W05B	5	809.2548641	1.463492
W05B	5	811.9171356	1.5678
W05B	5	816.1271992	1.608824
W05B	5	820.3372628	1.610133
W05B	5	824.5473264	1.614061
W05B	5	828.75739	1.620607
W05B	5	832.9642151	1.619775
W05B	5	837.1710402	1.627637
W05B	5	841.3811038	1.625845
W05B	5	845.5911674	1.6337
W05B	5	849.8044695	1.633213
W05B	5	854.0145331	1.632391
W05B	5	858.2245967	1.636319
W05B	5	862.4346604	1.638938
W05B	5	866.644724	1.644175
W05B	5	870.8547876	1.644175

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W05B	5	875.0648512	1.650721
W05B	5	879.2749148	1.65334

Table E.11. Tabulated Resistance From W-06

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W06	1	3.791971905	1.860193
W06	1	7.998797001	1.848365
W06	1	12.2056221	1.881247
W06	1	16.4156857	1.847712
W06	1	20.62898782	1.879893
W06	1	24.84228994	1.906158
W06	1	29.61369536	1.867427
W06	1	33.26241715	1.854284
W06	1	37.47248076	1.893712
W06	1	41.68254436	1.893712
W06	1	45.88936946	1.900977
W06	1	50.10267158	1.886459
W06	1	54.31273518	1.887141
W06	1	58.52279879	1.906855
W06	1	62.7328624	1.860855
W06	1	66.942926	1.893712
W06	1	71.15298961	1.893712
W06	1	75.35981471	1.8944
W06	1	79.56987831	1.900284
W06	1	83.77994192	1.887141
W06	1	87.99324404	1.879893
W06	1	92.20654615	1.893025
W06	1	96.41660976	1.893712
W06	1	100.6266734	1.867427
W06	1	104.836737	1.880569
W06	1	109.0468006	1.854284
W06	1	113.2568642	1.860855
W06	1	117.4669278	1.887141
W06	1	121.6769914	1.880569
W06	1	125.887055	1.867427
W06	1	130.0971186	1.854284
W06	1	134.3071822	1.880569
W06	1	138.5204843	1.879893
W06	1	142.7305479	1.887141
W06	1	146.937373	1.907553
W06	1	151.1441981	1.907553

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W06	1	155.3542617	1.906855
W06	1	159.5675639	1.906158
W06	1	163.7776275	1.906855
W06	1	167.9844526	1.900977
W06	1	172.1912777	1.927283
W06	1	176.4013413	1.919998
W06	1	180.6114049	1.919998
W06	1	185.5193675	1.907553
W06	1	189.0277538	1.933141
W06	1	193.2378174	1.919998
W06	1	197.447881	1.939712
W06	1	201.6547061	1.953588
W06	2	203.7484031	1.518731
W06	2	205.8518157	1.576399
W06	2	210.0586408	1.583775
W06	2	214.2654659	1.581668
W06	2	218.4755295	1.585432
W06	2	222.6855931	1.588591
W06	2	226.8956567	1.587538
W06	2	231.1057203	1.582273
W06	2	235.3157839	1.585432
W06	2	239.5258475	1.585432
W06	2	243.7359111	1.574903
W06	2	247.9459747	1.578061
W06	2	252.1560383	1.574903
W06	2	256.3661019	1.587538
W06	2	260.5761656	1.585432
W06	2	264.7829907	1.584829
W06	2	268.9930543	1.584379
W06	2	273.2031179	1.586485
W06	2	277.409943	1.584829
W06	2	281.6200066	1.597014
W06	2	285.8300702	1.588591
W06	2	290.0433723	1.590243
W06	2	294.2534359	1.57385
W06	2	298.460261	1.589044
W06	2	302.7350948	1.585895
W06	2	306.9451584	1.592803
W06	2	311.155222	1.592803
W06	2	315.3652856	1.59175
W06	2	319.5753492	1.59175
W06	2	323.7854128	1.590697

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W06	2	327.9954764	1.593855
W06	2	332.2055401	1.594908
W06	2	336.4156037	1.587538
W06	2	340.6224288	1.578506
W06	2	344.8324924	1.582273
W06	2	349.0393175	1.592205
W06	2	353.2493811	1.595961
W06	2	357.4594447	1.582273
W06	2	361.6662698	1.585883
W06	2	365.8763334	1.578061
W06	2	370.086397	1.593855
W06	2	374.2964606	1.585432
W06	2	378.5065242	1.590697
W06	2	382.7101108	1.587389
W06	2	386.9201744	1.587538
W06	2	391.130238	1.583326
W06	2	395.3403016	1.598067
W06	2	399.5503652	1.592803
W06	2	403.7798599	1.596368
W06	3	405.3164251	1.587568
W06	3	407.9643392	1.701426
W06	3	412.1744029	1.768855
W06	3	416.3844665	1.795141
W06	3	420.5945301	1.814855
W06	3	424.8045937	1.808284
W06	3	429.0146573	1.834569
W06	3	433.2247209	1.847712
W06	3	437.4347845	1.827998
W06	3	441.6448481	1.847712
W06	3	445.8581502	1.840494
W06	3	450.0682138	1.847712
W06	3	454.2815159	1.853627
W06	3	458.4948181	1.853627
W06	3	462.7081202	1.847061
W06	3	466.9181838	1.854284
W06	3	471.1282474	1.841141
W06	3	475.338311	1.854284
W06	3	479.5451361	1.861518
W06	3	483.7551997	1.854284
W06	3	487.9620248	1.861518
W06	3	492.1720884	1.867427
W06	3	496.382152	1.867427

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W06	3	500.5922156	1.867427
W06	3	504.8022792	1.873998
W06	3	509.0123428	1.880569
W06	3	513.2224064	1.873998
W06	3	517.43247	1.887141
W06	3	521.6425336	1.880569
W06	3	525.8525973	1.887141
W06	3	530.0626609	1.893712
W06	3	534.2727245	1.893712
W06	3	538.4795496	1.887824
W06	3	542.6896132	1.841141
W06	3	546.8964383	1.874671
W06	3	551.1065019	1.860855
W06	3	555.3165655	1.860855
W06	3	559.5233906	1.887824
W06	3	563.7334542	1.827998
W06	3	567.9435178	1.841141
W06	3	572.1568199	1.886459
W06	3	576.363645	1.887824
W06	3	580.5737086	1.887141
W06	3	584.7837722	1.880569
W06	3	588.9938358	1.893712
W06	3	593.2038994	1.893712
W06	3	597.413963	1.887141
W06	3	601.6240266	1.854284
W06	3	605.8340902	1.880569
W06	4	610.0538694	1.565175
W06	4	614.263933	1.571744
W06	4	618.4739966	1.565426
W06	4	622.6840602	1.568585
W06	4	626.8941238	1.569638
W06	5	628.8557975	1.59892
W06	5	631.1046192	1.643009
W06	5	635.3146828	1.735998
W06	5	639.5247464	1.775427
W06	5	643.73481	1.775427
W06	5	647.9448736	1.814855
W06	5	652.1549372	1.814855
W06	5	656.3650009	1.808284
W06	5	660.5750645	1.821427
W06	5	664.7883666	1.827362
W06	5	668.9984302	1.821427

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W06	5	673.2084938	1.827998
W06	5	677.4185574	1.821427
W06	5	681.628621	1.801712
W06	5	685.8386846	1.847712
W06	5	690.0487482	1.841141
W06	5	694.2588118	1.847712
W06	5	698.4688754	1.834569
W06	5	702.678939	1.841141
W06	5	706.8890026	1.867427
W06	5	711.0990663	1.867427
W06	5	715.3091299	1.860855
W06	5	719.5191935	1.867427
W06	5	723.7292571	1.867427
W06	5	727.9393207	1.880569
W06	5	732.1493843	1.827998
W06	5	736.3594479	1.867427
W06	5	740.5695115	1.841141
W06	5	744.7828136	1.840494
W06	5	748.9928772	1.847712
W06	5	753.1997023	1.854941
W06	5	757.4097659	1.847712
W06	5	761.6198295	1.867427
W06	5	765.8298931	1.854284
W06	5	770.0367182	1.848365
W06	5	774.2467818	1.854284
W06	5	778.4568454	1.847712
W06	5	782.6669091	1.854284
W06	5	786.8802112	1.853627
W06	5	791.0902748	1.867427
W06	5	795.3003384	1.860855
W06	5	799.5136405	1.853627
W06	5	803.7237041	1.867427
W06	5	807.9337677	1.867427
W06	5	812.1438313	1.873998
W06	5	816.3538949	1.867427
W06	5	820.5639585	1.867427
W06	5	824.7772606	1.873326
W06	5	828.9873243	1.873998
W06	5	833.1973879	1.880569
W06	6	835.1590616	1.51146
W06	6	837.388884	1.549223
W06	6	841.5989476	1.543315

Run	Period	Normalized Flow (v^+)	Normalized Resistance (ω)
W06	6	845.8090112	1.541209
W06	6	850.0190748	1.542262
W06	6	854.2291384	1.543315
W06	6	858.439202	1.546473

E.3 LS1 Data

Table E.12. LS1 Baseline Resistance and Permeability

	Target Flow Rate	Initial membrane resistance [$R_{m,o}$]		Baseline Permeability [b]			
	FM-02	DEF-01	DEF-02	DEF-01	DEF-02	IXC-01	IXC-01
Test	mL min^{-1}	m^{-1}	m^{-1}	m^2	m^2	m^2	Da
W-01A/W-01B	130	5.28E+10	5.60E+10	3.00E-14	2.83E-14	2.53E-10	256.6
W-02	130	7.20E+10	8.19E+10	2.07E-14	1.38E-14	2.08E-10	210.8
W-02	91	7.68E+10	1.15E+11	2.07E-14	1.38E-14	2.89E-10	293.3
W-02	195	9.81E+10	9.58E+10	1.62E-14	1.66E-14	1.74E-10	175.9
Post W-02	130	3.75E+09	2.34E+10	4.24E-13	6.79E-14	2.04E-10	207.1
Post W-02	91	2.32E+09	2.77E+10	6.85E-13	5.74E-14	2.43E-10	246.7
Post W-02	195	9.64E+09	1.86E+10	1.65E-13	8.54E-14	1.65E-10	167.1
Post W-02	75	2.77E+09	3.03E+10	5.72E-13	5.23E-14	2.73E-10	276.8
W-03	130	8.71E+09	2.25E+10	1.82E-13	7.07E-14	2.08E-10	210.8
W-03	91	8.60E+09	2.55E+10	1.85E-13	6.22E-14	2.74E-10	277.3
W-03	195	1.57E+10	1.59E+10	1.01E-13	9.99E-14	1.69E-10	171.7

Table E.13. LS1 Baseline Pre and Post W-02 Filter Permeability and Resistance

Target Flow Rate (mL min^{-1})	91				130				195			
	Initial membrane resistance [$R_{m,o}$]		Baseline permeability [b]		Initial membrane resistance [$R_{m,o}$]		Baseline permeability [b]		Initial membrane resistance [$R_{m,o}$]		Baseline permeability [b]	
	m^{-1}		m^2		m^{-1}		m^2		m^{-1}		m^2	
Test	DEF-01	DEF-02	DEF-01	DEF-02	DEF-01	DEF-02	DEF-01	DEF-02	DEF-01	DEF-02	DEF-01	DEF-02
W-02	7.68E+10	1.15E+11	2.07E-14	1.38E-14	7.20E+10	8.19E+10	2.07E-14	1.38E-14	9.81E+10	9.58E+10	1.62E-14	1.66E-14
Post W-02	2.32E+09	2.77E+10	6.85E-13	5.74E-14	3.75E+09	2.34E+10	4.24E-13	6.79E-14	9.64E+09	1.86E+10	1.65E-13	8.54E-14
Average	3.96E+10	7.13E+10	3.53E-13	3.56E-14	3.79E+10	5.27E+10	2.22E-13	4.09E-14	5.39E+10	5.72E+10	9.05E-14	5.10E-14
Difference	7.45E+10	8.72E+10	6.64E-13	4.36E-14	6.83E+10	5.86E+10	4.03E-13	5.41E-14	8.85E+10	7.72E+10	1.49E-13	6.89E-14
Difference/Average	188%	122%	188%	122%	180%	111%	181%	132%	164%	135%	164%	135%

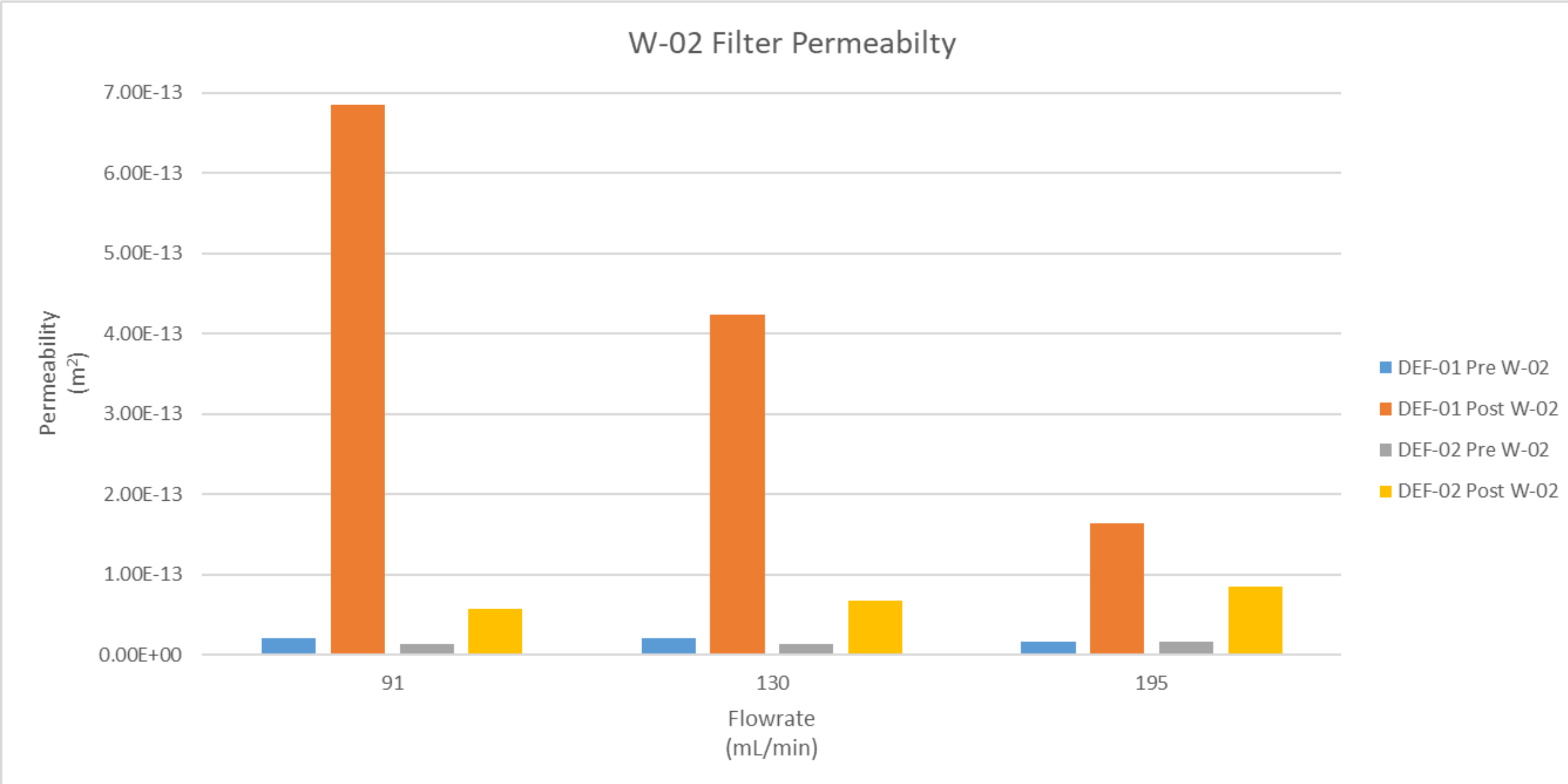


Figure E.1. Baseline filter permeability pre and post W-02 organized by flow rate.

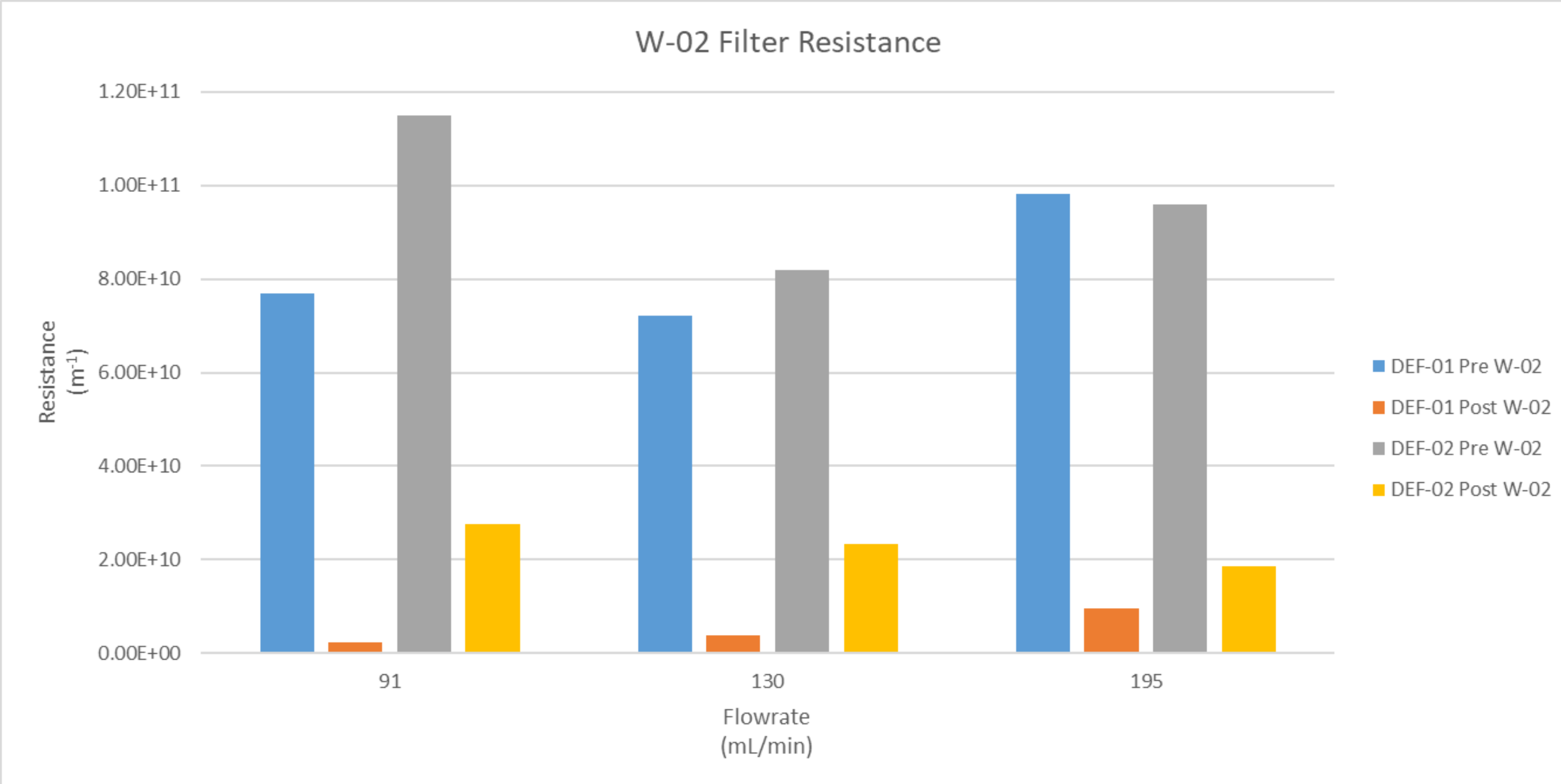


Figure E.2. Baseline filter resistance pre and post W-02 organized by flow rate.

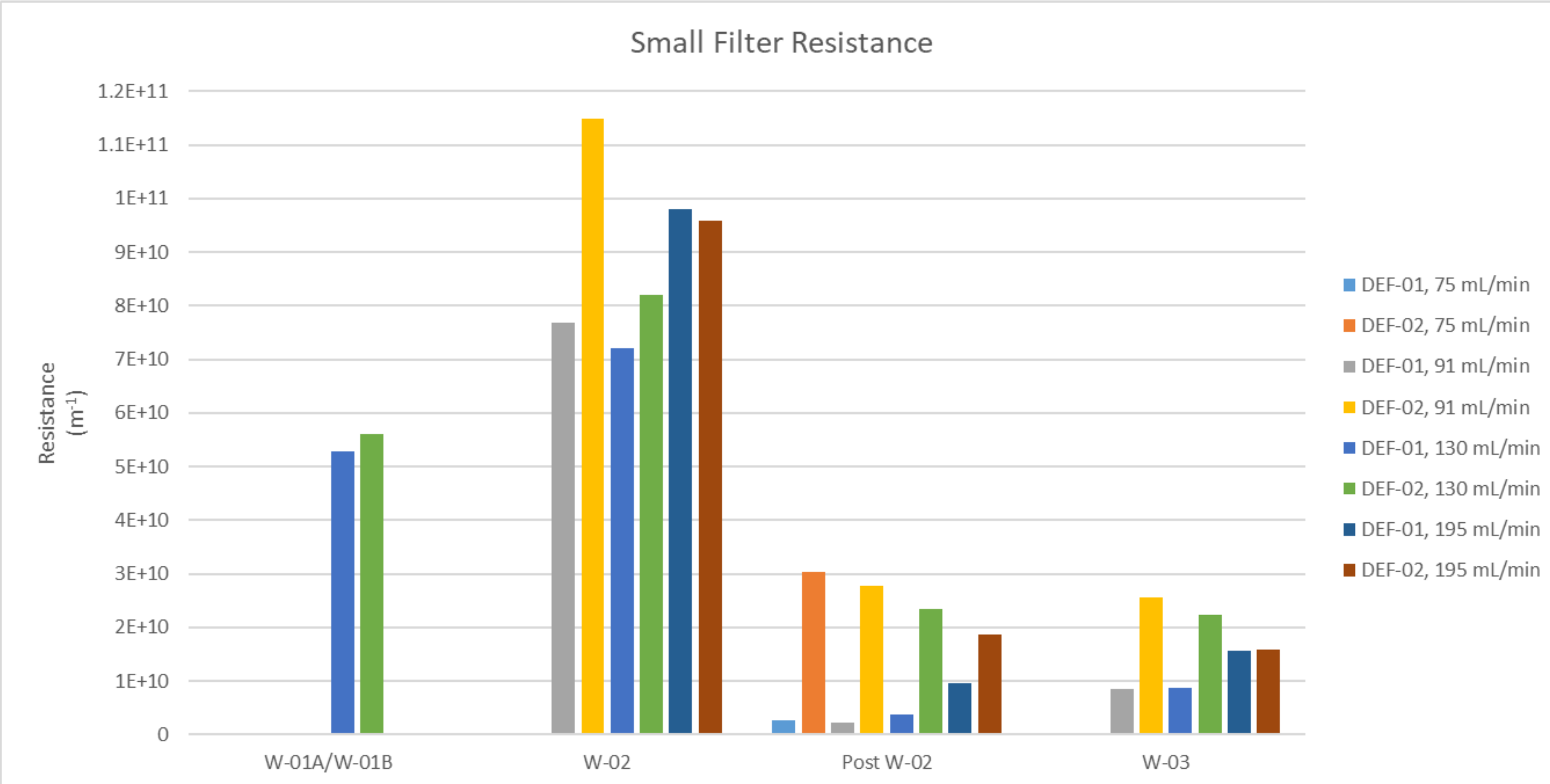


Figure E.3. LS1 baseline filter resistance organized by run and by flow rate.

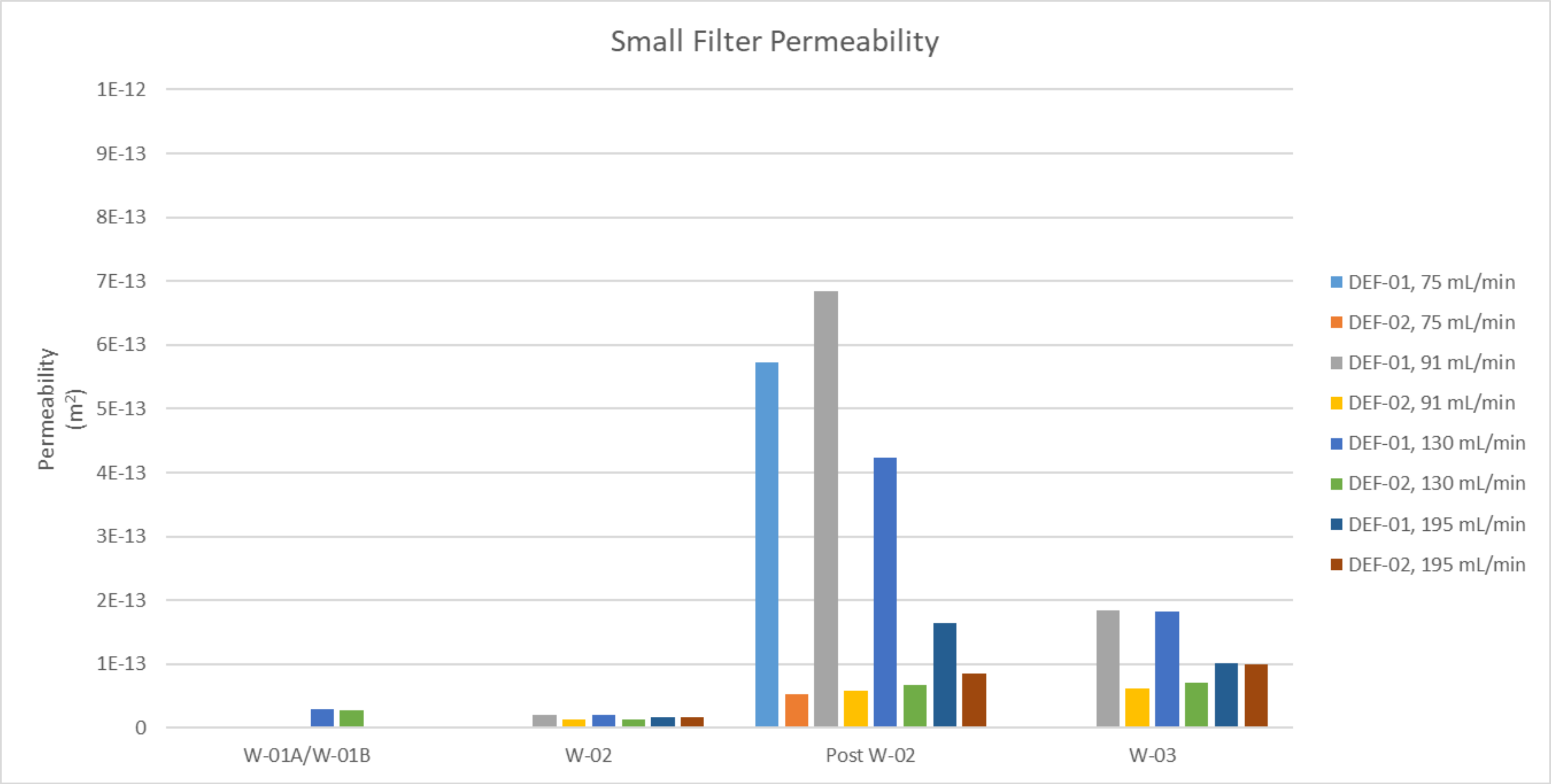


Figure E.4. LS1 baseline filter permeability organized by run and by flow rate.

E.4 LS2 Data

Table E.14. LS2 Baseline Resistance and Permeability

	Target Flow Rate	Initial membrane resistance [$R_{m,o}$]		Baseline permeability [b]			
	FM-02	DEF-01	DEF-02	DEF-01	DEF-02	IXC-01	IXC-01
Test	mL min^{-1}	m^{-1}	m^{-1}	m^{2}	m^{2}	m^{2}	Da
W-04	130	1.56E+11	8.40E+11	2.05E-14	3.81E-15	2.16E-10	218.7
W-05A/W-05B	91	8.94E+10	6.35E+11	3.58E-14	5.04E-15	2.59E-10	262.7
W-05A/W-05B	110	1.17E+11	7.32E+11	2.73E-14	4.37E-15	2.30E-10	233.5
W-05A/W-05B	130	1.21E+11	7.99E+11	2.65E-14	4.00E-15	2.10E-10	212.7
W-05A/W-05B	150	1.43E+11	8.84E+11	2.23E-14	3.62E-15	1.95E-10	197.8
W-05A/W-05B	170	1.58E+11	9.62E+11	2.03E-14	3.33E-15	1.81E-10	183.3
W-05A/W-05B	195	1.64E+11	1.05E+12	1.95E-14	3.04E-15	1.70E-10	171.8
W-06	91	9.02E+10	6.04E+11	3.55E-14	5.30E-15	2.28E-10	231.4
W-06	130	1.23E+11	7.66E+11	2.61E-14	4.18E-15	1.90E-10	192.4
W-06	195	1.72E+11	1.04E+12	1.86E-14	3.09E-15	1.56E-10	158.6

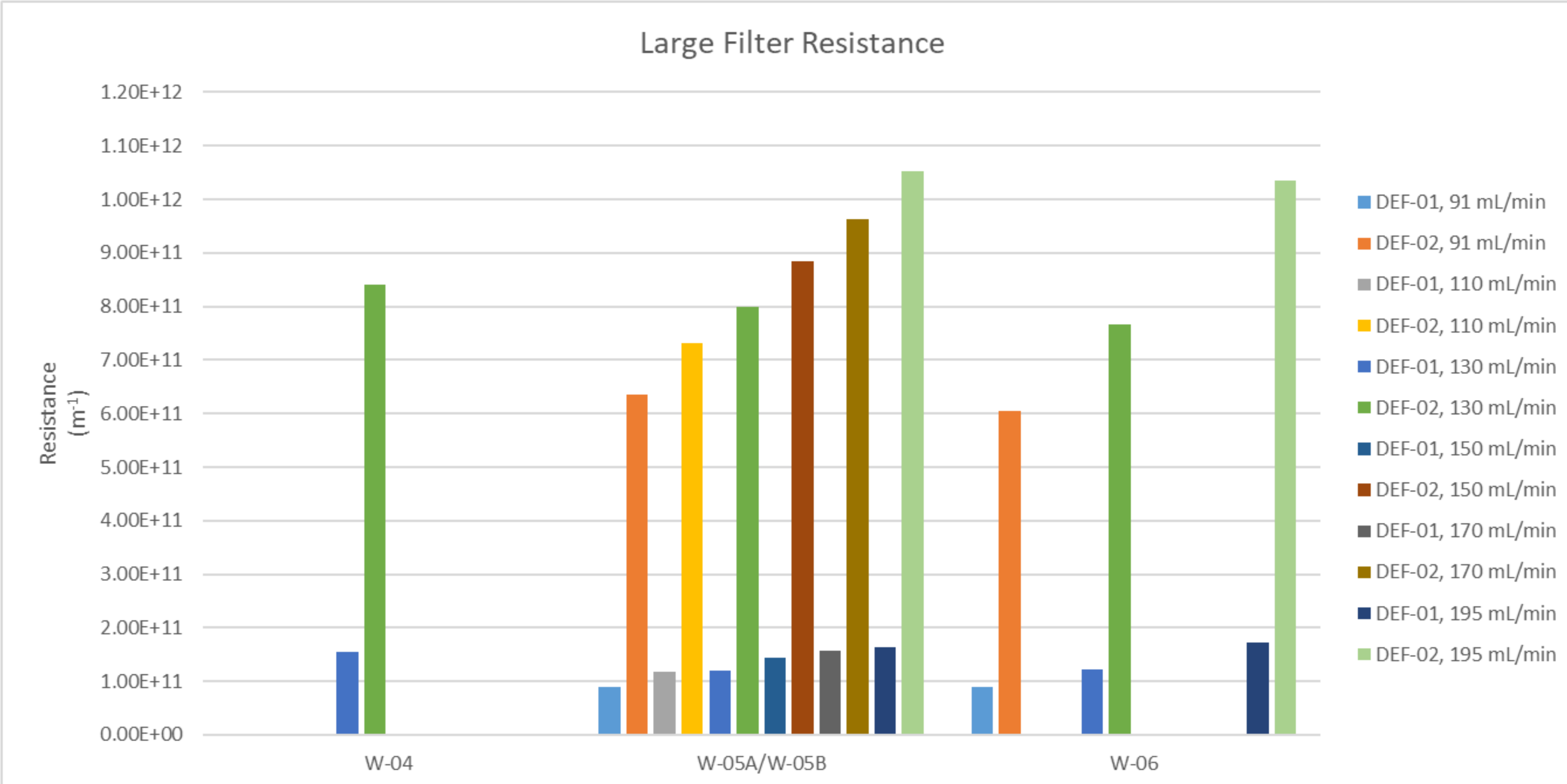


Figure E.5. LS2 baseline filter resistance organized by run and by flow rate.

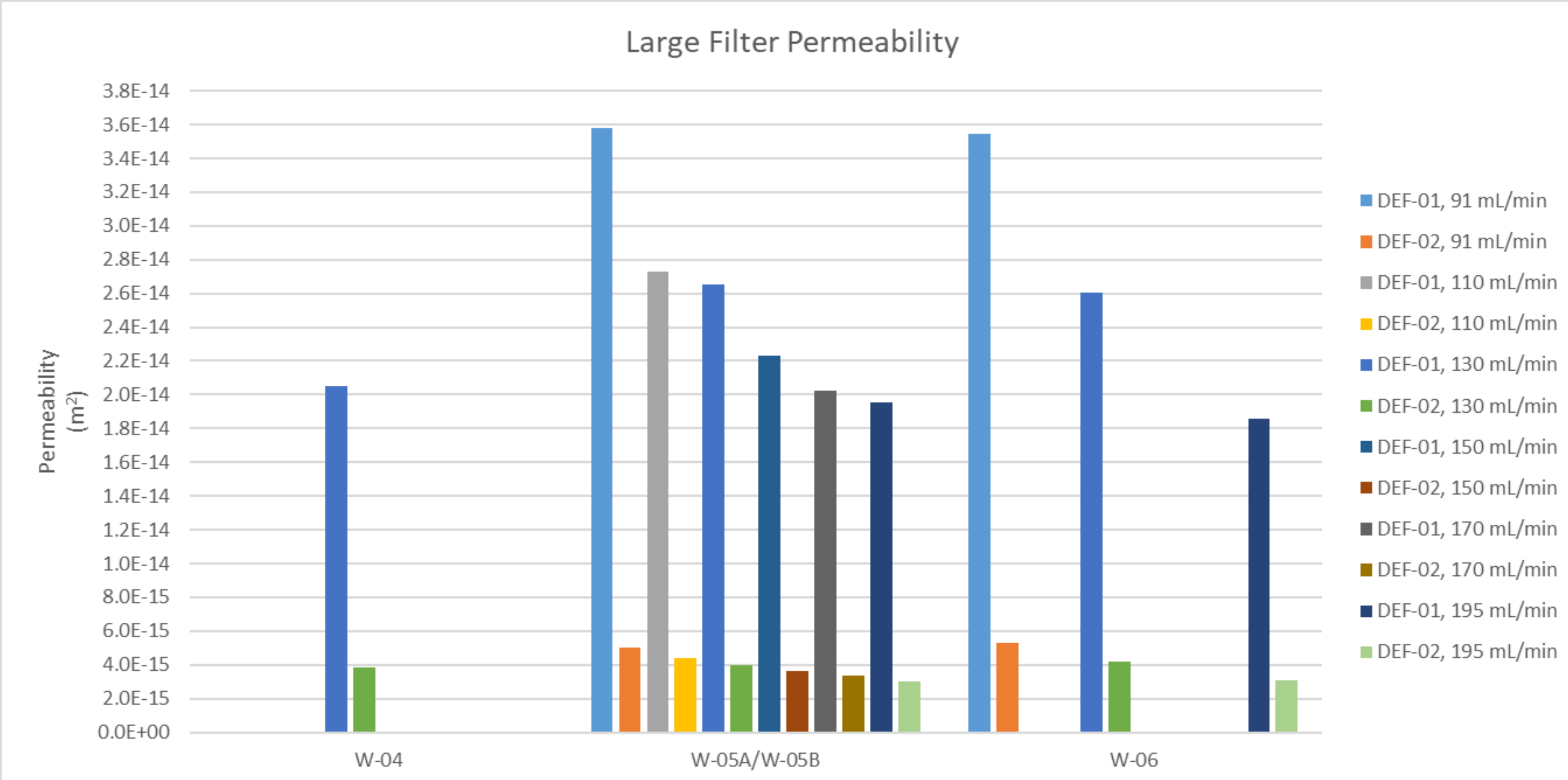


Figure E.6. LS2 baseline filter permeability organized by run and by flow rate.

Pacific Northwest National Laboratory

902 Battelle Boulevard
P.O. Box 999
Richland, WA 99354

1-888-375-PNNL (7665)

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