

AGR-5/6/7 Capsule Leach Station Hardware Qualification - Phase 1

Douglas W Marshall

November 2020



The INL is a U.S. Department of Energy National Laboratory
operated by Battelle Energy Alliance

AGR-5/6/7 Capsule Leach Station Hardware Qualification - Phase 1

Douglas W Marshall

November 2020

**Idaho National Laboratory
Idaho Falls, Idaho 83415**

<http://www.inl.gov>

**Prepared for the
U.S. Department of Energy
Under DOE Idaho Operations Office
Contract DE-AC07-05ID14517**

Remote or Process Equipment Qualification Procedure

AGR-5/6/7 Capsule Leach Station Hardware Qualification – Phase I

EJ: 3244

Project: 23841



The INL is a U.S. Department of Energy National Laboratory
operated by Battelle Energy Alliance.

Idaho National Laboratory

AGR-5/6/7 CAPSULE LEACH STATION HARDWARE QUALIFICATION – PHASE I	Identifier: MFC-EQP-0352
	Revision: 0
	Effective Date: 10/08/20 Page: 2 of 18

Materials and Fuels Complex	Remote or Process Equipment Qualification Procedure	eCR Number: 681471
-----------------------------	---	--------------------

Manual: MFC Equipment Qualification Procedure

CONTENTS

EQP CHANGE LOG	3
1. PURPOSE.....	4
2. SCOPE	4
2.1 Glass Leach Station.....	4
2.2 Qualification Testing – List of Requirements Being Verified.....	5
3. PRECAUTIONS AND LIMITATIONS.....	5
3.1 Precautions.....	5
3.2 Permits	6
3.3 Special Procedures	6
3.4 Hoisting and Rigging	6
4. PREREQUISITES	6
4.1 Training/Qualification.....	7
4.2 Utilities and Materials.....	7
5. INSTRUCTIONS.....	8
5.1 Phase I: Assembly and Checkout.....	9
6. HAZARDS AND CONTROLS	14
7. RECORDS	15
8. REFERENCES	15
9. APPENDIXES	15
Appendix A Acceptance Approval Sheet	16
Appendix B Engineering Drawing Change Log.....	17
Appendix C Equipment Photographs.....	18

[illegible]

Idaho National Laboratory

AGR-5/6/7 CAPSULE LEACH STATION HARDWARE QUALIFICATION – PHASE I	Identifier: MFC-EQP-0352
	Revision: 0
	Effective Date: 10/08/20 Page: 4 of 18

1. PURPOSE

AGR-5/6/7 test train capsule components will be contaminated with fission products from the high-temperature irradiation of experimental tristructural isotropic fuel. To facilitate a closure on the fission product mass balance, capsule shell and internals will be leached in hot nitric acid to recover the fission products. The objective of these tests is to ascertain the functionality of the leach station equipment and its suitability for use in cell.

2. SCOPE

Qualification testing of the leach stations and ancillary equipment will verify fit and function of the assemblies and the practicality of equipment leach stations in a remotely-handled working environment.

The approach being tested for leaching of the capsule shells and components is to use nested glass tubes that form an annular vessel in which the capsule shell will be leached or tall beakers for capsule internal components and heads components. The shells, internals, and heads will be held in stainless steel baskets to facilitate loading and unloading of the leach vessels and stainless steel bases for stabilizing the borosilicate glass leach vessels.

The leach vessels assemblies will be filled with water and heated on a hotplate to simulate the leaching of fission product residues from the capsule components. A small quantity of non-toxic dye will be added to the water to enable mixing to be observed.

2.1 Glass Leach Station

In addition to the common equipment, the leach station includes a stainless-steel base for holding a leach vessel, a stainless-steel basket for holding the capsule shell or components, and the borosilicate glass leach vessel. The glass leach vessel may include an integral airlift for solution recirculation and mixing. Ancillary equipment includes a stainless-steel rod and lifting hook to facilitate handling of the leach vessel, a catch container for collecting the leachate and rinsate, air pump, laboratory ring stand, and a thermometer. A non-integrated airlift device may also be included. The outcome to be noted in the table below is generally a pass/fail indication.

Idaho National Laboratory

AGR-5/6/7 CAPSULE LEACH STATION HARDWARE QUALIFICATION – PHASE I	Identifier: MFC-EQP-0352
	Revision: 0
	Effective Date: 10/08/20 Page: 5 of 18

2.1.1 Phase I tests activities:

Phase I tests are hands-on, table-top exercises to verify fit and function of the equipment in preparation for Phase II simulated remote operations.

- Bench-top fit and assembly of capsule components into the basket and basket into the leach vessel
- Heating of a water-filled leach vessel with a surrogate capsule shell
- Recording elapsed time to bring a water-filled leach assembly from room temperature to 95°C on the hotplate
- Recording the hotplate setting for incipient water boiling
- Recording the indicated temperature on the temperature strips, applied to the vessel exterior, when water is boiling
- Qualitatively assessing mixing of a non-toxic dye in the water during heating; with and without the airlift assist
- Decanting of leachate from the leach vessel
- Sampling of leachate from the leach vessel and the catch container using a ring-stand mounted pipette controller
- Rinsing of the basket after removal from the leach vessel and collection of the rinsate.

2.2 Qualification Testing – List of Requirements Being Verified

Not applicable for Phase I.

3. PRECAUTIONS AND LIMITATIONS**3.1 Precautions**

The stainless-steel components pose a small risk of pinching and laceration during the Phase I bench-top tests if edges are not smoothed and rounded as materials will be manipulated by hand. Glassware is heavy, especially when loaded with capsule components and water. This presents a minor risk of contusion if a hand or finger is caught between the glass vessel and another solid object. Contact with the metal edges should be avoided when handling the stands and when inserting glassware. Use of gloves is not advised, when the glassware is cool, as this may increase the risk of dropping the glassware.

Idaho National Laboratory

AGR-5/6/7 CAPSULE LEACH STATION HARDWARE QUALIFICATION – PHASE I	Identifier:	MFC-EQP-0352
	Revision:	0
	Effective Date:	10/08/20

Page: 6 of 18

The most probable and significant risks are that of laceration during cleanup if the glass vessel is broken and thermal burns associated with the heat-up testing.

These risks are mitigated by wearing appropriate gloves and eye protection while handling the leach station materials and wearing ANSI A4 cut-resistant gloves when handling broken glass. Two temperature indicating strips will be applied to the exterior of the glassware. One is irreversible and records the maximum temperature ($77^{\circ}\text{C} - 127^{\circ}\text{C}$; $\pm 5^{\circ}\text{C}$) while the other is reversible and indicates the present temperature if elevated within the $55^{\circ}\text{C} - 100^{\circ}\text{C}$ range. Handling of the heated glassware and stainless-steel base should only be done when the glassware has cooled $\leq 50^{\circ}\text{C}$ except when lifting tools or gloves can be safely employed.

3.2 Permits

No special permits have been identified.

3.3 Special Procedures

Approved Laboratory Instructions, 1671-11-IRC, is the controlling document for the Phase I operations in IRC Lab A-12.

3.4 Hoisting and Rigging

None required.

Leach station bases, glassware, baskets, hotplate, analytical balance, and simulated capsule shell components are hand-carried equivalent materials.

4. PREREQUISITES

The following prerequisites are to be satisfied before executing the Phase I operations:

- Walk down of the test requirements and operations
 - Condition of the equipment and materials
 - Availability of tools and materials
 - Adequacy of workspace for the intended operations
 - Completion of pre-job brief
 - Review of the intended operations
 - Discussion on hazards and mitigations

Idaho National Laboratory

**AGR-5/6/7 CAPSULE LEACH STATION
HARDWARE QUALIFICATION –
PHASE I**

Identifier: MFC-EQP-0352

Revision: 0

Effective Date: 10/08/20

Page: 7 of 18

- Calibrated instrumentation, if used.
- Condition of equipment and item to be tested

Assembly of the simulated capsule components, glassware, baskets, and bases are shown in the following drawings:

See CN#10
DWM
11/24/20

- Dwg. 1000766 MFC-785, AGR 5/6/7 Capsule 1 Shell Acid Leaching Vessel Final Assembly
- Dwg. 1000769 MFC-785, AGR 5/6/7 Capsule 2 & 3 Shell Acid Leaching Vessel Final Assembly
- Dwg. 1000772 MFC-785, AGR 5/6/7 Capsule 4 & 5 Shell Acid Leaching Vessel Final Assembly
- Dwg. 1000777 MFC-785, AGR 5/6/7 Capsule Internals Acid Leaching Vessel Final Assembly
- Dwg. 1000781 MFC-785, AGR 5/6/7 Top & Bottom Head Acid Leaching Vessel Final Assembly

4.1 Training/Qualification

Applicable training and qualifications specified in LI-1671-11-IRC must be completed. Personnel performing work in lab A-12 must complete the read and sign portion of LI-1671-11-IRC.

4.2 Utilities and Materials

4.2.1 Electrical Power

120 VAC is required to operate the analytical balance, hotplate, and air pump used for supplying air to the airlift.

4.2.2 Water

Approximately two liters of water will be needed to fill the glassware submerge the tallest component and to rinse components after the heating demonstration.

Idaho National Laboratory

AGR-5/6/7 CAPSULE LEACH STATION HARDWARE QUALIFICATION – PHASE I	Identifier: MFC-EQP-0352
	Revision: 0
	Effective Date: 10/08/20 Page: 8 of 18

4.2.3 Miscellaneous

The following equipment are needed:

- Catch basin for water
- Paper towels to clean up water spills
- Temperature indicating strips
- Pipettes and pipette controller
- Sample bottles
- Simulated capsule shells, heads, tubes, etc.
- Lifting tools and rod(s)
- Small air pump
- Thermometer or thermocouple (hereafter referred to as TC).

5. INSTRUCTIONS

Throughout the completion of this procedure, photograph the equipment and noteworthy activities to augment the documentation of the equipment and/or qualification process. At a minimum, photograph the equipment in its assembled configuration. Insert the photographs into Appendices.

As each step in Section 5 is completed, the performer shall place his or her initials and date of completion in the column labeled "Performed By/Date" as required. Unless otherwise noted, steps may be performed in a sequence other than specified.

If the system design or behavior is not what is expected, the technician/operator should discontinue assembly or testing and notify the Lead Engineer. Any changes to this document shall be logged in the EQP Change Log, Phase I and Phase II only. Equipment changes shall be documented using Form 431.502, "Engineering Drawing Change Log."

Idaho National Laboratory

AGR-5/6/7 CAPSULE LEACH STATION HARDWARE QUALIFICATION – PHASE I	Identifier: MFC-EQP-0352 Revision: 0 Effective Date: 10/08/20
---	---

Page: 9 of 18

5.1 Phase I: Assembly and Checkout**5.1.1 Confirm Fit and Stability of the Capsule 1 Leach Assembly**

5.1.1.1 Position the Capsule 1 stainless-steel base on the analytical balance.

Performed by: <i>AD Marshall</i>	Remarks: <i>None</i>
Date: <i>9/14/20</i>	
Change Log:	

5.1.1.2 Insert the Capsule 1 glass leach vessel into the base.

Performed by: <i>AD Marshall</i>	Remarks: <i>None</i>
Date: <i>9/14/20</i>	
Change Log: <i>CN#6</i>	

5.1.1.3 Verify that all shell baskets fit into the leach vessel.
Photograph each basket before and after placement in the leach vessel.

Performed by: <i>AD Marshall</i>	Remarks: <i>Prototype basket OD too large to fit inside glass leach vessel. Only one basket available.</i>
Date: <i>9/14/20</i>	
Change Log: <i>CN#7</i>	

5.1.1.4 Insert Capsule 1 shell into the wire basket. Photograph the shell and basket assembly.

Performed by: <i>AD Marshall</i>	Remarks: <i>Simulated shell fit inside the basket prototype.</i>
Date: <i>9/14/20</i>	
Change Log:	

5.1.1.5 Insert the Capsule 1 wire basket & shell into the glass leach vessel.

Performed by: <i>AD Marshall</i>	Remarks: <i>Prototype basket diameter too large to fit in glass leach vessel.</i>
Date: <i>9/14/20</i>	
Change Log:	

9/17/20 Test fit was successful after reducing basket diameter.

Idaho National Laboratory

AGR-5/6/7 CAPSULE LEACH STATION HARDWARE QUALIFICATION – PHASE I	Identifier:	MFC-EQP-0352
	Revision:	0
	Effective Date:	10/08/20

Page: 10 of 18

5.1.1.6 Record the mass of the dry assembly in the Remarks section.

Performed by:	<i>ADW</i>	Remarks: <i>Using SS vessel with integral base:</i> <i>Leach vessel 3.890 kg Leach vessel outer ID 3.875"</i> <i>Basket 0.114 kg Inner tube OD 1.8945"</i> <i>Shell 0.918 kg</i> <i>Assembly 4.920 kg</i>
Date:	<i>9/17/20</i>	
Change Log:		

5.1.1.7 Add water until it is above the top of the capsule shell/components and inner void tube. Photograph the upper portion of the leach vessel; showing the capsule component(s) and water meniscus.

Performed by:	<i>ADW</i>	Remarks: <i>SS leach vessel. Could not photograph the meniscus.</i>
Date:	<i>9/17/20</i>	
Change Log:	<i>CN#4</i>	

5.1.1.8 Record the component submergence and mass of the wet assembly in the Remarks section.

Performed by:	<i>ADW</i>	Remarks: <i>Couldn't record accurate submergence.</i> <i>~1600 ml of water added to cover shell.</i> <i>Gross wt = 6.486 kg; A = 1.566 grams</i>
Date:	<i>9/17/20</i>	
Change Log:		

5.1.1.9 Verify that the leach vessel and base are stable on the hotplate.

Performed by:	<i>ADW</i>	Remarks: <i>Base and leach vessel were stable on the hotplate.</i>
Date:	<i>9/14/20</i>	
Change Log:		

Idaho National Laboratory

AGR-5/6/7 CAPSULE LEACH STATION HARDWARE QUALIFICATION – PHASE I	Identifier: MFC-EQP-0352 Revision: 0 Effective Date: 10/08/20
---	---

Page: 11 of 18

~~5.1.1~~ *Adm 11/24/20* ~~5.1.2~~ **Capsule 1 Leach Vessel Heating Test**

~~5.1.1.1~~ *Adm 11/24/20* ~~5.1.2.1~~ Move the assembly from the analytical balance to the hotplate using the manipulator lifting tools as much as possible.

Performed by:	<i>Adm</i>	Remarks: <i>Cannot lift assembly with the manipulator tool. Lugs on base too close to center of mass. Glass leach vessel too tall. Lifted and moved vessel and base individually.</i>
Date:	<i>9/14/20</i>	
Change Log:	<i>CN#8</i>	

~~5.1.1.2~~ *Adm 11/24/20* ~~5.1.2.2~~ Insert a TC between the shell and glass leach vessel wall to an elevation about mid-way on the temperature strips.

Performed by:	<i>Adm</i>	Remarks: <i>Had no way to secure the TC at the midpoint elevation. See 5.1.2.5 Remarks</i>
Date:	<i>9/14/20</i>	
Change Log:	<i>CN#1</i>	

~~5.1.1.3~~ *Adm 11/24/20* ~~5.1.2.3~~ Inject non-toxic dye at the bottom or top of the water column as a marker for liquid mixing and circulation. Photograph dye placement.

Performed by:	<i>Adm</i>	Remarks: <i>Blue dye placement on surface. Mixing visibly complete in 2-3 seconds with air sparger operating.</i>
Date:	<i>9/14/20</i>	
Change Log:		

~~5.1.1.4~~ *Adm 11/24/20* ~~5.1.2.4~~ Energize the hotplate; noting the time when heating is started and initial water temperature.

Performed by:	<i>Adm</i>	Remarks: <i>Test #1. 09:20, 64.4°F, Setting = 10 (max)</i> <i>Test #2. 11:54, 18.5°C, Setting = 3 (1-10 scale)</i>
Date:	<i>9/14/20</i>	
Change Log:		

Idaho National Laboratory

AGR-5/6/7 CAPSULE LEACH STATION HARDWARE QUALIFICATION – PHASE I	Identifier: MFC-EQP-0352 Revision: 0 Effective Date: 10/08/20
	Page: 12 of 18

- ~~5.1.1.5~~ Record the time and the temperatures on the TC and indicating strips approximately every 5 – 10 minutes until the temperature reaches 95°C on the TC or the temperature change is less than 1°C in 5 minutes.
- 5.1.2.5*
ADJM 11/24/20

Performed by:	<i>ADJM</i>	Remarks: <i>Test #1 aborted when glass vessel failed. Did not observe an axial temperature gradient in the glass vessel with sparger running. Time and temps recorded below.</i>
Date:	<i>9/14/20</i>	
Change Log:		

Test #2 Setup 3-6, glassware broke at 90°C on TC.

- ~~5.1.1.6~~ Adjust the hotplate setting to achieve incipient boiling. Note the final hotplate setting in the Remarks.
- 5.1.2.6*
ADJM 11/24/20

Performed by:	<i>ADJM</i>	Remarks: <i>Incipient boiling not achieved as glassware failed in both tests. Did note that air/gas bubbles clinging on vessel wall began to dislodge at ~74°C on submerged TC.</i>
Date:	<i>9/14/20</i>	
Change Log:	<i>CN#2, #5</i>	

- ~~5.1.1.7~~ De-energize the hotplate and allow to cool for safe handling.
- ADJM 5.1.2.7*
11/24/20 Add remarks regarding the extent of liquid mixing. Photograph the liquid to document the dye dispersion.

Time	Temperature			Time	Temperature			Time	Temperature		
	TC	Blue	Black		TC	Blue	Black		TC	Blue	Black

Performed by:	<i>ADJM</i>	Remarks: <i>Solution with dye marker appears uniformly mixed. Cool down not recorded as glassware failed. See Appendix C</i>
Date:	<i>9/14/20</i>	
Change Log:	<i>CN#3</i>	

Test #1	Time	IR T ₁	Blue T ₁	Black T ₁	Test #2	Time	IR T ₁	Blue	Black	Time	IR T ₁	Blue	Black	TC
	0920	69.4°F	≤ 77°C	≤ 50°C	11:54 Adm *	11:54	18.5°C	≤ 77°C	≤ 50°C	12:50	74.2°C	≤ 77°C	≤ 55°C	53%
	0925	21.8°C	"	"		12:02	24.8	"	"	12:55	77.8	"	≤ 60	
	0931	39.3°C	"	"		12:05	28.2	"	"	13:00	82.0	"	≤ 65	68%
	0933	66.8°C	"	≤ 65°C		12:10	33.5	"	"	13:05	87.5	"	≤ 65	72%
Glassware failed at joint with the base and cylinder.						12:16	37.5	"	"	13:10	91.1	"	≤ 70	75%
						12:20	43.0	"	"	13:15	95.5	"	≤ 75	78
						12:25	48.4	"	"	13:20	97.7	"	≤ 75	81
						12:30	53.4	"	"	13:25	100.4	77	80	83
					**	12:35	56.8	"	"	13:31 13:35	102.8	77	80	84
						12:40	62.7	"	"	13:40 13:40	100.7	82	80	87
						12:45	68.9	"	≤ 55	13:45 13:45	107.5	82	> 80	89
										13:48	Glassware broke!			90
Test #2														
* Hotplate setting at 3														
*** Hotplate setting at 4														
*** Hotplate setting at 5														
*** Hotplate setting at 6														

Test #2

- * Hotplate setting at 3
** Hotplate setting at 4
*** Hotplate setting at 5
**** Hotplate setting at 6

Idaho National Laboratory

AGR-5/6/7 CAPSULE LEACH STATION HARDWARE QUALIFICATION – PHASE I	Identifier: MFC-EQP-0352	
	Revision: 0	12a
	Effective Date: 10/08/20	Page: 12 of 18

~~5.1.1.5~~ Record the time and the temperatures on the TC and
 5.1.2.5 indicating strips approximately every 5 – 10 minutes until
 11/24/20 the temperature reaches 95°C on the TC or the temperature
 change is less than 1°C in 5 minutes.

Performed by: <i>ADTM</i>	Remarks: Test #3 w/ stainless steel leach vessel. Hotplate setting = 6. Bubble not installed. Data recorded below. Small bubbles rising @ 35 minutes
Date: 9/17/20	
Change Log:	

ADTM ~~5.1.1.6~~ Adjust the hotplate setting to achieve incipient boiling. Note
 11/24/20 5.1.2.6 the final hotplate setting in the Remarks.

Performed by: <i>ADTM</i>	Remarks: Observed circulation ascending between outer tube and capsule shell and descending in the center. TC = 94°C, TI = 90-93°C. Hotplate setting 3-4 for intermittent boiling.
Date: 9/17/20	
Change Log: CN#2, #5	

ADTM ~~5.1.1.7~~ De-energize the hotplate and allow to cool for safe handling.
 11/24/20 5.1.2.7 Add remarks regarding the extent of liquid mixing.
 Photograph the liquid to document the dye dispersion.

Time	Temperature			Time	Temperature			Time	Temperature		
	TC	Blue	Black		TC	Blue	Black		TC	Blue	Black

Performed by: <i>ADTM</i>	Remarks: cooldown could not be recorded in glass leach vessel because the second glass leach vessel also failed.
Date: 9/17/20	
Change Log: CN#3	

Hotplate = 6	Δtime	TC	TI strips		Hotplate setting = 6	Δtime	TC	TI strips	
			Blue	Black				Blue	Black
	00 min	19°C	~77°C	~50°C		55	95	~93	~90
	05	24	"	"		60	95	"	"
	10	30	"	"		Boiling intermittent			
	15	38	"	"		65	94	"	"
	20	46	"	"		Boiling more intermittent			
	25	56	"	~55		to	92	"	90 with sparge
	30	65	"	~65			86°		
	35	74	"	~70		Sparge cooled liquid to 86°C.			
	40	82	~77	~80					
	45	89	~88	~90					
	50	94	~93	~90					
	51	95	~93	~90					

Idaho National Laboratory

AGR-5/6/7 CAPSULE LEACH STATION HARDWARE QUALIFICATION – PHASE I	Identifier: MFC-EQP-0352 Revision: 0 Effective Date: 10/08/20
	Page: 13 of 18

~~5.1.3~~ Sample Collection from Capsule 1 Leach Vessel

~~5.1.3~~
ADDM
11/24/20 ~~5.1.3.1~~
5.1.3.1

Return the wet assembly to the analytical balance and record the mass and subtract the dry mass (§5.1.1.6).

Performed by: <i>ADDM</i>	Remarks: <i>Broken glassware precluded making a wet assembly mass measurement.</i>	
Date: 9/14/20		
Change Log:		

~~5.1.3.2~~
ADDM
11/24/20 ~~5.1.3.2~~
5.1.3.2

Move the assembly as needed to obtain a sample

Performed by: <i>ADDM</i>	Remarks: <i>Substituted prototype stainless steel leach vessel and took a sample with the pipette.</i>	
Date: 9/17/20		
Change Log: CN#4		

~~5.1.3.3~~
ADDM
11/24/20 ~~5.1.3.3~~
5.1.3.3

Draw a sample of the catch container water using the auto pipette controller and dispense the sample into a sample bottle.

Performed by: <i>ADDM</i>	Remarks: <i>Drew a sample and dispensed into a glass sample vial. Sample drawn from SS leach vessel. No problems.</i>	
Date: 9/17/20		
Change Log: CN#4		
Catch container wt: Gross – Tare = Net	Not recorded. 10ml dispensed.	

~~5.1.4~~ Photographs

~~5.1.4~~
ADDM
11/24/20 ~~5.1.4.1~~
5.1.4.1

Photograph top, bottom, and side views from at least one each of baskets fabricated to drawings Dwg. 1000776, Dwg. 1000778, and Dwg. 1000784. Document any features on other baskets that may impair fit or function (e.g., out-of-round, etc.)

Performed by: <i>ADDM</i>	Remarks: <i>Siderview of all baskets in a shipping box and insertion of the 1000776 baskets into nested 3" Sch 10 and 1 1/2" pipes photographed.</i>	
Date: 11/12/20		
Change Log:		

Idaho National Laboratory

**AGR-5/6/7 CAPSULE LEACH STATION
HARDWARE QUALIFICATION –
PHASE I**

Identifier: MFC-EQP-0352

Revision: 0

Effective Date: 10/08/20

Page: 14 of 18

~~5.1.4.2~~
5.1.4.2
DWM 11/24/20

Photograph the three stainless steel bases fabricated to drawings Dwg. 1000775, Dwg. 1000779, and Dwg. 1000782.

Performed by:		Remarks:
Date:		
Change Log:	CN#9	

~~5.1.4.3~~
5.1.4.3
DWM 11/24/20

Photograph the at least one each of the leach vessels fabricated to drawings Dwg. 1000767/768, Dwg. 1000770/771, Dwg. 1000773/774, Dwg. 1000780, and Dwg. 1000783. Photograph any features on other glassware that may impair fit or function.

Performed by:		Remarks:
Date:		
Change Log:	CN#10	

DWM 11/24/20 ~~5.1.4.4~~
5.1.4.4

Dwg. 1000775, Dwg. 1000779, and Dwg. 1000782.

Performed by:		Remarks:
Date:		
Change Log:	CN#9	

DWM 11/24/20 ~~5.1.4.5~~
5.1.4.5

Attach these and fit test photographs to Appendix A of this procedure.

DWM 11/24/20

Performed by:	DWM	Remarks:
Date:	11/24/20, 12/3/20	
Change Log:		

6. HAZARDS AND CONTROLS

Contact the ES&H SME and augment the Hazards and Controls table below, as necessary, to identify and mitigate hazards present while performing the EQP. Potential hazards that may be encountered during equipment testing operations are listed in LI-1671-11-IRC.

Idaho National Laboratory

AGR-5/6/7 CAPSULE LEACH STATION HARDWARE QUALIFICATION – PHASE I	Identifier: MFC-EQP-0352
	Revision: 0
	Effective Date: 10/08/20 Page: 15 of 18

7. RECORDS

Executed copies of laboratory instructions or operations forms.

NOTE: LWP-1202, "Records Management," the INL Records Schedule Matrix, and associated record types list(s) provide current information on the retention, quality assurance, and/or destruction moratorium requirements for these records. Contact a Records Coordinator for assistance if needed.

8. REFERENCES

EJ-3244, AGR-5/6/7 Leaching Equipment

LI-1671-11-IRC, "General Equipment Handling and Operation," Rev. 5.

Dwg. 1000766 MFC-785, AGR 5/6/7 Capsule 1 Shell Acid Leaching Vessel Final Assembly

Dwg. 1000769 MFC-785, AGR 5/6/7 Capsule 2 & 3 Shell Acid Leaching Vessel Final Assembly

Dwg. 1000772 MFC-785, AGR 5/6/7 Capsule 4 & 5 Shell Acid Leaching Vessel Final Assembly

Dwg. 1000777 MFC-785, AGR 5/6/7 Capsule Internals Acid Leaching Vessel Final Assembly

Dwg. 1000781 MFC-785, AGR 5/6/7 Top & Bottom Head Acid Leaching Vessel Final Assembly

9. APPENDIXES

Appendix A, Acceptance Approval Sheet

Appendix B, Engineering Drawing Change Log

Appendix C, Equipment Photographs

Idaho National Laboratory

AGR-5/6/7 CAPSULE LEACH STATION HARDWARE QUALIFICATION – PHASE I	Identifier:	MFC-EQP-0352
	Revision:	0
	Effective Date:	10/08/20
		Page: 16 of 18

Appendix A**Acceptance Approval Sheet**

Not applicable for Phase I testing

Idaho National Laboratory

AGR-5/6/7 CAPSULE LEACH STATION HARDWARE QUALIFICATION – PHASE I	Identifier:	MFC-EQP-0352
	Revision:	0
	Effective Date:	10/08/20
		Page: 17 of 18

Appendix B**Engineering Drawing Change Log**

Add EDCL as required.

Number of Sheets: 2

Idaho National Laboratory

**AGR-5/6/7 CAPSULE LEACH STATION
HARDWARE QUALIFICATION –
PHASE I**

Identifier: MFC-EQP-0352

Revision: 0

Effective Date: 10/08/20

Page: 18 of 20

- CN#1 5.1.2.2 9/14/20 No means for securing TC at midpoint. TC placement was approximately at midpoint.
- CN#2 5.1.2.6 9/14/20 Glass leach vessel failure precluded completion of this test. Incipient boiling was not achieved.
- CN#3 5.1.2.7 9/14/20 Cooldown data could not be recorded due to the glassware failure and loss of water.
- CN#4 5.1.1.7 9/17/20 Stainless steel prototype leach vessel used. Could not photograph the meniscus or shell submergence.
- CN#5 5.1.2.6 9/17/20 Using a prototypic stainless steel leach vessel, intermittent boiling was achieved with hotplate setting of 3-d. "Incipient" boiling not observed.
- CN#6 5.1.1.2 9/22/20 Stainless steel base being incorporated into new stainless steel leach vessel designs. No other base is required. Step not required.
- CN#7 5.1.1.3 11/12/20 Test fitted all six capsule shell leach baskets into nested pipes (3" Sch 10 and 1 1/2") to simulate new leach vessel design and dimensions. Fit was successful.
- CN#8 5.1.2.1 11/12/20 Stainless steel leach vessels being designed with an articulating handle. Should resolve issue noted in 5.1.2.1.

Idaho National Laboratory

AGR-5/6/7 CAPSULE LEACH STATION HARDWARE QUALIFICATION - PHASE I	Identifier: MFC-EQP-0352 Revision: 0 Effective Date: 10/08/20 <div style="text-align: right;">Page: 19 of 20</div>
---	--

CN #9 5.1.4.4,
 5.1.4.2
 11/24/20 Step not required. Stainless steel
 leach vessels have an integral base.
 No other bases are required.

CN #10 74,
 5.1.4.3
 11/24/20 New leach vessel drawing numbers
 are 1004065, 1004067, 1004069,
 1004071, and 1004072.

Idaho National Laborato

AGR-5/6/7 CAPSULE LEACH STATION HARDWARE QUALIFICATION – PHASE I	Identifier: MFC-EQP-0352 Revision: 0 Effective Date: 10/08/20
---	---

20 of 20
Page: 18 of 18

chdm
11/24/20

Appendix C

Equipment Photographs

N/A chdm 11/24/20

Figures

Figure C - 1. Assembled equipment for Phase I testing.

Figure C - 2. Test fit of capsule shell basket into glass leach vessel at American Fabrication (basket fabricators).

Figure C - 3. Test fit of simulated capsule shell in prototype basket (a) and actual basket at American Fabrication (b).

Figure C - 4. First (a) and second (b) glass leach vessels in base and on hotplate.

Figure C - 5. First glass leach vessel with dye and being heated.

Figure C - 6. Sparge (right side of image) in annulus and small bubbles showing water circulation patterns.

Figure C - 7. Sparge (front) and TC positions during heating test.

Figure C - 8. Insertion of a capsule shell basket in a 3-inch Schedule 10 pipe.

Figure C - 9. Capsule shell basket fully inserted between nested 3" Sched. 10 and 1.5" pipes.

Figure C- 10. Fit test of simulated capsule shell into a wire basket prototype.

Figure C- 11. Dye addition for the liquid mixing test.

Figure C- 12. Sampling liquid in leach vessel.

Figure C-13. As-fabricated wire baskets.

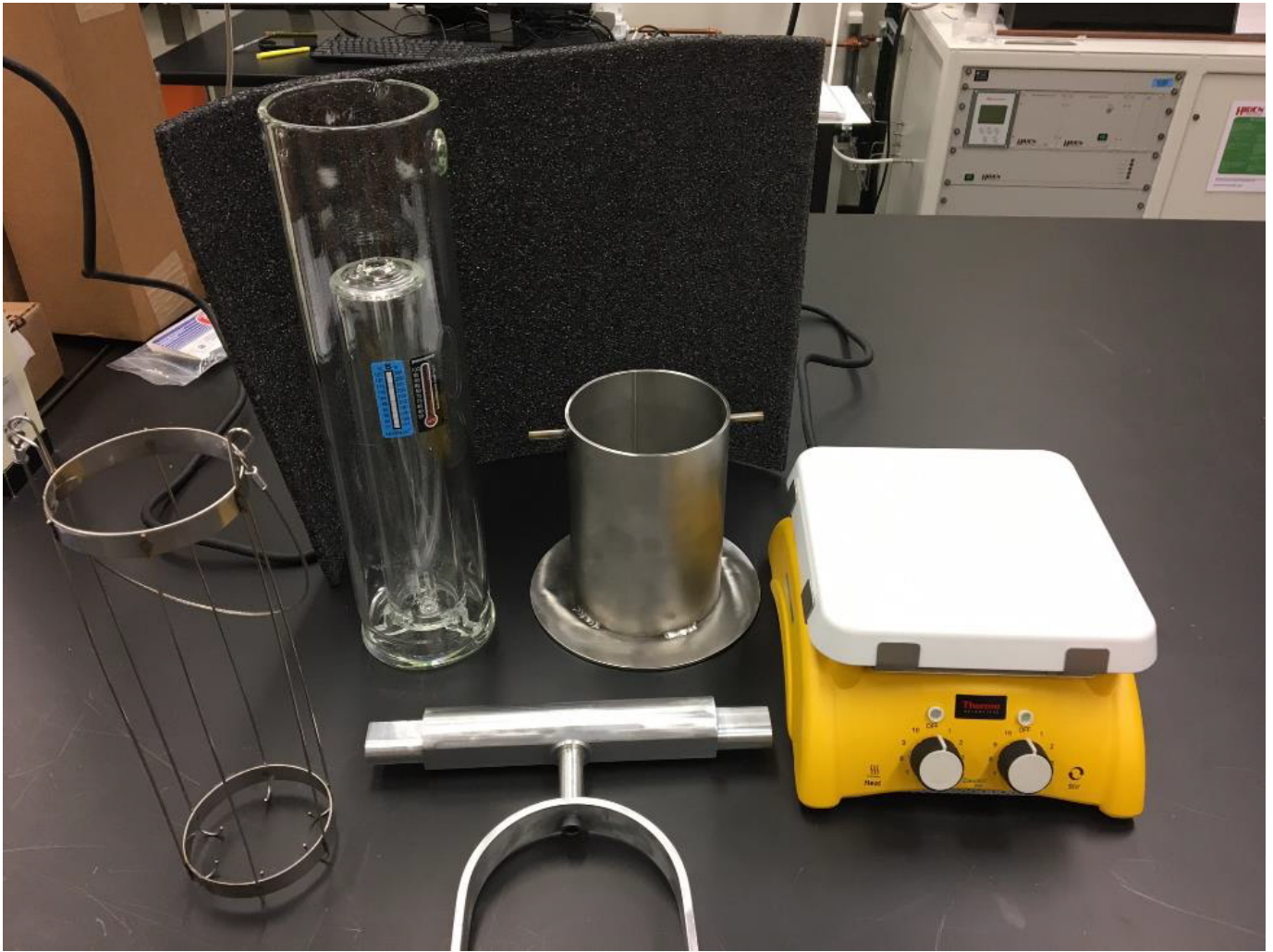


Figure C - 1. Assembled equipment for Phase I testing

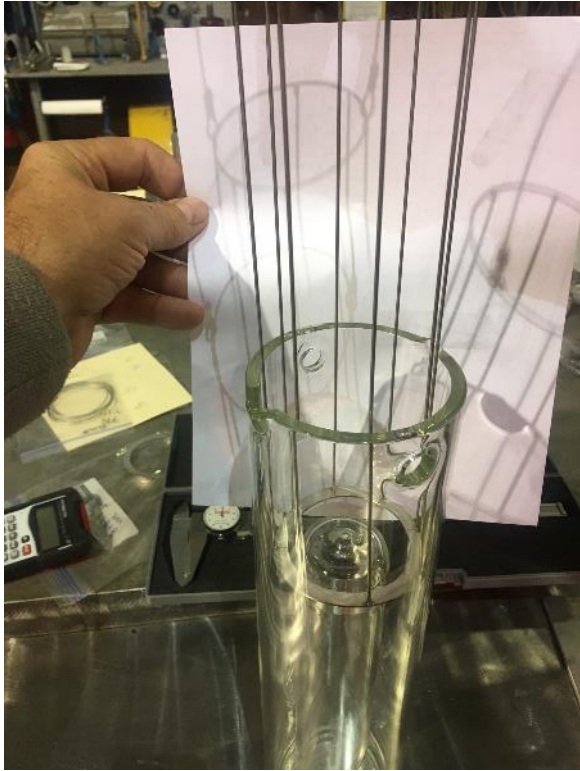


Figure C - 2. Test fit of capsule shell basket into glass leach vessel at American Fabrication (basket fabricators).



Figure C - 3. Test fit of simulated capsule shell in prototype basket (a) and actual basket at American Fabrication (b).



Figure C - 4. First (a) and second (b) glass leach vessels in base and on hotplate.

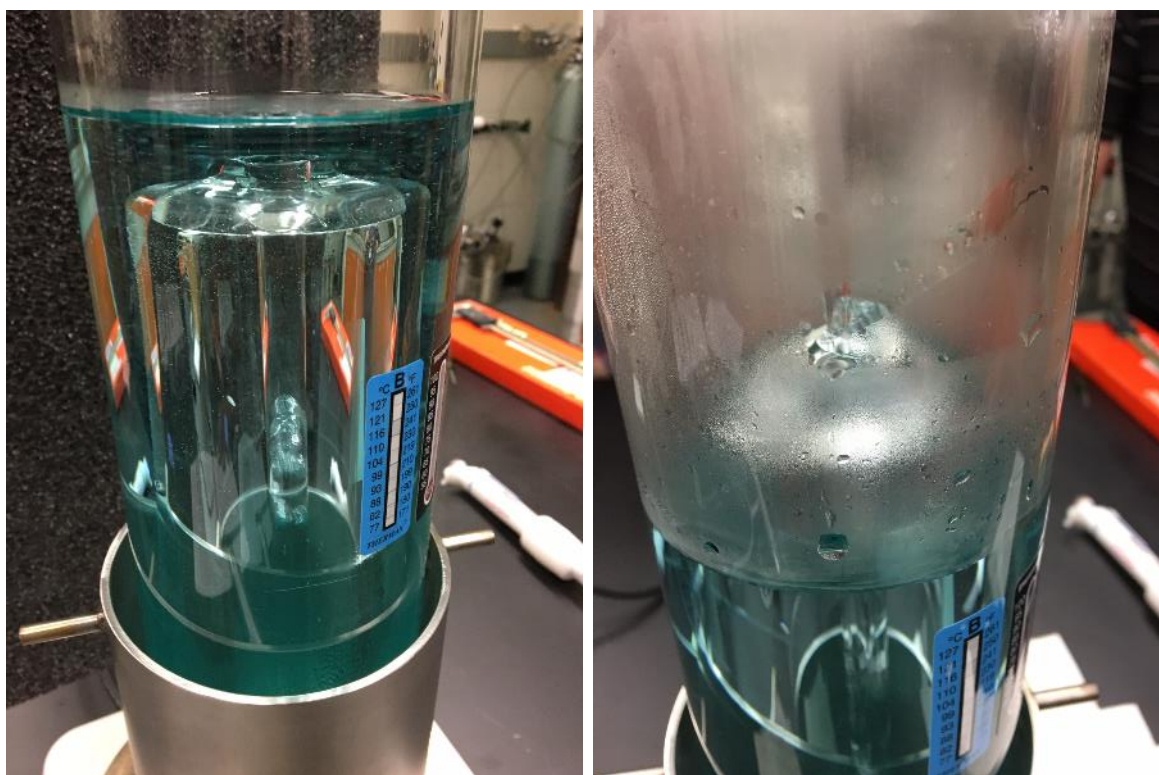


Figure C - 5. First glass leach vessel with dye and being heated.



Figure C - 6. Sparge (right side of image) in annulus and small bubbles showing water circulation patterns.



Figure C - 7. Sparge (front) and TC positions during heating test.

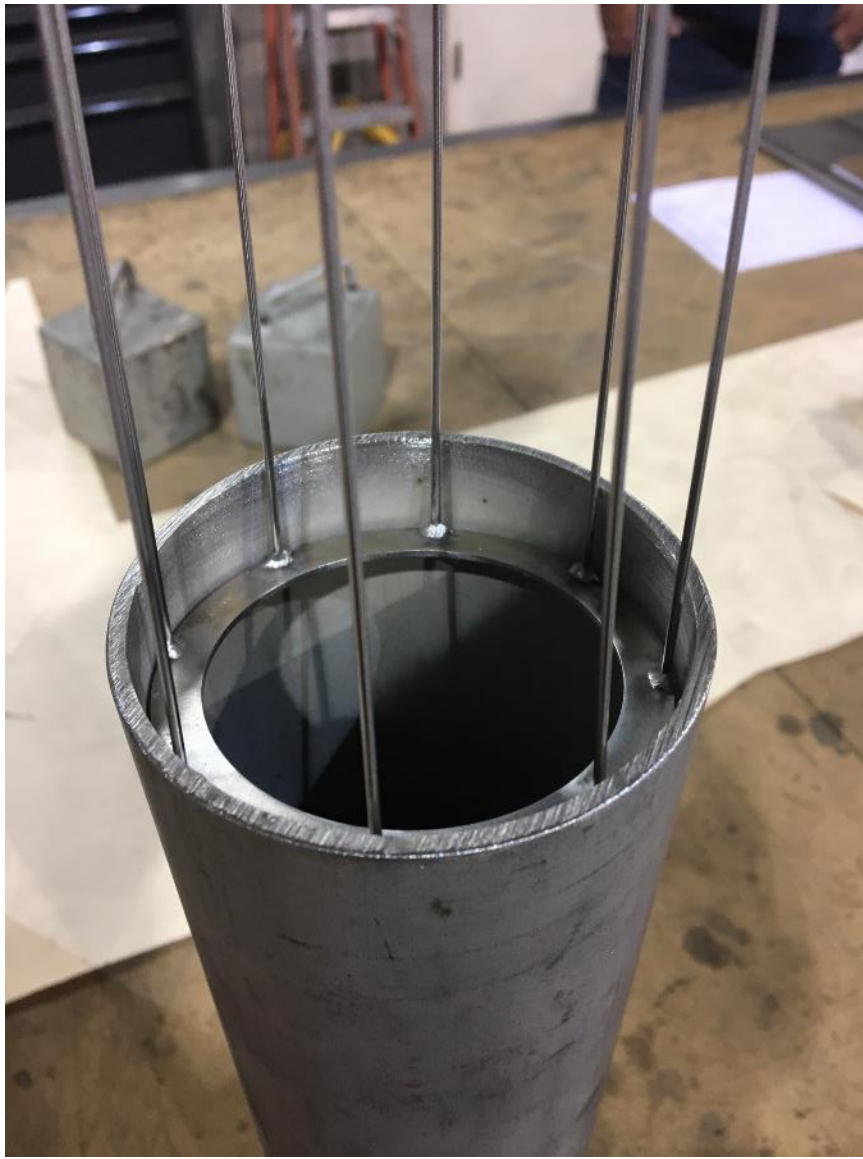


Figure C - 8. Insertion of a capsule shell basket in a 3-inch Schedule 10 pipe.



Figure C - 9. Capsule shell basket fully inserted between nested 3" Sched. 10 and 1.5" pipes.

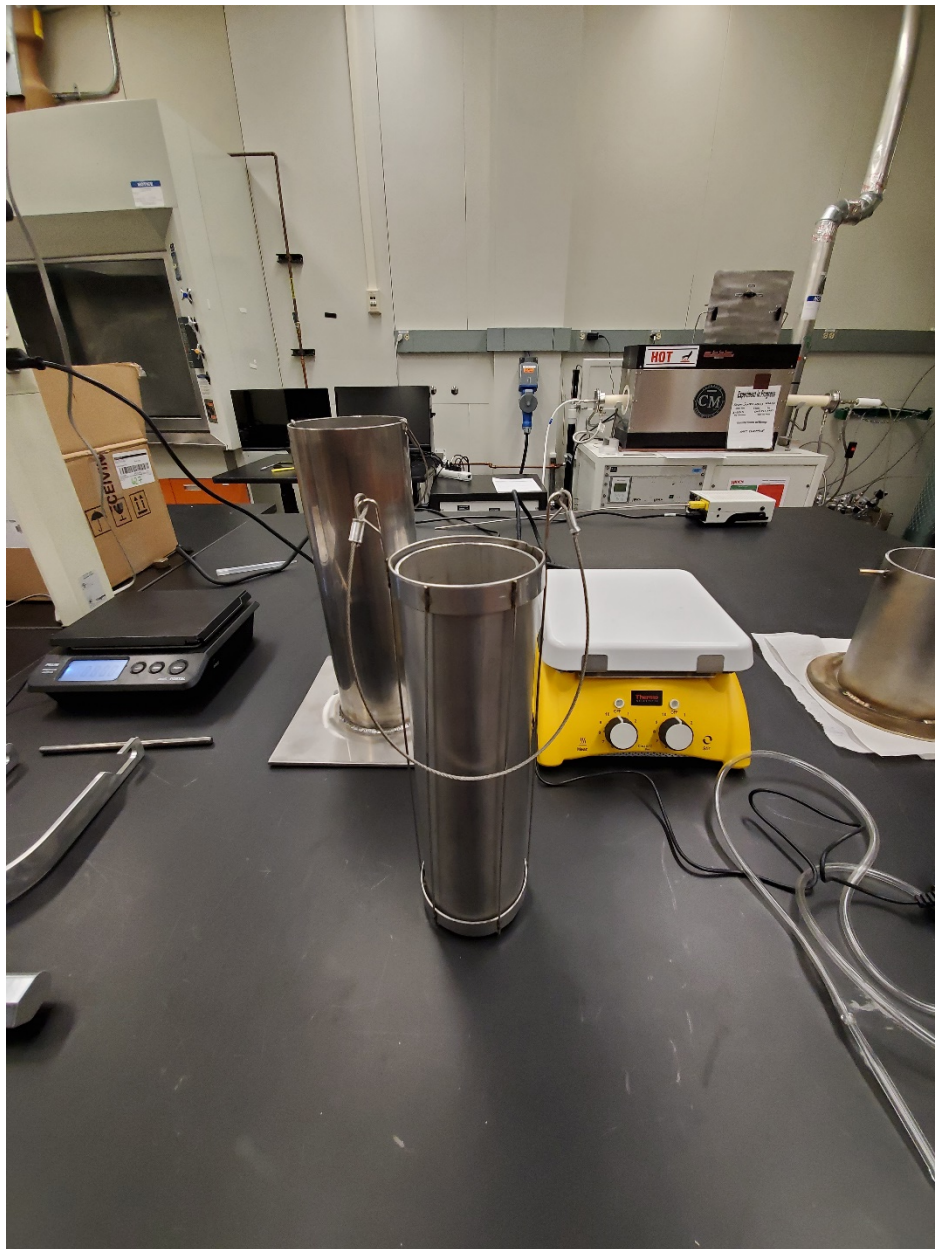


Figure C- 10. Fit test of simulated capsule shell into a wire basket prototype.



Figure C- 11. Dye addition for the liquid mixing test.

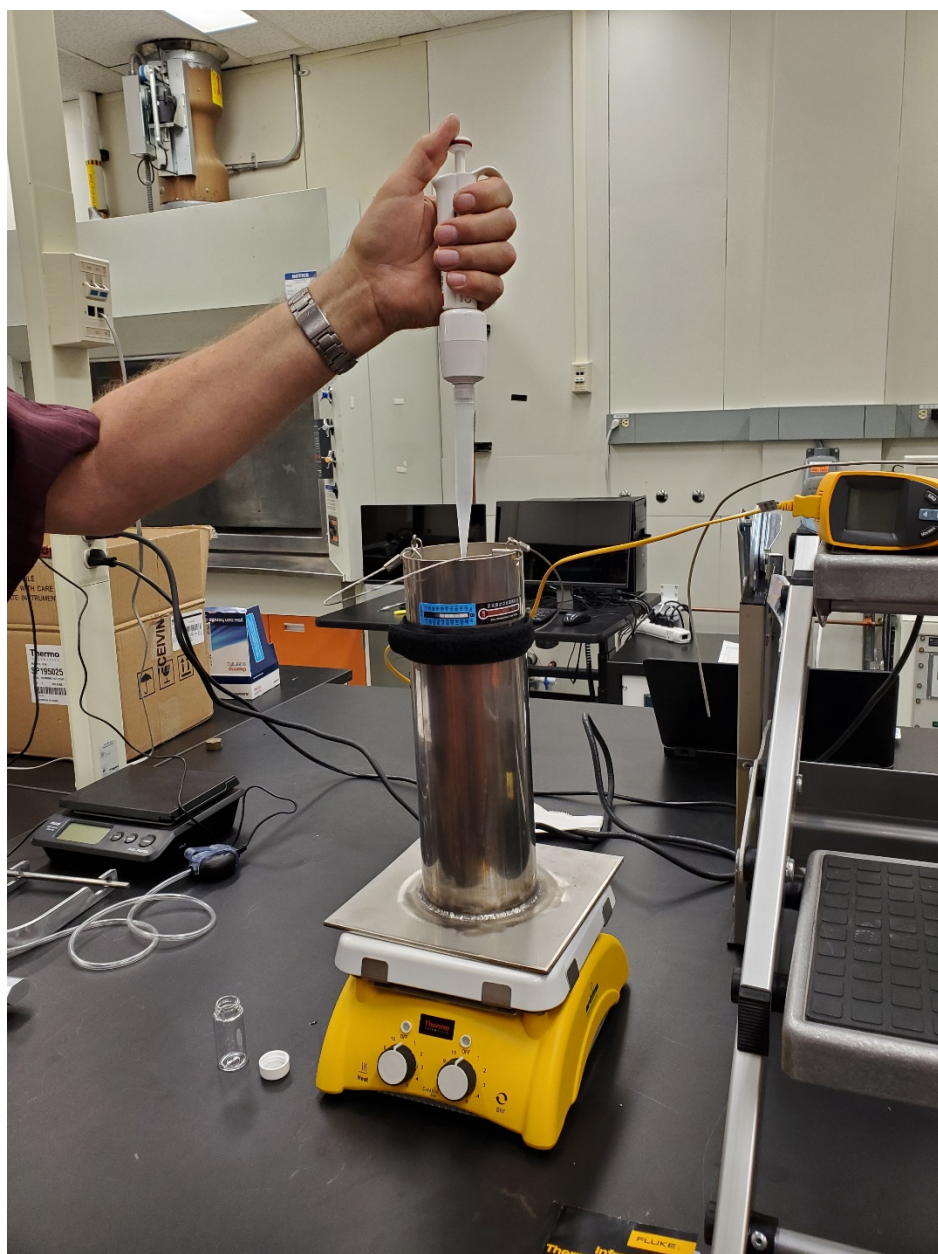


Figure C- 12. Sampling liquid in leach vessel.



Figure C-13. As-fabricated wire baskets.