REPORT NUMBER: 201601014 REV. 7
MODELS: MEP-HCU/C & MMEP

Engineering Peer Review

for Solvent-Based Extraction Equipment

Prepared for

EXTRACTIONTEK SOLUTIONS

Review date: February 25, 2020

Pressure Safety Inspectors, LLC
3750 Dacoro Lane, Unit 155
Castle Rock, CO 80109
303-317-6877

Signature Page

The designs of the ExtractionTek Solutions models listed have been found suitable provided that the equipment is fabricated and assembled using the components listed on the design documentation provided for this review. ***This report offers conditional approval of the design. PSI has determined that the models listed are safe for use so long as the following conditions are met:***

1. *At installation, the equipment must be successfully field verified by PSI to confirm the equipment is installed in accordance with this report. (CFC 3804.4, IFC 3904.4, NFPA 1: 38.6.1.5.6.1)*

This Engineering Peer Review was prepared for:

Original Equipment Manufacturer (OEM): **ExtractionTek Solutions**
2190 W. Bates Ave, Englewood, CO, 80110

For the following Model Numbers: **MeP-HCU/C & mMeP**

Authored by:	John Andrzejczak, PE	AR/CA/CO/ID/IL/KS/KY/MD/
Date:	February 25, 2020	NC/ND/NM/NY/OK/PA/SC/
Signature:		TN/TX/VA/VT/WA
Checked by:	Chris Witherell, PE	AZ/CA/CO/FL/HI/MA/ME/
Date:	February 25, 2020	MI/MN/NV/OH/OR/WA
Signature:		

Report Number: **201601014 Rev. 7**

Revision History

Revision	Date	Description
0	May 31, 2016	Original Release
1	February 7, 2017	Added mMeP
2	September 20, 2017	Updated Codes – No technical changes
3	February 19, 2018	Update to NFPA 1 2018, IFC, 2018, ASME BPVC 2017, NFPA 58 2017; Add AZ/FL/HI/MA/ME/MI/OH requirements; Added Master Vapor Pump MVP-6CFM recovery pump; Added ASME PRV
4	June 12, 2018	Updated Photos; Updated Drawings; Added 2nd ASME Operating Vessel; Updated Codes; Added PRV; Added GC5000 recovery pump
5	August 12, 2019	Updated ETS address and contact information; Added ID/MN/ NC/ND/NM/NY/OK/SC/TN/TX requirements; Updated Codes; Updated Not-Odorized label information; Updated Process Hazard Analysis and Thermal Analysis discussions; Added MVP-150 and Corkin recovery pump options; Removed Facility Installation discussion; Added Purge Gas discussion; Added 55 Liter Operating Tanks, Extended Collector Vessel, Extraction Vessel Extender, Shatter Bowls; Added Huber, Julabo, and Chromite heaters and chillers
6	February 24, 2020	Added AR/IL/KS/KY/VA/VT requirements; Added 1/2-in Coil, Sintered Filter Housing (Optional), Sintered 6-in Filter (Optional), 6-in Dome Cup SG (Optional); Updated Component Compliance Matrix
7	February 25, 2020	Updated Operating Temperature Range

Engineer Seals

State of Arizona

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by an Arizona Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- Arizona Fire Code 2016
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of Arkansas

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by an Arkansas Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- International Fire Code 2018
- NFPA 58 Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of California

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by a California Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- California Fire Code 2016
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of Colorado

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by a Colorado Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- International Fire Code 2018
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of Florida

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by a Florida Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- NFPA 1 Fire Code 2018
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of Hawaii

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by a Hawaii Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- NFPA 1 Fire Code 2018
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of Idaho

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by an Idaho Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- International Fire Code 2018
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of Illinois

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by an Illinois Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- International Fire Code 2018
- NFPA 58 Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of Kansas

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by a Kansas Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- International Fire Code 2018
- NFPA 58 Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of Kentucky

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by a Kentucky Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- International Fire Code 2018
- NFPA 58 Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of Maine

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by a Maine Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- NFPA 1 Fire Code 2018
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of Maryland

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by a Maryland Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- NFPA 1 Fire Code 2018
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland, License No. 25485; Expiration Date: 08-18-2020

State of Massachusetts

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by a Massachusetts Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- NFPA 1 Fire Code 2018
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of Michigan

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by a Michigan Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- NFPA 1 Fire Code 2018
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of Minnesota

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by a Minnesota Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- International Fire Code 2018
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

Professional Certification: I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the state of Minnesota.

State of Nevada

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by a Nevada Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- International Fire Code 2018
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of New Mexico

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by a New Mexico Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- International Fire Code 2018
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of New York

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by a New York Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- New York State Uniform Fire Prevention and Building Code 2017
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

Notice: It is a violation of Section 7209 of Article 145 of the New York State Education Law for any person to alter this document once signed and sealed without the express written consent of the engineer of record.

State of North Carolina

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by a North Carolina Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- International Fire Code 2018
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of North Dakota

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by a North Dakota Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- International Fire Code 2018
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of Ohio

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by an Ohio Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- International Fire Code 2015
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of Oklahoma

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by an Oklahoma Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- International Fire Code 2015
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of Oregon

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by an Oregon Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- Oregon Fire Code 2014
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of Pennsylvania

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by a Pennsylvania Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- International Fire Code 2018
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of South Carolina

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by a South Carolina Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- International Fire Code 2018
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of Tennessee

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by a Tennessee Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- International Fire Code 2018
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of Texas

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by a Texas Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- NFPA 1 Fire Code 2018
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of Vermont

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by a Vermont Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- NFPA 1 Fire Code 2018
- NFPA 58 Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of Virginia

ExtractionTek Solutions model numbers MeP-HCU/C & mMeP have been evaluated by a Virginia Professional Engineer and been found suitable for use, providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- International Fire Code 2018
- NFPA 58 Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of Washington

ExtractionTek Solutions model number MeP-HCU/C & mMeP have been evaluated by a Washington Professional Engineer and found to be professional grade, commercially manufactured, designed and fabricated as described in (WAC) 314-55-104 (4); providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- Washington Fire Code 2015 (WAC 51-54A)
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

State of Washington

ExtractionTek Solutions model number MeP-HCU/C & mMeP have been evaluated by a Washington Professional Engineer and found to be professional grade, commercially manufactured, designed and fabricated as described in (WAC) 314-55-104 (4); providing at installation, the equipment is successfully field verified by PSI to confirm the equipment is installed in accordance with this report. All models were reviewed using the following internationally recognized codes and standards:

- Washington Fire Code 2015 (WAC 51-54A)
- National Fire Protection Association (NFPA) 58, Liquefied Petroleum Gas Code 2017
- ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2017

Table of Contents

Attachment 5 – Design Notebook – Rev. 4

Attachment 6 – Design Notebook – Rev. 5

Attachment 7 – Design Notebook – Rev. 6

Executive Summary

The designs of the ExtractionTek Solutions models listed have been found suitable provided that the equipment is fabricated and assembled using the components listed on the design documentation provided for this review. ***This report offers conditional approval of the design. PSI has determined that the models listed are safe for use so long as the following conditions are met:***

1. *At installation, the equipment must be successfully field verified by PSI to confirm the equipment is installed in accordance with this report. (CFC 3804.4, IFC 3904.4, NFPA 1: 38.6.1.5.6.1)*

ExtractionTek Solutions Modular Extraction Platform models MeP-HCU/C & mMeP are closed loop systems used for extractions of botanical compounds. These products are used for extraction of marijuana and hemp concentrates. Per the Designer of Record, model MeP-HCU/C & mMeP are designed for use with Butane and Propane, or any combination of the two. A nameplate and warning decals are provided with the equipment.

The equipment is design such that ancillary electrical equipment (water heater, water pump etc.) not rated for the electrical classification of the extraction room can be located remotely.

The ExtractionTek Solutions models MeP-HCU/C & mMeP are designed as a modular system. End users can select from various approved components to configure a system that meets their specific needs.

Butane and Propane are classified as Liquefied Petroleum Gas (LPG or LP-Gas) by the International Fire Code (IFC) ; Arizona Fire Code (AFC); California Fire Code (CFC); New York State Uniform Fire Prevention and Building Code (NYUC); Oregon Fire Code (OFC); Washington Fire Code (WFC), which invokes *NFPA 58: Liquefied Petroleum Gas Code*. ExtractionTek Solutions models MeP-HCU/C & mMeP were reviewed using the following codes:

- *Arizona Fire Code, 2016 Edition (Based upon IFC 2012)*
- *California Fire Code, 2016 Edition (Based upon IFC 2015)*
- *International Fire Code, 2018 Edition*
- *New York State Uniform Fire Prevention and Building Code 2017*
- *Oregon Fire Code 2014 (Based upon IFC 2012)*
- *Washington Fire Code, 2015 Edition (WAC 51-54A, Based upon IFC 2015)*
- *NFPA 1 Fire Code, 2018 Edition*
- *NFPA 58 Liquefied Petroleum Gas Code, 2017 Edition*
- *ASME Boiler and Pressure Vessel Code, Section VIII, 2017 Edition*

ExtractionTek Solutions models MeP-HCU/C & mMeP are:

- Professional closed-loop extraction systems
- Commercially manufactured
- Safe for their intended use
- Built to the codes of recognized and generally accepted good engineering practices

Methodology

An Engineering Peer Review (EPR) otherwise known as an independent design verification, is a focused, in-depth technical review by a Professional Engineer. The purpose of an EPR is to add value and reduce risk through expert knowledge infusion, confirmation of approach, and specific recommendations. An EPR provides a penetrating examination of design, analysis, manufacturing, test and operational details, drawings, processes and data. PSI will review all relevant design documents, including all:

- Design inputs
  - Performance criteria
  - Service conditions
  - Working fluids
  - Boundaries for Pressures, Temperatures, and Flows
- Process Flow Diagram (PFD), and/or Piping and Instrumentation Diagram (P&ID)
  - Diagrams showing all system pressure and control components
  - Illustrates the control ties between components
  - Provides summary of major mechanical items (e.g., vessels, pumps, heaters, chillers, etc.)
- Material Take-Offs (MTO)/Bills of Material (BOM)
  - Identification of components and subassemblies
- Vendor Cutsheets
  - Vendor information for purchased components
- Detail design drawings
  - Materials of Construction (MOC)
  - Sizes and thicknesses
  - Arrangements and Assembly views
- Calculations
  - Electrical loads
  - Pressure components
- Specifications
  - Performance-based requirements for purchased components (e.g., “vessels shall be suitable for 100 psig operation at 250°F with LPG”)
  - Compliance-based requirements for purchased or fabricated components (e.g., “vessels shall be type 304L stainless steel, 3 inch outside diameter with 0.188 inch wall thickness, fabricated in accordance with ASME Boiler and Pressure Vessel Code Section VIII Division 1”)

- Procedures
  - Quality Assurance (governing QA Plan, if any)
  - Fabrication procedures (welding, examination, testing)
  - Material traceability (control of items before, during, after fab)
  - Configuration control (verification item conforms to design)
- Codes and standards
  - Governing Codes or Standards, if any
- Factory Acceptance Tests (FAT)
  - Test plan
  - Test documentation
  - 3rd Party testing or certification (ETL/UL)
- Operating Manual
  - Safety
  - Maintenance
  - Minimum facility requirements
  - Operation
- Other relevant design documents used during the design process

The appropriate governing codes are selected based upon the service conditions provided by the equipment manufacturer. Each code is then analyzed for specific requirements. The equipment is then compared to the code requirements as an assembled unit and on an individual component level. Once the equipment has been analyzed in accordance with the governing codes, any deficiencies are reported as either Findings or Observations.

A Finding is defined as anything that could adversely affect safety as related to products, persons or property; or impact the usability of the product. An Observation is defined as a recommendation for process or design improvements, but does not adversely affect safety of the system. Any unresolved Findings described in this report will need to be resolved either through testing (by others) or replacement of affected components (by others) for the equipment to be considered safe for use.

Equipment Description

The designs of the ExtractionTek Solutions models listed have been found suitable provided that the equipment is fabricated and assembled using the components listed on the design documentation provided for this review. ***This report offers conditional approval of the design. PSI has determined that the models listed are safe for use so long as the following conditions are met:***

1. *At installation, the equipment must be successfully field verified by PSI to confirm the equipment is installed in accordance with this report. (CFC 3804.4, IFC 3904.4, NFPA 1: 38.6.1.5.6.1)*

Manufacturer: **ExtractionTek Solutions**
2190 W. Bates Ave, Englewood, CO, 80110
https://extractiontek.com/
sales@extractiontek.com
720-306-9164

Model Number(s): **MeP-HCU/C & mMeP**

ExtractionTek Solutions Modular Extraction Platform models MeP-HCU/C & mMeP are closed loop systems used for extractions of botanical compounds. These products are used for extraction of marijuana and hemp concentrates. Per the Designer of Record, models MeP-HCU/C & mMeP are designed for use with Butane and Propane. A nameplate and warning decals are provided with the equipment. The OEM states that the operating conditions are as follows:

MeP-HCU/C Extractor Operating Pressures

Vessel	Operating Conditions[1]	Design Pressure	Relief Settings
Extraction Vessel without Sight Glass	250 psig @ -30°F to 125°F	350 psig @ 125°F	450 psig
Extraction Vessel with Sight Glass	250 psig @ -30°F to 125°F	350 psig @ 125°F	450 psig
Extraction Vessel Extender (Optional)	250 psig @ -30°F to 125°F	350 psig @ 125°F	450 psig
Collector Vessel	250 psig @ -30°F to 125°F	350 psig @ 125°F	450 psig
Extended Collector Vessel	250 psig @ -30°F to 125°F	250 psig @ -85°F to 125°F	250psig
DWax Vessel	250 psig @ -85°F to 125°F	350 psig @ -85°F to 125°F	450 psig
Expansion Filter	250 psig @ -30°F to 125°F	350 psig @ 125°F	450 psig
30 Liter Operating Tank (Option 1)	250 psig @ -30°F to 125°F	250 psig @ -30°F to 125°F	250 psig

[1] Operating temperature may be reduced to -65˚F when using low temperature Viton elastomers.

Vessel	Operating Conditions[1]	Design Pressure	Relief Settings
Operating Tank (Option 2)	250 psig @ -30°F to 125°F	250 psig @ -30°F to 125°F	250 psig
55 Liter Operating Tank (Option 3)	250 psig @ -30°F to 125°F	250 psig @ -30°F to 125°F	250 psig
55 Liter Jacketed Operating Tank (Option 4)	250 psig @ -30°F to 125°F	250 psig @ -85°F to 125°F	250 psig
Shatter Bowl	250 psig @ -30°F to 125°F	350 psig @ 125°F	450 psig
Sintered Filter Housing (Optional)	250 psig @ -30°F to 125°F	350 psig @ 125°F	450 psig
Sintered 6-in Filter (Optional)	250 psig @ -30°F to 125°F	350 psig @ 125°F	450 psig
6-in Dome Cup SG (Optional)	250 psig @ -30°F to 125°F	350 psig @ 125°F	450 psig

mMeP Extractor Operating Pressures

Vessel	Operating Conditions [2]	Design Pressure	Relief Settings
Extraction Vessel with Sight Glass	250 psig @ -30°F to 125°F	350 psig @ 125°F	450 psig
Extraction Vessel Extender (Optional)	250 psig @ -30°F to 125°F	350 psig @ 125°F	450 psig
Collector Vessel	250 psig @ -30°F to 125°F	350 psig @ 125°F	450 psig
Expansion Filter	250 psig @ -30°F to 125°F	350 psig @ 125°F	450 psig
30 Liter Operating Tank (Option 1)	250 psig @ -30°F to 125°F	250 psig @ -30°F to 125°F	250 psig
Operating Tank (Option 2)	250 psig @ -30°F to 125°F	250 psig @ -30°F to 125°F	250 psig
55 Liter Operating Tank (Option 3)	250 psig @ -30°F to 125°F	250 psig @ -30°F to 125°F	250 psig
55 Liter Jacketed Operating Tank (Option 4)	250 psig @ -30°F to 125°F	250 psig @ -85°F to 125°F	250 psig
Shatter Bowl	250 psig @ -30°F to 125°F	350 psig @ 125°F	450 psig
Sintered Filter Housing (Optional)	250 psig @ -30°F to 125°F	350 psig @ 125°F	450 psig
Sintered 6-in Filter (Optional)	250 psig @ -30°F to 125°F	350 psig @ 125°F	450 psig
6-in Dome Cup SG (Optional)	250 psig @ -30°F to 125°F	350 psig @ 125°F	450 psig

The vapor pressure of propane at 100°F is approximately 200 psig, therefore per NFPA 58 table 5.2.4.2 requires the maxumum allowable working pressure (MAWP) for ASME containers with vapor space to be 250 psig. All pipe weldments (non-ASME pressure vessels) can be isolated by valving and may not have vapor space; therefore the design operating pressure shall be 350 psig (NFPA 58: 5.9.1.4).

The equipment is design such that ancillary electrical equipment (water heater, water pump etc.) not rated for the electrical classification of the extraction room can be located remotely.

The ExtractionTek Solutions models MeP-HCU/C & mMeP are designed as modular systems. End users can select from various approved components to configure a system that meets their specific needs.

[2] Operating temperature may be reduced to -65˚F when using low temperature Viton elastomers.

Maximum Quantity of LPG per Model

Model	Max LPG in Solvent Tank (Max 80% fill)
MeP-HCU/C	11 pounds, 20 pounds, 38 pounds, 63 pounds, 83, or 110 pounds
mMeP	11 pounds, 20 pounds, 38 pounds, 63 pounds, or 83 pounds

OEM Manual and Warning Labels

All ExtractionTek Solutions extractors are supplied with an operating manual. The operational manual clearly describes the safe operation of the system and periodic maintenance requirements.

Appropriate warning labels must be provided with the equipment as described in NFPA 58 Sections 5.2.8.4 and 5.2.8.5. Because the LP-Gas used in an extraction process is not odorized, the equipment shall be marked "NOT ODORIZED". The marking shall have a contrasting background surrounded by a rectangular red border and with red letters in the sizes shown in Table 5.2.8.5(A).

Table 5.2.8.5(A) "NOT ODORIZED" Label Size

Water Capacity		Letter Height		Border Width	
gal	m^3	in.	cm	in.	cm
≥499	≥1.89	4	10.0	½	1.3
49–498	0.19–1.88	1½	3.7	5/16	0.8
2.6–48	0.01–0.18	¾	1.8	¼	0.6
1–2.5	0.004–0.009	⅜	1.0	1/16	0.2

Observation: *The ExtractionTek Solutions extractor system is 2.6-48 gallon water capacity and must be equipped with "Not Odorized" warning labels with letter heights of at least 3/4-inch and in accordance with NFPA Table 5.2.8.5(A).*

Examples of warning labels for odorized LP-Gas equipment are shown below (See Figure 1 & Figure 2). Warning labels for this equipment must be modified for non-odorized LP-Gas.

Figure 1: Typical MeP Manual Warning Labels

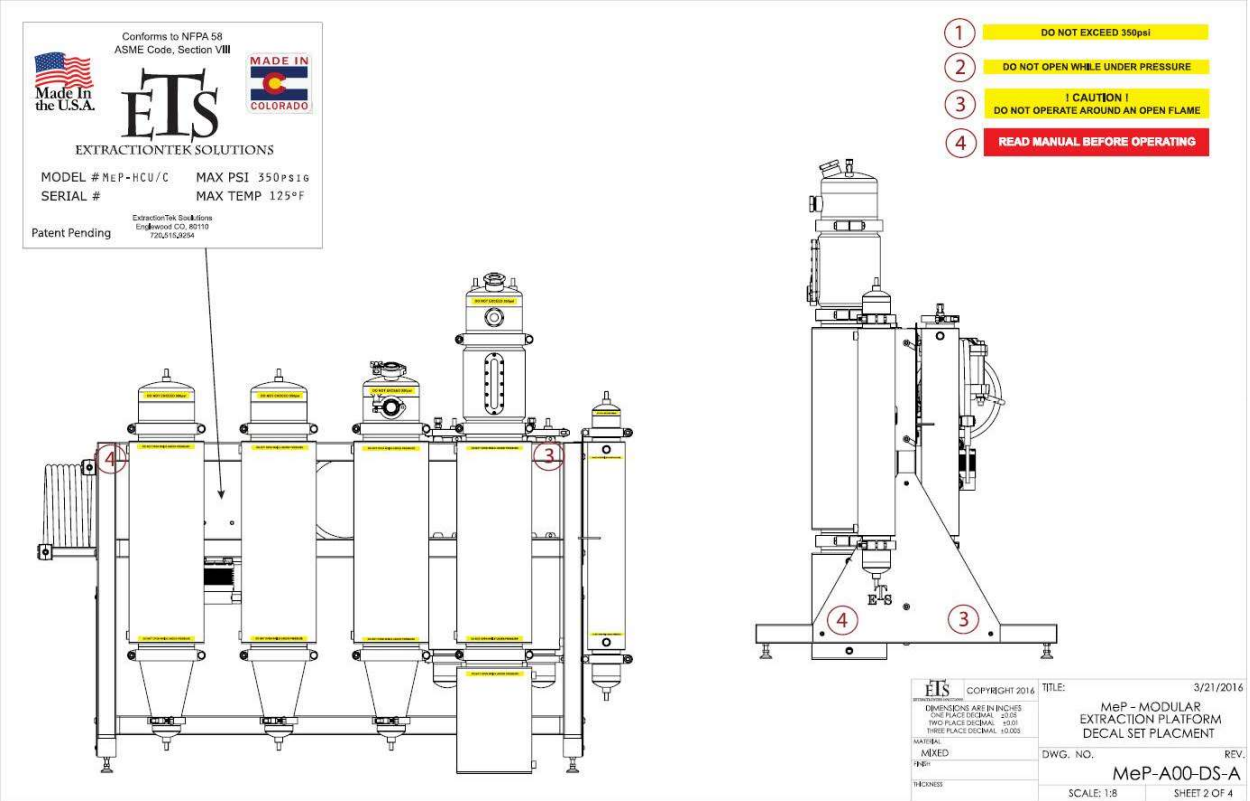


Figure 2: Typical MeP Equipment Warning Labels

For additional warnings and cautions, see the OEM operation and maintenance manual i.

Recovery Units

Recovery Option 1

Haskel Hydrocarbon Recovery Pump (Class I Div 1)

ExtractionTek Solutions' systems are supplied with a modified Haskel 59025 (or EXT-420-ETS) Recovery Pump, model number 59025 (or EXT-420-ETS). The major modifications to the unit include replacing all seals and O-rings with Viton seals and O-rings. This model is recommended by the manufacturer for use with LP-Gases and is modified specifically for this process. The Haskel 59025 (or EXT-420-ETS) is pneumatically driven, and therefore has no electrical components. The pump is driven by an air compressor located elsewhere in the facility.

The output pressure of this pump can reach up to 1250 psig, and therefore must be regulated to prevent over-pressurization of the equipment. To regulate the pressure, ExtractionTek has installed a locking pressure regulator on the air input side of the system to limit the output pressure to 340 psig maximum. The pressure regulator is factory preset to 85 psig (air in), then locked in place. In the unlikely event that the pump over-pressurizes the equipment, the equipment is protected with spring loaded pressure relief valves.

The modified Haskel 59025 (or EXT-420-ETS) may also be labeled as the model 83354 by Haskel.

Manufacturer:	Haskel International
Manufacturer Address:	100 E. Graham Place, Burbank, CA 91502
Model:	59025 (or EXT-420-ETS) or 83354

Recovery Option 2

Master Vapor Pumps Hydrocarbon Recovery Pump (Class I Division 1)

ExtractionTek Solutions' systems may be supplied with a Master Vapor Pumps MVP-6CFM. The Master Vapor Pumps compressor is designed to pump LP-Gas liquid and vapor.

The motor is UL/CSA rated for use in Class I Group D Division 1 environments. The maximum working pressure of the Master Vapor Pumps compressor is 350 psig. This unit is acceptable for use so long as the motor starter and disconnect are installed in accordance with the manufacturer's instructions (items not rated for a CID1 area must be located outside the electrically classified environment). The CO2 purge gas cylinder must be properly secured.

Manufacturer:	Master Vapor Pumps
Manufacturer Address:	849 Almar Ave, #C209, Santa Cruz, CA 95060
Model:	MVP-6CFM-1PH

Recovery Option 3

Precision Extraction Solutions GC5000 Recovery Pump (Class I Division 1)

ExtractionTek Solutions' systems may be supplied with a Precision Extraction Solutions GC5000 recovery pump. The GC5000 recovery pump is designed to pump LP-Gas liquid and vapor.

The motor is UL rated for use in Class I Group D Division 1 environments. The MAWP of the GC5000 recovery pump is 350 psig.

Manufacturer:	Precision Extraction Solutions
Manufacturer Address:	4820 Delemere Ave, Royal Oak, MI 48073

Recovery Option 4

Corken Recovery Pump (Class I Division 1)

ExtractionTek Solutions' systems may be supplied with a Corken D-91-103 (single distance piece) or T-91-103 (double distance piece). The Corken compressors are designed to pump LP-Gas vapor.

The motor is UL rated for use in Class I Group D Division 1 environments. The maximum working pressure of the Corken compressor is 335 psig.

Manufacturer:	Corken, Inc
Manufacturer Address:	3805 NW 36th Street, Oklahoma City, OK 73112
Model:	D91-103
	T91-103

Recovery Option 5

Master Vapor Pumps Hydrocarbon Recovery Pump (Class I Division 1)

ExtractionTek Solutions' systems may be supplied with a Master Vapor Pumps MVP-150. The Master Vapor Pumps compressor is designed to pump LP-Gas liquid and vapor.

The motor is UL/CSA rated for use in Class I Group D Division 1 environments. The maximum working pressure of the Master Vapor Pumps compressor is 350 psig. This unit is acceptable for use so long as the motor starter and disconnect are installed in accordance with the manufacturer's instructions (items not rated for a CID1 area must be located outside the electrically classified environment). The CO2 purge gas cylinder must be properly secured.

Manufacturer:	Master Vapor Pumps
Manufacturer Address:	849 Almar Ave, #C209, Santa Cruz, CA 95060
Model:	MVP-150-1PH

Purge Gases

Carbon Dioxide Purge

The operator may use a regulated, filtered, inert gas (e.g., carbon dioxide) to purge the Master Vapor Recovery pump prior to operations.

> ***Observation:*** *Purge gas cylinders must be secured in accordance with Compressed Gas Association (CGA) guideline P-1, "Safe Handling of Compressed Gases."*

> ***Observation:*** *Carbon dioxide purge gas supply should be regulated to no more than 250 psig; however, may be set as low as practical for the intended operation.*

Code Analysis

Per the Designer of Record, the ExtractionTek Solutions Modular Extraction Platform models MeP-HCU/C & mMeP are designed for use with Butane and Propane.

Butane and Propane are classified as Liquefied Petroleum Gas (LPG or LP-Gas) by the International Fire Code (IFC); Arizona Fire Code (AFC); California Fire Code (CFC); New York State Uniform Fire Prevention and Building Code (NYUC); Oregon Fire Code (OFC); Washington Fire Code (WFC), which invokes *NFPA 58: Liquefied Petroleum Gas Code*. ExtractionTek Solutions models MeP-HCU/C & mMeP have been reviewed using the following codes:

- *Arizona Fire Code, 2016 Edition (Based upon IFC 2012)*
- *California Fire Code, 2016 Edition (Based upon IFC 2015)*
- *International Fire Code, 2018 Edition*
- *New York State Uniform Fire Prevention and Building Code 2017*
- *Oregon Fire Code 2014 (Based upon IFC 2012)*
- *Washington Fire Code, 2015 Edition (WAC 51-54A, Based upon IFC 2015)*
- *NFPA 1 Fire Code, 2018 Edition*
- *NFPA 58 Liquefied Petroleum Gas Code, 2017 Edition*
- *ASME Boiler and Pressure Vessel Code, Section VIII, 2017 Edition*

Per the IFC/AFC/CFC/NYUC/OFC/WFC, a compressed gas container is defined as a pressure vessel designed to hold compressed gases at pressures greater than one atmosphere at 68°F (20°C) and includes cylinders, containers and tanks. Compressed gas containers, cylinders and tanks shall be designed, fabricated, tested, marked with the specifications of manufacture and maintained in accordance with the regulations of the *ASME Boiler and Pressure Vessel Code, Section VIII* (IFC/AFC/CFC/NYUC/OFC/WFC 5303.2). Per the ASME Boiler and Pressure Vessel Code Section VIII – Division 1, Section U-1, (c) (2) (-i), vessels having an inside diameter, width, height, or cross section diagonal not exceeding 6 in. (152 mm), with no limitation on length of vessel or pressure, are not included in the scope of the Division.

LP-gas shall not be used for the purpose of operating devices or equipment unless such device or equipment is approved for use with LP-gas. (IFC/AFC/CFC/NYUC/OFC/WFC 6105.1)

LP-Gas containers shall be designed, fabricated, tested, and marked (or stamped) in accordance with the regulations of the U.S. Department of Transportation (DOT); the ASME Code, Section VIII, "Rules for the Construction of Unfired Pressure Vessels"; or the API-ASME Code for Unfired Pressure Vessels for Petroleum Liquids and Gases, except for UG-125 through UG-136 (NFPA 58: 5.2.1.1).

The following components of the MeP-HCU/C & mMeP are considered pressure vessels due to their size and are required to comply with *ASME Boiler and Pressure Vessel Code, Section VIII*:

- Extended Collector Vessel
- 30 Liter Operating Tank (Option 1)
- Operating Tank (Option 2)
- 55 Liter Operating Tank (Option 3)
- 55 Liter Jacketed Operating Tank (Option 4)

Observation: *ASME vessels may need to be registered with the National Board of Boiler and Pressure Vessel Inspectors per Boiler and Pressure Vessel Regulations of the State in which the equipment is installed.*

The maximum allowable working pressure (MAWP) for ASME containers with vapor space shall be in accordance with NFPA 58 Table 5.2.4.2. Since the MeP-HCU/C & mMeP is designed for use with Butane and Propane, the MAWP required is at least 250 psig. This is based on the Maximum Vapor Pressure for LP Gas at 100°F of approximately 200 psig (propane). Note that this pressure rating assumes that the container is not filled beyond 80% liquid capacity.

Pressure Relief Devices (NFPA 58 5.9.2)

ASME containers shall be equipped with one or more pressure relief valves that are designed to relieve vapor. (NFPA 58 5.9.2.1)

ASME containers for LP-Gas shall be equipped with direct spring-loaded pressure relief valves conforming with the applicable requirements of ANSI/UL 132, Standard for Safety Relief Valves for Anhydrous Ammonia and LP-Gas, or other equivalent pressure relief valve standards (NFPA 58: 5.9.2.5).

The start-to-leak setting of the pressure relief valves specified in 5.9.2.5, in relation to the pressure rating of the container, shall be in accordance with Table 5.9.2.5(A) (NFPA 58: 5.9.2.5 (A)).

Table 5.9.2.5(A) Start-to-Leak Pressure Settings of Pressure Relief Valves in Relation to Container Pressure Rating

Containers	Minimum (%)	Maximum (%)
All ASME codes prior to the 1949 edition, and the 1949 edition, paragraphs U-68 and U-69	110	125*
ASME Code, 1949 edition, paragraphs U-200 and U-201, and all ASME codes later than 1949	100	100*

*Manufacturers of pressure relief valves are allowed a plus tolerance not exceeding 10 percent of the set pressure marked on the valve.

The minimum rate of discharge of pressure relief valves installed in ASME containers shall be in accordance with Table 5.9.2.6 or shall be calculated using the following formula:

$$F = 53.632A^{0.82}$$

Table 5.9.2.6 Pressure Relief Valve Flow Capacity as Function of Container Surface Area

SurfaceArea (ft^2)	Flow Rate (SCFM)	Surface Area (ft^2)	Flow Rate (SCFM)	Surface Area (ft^2)	Flow Rate (SCFM)
≤20	626	170	3620	600	10,170
25	751	175	3700	650	10,860
30	872	180	3790	700	11,550
35	990	185	3880	750	12,220
40	1100	190	3960	800	12,880
45	1220	195	4050	850	13,540
50	1330	200	4130	900	14,190
55	1430	210	4300	950	14,830
60	1540	220	4470	1000	15,470
65	1640	230	4630	1050	16,100
70	1750	240	4800	1100	16,720
75	1850	250	4960	1150	17,350
80	1950	260	5130	1200	17,960
85	2050	270	5290	1250	18,570
90	2150	280	5450	1300	19,180
95	2240	290	5610	1350	19,780
100	2340	300	5760	1400	20,380
105	2440	310	5920	1450	20,980
110	2530	320	6080	1500	21,570
115	2630	330	6230	1550	22,160
120	2720	340	6390	1600	22,740
125	2810	350	6540	1650	23,320
130	2900	360	6690	1700	23,900
135	2990	370	6840	1750	24,470
140	3080	380	7000	1800	25,050
145	3170	390	7150	1850	25,620
150	3260	400	7300	1900	26,180
155	3350	450	8040	1950	26,750
160	3440	500	8760	2000	27,310
165	3530	550	9470	—	—

For SI units, 1 ft^2 = 0.0929 m^2; 1 SCFM = 0.0283 m^3/min.
Note: Flow rate in SCFM air.

Each pressure relief valve shall be plainly and permanently marked with the following: (NFPA 58 5.9.2.9)

(1) Pressure in psig at which the valve is set to start-to-leak

(2) Rated relieving capacity in SCFM air
(3) Manufacturer's name and catalog number

Pressure relief valves shall be designed to minimize the possibility of tampering. (NFPA 58 5.9.2.11)

A hydrostatic relief valve or a device providing pressure-relieving protection shall be installed in each section of piping and hose in which liquid LP-Gas can be isolated between shutoff valves (NFPA 58: 6.15).

From the LP Gas Code Handbook:

> *If liquid LP-Gas is trapped in a length of pipe between two closed valves, there is no room for expansion of the liquid. The pressure developed can be very high (thousands of psi) and can result in pipe or valve failures. Operation of a hydrostatic relief valve prevents this pressure from developing by discharging liquid. Liquid, however, represents a greater quantity of discharged flammable gas than vapor, and its presence can present hazards including that of fire and of skin freezing (i.e., as the liquid vaporizes it absorbs heat) to personnel. Over a temperature range from 30°F to 90°F (0°C to 32°C), liquid propane expands an average of about 1.6 percent for each 10 Fahrenheit degrees (5.5 Celsius degrees). Because liquid propane and most other liquids are not compressible, this thermal expansion results in a tremendous pressure rise. Hydrostatic relief valves are usually small [about ¼ in. (6 mm) pipe size], because only a small amount of liquid has to be released to lower pressure enough to prevent an overpressure hazard.*

Hydrostatic relief valves designed to relieve the hydrostatic pressure that can develop in sections of liquid piping between closed shutoff valves shall have pressure settings not less than 400 psig or more than 500 psig, unless installed in systems designed to operate above 350 psig (NFPA 58: 5.15.1).

Piping Systems (NFPA 58)

The most appropriate classification of the remaining components of the ExtractionTek Solutions extractors is as a piping system and therefore must meet the requirements listed in NFPA 58 Chapters 5, *LP-Gas Equipment and Appliances*, and 6, *Installation of LP-Gas Systems*. Due to this classification as a piping system, the sections of NFPA 58 that invoke the *ASME Boiler and Pressure Vessel Code (BPVC)*, or *ASME B31.3 Process Piping*, are not applicable to these components. In addition, the *ASME Boiler and Pressure Vessel Code Section VIII – Division 1, Section U-1, (c) (2) (-i),* states that vessels having an inside diameter, width, height, or cross section diagonal not exceeding 6 in. (152 mm), with no limitation on length of vessel or pressure, are not included in the scope of the Division. That is, the IFC/AFC/CFC/OFC/WFC invokes the *ASME Boiler and Pressure Vessel Code* for pressure vessels, however these remaining components are considered a piping system and therefore exempt from this requirement. The IFC/AFC/CFC/OFC/WFC invokes *ASME B31.3 Process Piping* for compressed gas supply piping. These components are not considered supply piping and are therefore not required to follow *ASME B31.3*.

Piping that can contain liquid LP-Gas and that can be isolated by valving and that requires hydrostatic relief valves, as specified under Section 6.15, shall have an operating pressure of 350 psig or a pressure that is equivalent to the maximum discharge pressure of any pump or other source feeding the fixed piping system if it is greater than 350 psig (NFPA 58: 5.11.1.4).

All materials used shall be resistant to the action of LP-Gas both as liquid and vapor under service conditions.

Hose shall be designed for a working pressure of at least 350 psig, with a safety factor of 5 to 1 and comply with ANSI/UL 569, *Standard for Pigtails and Flexible Hose Connectors for LP-Gas*, or ANSI/UL 21, *Standard for LP-Gas Hose* (NFPA 58: 5.11.6.4).

Pipe, Tube Fittings and Valves shall have a service pressure rating of 350 psig or the MAWP, whichever is higher, or 400 psig water, oil, and gas (WOG) rating (NFPA 58: Table 5.11.4.2).

Table 5.11.4.2 Service Pressure Rating of Pipe, Tube Fittings, and Valves

Service	Minimum Pressure
Higher than container pressure	350 psig (2.4 MPag) or the MAWP, whichever is higher, or 400 psig (2.8 MPag) water, oil, and gas (WOG) rating
LP-Gas liquid or vapor at operating pressure over 125 psig (0.9 MPag) and at or below container pressure	250 psig (1.7 MPag)
LP-Gas vapor at operating pressure of 125 psig (0.9 MPag) or less	125 psig (0.9 MPag)

The service pressure rating of equipment shall be in accordance with Table 5.20.1.2. (NFPA 58 5.20.1.2)

Table 5.20.1.2 Service Pressure Rating

Fluid	Pressure	Equipment Design Pressure
LP-Gas vapor	≤20 psig (≤138 kPag)	Maximum anticipated pressure
	20 psig–125 psig (138 kPag–0.9 MPag)	125 psig (0.9 MPag)
	>125 psig (>0.9 MPag)	250 psig (1.7 MPag) or the anticipated pressure, whichever is higher
LP-Gas liquid	≤250 psig (≤1.7 MPag)	250 psig (1.7 MPag)
	>250 psig (>1.7 MPag)	350 psig (2.4 MPag) or the anticipated pressure, whichever is higher

Pressure Containing Metal parts shall be fabricated of materials that are compatible with LP-Gas under service conditions and shall be in accordance with NFPA 58 Table 5.20.1.3.

Sight flow indicators shall either be the simple observation type or be combined with a backflow check valve (NFPA 58: 5.20.8).

IFC 2018 Chapter 39 (Retroactive)

The 2018 edition of the International Fire Code adds Chapter 39, Processing and Extraction Facilities. Chapter 39 is a new chapter focused on the processing and extraction of oils and fats from various plants. This process includes extraction by use of a solvent, desolventizing the raw material, production of the miscella, distillation of the solvent from the miscella and solvent recovery. The processes used are not necessarily typical hazardous material processes, and often the systems and equipment associated with such processes are not listed. Because of the typical lack of listings, the systems and equipment need specific approvals for each installation. This chapter provides the tools to appropriately address the hazards while also meeting the unique needs of industry. This chapter has provisions for a technical report prepared by a registered design professional and requires site inspections to make sure equipment and systems are installed as designed and approved.

The extraction equipment and extraction processes utilizing hydrocarbon solvents shall be located in a room or area dedicated to extraction. (IFC 3903.3)

Systems or equipment used for the extraction of oils from plant material shall be listed or approved for the specific use. If the system used for extraction of oils and products from plant material is not listed, the system shall be reviewed by a registered design professional. The registered design professional shall review and consider any information provided by the system's designer or manufacturer. For systems and equipment not listed for the specific use, a technical report in accordance with Section 3904.3 shall be prepared and submitted to the fire code official for review and approval. The firm or individual preparing the technical report shall be approved by the fire code official prior to performing the analysis. (IFC 3904.2)

IFC 2018 Chapter 39 Technical Report (Retroactive)

A technical report, reviewed and approved by the fire code official as required by Section 3904.2, is required prior to the equipment being located or installed at the facility. The report shall be prepared by a registered design professional or other professional approved by the fire code official. (IFC 3904.3)

The technical report shall contain all of the following: (IFC 3904.3.1)

1. Manufacturer information.
2. Preparer of record of the technical report.
3. Date of review and report revision history.
4. Signature page, including all of the following:
    4.1. Author of the report.
    4.2. Date of report.
    4.3. Date and signature of registered design professional of record performing the design or peer review.
5. Model number of the item evaluated. If the equipment is provided with a serial number, the serial number shall be included for verification at the time of site inspection.
6. Methodology of the design or peer review process used to determine minimum safety requirements. Methodology shall consider the basis of design, and shall include a code analysis and code path to demonstrate whether specific codes or standards are applicable.
7. Equipment description. A list of every component and subassembly, such as fittings, hose, quick disconnects, gauges, site glass, gaskets, valves, pumps, vessels, containers and switches, of the system or equipment, indicating the manufacturer, model number, material and solvent compatibility. Manufacturer's data sheets shall be provided.
8. A general flow schematic or general process flow diagram of the process. Post-processing or winterization shall be included in this diagram. Primary components of the process equipment shall be identified and match the equipment list required in Item 7. Operating temperatures, pressures and solvent state of matter shall be identified in each primary step or component. A piping and instrumentation diagram (PID or P&ID) shall be provided.
9. Analysis of the vessel(s) if pressurized beyond standard atmospheric pressure. Analysis shall include purchased and fabricated components.
10. Structural analysis for the frame system supporting the equipment.

11. Process safety analysis of the extraction system, from the introduction of raw product to the end of the extraction process.
12. Comprehensive process hazard analysis considering failure modes and points of failure throughout the process. The process hazard analysis shall include a review of emergency procedure information provided by the manufacturer of the equipment or process and not that of the facility, building or room.
13. Review of the assembly instructions, operational and maintenance manuals provided by the manufacturer.
14. List of references used in the analysis.

IFC 2018 Chapter 39 Site Inspection (Retroactive)

Prior to operation of the extraction equipment, where required by the fire code official, the engineer of record or approved professional, as approved in Section 3904.2, shall inspect the site of the extraction process once equipment has been installed for compliance with the technical report and the building analysis. The engineer of record or approved professional shall provide a report of findings and observations of the site inspection to the fire code official prior to the approval of the extraction process. The field inspection report authored by the engineer of record shall include the serial number of the equipment used in the process and shall confirm that the equipment installed is the same model and type of equipment identified in the technical report. (IFC 3904.4)

NFPA 1, 2018, Marijuana Processing Equipment

The 2018 edition of NFPA 1 adds Chapter 38, Marijuana Growing, Processing, or Extraction Facilities.

Systems or equipment used for the extraction of marijuana/cannabis oils and products from plant material shall be performed using equipment that has been listed or approved. (NFPA 1: 38.6.1.5.1.4)

Where the system used for extraction of marijuana oils and products from plant material is not listed, the system shall have a designer of record. (NFPA 1: 38.6.1.5.3.1)

The designer of record shall be a registered design professional. (NFPA 1: 38.6.1.5.3.2)

For systems and equipment not listed for the specific use, a technical report in accordance with Section 1.15 documenting the design or peer review of the equipment shall be prepared and submitted to the AHJ for review and approval. (NFPA 1: 38.6.1.5.4)

Where the medium of extraction or solvent is changed from the material indicated in the technical report or as required by the manufacturer, the technical report shall be revised at the cost of the facility owner and submitted for review and approval by the AHJ prior to the use of the equipment with the new medium or solvent. (NFPA 1: 38.6.1.5.5.1)

NFPA 1, 2018, Field Verification

Prior to operation of the extraction equipment, the designer of record for the equipment shall inspect the site of the extraction process once equipment has been installed for compliance with the technical report and the building analysis. (NFPA 1: 38.6.1.5.6.1)

The designer of record performing the field verification shall provide a report of findings and observations of the site inspection to the AHJ for review and approval prior to the approval of the extraction process. (NFPA 1: 38.6.1.5.6.2)

The field inspection report authored by designer of record shall include the serial number of the equipment used in the process and shall confirm the equipment installed is the same model and type of equipment identified in the technical report. (NFPA 1: 38.6.1.5.6.3)

Structure Analysis

The support frame of an extraction system must be evaluated for strength and stability.

> ***Observation:*** *Certain AHJs may require additional structural analysis and or additional restraints, such as seismic. This report does not include analysis by a licensed structural Professional Engineer.*

Model MeP-HCU/C

The support frame weldment is constructed of 2" stainless steel square tubing and flat plate (see Figure 3 and Figure 4). The MeP-HCU/C empty weight varies, based on the configuration selected, but is less than ~500 pounds in the heaviest extractor configuration (three (3) extractors). The overall height of the assembly (not including hoses) is ~62". By inspection, it can be concluded that the support frame is of sufficient strength to support the equipment. The stand is sufficiently stabilized with leveling feet to prevent the equipment from tipping over.

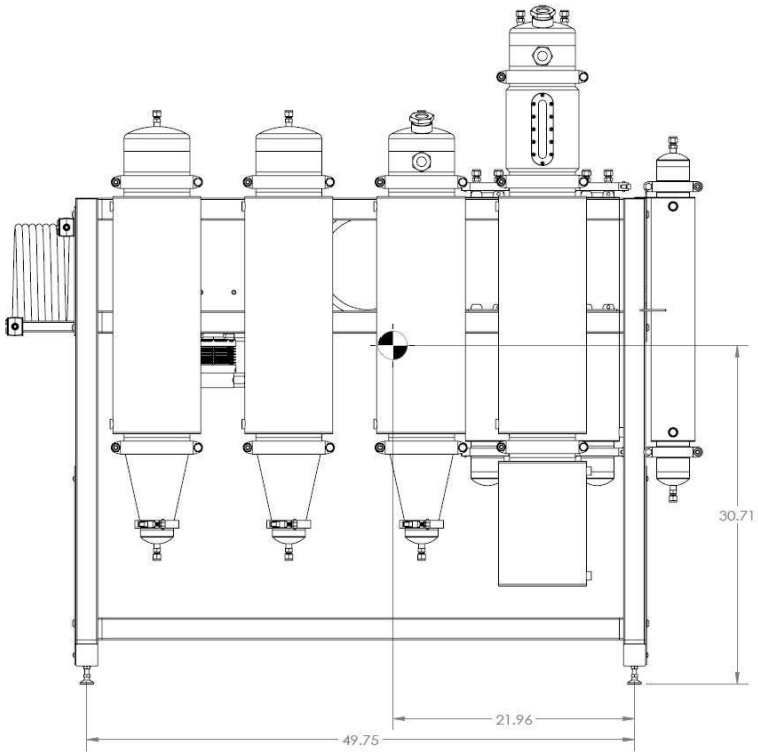


Figure 3: Center of Gravity - Front View

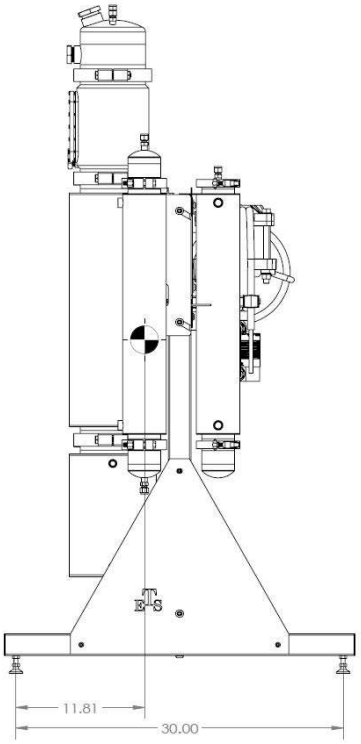


Figure 4: Center of Gravity - Side View

Model mMeP

The support frame weldment is constructed of 2" stainless steel square tubing and flat plate. The overall height of the assembly (not including hoses) is ~56". By inspection, it can be concluded that the support frame is of sufficient strength to support the equipment. The stand is sufficiently stabilized with leveling feet to prevent the equipment from tipping over.

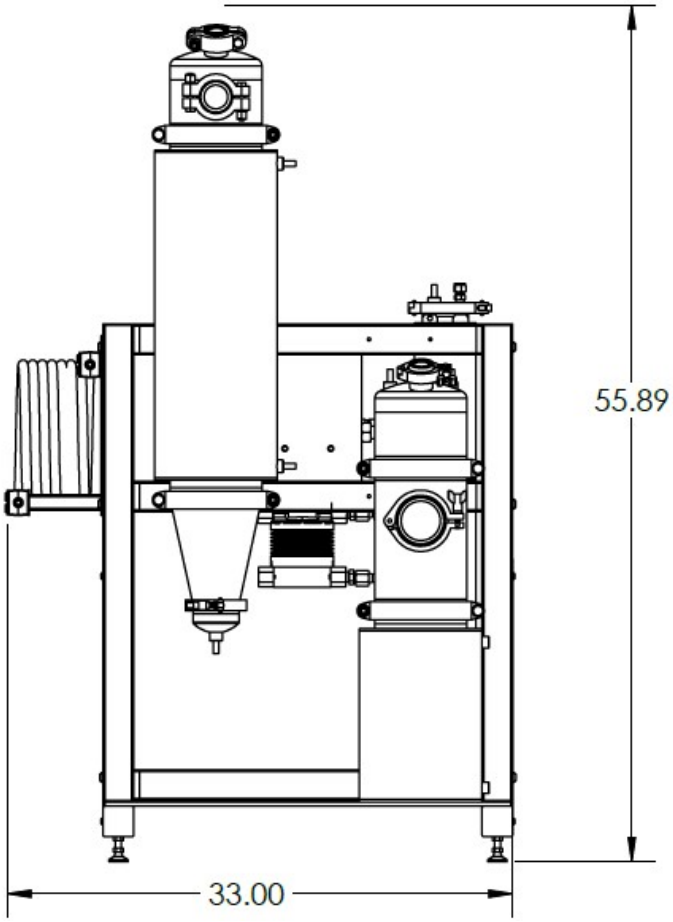


Figure 5: mMeP Structure

Extended Collector Vessel

The support frame weldment is constructed of 1.5" stainless steel square tubing and flat plate. The overall height of the assembly (not including hoses) is ~73". By inspection, it can be concluded that the support frame is of sufficient strength to support the equipment. The stand is sufficiently stabilized with leveling feet to prevent the equipment from tipping over.

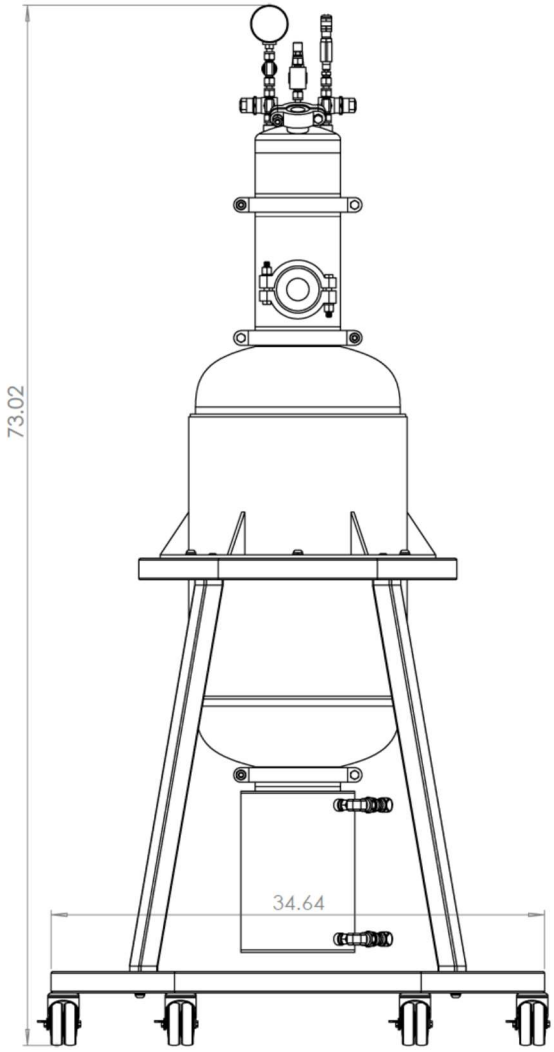


Figure 6: Extended Collector Vessel Stand

Electrical and Control System Analysis

ExtractionTek Solutions models are manually controlled systems with no electrical components, other than those found on the ancillary equipment.

The ancillary equipment does not pose a safety risk in the event of a power failure. An unexpected power loss will leave the equipment in a safe standby state.

> ***Note:*** *The Electrical and Control System analysis above only evaluates the logic of the control system. The electrical and control system has not been evaluated by a licensed electrical Professional Engineer.*

Process Hazard Analysis

This process uses butane and propane to extract desired products from plant material.

Propane and Butane (also called LPG, Liquefied Petroleum Gas, or LP-Gas) are liquid fuel stored under pressure. In most systems, LP-Gas is vaporized to a gas before it leaves the tank. LP-Gas is highly flammable when mixed with air (oxygen) and can be ignited by many sources, including open flames, smoking materials, electrical sparks, and static electricity. Severe "freeze burn" or frostbite can result if LP-Gas liquid comes in contact with your skin. Reference a Safety Datasheet (SDS) for more detailed information and personal protective equipment (PPE) that must be used when using this equipment.

Hazard	Cause	Safeguards
High Pressure	Over Pressurization	The design of the fabricated components is adequate for the temperature, pressure, and process conditions.
High Pressure	Over Pressurization	Purchased components are selected for use that are adequate for the temperature, pressure, and process conditions.
High Pressure	Over Pressurization	The equipment is equipped with pressure relieving devices to protect the equipment and the operator.
Asphyxiation	Release of LP-Gas in the facility due to relief valves cracking	The facility must have an appropriate hazardous exhaust system installed to ensure any LP-Gas release is exhausted from the space.
Asphyxiation	Release of LP-Gas in the facility due to a leaking seal or fitting	A local LP-Gas monitor shall be in operation at all times during the extraction process or where LP-Gas is used or stored.
Asphyxiation	Release of LP-Gas in the facility due to a leaking seal or fitting	The facility must have an appropriate hazardous exhaust system installed to ensure any LP-Gas release is exhausted from the space.

Hazard	Cause	Safeguards
Asphyxiation	Release of LP-Gas in the facility due to a leaking seal or fitting	Proper signage must be posted on the exterior door of each room/area utilizing LP-Gas and in each room storing LP-Gas. NFPA 704 Hazard Diamonds shall be posted at the exterior main entrance and at rooms where LP-Gas is used or stored.
Explosion Hazard/Fire	Release of LP-Gas in the facility due to relief valves cracking	The facility must have an appropriate hazardous exhaust system installed to ensure any LP-Gas release is exhausted from the space. The facility must provide adequate ventilation/exhaust as determined by the Engineer of Record in order to maintain the local atmosphere below 25% of the Lower Flammability Limit (LFL) for this application. Ancillary equipment should be located in another room. An alarming hydrocarbon detector shall be employed in the extraction area.
Explosion Hazard/Fire	Release of LP-Gas in the facility due to a leaking seal or fitting	The facility must have an appropriate hazardous exhaust system installed to ensure any LP-Gas release is exhausted from the space. The facility must provide adequate ventilation/exhaust as determined by the Engineer of Record in order to maintain the local atmosphere below 25% of the Lower Flammability Limit (LFL) for this application. Ancillary equipment should be located in another room. An alarming hydrocarbon detector shall be employed in the extraction area.

Hazard	Cause	Safeguards
Contact with skin or eyes	Release of LP-Gas in the facility due to a leaking seal or fitting	Appropriate PPE should be worn at all times. Refer to Propane and/or Butane Safety Data Sheet for detailed information.
Asphyxiation	Release of inert gas in the facility due to a leaking seal or fitting	The facility must have an appropriate hazardous exhaust system installed to ensure any gas release is exhausted from the space.

Fabricated Component Analysis

Material Properties

Per the designer of record, the ExtractionTek Solutions models MeP-HCU/C & mMeP are intended to normally operate at 100°F and has a maximum operating temperature of 125°F. For this analysis, material properties at the maximum operating temperature are utilized.

Mechanical properties per ASME BPVC Section II Part D:

Material Description	**UNS Number**	**Maximum Allowable Stress (S_1)**	**Minimum Tensile (σ_u)**	**Minimum Yield (σ_y)**
Stainless 304SS (Smls Tube) @ 125°F	S30400	19.7 ksi	70 ksi	30 ksi
Stainless 304LSS (Plate) @ 125°F	S30403	16.7 ksi	70 ksi	25 ksi
Stainless 316LSS (Smls Tube) @ 125°F	S31603	16.7 ksi	70 ksi	25 ksi

Class 1000 Pipe Couplings

Class 1000 type 304 stainless steel pipe half couplings are used throughout the fabricated components. These pipe couplings are rated for a maximum working pressure of 1000 psig and are therefore suitable for use in this application.

Shell Weldment Seams

All pressure vessel welds are full penetration butt welds. Full penetration butt welds are designed to transmit the full strength of the section. Therefore, it can be concluded that the butt welds are of adequate strength and the point of failure in the weldment would be circumferential stress also known as hoop stress.

Chiller Coil

The Chiller Coil (Drawing Number MEP-CC, Rev. A) consists of two concentric tubes. The outer tube serves as the jacket for the inner tube. The jacket is not pressurized. The inner tube is a 3/8" diameter by 0.049" wall seamless stainless-steel tube. The inner tubing is rated for 4,800 psig at 100°F.

The Chiller Coil (Drawing Number 1_2x3_4-HX_001, Rev. C) consists of two concentric tubes. The outer tube serves as the jacket for the inner tube. The jacket is not pressurized. The inner tube is a 1/2" diameter by 0.035" wall seamless stainless-steel tube. The inner tubing is rated for 2,600 psig at 100°F.

Sanitary Tube Information

The analysis in the following sections assumes that standard sanitary tube is used in the fabrication process.

Standard sanitary tube has the following critical dimensions (Shaw Stainless):

Tube OD	Tube ID	Wall Thickness	End Cap Thickness
1.00”	0.87”	0.065”	0.25”
1.50”	1.37”	0.065”	0.25”
2.00”	1.87”	0.065”	0.25”
3.00”	2.87”	0.065”	0.25”
4.00”	3.83”	0.083”	0.31”
5.00”	4.83”	0.083”	0.39”
6.00”	5.78”	0.109”	0.44”
8.00”	7.78”	0.109”	0.44”

MeP-HCU/C & mMeP ASME Pressure Vessels

Vessel	Operating Conditions	Design Pressure	Drawing Number
Extended Collector Vessel	250 psig @ 125°F	250 psig @ 125°F	Titan-V2-CV-A00
30 Liter Operating Tank (Option 1)	250 psig @ 125°F	350 psig @ 125°F	1605240-01-01-01, Rev. A
Operating Tank (Option 2)	250 psig @ 125°F	250 psig @ 125°F	146987-1
55 Liter Operating Tank (Option 3)	250 psig @ 125°F	250 psig @ 125°F	147450-1
55 Liter Jacketed Operating Tank (Option 4)	250 psig @ 125°F	250 psig @ 125°F	202867

The following components of the MeP-HCU/C & mMeP are considered pressure vessels due to their size and are required to comply with *ASME Boiler and Pressure Vessel Code, Section VIII*:

- Extended Collector Vessel
- 30 Liter Operating Tank (Option 1)
- Operating Tank (Option 2)
- 55 Liter Operating Tank (Option 3)
- 55 Liter Jacketed Operating Tank (Option 4)

ASME Certificate

ASME vessels may supplied by Paul Mueller Company, which is a verified ASME Certificate holder.

CERTIFICATE HOLDER DETAILS

Certificate Type:	U
Certificate Number:	36769
Certificate Status:	Active
Company Name:	Paul Mueller Company
Abbreviation:	Mueller
Legal Name:	Paul Mueller Company
Company Address:	1715 Tieken Drive Osceola Iowa USA 50213
Scope:	U-1 - Manufacture of pressure vessels at the above location only
Original Authorized Date:	07/10/2007
Authorized Date:	04/26/2019
Expiration Date:	06/14/2022

ASME vessels may supplied by Apache Stainless Equipment Corporation, which is a verified ASME Certificate holder.

CERTIFICATE HOLDER DETAILS

Certificate Type:	UM
Certificate Number:	24938
Certificate Status:	Active
Company Name:	Apache Stainless Equipment Corporation
Abbreviation:	Apache Stainless Equipment Corp.
Legal Name:	Apache Stainless Equipment Corporation
Company Address:	200 West Industrial Drive Beaver Dam Wisconsin USA 53916
Scope:	UM-4 - Manufacture of miniature pressure vessels at the above location and field sites controlled by the above location
Original Authorized Date:	06/29/1990
Authorized Date:	06/12/2019
Expiration Date:	07/02/2020

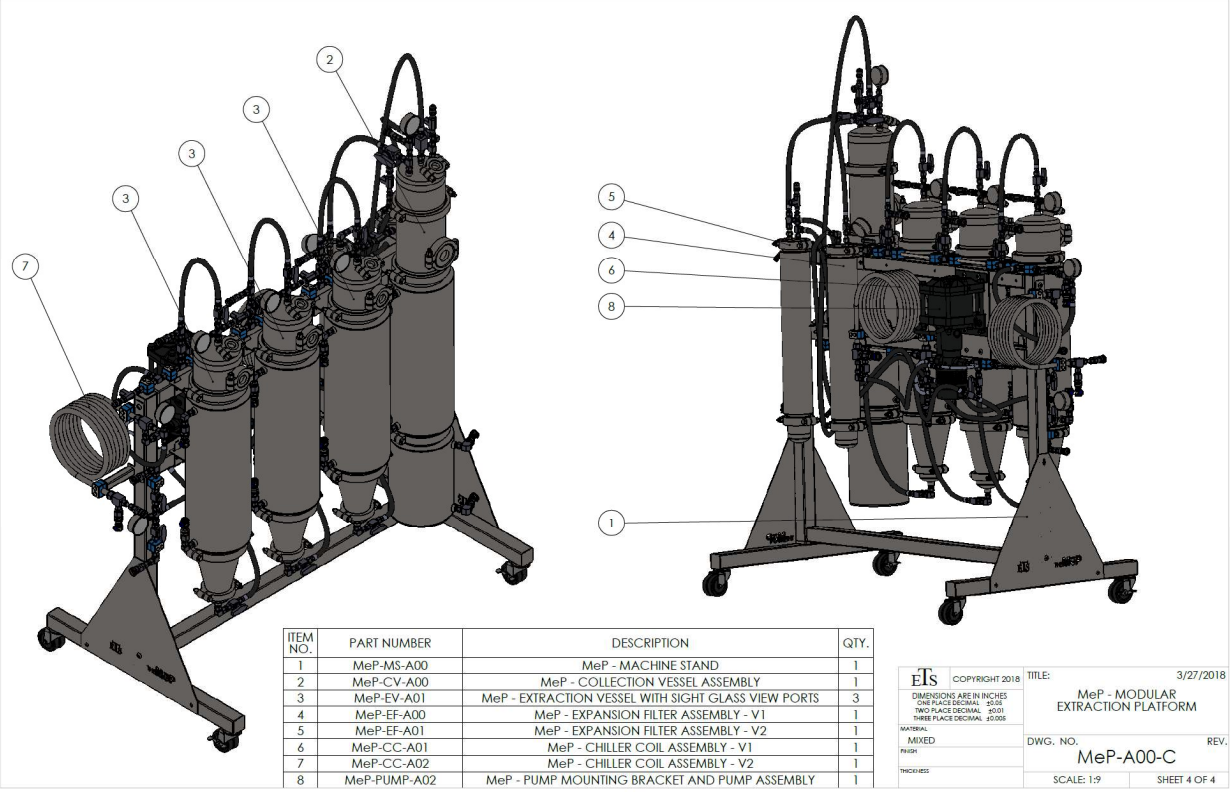
CERTIFICATE HOLDER DETAILS

Certificate Type:	U
Certificate Number:	16784
Certificate Status:	Active
Company Name:	Apache Stainless Equipment Corporation
Abbreviation:	Apache Stainless Equipment Corp.
Legal Name:	Apache Stainless Equipment Corporation
Company Address:	200 West Industrial Drive Beaver Dam Wisconsin USA 53916
Scope:	U-4 - Manufacture of pressure vessels at the above location and field sites controlled by the above location (This authorization does not cover impregnated graphite)
Original Authorized Date:	07/02/1981
Authorized Date:	06/19/2017
Expiration Date:	07/02/2020

MeP-HCU/C

The MeP-HCU/C fabricated components consist of six (6) vessels which are considered pipe weldments.

Vessel	Drawing, Revision
Extraction Vessel without Sight Glass	MEP-EV-A00, Rev. A
Extraction Vessel with Sight Glass	MEP-EV-A01, Rev. C
Extraction Vessel Extender (Optional)	MEP-EV-JE-A00-A
Collector Vessel (Primary Separator)	MEP-CV-A00, Rev. C
DWax Vessel	MEP-DWX-A00, Rev. A
Expansion Filter	MEP-EF-A00, Rev. A
Sintered Filter Housing (Optional)	081211-FF-002
Sintered 6-in Filter (Optional)	ExtractionTek Sintered 6.0
6-in Dome Cup SG (Optional)	MP-EV-DC-SG-A02, Rev. E



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	MeP-MS-A00	MeP - MACHINE STAND	1
2	MeP-CV-A00	MeP - COLLECTION VESSEL ASSEMBLY	1
3	MeP-EV-A01	MeP - EXTRACTION VESSEL WITH SIGHT GLASS VIEW PORTS	3
4	MeP-EF-A00	MeP - EXPANSION FILTER ASSEMBLY - V1	1
5	MeP-EF-A01	MeP - EXPANSION FILTER ASSEMBLY - V2	1
6	MeP-CC-A01	MeP - CHILLER COIL ASSEMBLY - V1	1
7	MeP-CC-A02	MeP - CHILLER COIL ASSEMBLY - V2	1
8	MeP-PUMP-A02	MeP - PUMP MOUNTING BRACKET AND PUMP ASSEMBLY	1

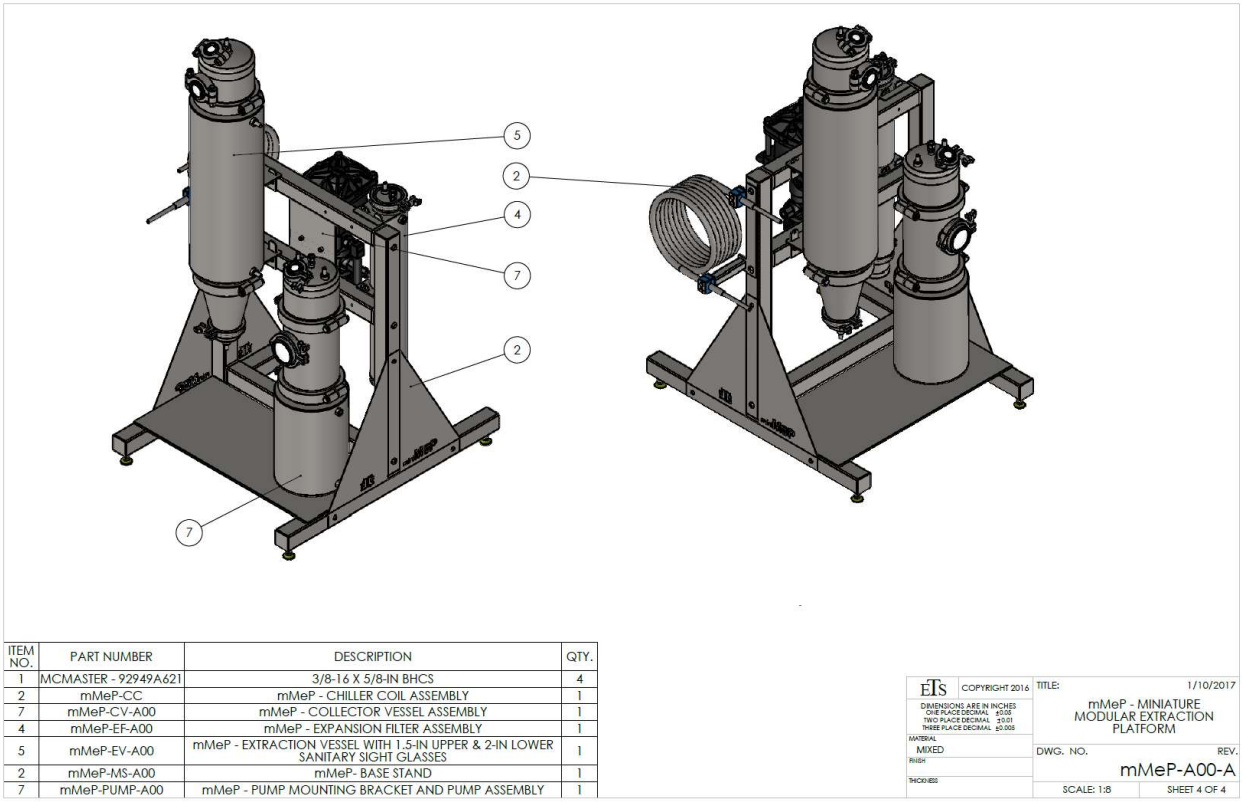
ETS COPYRIGHT 2018
DIMENSIONS ARE IN INCHES
ONE PLACE DECIMAL ±0.05
TWO PLACE DECIMAL ±0.01
THREE PLACE DECIMAL ±0.005
MATERIAL: MIXED
FINISH:
THICKNESS:
TITLE: MeP - MODULAR EXTRACTION PLATFORM
3/27/2018
DWG. NO. MeP-A00-C
REV.
SCALE: 1:9
SHEET 4 OF 4

Figure 7: MeP - Modular Extraction Platform

mMeP

The mMeP fabricated components consist of four (4) vessels which are considered pipe weldments.

Vessel	Drawing, Revision
Extraction Vessel with Sight Glass	mMeP-EV-A00, Rev. A
Extraction Vessel Extender (Optional)	MEP-EV-JE-A00-A
Collector Vessel (Primary Separator)	mMeP-CV-A00, Rev. C
Expansion Filter	mMeP-EF-A00, Rev. A
Sintered Filter Housing (Optional)	081211-FF-002
Sintered 6-in Filter (Optional)	ExtractionTek Sintered 6.0
6-in Dome Cup SG (Optional)	MP-EV-DC-SG-A02, Rev. E



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	MCMASTER - 92949A621	3/8-16 X 5/8-IN BHCS	4
2	mMeP-CC	mMeP - CHILLER COIL ASSEMBLY	1
7	mMeP-CV-A00	mMeP - COLLECTOR VESSEL ASSEMBLY	1
4	mMeP-EF-A00	mMeP - EXPANSION FILTER ASSEMBLY	1
5	mMeP-EV-A00	mMeP - EXTRACTION VESSEL WITH 1.5-IN UPPER & 2-IN LOWER SANITARY SIGHT GLASSES	1
2	mMeP-MS-A00	mMeP- BASE STAND	1
7	mMeP-PUMP-A00	mMeP - PUMP MOUNTING BRACKET AND PUMP ASSEMBLY	1

ETS COPYRIGHT 2016
DIMENSIONS ARE IN INCHES
ONE PLACE DECIMAL ±0.05
TWO PLACE DECIMAL ±0.01
THREE PLACE DECIMAL ±0.005
MATERIAL: MIXED
FINISH:
THICKNESS:
TITLE: mMeP - MINIATURE MODULAR EXTRACTION PLATFORM
1/10/2017
DWG. NO. mMeP-A00-A
REV.
SCALE: 1:8
SHEET 4 OF 4

Figure 8: mMeP

The mMeP vessels are identical to the corresponding MeP-HCU/C vessels only with different drawing numbers.

All pipe weldments (non-ASME pressure vessels) can be isolated by valving and may not have vapor space; therefore the design operating pressure shall be 350 psig (NFPA 58: 5.9.1.4). The pipe weldment must be fitted with a relief valve designed to relieve the pressure that can develop in sections of liquid piping between closed shutoff valves shall have pressure settings not less than 400 psig or more than 500 psig (NFPA 58: 5.13.1).

The MeP-HCU/C extractor design is modular and may be configured multiple ways. In each configuration, it has one (1) pressure relieving device located on each extractor, the DWax vessel, and the collector vessel (primary separator). The expansion filter vessels (secondary and tertiary separators) are protected by a common relief, as are any lines that can contain liquid and be isolated by valving. The hydrostatic pressure relief valves are set to crack at 450 psig. ASME pressure relief valves are set to crack at 250 psig.

Vessel	**Operating Conditions**	**Relief Settings**
Extraction Vessel without Sight Glass	350 psig @ 125°F	450 psig
Extraction Vessel with Sight Glass	350 psig @ 125°F	450 psig
Extraction Vessel Extender (Optional)	350 psig @ 125°F	450 psig
Collector Vessel	350 psig @ 125°F	450 psig
DWax Vessel	350 psig @ 125°F	450 psig
Expansion Filter	350 psig @ 125°F	450 psig
Sintered Filter Housing (Optional)	350 psig @ 125°F	450 psig
Sintered 6-in Filter (Optional)	350 psig @ 125°F	450 psig
6-in Dome Cup SG (Optional)	350 psig @ 125°F	450 psig

Extraction Vessel without Sight Glass

The Extraction Vessel without Sight Glass (Drawing Number MEP-EV-A00 Rev. A) consists of the jacketed vessel assembly, a six inch dome cap assembly, a commercial 6-to-3 reducer, and a 3 inch dome cap assembly (see Figure 9).

Component	Drawing, Revision
EXTRACTION VESSEL JACKET VESSEL ASSEMBLY	MEP-EV-JV-A00, Rev. A
6-IN DOME CUP ASSEMBLY	MEP-EV-DC-A01, Rev. A
3-IN DOME CUP ASSEMBLY	MEP-EV-DC-A00, Rev. A

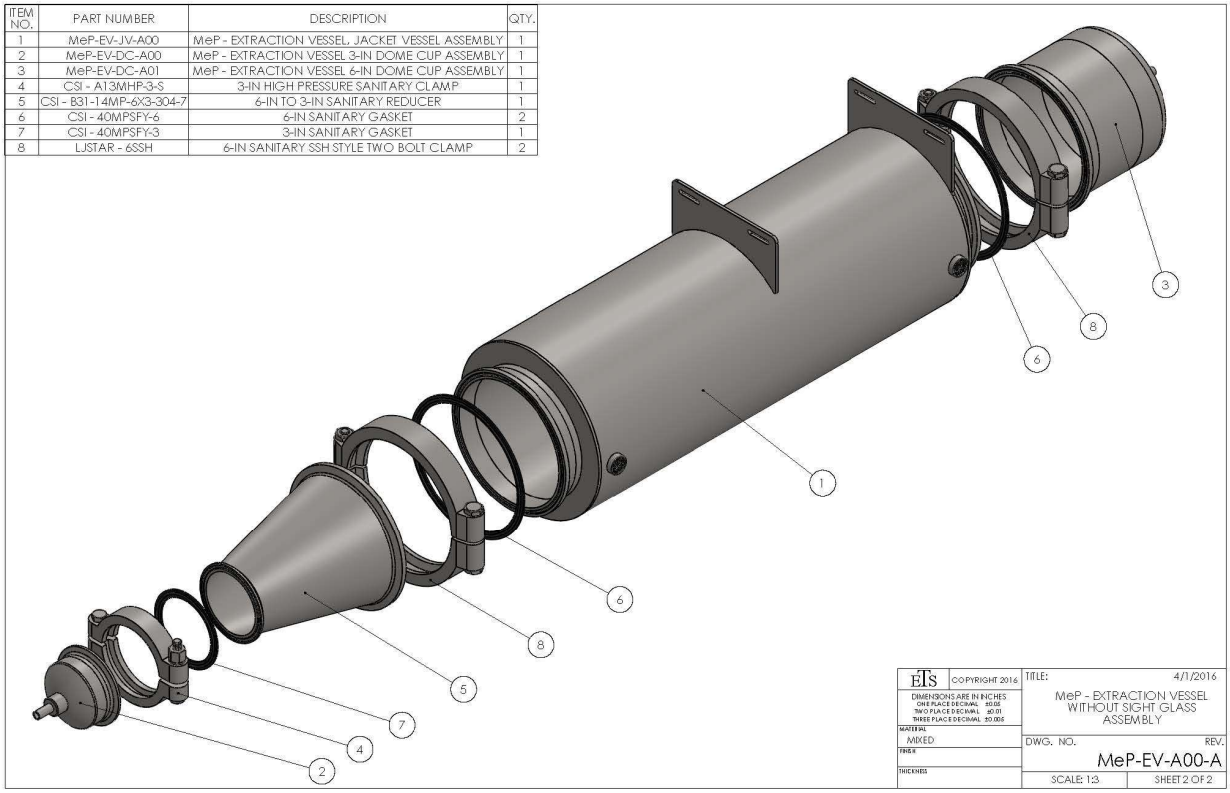


Figure 9: Extraction Vessel without Sight Glass

Extraction Vessel, Jacket Vessel Analysis, MEP-EV-JV-A00, Rev. A

The heat transfer jacket is not pressurized and no credit is taken for it in the analysis of the solvent pressure boundary.

Though the Extraction Vessel Jacket Vessels are not considered ASME pressure vessels due to their size, the components may still be analyzed per ASME BPVC.

The shell inner diameter (d) is 5.782 in. The joint efficiency (E) for a full penetration butt weld with no radiographic examination per ASME BPVC Table UW-12 is 0.70. The maximum allowable pressure (P) is calculated per equation (The American Society of Mechanical Engineers, 2017) UG 27 (c) 1:

$$P = \frac{S_1 E t}{\frac{d}{2} + 0.6t}$$

$$P = \frac{(19700)(0.70)(0.109)}{\frac{5.782}{2} + 0.6(0.109)} = 508\ psig$$

The Extraction Vessel Jacket Vessel is connected on one end to the 6" Dome Cup Assembly Weldment using an LJ Star 6" SSH High Pressure clamp. The service rating of the SSH clamp is 725 psig @ 100°F and 613 psig @ 250°F.

The other end of the Jacket Vessel is clamped to a commercial 6x3 concentric reducer. These reducers have pressure ratings at least as high as the weakest end connection. The maximum allowable pressure (P) for a conical section is calculated per equation (The American Society of Mechanical Engineers, 2017) UG 32 (g) 4:

$$P = \frac{2S_1 E t\ cos\ \alpha}{D + 1.2t\ cos\ \alpha}$$

$$P = \frac{(2)\ (19700)\ (0.70)(0.109)\cos 13.24°}{5.782 + 1.2\ (0.109)\cos 13.24°} = 495\ psig$$

6 Inch Dome Cup Analysis, MEP-EV-DC-A01

The cylinder and ferrule for the 6" Dome Cup is identical to the Extraction Vessel Jacket Vessel cylinder analysis performed for the Extraction Vessel, Jacket Vessel. The cylinder is welded to a commercial sanitary tube end cap (16W-6). These end caps have pressure ratings at least as high as the cylinder and can be approximated to be semi-ellipsoidal heads. The maximum allowable pressure (P) for a semi-ellipsoidal head is calculated per equation (The American Society of Mechanical Engineers, 2017) UG 32 (d) 1:

$$P = \frac{2S_1 E t}{D + 0.2t}$$

$$P = \frac{(2)(19700)(0.70)(0.109)}{5.782 + 0.2(0.109)} = 518\ psig$$

3 Inch Dome Cup Analysis, MEP-EV-DC-A00

Though the 3" Dome Cup Vessels are not considered ASME pressure vessels due to their size, the components may still be analyzed per ASME BPVC.

The shell inner diameter (d) is 2.870 in. The joint efficiency (E) for a full penetration butt weld with no radiographic examination per ASME BPVC Table UW-12 is 0.70. The maximum allowable pressure (P) is calculated per equation (The American Society of Mechanical Engineers, 2017) UG 27 (c) 1:

$$P = \frac{S_1 E t}{\frac{d}{2} + 0.6t}$$

$$P = \frac{(19700)(0.70)(0.065)}{\frac{2.870}{2} + 0.6(0.065)} = 608\ psig$$

The 3" Dome Cup Vessel is connected on one end to the commercial 6x3 concentric reducer using a 3" high pressure sanitary clamp (13MHP). The service rating of the 3" high pressure clamp is 1000 psig @ 70°F and 800 psig @ 250°F.

The cylinder is welded to a commercial sanitary tube end cap (16W-3). These end caps have pressure ratings at least as high as the cylinder and can be approximated to be semi-ellipsoidal heads. The maximum allowable pressure (P) for a semi-ellipsoidal head is calculated per equation (The American Society of Mechanical Engineers, 2017) UG 32 (d) 1:

$$P = \frac{2S_1 E t}{D + 0.2t}$$

$$P = \frac{(2)(19700)(0.70)(0.065)}{2.870 + 0.2(0.065)} = 622\ psig$$

Extraction Vessel without Sight Glass Summary

Based on this analysis, it is clear that the Extraction Vessel without Sight Glass is adequately designed and capable of handling a design operating pressure of 350 psig.

Since the entire assembly is constructed of stainless steel, the weldment is suitable for use in LP-Gas service.

Observation: *The commercial 6x3 sanitary reducer part number should be updated to reflect a concentric reducer (CSI part number 9634-600026 should be 9634-050022). This discrepancy does not impact the safe operation of this equipment.*

Extraction Vessel with Sight Glass

The Extraction Vessel with Sight Glass (Drawing Number MEP-EV-A01, Rev. C) consists of the jacketed vessel assembly, a six inch dome cap with sight glass assembly, a commercial 6-to-3 reducer, and a 3 inch dome cap assembly (see Figure 10). The six inch dome cap can be supplied in one of four configurations.

Component	**MeP Drawing**	**mMeP Drawing**
EXTRACTION VESSEL JACKET VESSEL ASSEMBLY	MEP-EV-JV-A00, Rev. A	mMeP-EV-JV-A00, Rev. A
3-IN DOME CUP ASSEMBLY	MEP-EV-DC-A00, Rev. A	mMeP-EV-DC-A00, Rev. A
6-IN DOME CUP ASSEMBLY WITH SG	MEP-EV-DC-SG-A00, Rev. A	N/A
6-IN DOME CUP ASSEMBLY WITH SG	MEP-EV-DC-SG-A01, Rev. A	N/A
6-IN DOME CUP ASSEMBLY WITH SG	MEP-EV-DC-SG-A02, Rev. A	mMeP-EV-DC-SG-A00, Rev. A
6-IN DOME CUP ASSEMBLY WITH SG	MEP-EV-DC-SG-A03, Rev. A	N/A

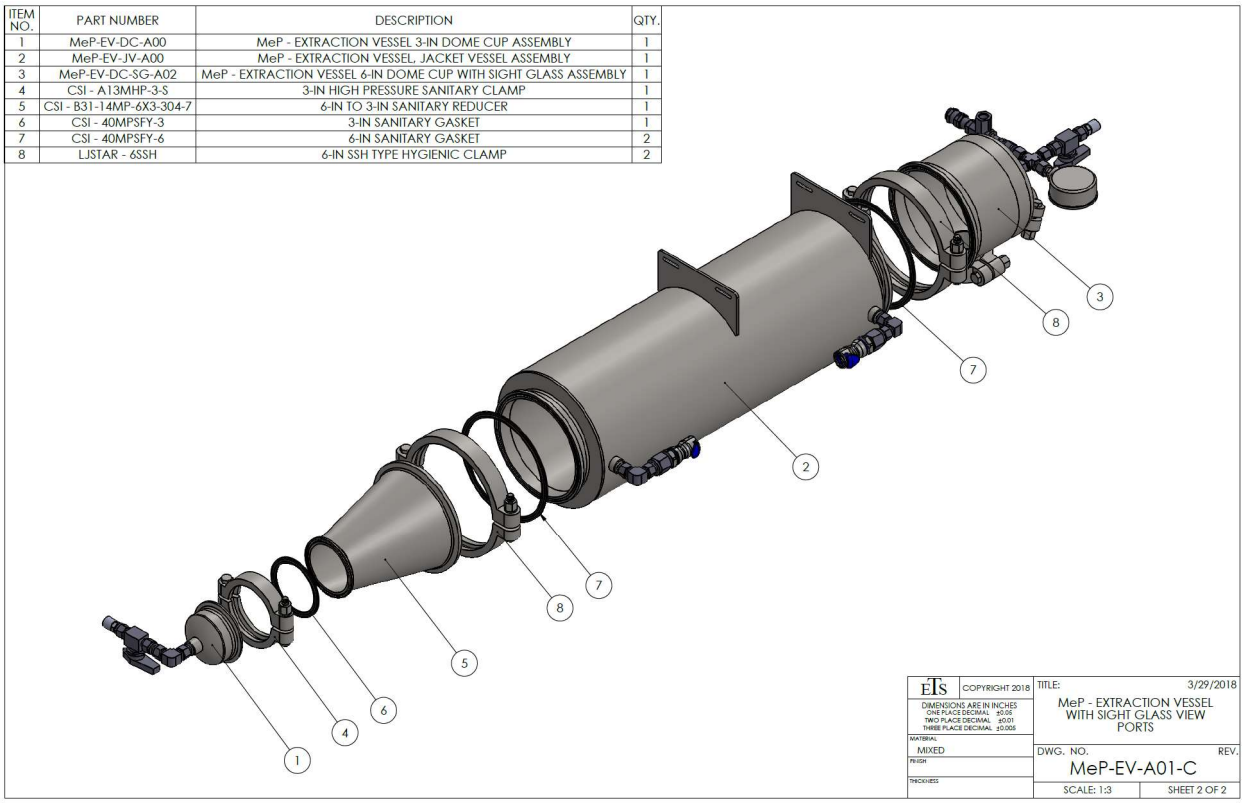


Figure 10: Extraction Vessel with Sight Glass

Common Components

The Extraction Vessel with Sight Glass shares these identical components with the Extraction Vessel without Sight Glass analyzed previously:

- Extraction Vessel Jacket Vessel Assembly
- 3-In Dome Cup Assembly

The six inch dome cap can be supplied in one of four configurations.

6-In Dome Cup Assembly with Sight Glass, MEP-EV-DC-SG-A00

The 6-In Dome Cup Assembly with Sight Glass (configuration A00) is identical to the 6-In Dome Cup Assembly without Sight Glass analyzed above, except that its 6 dome cap has a 1" half coupling in the shell and a 1-1/4" half coupling in the end cap. These half couplings are attached using ASME Code compliant welds.

6-In Dome Cup Assembly with Sight Glass, MEP-EV-DC-SG-A01

The 6-In Dome Cup Assembly with Sight Glass (configuration A01) is identical to the 6-In Dome Cup Assembly without Sight Glass analyzed above, except that its 6 dome cap has a 1-1/2 inch x 1-1/8 inch weld ferrule in the shell and in the end cap. These weld ferrules are attached using ASME Code compliant welds. The sight glass is connected using a 1-1/2" high pressure sanitary clamp (13MHP). The service rating of the 1-1/2" high pressure clamp is 1500 psig @ 70°F and 1200 psig @ 250°F.

6-In Dome Cup Assembly with Sight Glass, MEP-EV-DC-SG-A02, mMeP-EV-DC-SG-A00-A

The 6-In Dome Cup Assembly with Sight Glass (configuration A02) is identical to the 6-In Dome Cup Assembly without Sight Glass analyzed above, except that its 6 dome cap has a 2 inch x 1-1/8 inch weld ferrule in the shell and an 1-1/2 inch (full bore) weld ferrule in the end cap. These weld ferrules are attached using ASME Code compliant welds. The sight glass is connected using either a 1-1/2" or 2" high pressure sanitary clamp (13MHP). The service rating of the 1-1/2" high pressure clamp is 1500 psig @ 70°F and 1200 psig @ 250°F. The service rating of the 2" high pressure clamp is 1000 psig @ 70°F and 800 psig @ 250°F.

6-In Dome Cup Assembly with Sight Glass, MEP-EV-DC-SG-A03

The 6-In Dome Cup Assembly with Sight Glass (configuration A03) is identical to the 6-In Dome Cup Assembly without Sight Glass analyzed above, except that its 6 dome cap has a 1" half coupling in the shell and a 1" half coupling in the end cap. These half couplings are attached using ASME Code compliant welds.

Extraction Vessel with Sight Glass Summary

Based on this analysis, it is clear that the Extraction Vessel with Sight Glass is adequately designed and capable of handling a design operating pressure of 350 psig

Since the entire assembly is constructed of stainless steel, the weldment is suitable for use in LP-Gas service.

> ***Observation:*** *The 6-In Dome Cup Assembly with Sight Glass detail drawings should be updated to reflect current high pressure sanitary clamp and sight glass part numbers. This discrepancy does not impact the safe operation of this equipment.*

Extraction Vessel Extender (Optional)

The Extraction Vessel Extender (Drawing Number MEP-EV-JE-A00-A) consists of a jacketed vessel assembly which is placed atop the standard Extraction Vessel Jacket Vessel Assembly.

Component	MeP Drawing	mMeP Drawing
EXTRACTION VESSEL EXTENDER	MEP-EV-JE-A00, Rev. A	MEP-EV-JE-A00-A

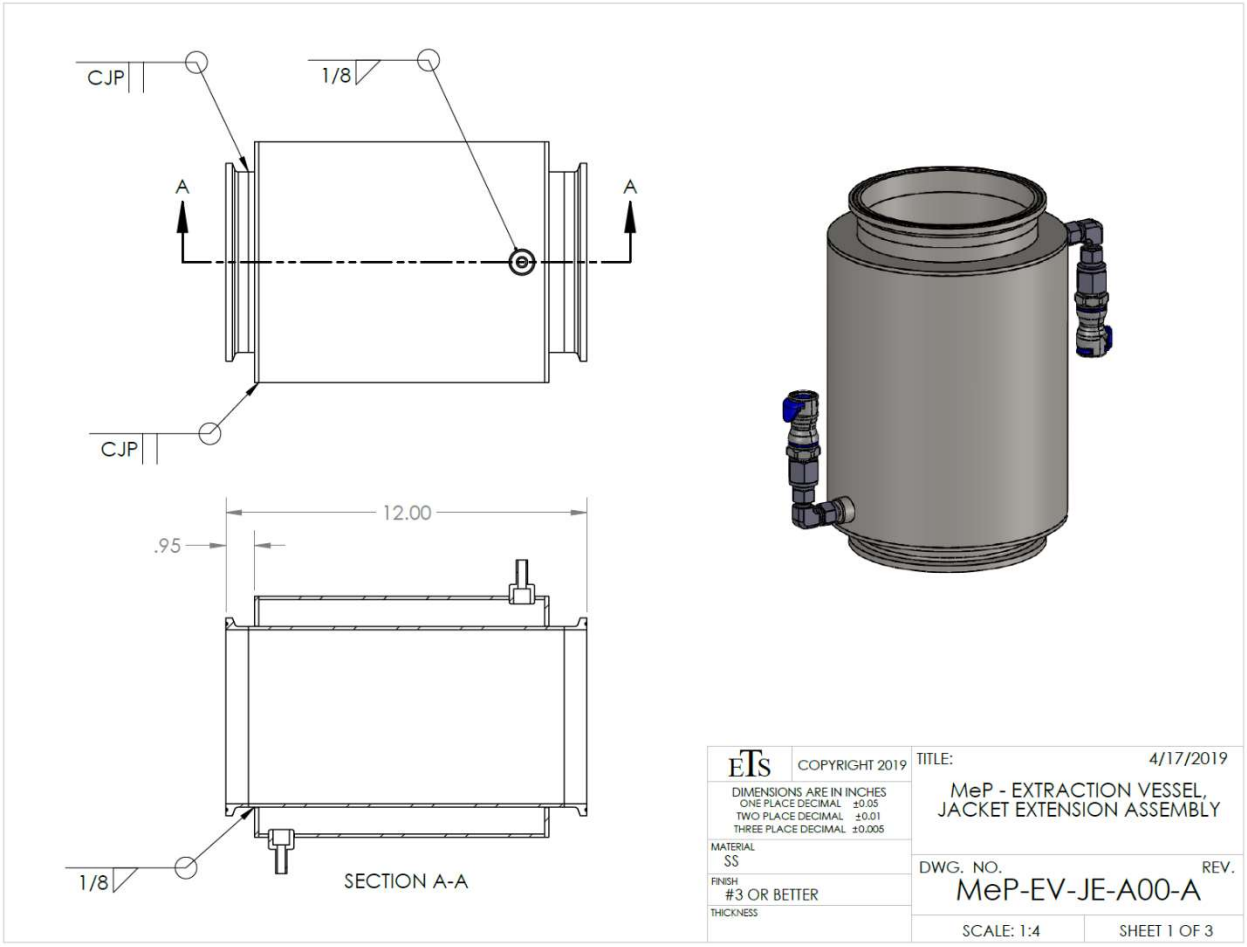


Figure 11: Extraction Vessel Extender

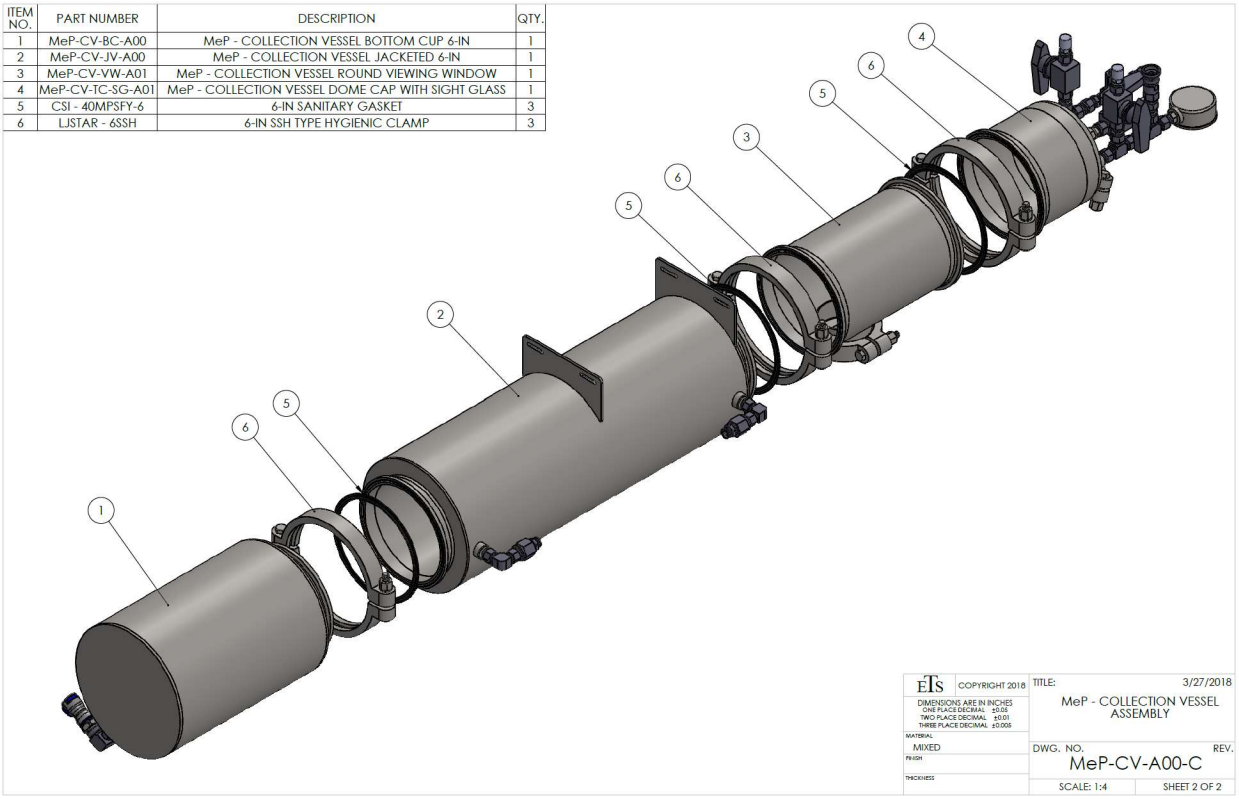
Common Components

The Extraction Vessel Extender is a shorter version of the Extraction Vessel, Jacket Vessel Analysis, MEP-EV-JV-A00, Rev. A, analyzed previously.

Collector Vessel

The Collector Vessel (Drawing Numbers MEP-CV-A00, Rev. C & mMeP-CV-A00, Rev A) consists of the jacketed vessel assembly, a six inch bottom cup assembly, a collector vessel dome cap with sight glass, and a collector vessel viewing window assembly (see Figure 12). The collector vessel dome cap with sight glass can be supplied in one of four configurations. The collector vessel viewing window assembly can be supplied in one of two configurations. The collector vessel is also referred to as the primary separator vessel.

Component	MeP Drawing	mMeP Drawing
EXTRACTOR VESSEL ASSEMBLY	MEP-EV-JV-A00, Rev. A	N/A
COLLECTION VESSEL BOTTOM CUP 6-IN	MEP-CV-BC-A00, Rev. A	mMeP-CV-BC-A00, Rev A
COLLECTOR VESSEL DOME CAP WITH SG	MEP-CV-TC-SG-A00, Rev. A	N/A
COLLECTOR VESSEL DOME CAP WITH SG	MEP-CV-TC-SG-A01, Rev. A	mMeP-CV-TC-SGA01, Rev A
COLLECTOR VESSEL DOME CAP WITH SG	MEP-CV-TC-SG-A02, Rev. A	N/A
COLLECTOR VESSEL DOME CAP WITH SG	MEP-CV-TC-SG-A03, Rev. A	N/A
COLLECTOR VESSEL VIEWING WINDOW	MEP-CV-VW-A00, Rev. A	N/A
COLLECTOR VESSEL VIEWING WINDOW	MEP-CV-VW-A01, Rev. A	mMeP-CV-VW-A01, Rev A



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	MeP-CV-BC-A00	MeP - COLLECTION VESSEL BOTTOM CUP 6-IN	1
2	MeP-CV-JV-A00	MeP - COLLECTION VESSEL JACKETED 6-IN	1
3	MeP-CV-VW-A01	MeP - COLLECTION VESSEL ROUND VIEWING WINDOW	1
4	MeP-CV-TC-SG-A01	MeP - COLLECTION VESSEL DOME CAP WITH SIGHT GLASS	1
5	CSI - 40MPSFY-6	6-IN SANITARY GASKET	3
6	LJSTAR - 6SSH	6-IN SSH TYPE HYGIENIC CLAMP	3

Figure 12: Collector Vessel

Common Components

The Collector Vessel shares these identical components with the Extraction Vessel without Sight Glass analyzed previously:

- Extraction Vessel Jacket Vessel Assembly

The Extraction Vessel Jacket Vessel is connected on one end to the Collection Vessel Bottom Cup 6-In Assembly Weldment using an LJ Star 6" SSH High Pressure clamp. The service rating of the SSH clamp is 725 psig @ 100°F and 613 psig @ 250°F.

The other end of the Extraction Vessel Jacket Vessel is clamped to the Collector Vessel Viewing Window Assembly Weldment using a LJ Star 6" SSH High Pressure clamp.

Collection Vessel Bottom Cup 6-In, MEP-CV-BC-A00, mMeP-CV-BC-A00

The collection vessel bottom cup jacket is not pressurized and no credit is taken for it in the analysis of the solvent pressure boundary.

Though the Collection Vessel Bottom Cup 6-in is not considered an ASME pressure vessels due to its size, the components may still be analyzed per ASME BPVC.

The shell inner diameter (d) is 5.782 in. The joint efficiency (E) for a full penetration butt weld with no radiographic examination per ASME BPVC Table UW-12 is 0.70. The maximum allowable pressure (P) is calculated per equation (The American Society of Mechanical Engineers, 2017) UG 27 (c) 1:

$$P = \frac{S_1 E t}{\frac{d}{2} + 0.6t}$$

$$P = \frac{(19700)(0.70)(0.109)}{\frac{5.782}{2} + 0.6(0.109)} = 508\, psig$$

The cylinder is welded to a commercial sanitary tube end cap (16W-6). These end caps have pressure ratings at least as high as the cylinder and can be approximated to be semi-ellipsoidal heads. The maximum allowable pressure (P) for a semi-ellipsoidal head is calculated per equation (The American Society of Mechanical Engineers, 2017) UG 32 (d) 1:

$$P = \frac{2S_1 E t}{D + 0.2t}$$

$$P = \frac{(2)(19700)(0.70)(0.109)}{5.782 + 0.2(0.109)} = 518\, psig$$

Collector Vessel Dome Cap with Sight Glass, MEP-CV-TC-SG-A00

The cylinder and flange for the Collector Vessel Dome Cap with Sight Glass (configuration A00) is identical to the Collection Vessel Bottom Cup 6-In analysis performed above, except that it has a 1" half coupling in the shell and a 1-1/4" half coupling in the end cap. These half couplings are attached using ASME Code compliant welds.

Collector Vessel Dome Cap with Sight Glass, MEP-CV-TC-SG-A01, mMeP-CV-TC-SGA01

The cylinder and flange for the Collector Vessel Dome Cap with Sight Glass (configuration A01) is identical to the Collection Vessel Bottom Cup 6-In analysis performed above, except that its 6 dome cap has a 1-1/2 inch x 1-1/8 inch weld ferrule in the shell and an 1-1/2 inch (full bore) weld ferrule in the end cap. These weld ferrules are attached using ASME Code compliant welds. The sight glass is connected using a 1-1/2" high pressure sanitary clamp (13MHP). The service rating of the 1-1/2" high pressure clamp is 1500 psig @ 70°F and 1200 psig @ 250°F.

Collector Vessel Dome Cap with Sight Glass, MEP-CV-TC-SG-A02

The cylinder and flange for the Collector Vessel Dome Cap with Sight Glass (configuration A02) is identical to the Collection Vessel Bottom Cup 6-In analysis performed above, except that its 6 dome cap has a 2 inch x 1-1/8 inch weld ferrule in the shell and an 1-1/2 inch x 1-1/8 inch weld ferrule in the end cap. These weld ferrules are attached using ASME Code compliant welds. The sight glass is connected using either a 1-1/2" or 2" high pressure sanitary clamp (13MHP). The service rating of the 1-1/2" high pressure clamp is 1500 psig @ 70°F and 1200 psig @ 250°F. The service rating of the 2" high pressure clamp is 1000 psig @ 70°F and 800 psig @ 250°F.

Collector Vessel Dome Cap with Sight Glass, MEP-CV-TC-SG-A03

The cylinder and flange for the Collector Vessel Dome Cap with Sight Glass (configuration A03) is identical to the Collection Vessel Bottom Cup 6-In analysis performed above, except that it has a 1" half coupling in the shell and end cap. These half couplings are attached using ASME Code compliant welds.

Collector Vessel Viewing Window, MEP-CV-VW-A00

The flange for the Collector Vessel Viewing Window (configuration A00) is identical to the Collection Vessel Bottom Cup 6-In analysis performed above.

The Collector Vessel Viewing Window is fabricated using a 304 Stainless Steel 6" Schedule 80 pipe which is welded to 6" sanitary weld ferrules at either end. The bore of the pipe is machined to match the ferrule inside diameter. The analysis of the Collection Vessel Bottom Cup 6-In analysis performed above bounds the analysis of this shell section (this shell is thicker and the minimum wall thickness of the pipe and sanitary fittings is 0.109", as analyzed above).

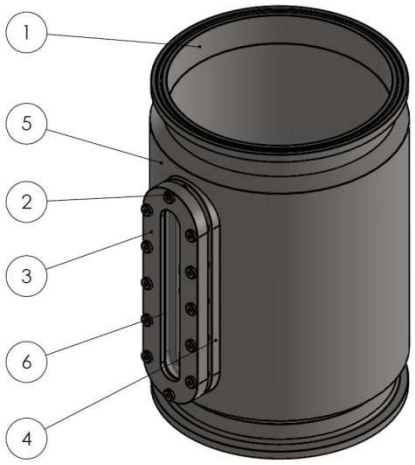


Figure 13: Collector Vessel Viewing Window Shell, Configuration A00

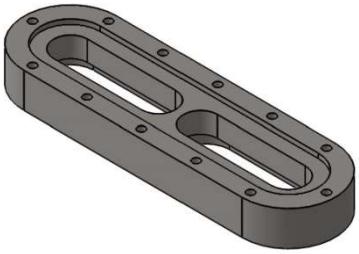


Figure 14: Weld-On Baseplate

A 6.5" long by 2" diameter slot is machined into the side of the pipe which is then reinforced with a 3/4" thick weld-on base plate which is then welded onto the pipe (See Figure 13 and Figure 14). The base plate creates a mounting surface for the sight glass window and clamp. The base plate is welded to the pipe with full penetration welds.

The acrylic sight glass window lens is held in place using a Viton™ gasket and twelve (12) #10-32 socket head capscrews. It is assumed that the point of failure in this assembly would be the acrylic sight glass lens or the capscrews.

The lens analysis can be approximated using a flat rectangular plate analysis. It is assumed that the sight glass distribution plate acts as a fixture to hold the unsupported sight glass window rigidly from the inside of the cutout. Using Roark's 7th Edition, Table 11.4, Case 8a, Rectangular Plate, All Edges Fixed, Uniform Load over Entire Plate, the maximum stress on the sight glass window is calculated:

$$\sigma_{max} = \frac{-\beta_1 q b^2}{t^2}$$

Where:

$$Length\ of\ Plate = a = 5.28\ inches$$

$$Width\ of\ Plate = b = 0.72\ inches$$

$$\frac{a}{b} = \frac{5.3}{0.72} = 7.33$$

Therefore:

$$Uniform\ Pressure = q = 350\ psi$$

$$Plate\ Thickness = t = 0.38\ inches$$

$$\beta_1 = 0.5000$$

$$\sigma_{max} = \frac{-(0.5000)(350)(0.72)^2}{(0.38)^2} = -628\ psi$$

The sight glass window is made of clear acrylic. Clear acrylic is a brittle material with a tensile strength of 10,500 psi. For brittle materials, a safety factor of 5 or more is required:

$$Safety\ Factor = \frac{10500}{628} = 16.7$$

The capscrews or bolts must also be analyzed. It is assumed that the entire gasket is energized. There are twelve (n = 12) #10-32 socket head capscrews used to secure the sight glass distribution plate. The tensile stress area (AS) of #10-32 UNF capscrews is 0.0200 in2. The surface area of the plate must be calculated to determine the load:

$$A_{Plate} = (4.58)(2)(0.63) + \pi(0.63)^2 = 7.0177\ in2$$

Therefore, the load (W) can be calculated:

$$W = qA_{Plate} = (350)(7.0177) = 2456\ lbf$$

$$\sigma_{Avg} = \frac{W}{nA_s} = \frac{2456}{(12)(0.0200)} = 10{,}234\ psi\ per\ capscrew$$

The allowable ASME recommended allowable load per bolt is 1,900 lbf. The average load per bolt is:

$$L_{Bolt} = \sigma_{Avg}A_S = (10234)(0.0200) = 204.7\ lbf$$

Collector Vessel Viewing Window, TES-CV-VW-A01, mMeP-CV-VW-A01

The flange for the Collector Vessel Viewing Window is identical to the Collection Vessel Bottom Cup 6-In analysis performed above. The shell is a 6-in sanitary tube, identical to the Dome Cup Assembly without Sight Glass analyzed above, except that it has a 3 inch weld ferrule in the shell. This weld ferrule is attached using ASME Code compliant welds. The sight glass is connected using a 3" high pressure sanitary clamp (13MHP). The service rating of the 3" high pressure clamp is 1000 psig @ 70°F and 800 psig @ 250°F.

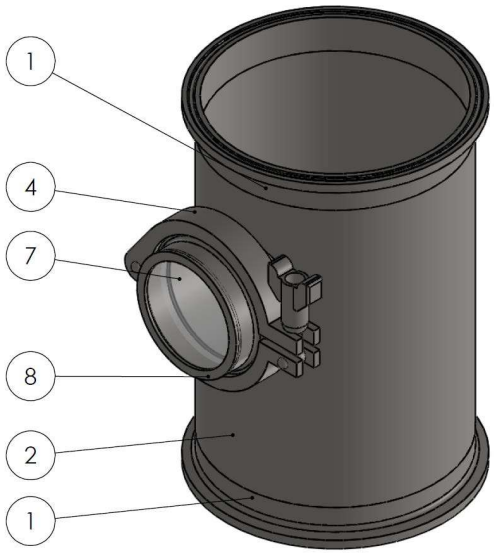


Figure 15: Collector Vessel Viewing Window Shell, Configuration A01

Collector Vessel Summary

The above analysis confirms that the sight glass window and bolts are adequately designed for an operating pressure of 350 psig. Based on this analysis, it is clear that the Collector Vessel is adequately designed and capable of handling a design operating pressure of 350 psig

Since the entire assembly is constructed of stainless steel, the weldment is suitable for use in LP-Gas service.

> ***Observation:*** *The Collector Vessel Dome Cap with Sight Glass detail drawings should be updated to reflect current high pressure sanitary clamp and sight glass part numbers. This discrepancy does not impact the safe operation of this equipment.*

Extended Collector Vessel

The Extended Collector Vessel (Drawing Number Titan-V2-CV-A00) consists of the jacketed central tank, a six inch bottom cup assembly, a collector vessel dome cap with sight glass, and a collector vessel viewing window assembly (see Figure 16). The collector vessel dome cap with sight glass can be supplied in one of three configurations. The extended collector vessel is also referred to as the primary separator vessel.

Component	MeP Drawing
CENTRAL TANK	204575
COLLECTION VESSEL BOTTOM CUP 6-IN	MEP-CV-BC-A00, Rev. A
COLLECTOR VESSEL DOME CAP WITH SG	MEP-CV-TC-SG-A01, Rev. A
COLLECTOR VESSEL DOME CAP WITH SG	MEP-CV-TC-SG-A02, Rev. A
COLLECTOR VESSEL DOME CAP WITH SG	MEP-CV-TC-SG-A03, Rev. A
COLLECTOR VESSEL VIEWING WINDOW	MEP-CV-VW-A01, Rev. A

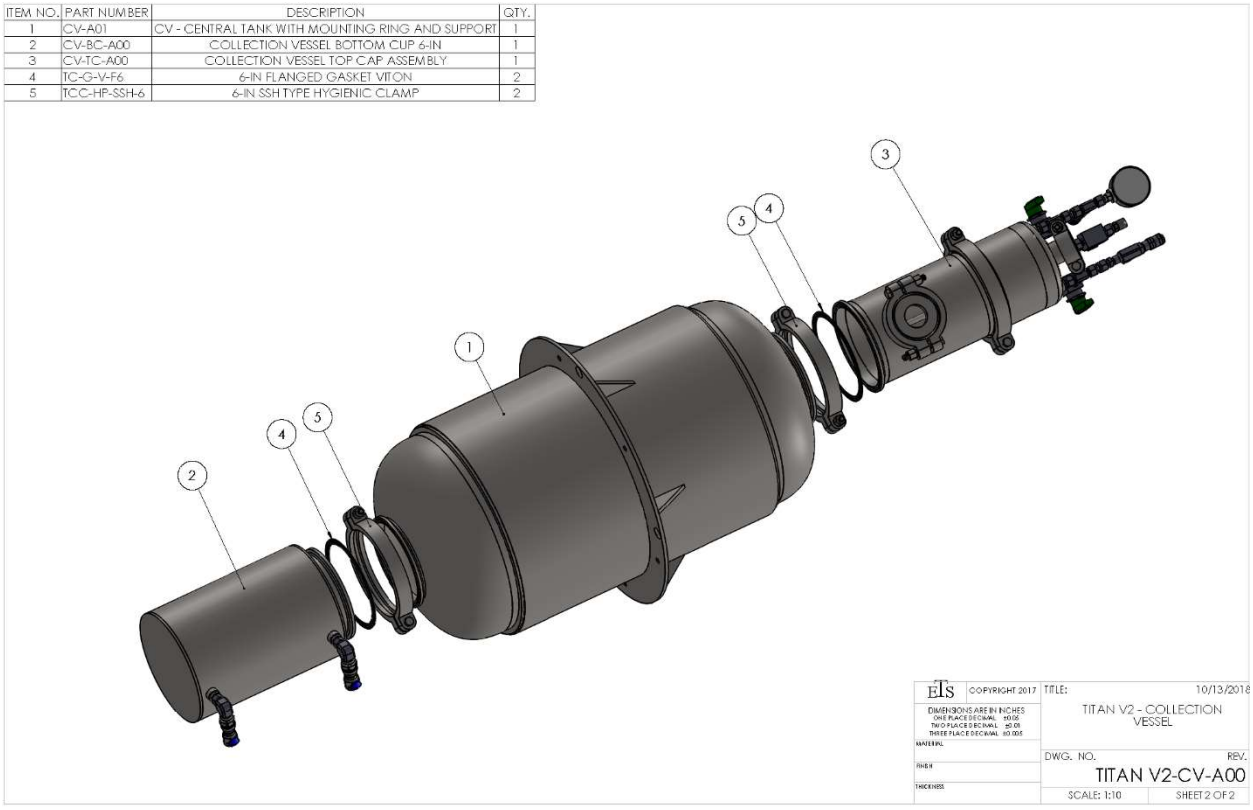


Figure 16: Extended Collector Vessel

Common Components

The Extended Collector Vessel shares these identical components with the Collector Vessel analyzed previously:

- Collector Vessel Bottom Cup 6-in
- Collector Vessel Dome Cap with SG, Configurations A01, A02, or A03
- Collector Vessel Viewing Window, Configuration A01

The Central Tank is connected on one end to the Collection Vessel Bottom Cup 6-In Assembly Weldment using an LJ Star 6" ASME High Pressure clamp. The service rating of the ASME clamp is 406 psig @ 300°F.

The other end of the Central Tank is clamped to the Collector Vessel Viewing Window Assembly using a LJ Star 6" ASME High Pressure clamp.

Central Tank

Manufacturer:	Apache Stainless Equipment Corp. 200 West Industrial Drive Beaver Dam, Wisconsin 53916
Vessel Type:	ASME U
MAWP:	250 psig @ 125°F
Hydrostatic Test Pressure:	325 psig

(

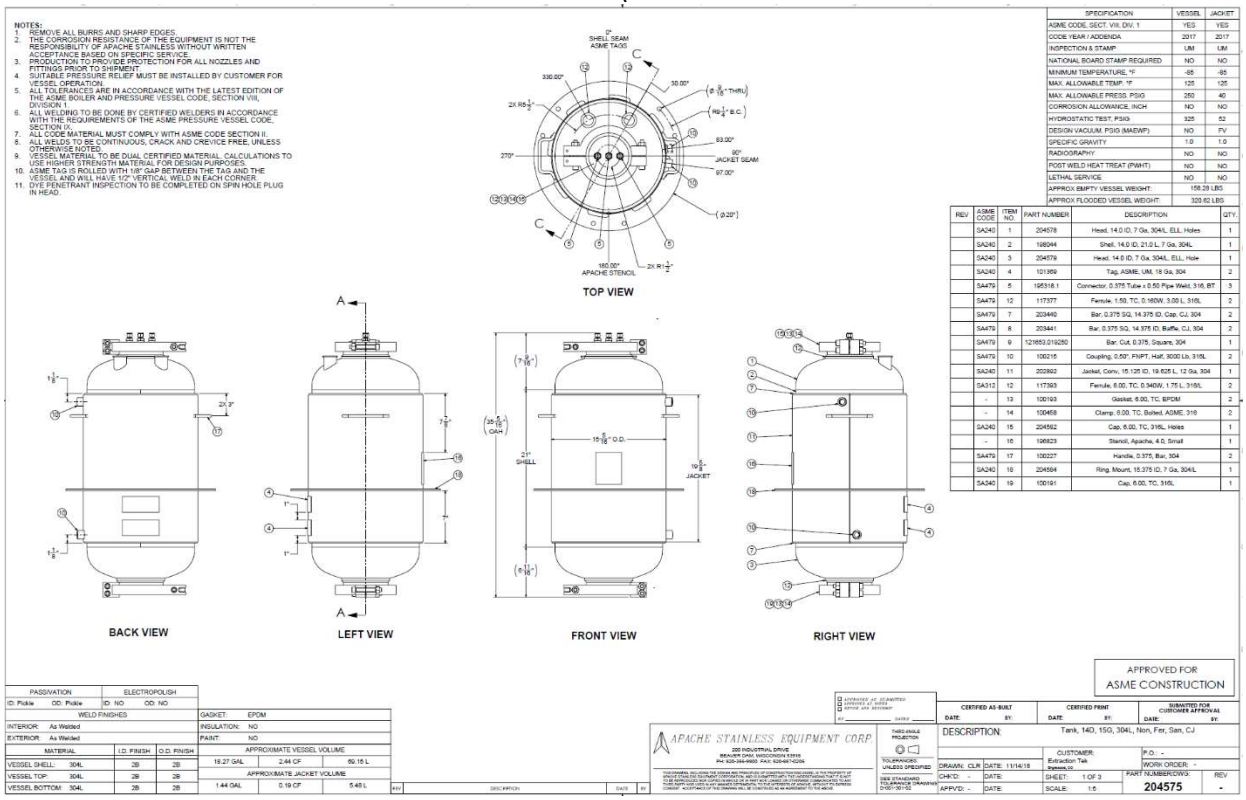


Figure 17: Extended Collector Vessel Central Tank

Vessel	Operating Conditions	Design Pressure	Drawing Number
Central Tank	250 psig @ 125°F	250 psig @ 125°F	204575

The Central Tank jacket is not pressurized and no credit is taken for it in the analysis of the solvent pressure boundary. The material is type 304L (S30403).

The Central Tank is manufactured by Apache Stainless Equipment Corp. The Central Tank is an ASME pressure vessels due to its size. No further analysis is necessary, as the certified Code shop provides the

necessary documentation to their Authorized Inspector and the National Board. For this review, its components may still be analyzed per ASME BPVC.

The shell inner diameter (d) is 14.00 in. The wall thickness is 0.1874 in (7 gauge). The joint efficiency (E) for a full penetration butt weld with no radiographic examination per ASME BPVC Table UW-12 is 0.70. The maximum allowable pressure (P) is calculated per equation (The American Society of Mechanical Engineers, 2017) UG 27 (c) 1:

$$P = \frac{S_1 E t}{\frac{d}{2} + 0.6t}$$

$$P = \frac{(16700)(0.70)(0.1874)}{\frac{14.00}{2} + 0.6(0.1874)} = 308\ psig$$

For the Semi-Elliptical Head, the maximum allowable pressure (P) is calculated per equation (The American Society of Mechanical Engineers, 2017) UG 32 (d) 1:

$$P = \frac{2S_1 E t}{D + 0.2t}$$

$$P = \frac{(2)(16700)(0.7)(0.1874)}{14.00 + 0.2(0.1874)} = 312\ psig$$

Extended Collector Vessel Summary

Based on this analysis, it is clear that the Extended Collector Vessel is adequately designed and capable of handling a design operating pressure of 250 psig

Since the entire assembly is constructed of stainless steel, the weldment is suitable for use in LP-Gas service.

DWax Vessel

The DWax Vessel (Drawing Number MEP-DWX-A00, Rev. A) consists of the jacketed vessel assembly with two (2) dome cup assemblies (see Figure 18).

Component	Drawing, Revision
GOLIATH DE-WAXING VESSEL ASSEMBLY	MEP-DWX-JV-A00, Rev. A
DWAX DOME CUP PORTED 3-IN	MEP-DWX-DCP-A00, Rev. A

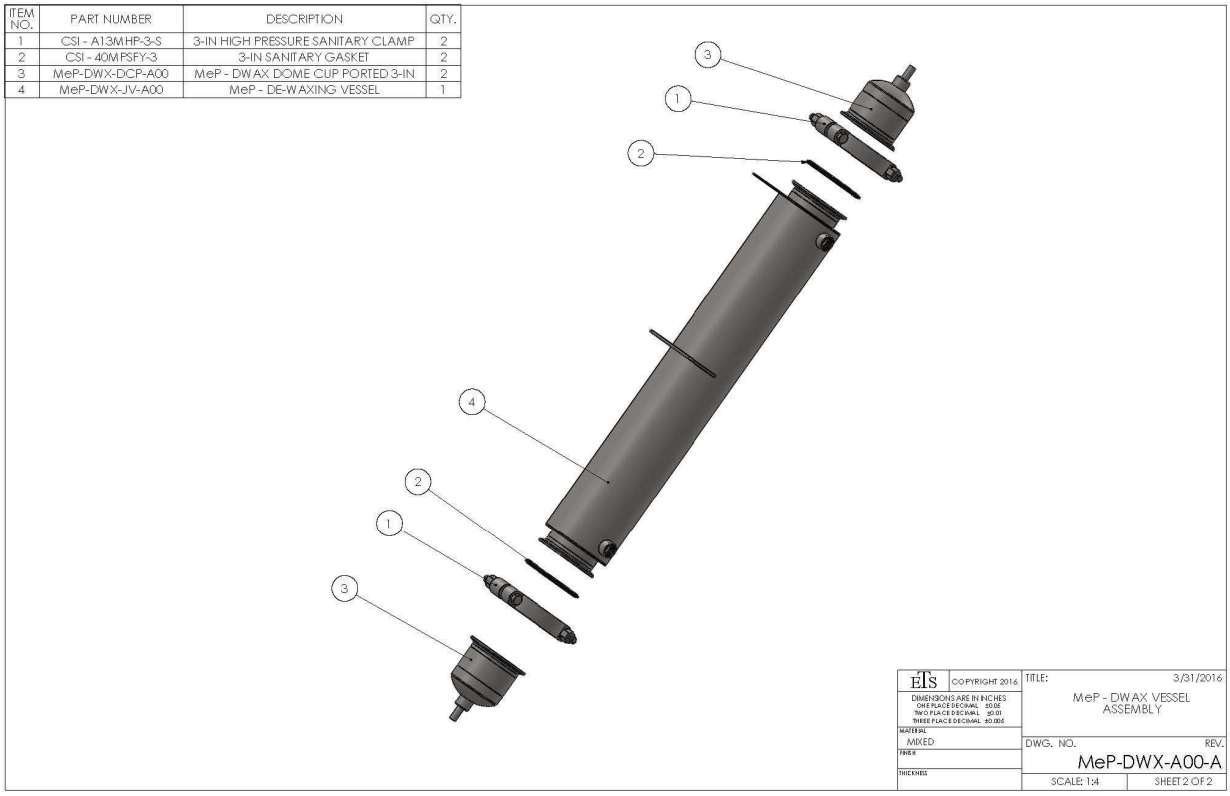


Figure 18: DWax Vessel

Goliath De-Waxing Vessel Analysis, MEP-DWX-JV-A00

The heat transfer jacket is not pressurized and no credit is taken for it in the analysis of the solvent pressure boundary.

Though the Goliath De-Waxing Vessel is not considered ASME pressure vessel due to its size, its components may still be analyzed per ASME BPVC.

The shell inner diameter (d) is 2.870 in. The joint efficiency (E) for a full penetration butt weld with no radiographic examination per ASME BPVC Table UW-12 is 0.70. The maximum allowable pressure (P) is calculated per equation (The American Society of Mechanical Engineers, 2017) UG 27 (c) 1:

$$P = \frac{S_1 E t}{\frac{d}{2} + 0.6t}$$

$$P = \frac{(19700)(0.70)(0.065)}{\frac{2.870}{2} + 0.6(0.065)} = 608\ psig$$

The Goliath De-Waxing Vessel is connected on either end to the DWax Dome Cup Ported 3-In heads using 3" high pressure sanitary clamps (A13MHP). The service rating of the 3" high pressure clamp is 1000 psig @ 100°F and 800 psig @ 250°F.

DWax Dome Cup Ported 3-In, MEP-DWX-DCP-A00

The cylinder and flange for the DWax Dome Cup Ported 3-in is identical to the Goliath De-Waxing Vessel analysis performed above.

The cylinder is welded to a commercial sanitary tube end cap (16W-3). These end caps have pressure ratings at least as high as the cylinder and can be approximated to be semi-ellipsoidal heads. The maximum allowable pressure (P) for a semi-ellipsoidal head is calculated per equation (The American Society of Mechanical Engineers, 2017) UG 32 (d) 1:

$$P = \frac{2S_1 E t}{D + 0.2t}$$

$$P = \frac{(2)(19700)(0.70)(0.065)}{2.870 + 0.2(0.065)} = 622\ psig$$

DWax Vessel Summary

Based on this analysis, it is clear that the Dwax Vessel is adequately designed and capable of handling a design operating pressure of 350 psig.

Since the entire assembly is constructed of stainless steel, the weldment is suitable for use in LP-Gas service.

Expansion Filter

The Expansion Filter (Drawing Number MEP-EF-A00, Rev. A & mMeP-EF-A00, Rev. A) consists of the jacketed vessel assembly with dome cup assembly and a modified commercial flat head (see Figure 19). The Expansion Filter is also referred to as the secondary or tertiary separator.

Component	MEP Drawing	mMEP Drawing
EXPANSION FILTER VESSEL 3-IN	MEP-EF-JV-A00, Rev. A	mMeP-EF-JV-A00, Rev. A
EXPANSION FILTER DOME CUP 3-IN	MEP-EF-DC-A00, Rev. A	mMeP-EF-DC-A00, Rev. A
EXPANSION FILTER TOP CAP	MEP-EF-TC-A00, Rev. A	mMeP-EF-TC-A00, Rev. A

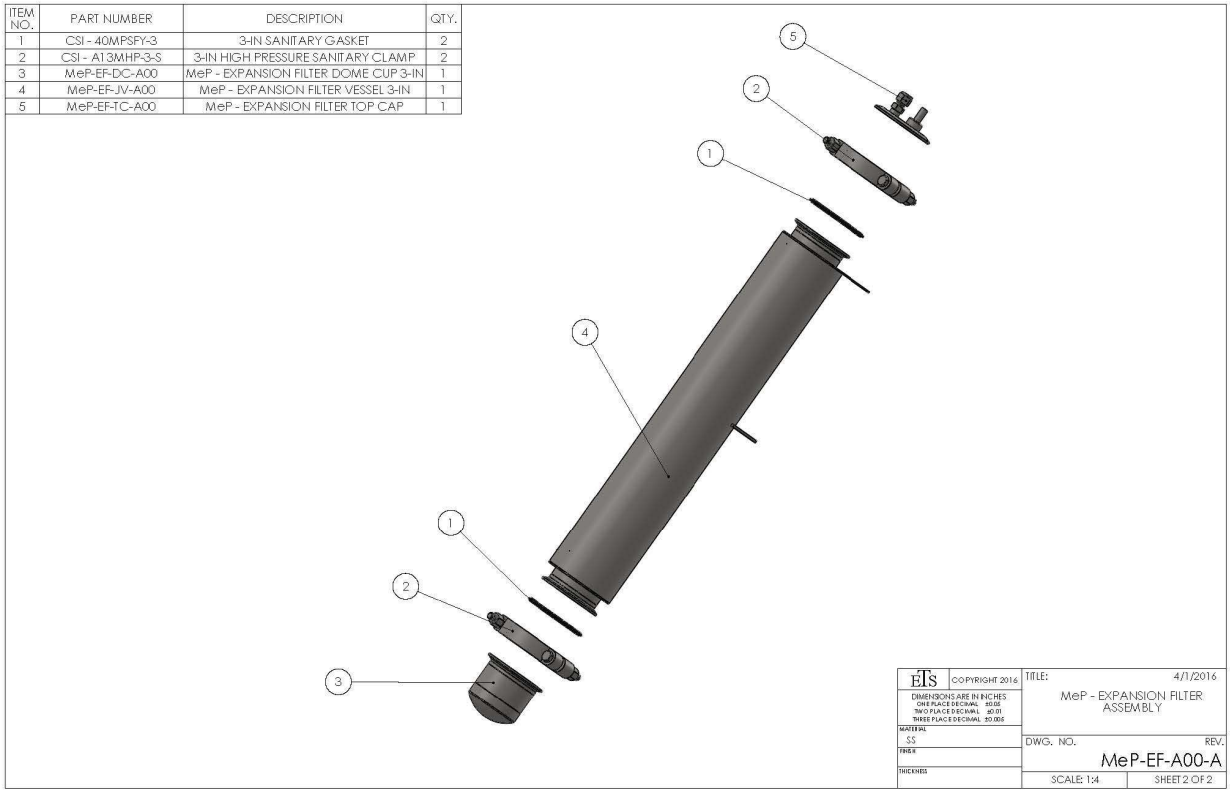


Figure 19: Expansion Filter

Expansion Filter Vessel 3-in, MEP-EF-JV-A00, mMeP-EF-JV-A00

The heat transfer jacket is not pressurized and no credit is taken for it in the analysis of the solvent pressure boundary.

Though the Expansion Filter Vessel is not considered ASME pressure vessel due to its size, its components may still be analyzed per ASME BPVC.

The shell inner diameter (d) is 2.870 in. The joint efficiency (E) for a full penetration butt weld with no radiographic examination per ASME BPVC Table UW-12 is 0.70. The maximum allowable pressure (P) is calculated per equation (The American Society of Mechanical Engineers, 2017) UG 27 (c) 1:

$$P = \frac{S_1 E t}{\frac{d}{2} + 0.6t}$$

$$P = \frac{(19700)(0.70)(0.065)}{\frac{2.870}{2} + 0.6(0.065)} = 608\ psig$$

The Expansion Filter Vessel is connected on either end to the heads using 3" high pressure sanitary clamps (13MHP). The service rating of the 3" high pressure clamp is 1000 psig @ 70°F and 800 psig @ 250°F.

Expansion Filter Dome Cup 3-in, MEP-EF-DC-A00, mMeP-EF-DC-A00

The cylinder and flange for the Expansion Filter Dome Cup 3-in is identical to the Expansion Filter Vessel analysis performed above.

The cylinder is welded to a commercial sanitary tube end cap (16W-3). These end caps have pressure ratings at least as high as the cylinder and can be approximated to be semi-ellipsoidal heads. The maximum allowable pressure (P) for a semi-ellipsoidal head is calculated per equation (The American Society of Mechanical Engineers, 2017) UG 32 (d) 1:

$$P = \frac{2 S_1 E t}{D + 0.2t}$$

$$P = \frac{(2)(19700)(0.70)(0.065)}{2.870 + 0.2(0.065)} = 622\ psig$$

Expansion Filter Top Cap, MEP-EF-TC-A00, mMeP-EF-TC-A00

The Expansion Filter Top Cap is a modified commercial sanitary tube end cap (16AMP-3). These end caps have pressure ratings at least as high as the cylinder and can be approximated to be a flat head. While the Expansion Filter is not considered a pressure vessel as defined by ASME BPVC, the most appropriate head analysis is ASME BPVC UG-34 (c).

The end cap is a 0.25" thick flat plate. For the purpose of the plate analysis, it is assumed that the cover attachment factor (C) is per UG-34 (f) or C=0.20. For the allowable stress (S_1) of 19.7 ksi, a cover plate thickness (t) of 0.250 inches, with an inner diameter (d) of 2.870 inches, joint efficiency (E) for a solid plate of 1.0, the maximum allowable pressure (P) for the flat plate is calculated per equation (The American Society of Mechanical Engineers, 2017) UG 34 (c) 2:

$$P = \frac{t^2 S_1 E}{d^2 C}$$

$$P = \frac{(0.250)^2(19700)(1.0)}{(2.870)^2(0.20)} = 747\ psig$$

Expansion Filter Vessel Summary

Based on this analysis, it is clear that the Expansion Filter Vessel is adequately designed and capable of handling a design operating pressure of 350 psig.

Since the entire assembly is constructed of stainless steel, the weldment is suitable for use in LP-Gas service.

Shatter Bowls

Manufacturer: Various
Vessel Type: Non-ASME
Design Pressure: 350 psig @ 100°F
Hydrostatic Test Pressure Unknown

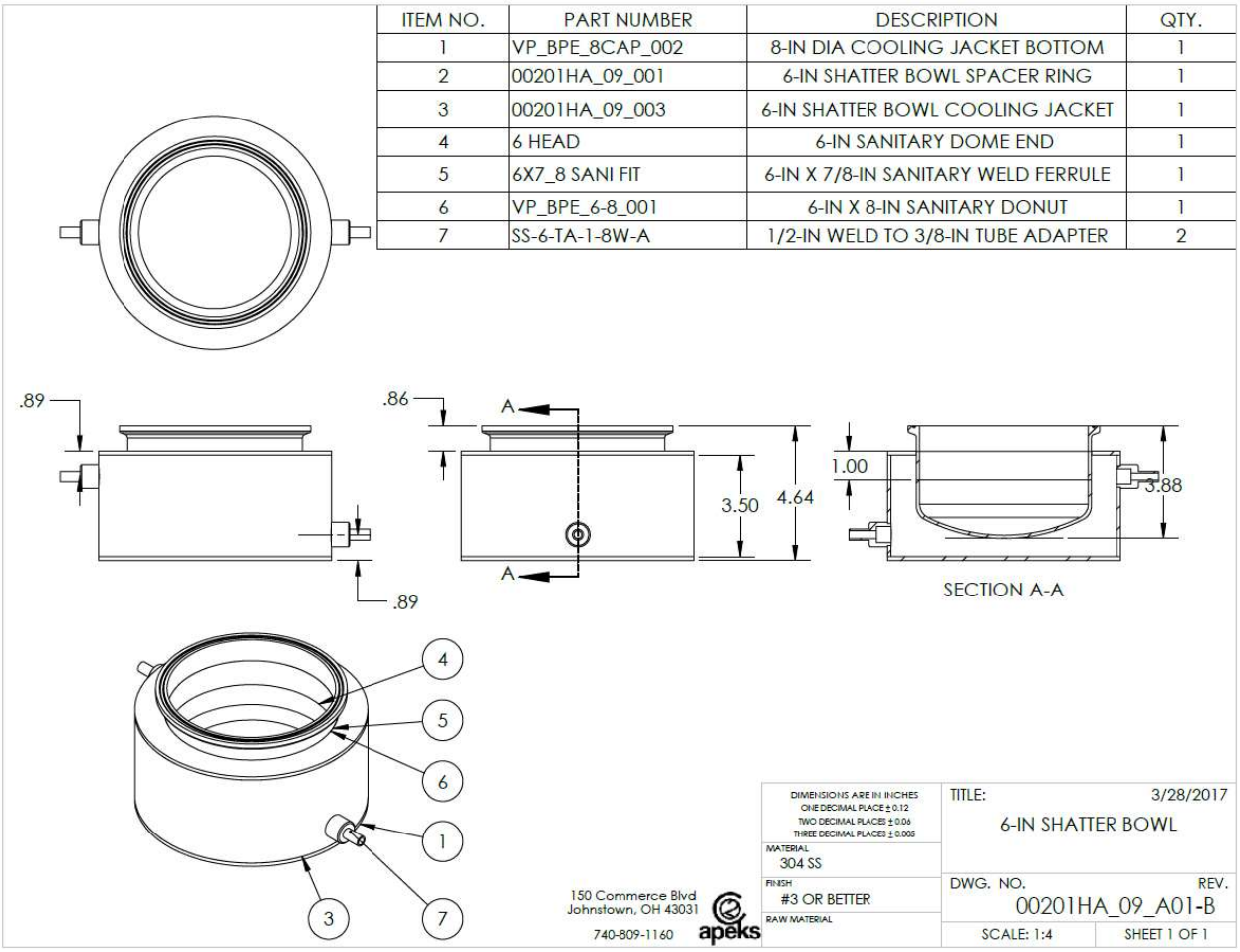


Figure 20: Typical 6-in Shatter Bowl

Vessel	Operating Conditions	Design Pressure	Drawing Number
6-in Shatter Bowl	250 psig @ 125°F	350 psig @ 125°F	00201HA_09_A01-B
6-in Shatter Bowl w/ Drain	250 psig @ 125°F	350 psig @ 125°F	00201HA_09_A02-A

The Shatter Bowls are manufactured by various ExtractionTek Solutions approved manufacturers. The analysis of the Shatter Bowls is identical to the Collection Vessel Bottom Cup 6-In (drawings MEP-CV-BC-

A00, mMeP-CV-BC-A00) performed elsewhere in this report. Based on the analysis, it is clear that the Shatter Bowls are adequately designed and capable of handling a maximum pressure of 350 psig.

Sintered Filter Housing (Optional)

Manufacturer:	Various
Vessel Type:	Non-ASME
Design Pressure:	350 psig @ 100°F
Hydrostatic Test Pressure	Unknown

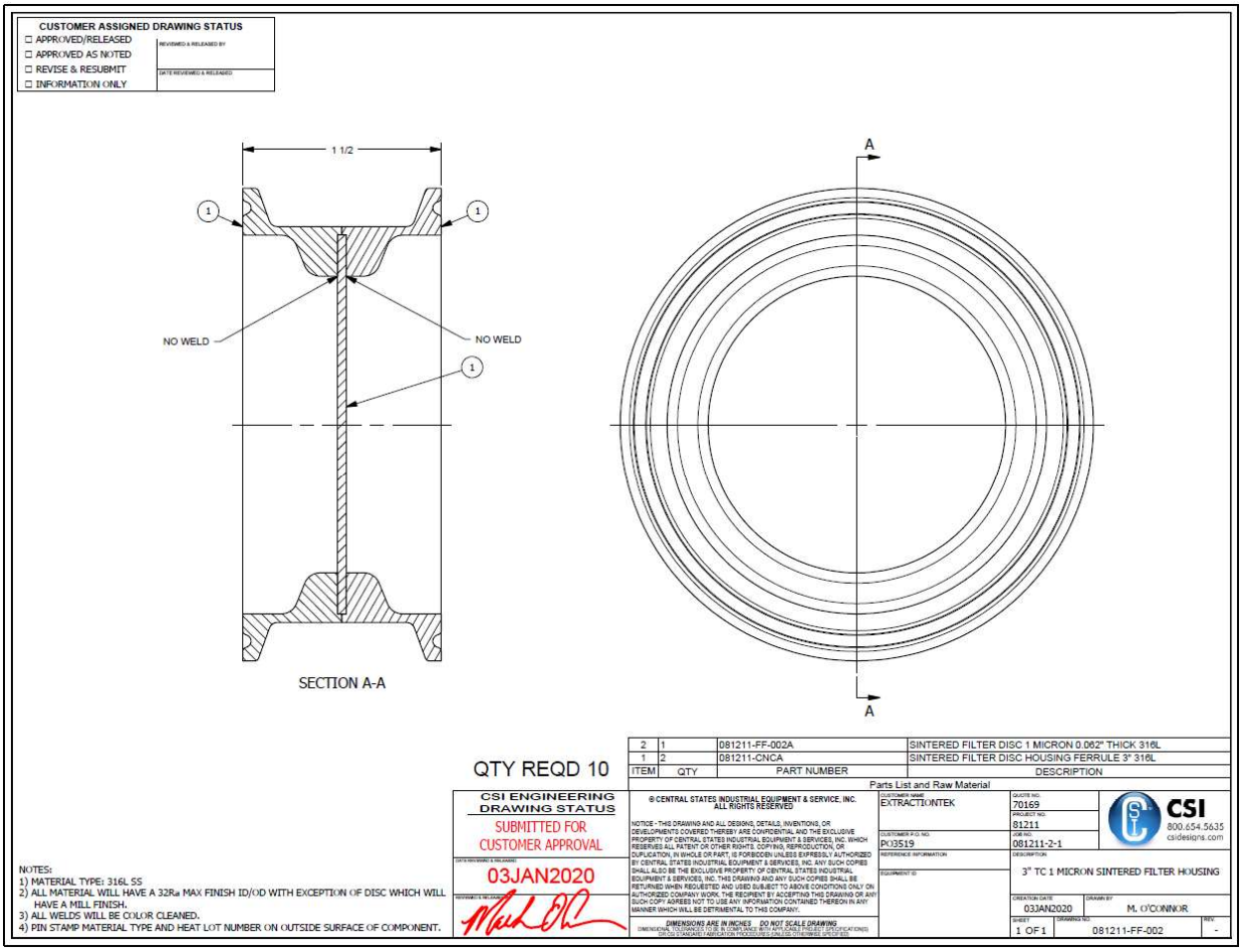


Figure 21: Sintered Filter Housing (Optional)

Vessel	Operating Conditions	Design Pressure	Drawing Number
Sintered Filter Housing (Optional)	250 psig @ 125°F	350 psig @ 125°F	081211-FF-002

The Sintered Filter Housing (Optional) is manufactured by various ExtractionTek Solutions approved manufacturers. The analysis of the Sintered Filter Housing (Optional) is identical to the Collection Vessel Bottom Cup 6-In (drawings MEP-CV-BC-A00, mMeP-CV-BC-A00) performed elsewhere in this report.

Based on the analysis, it is clear that the Sintered Filter Housing (Optional) is adequately designed and capable of handling a maximum pressure of 350 psig.

Sintered 6-in Filter (Optional)

Manufacturer:	Various
Vessel Type:	Non-ASME
Design Pressure:	350 psig @ 100°F
Hydrostatic Test Pressure	Unknown

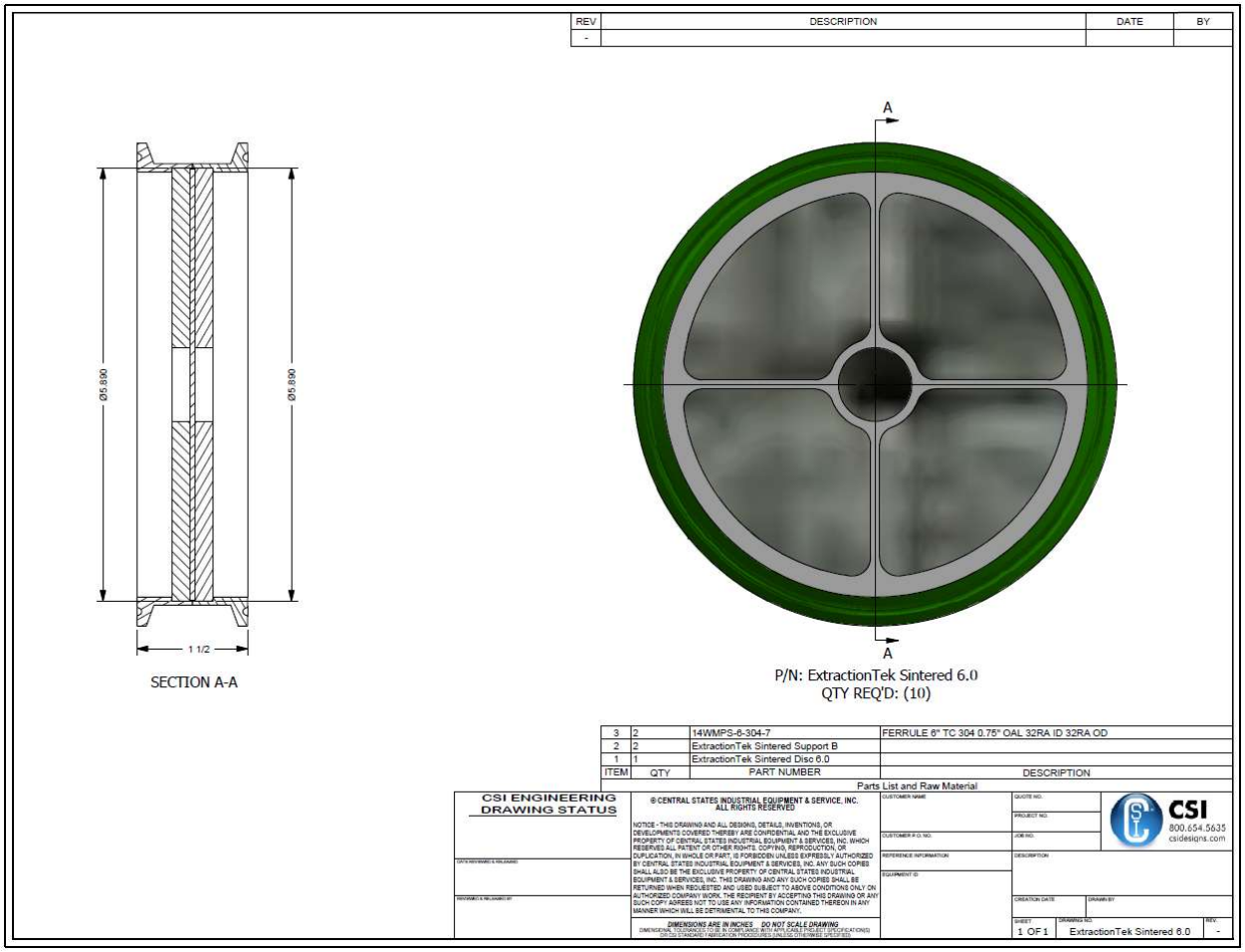


Figure 22: Sintered 6-in Filter (Optional)

Vessel	Operating Conditions	Design Pressure	Drawing Number
Sintered 6-in Filter (Optional)	250 psig @ 125°F	350 psig @ 125°F	ExtractionTek Sintered 6.0

The Sintered 6-in Filter (Optional) is manufactured by various ExtractionTek Solutions approved manufacturers. The analysis of the Sintered Filter Housing (Optional) is identical to the Collection Vessel Bottom Cup 6-In (drawings MEP-CV-BC-A00, mMeP-CV-BC-A00) performed elsewhere in this report.

Based on the analysis, it is clear that the S Sintered 6-in Filter (Optional) is adequately designed and capable of handling a maximum pressure of 350 psig.

6-in Dome Cup SG (Optional)

Manufacturer:	Various
Vessel Type:	Non-ASME
Design Pressure:	350 psig @ 100°F
Hydrostatic Test Pressure	Unknown

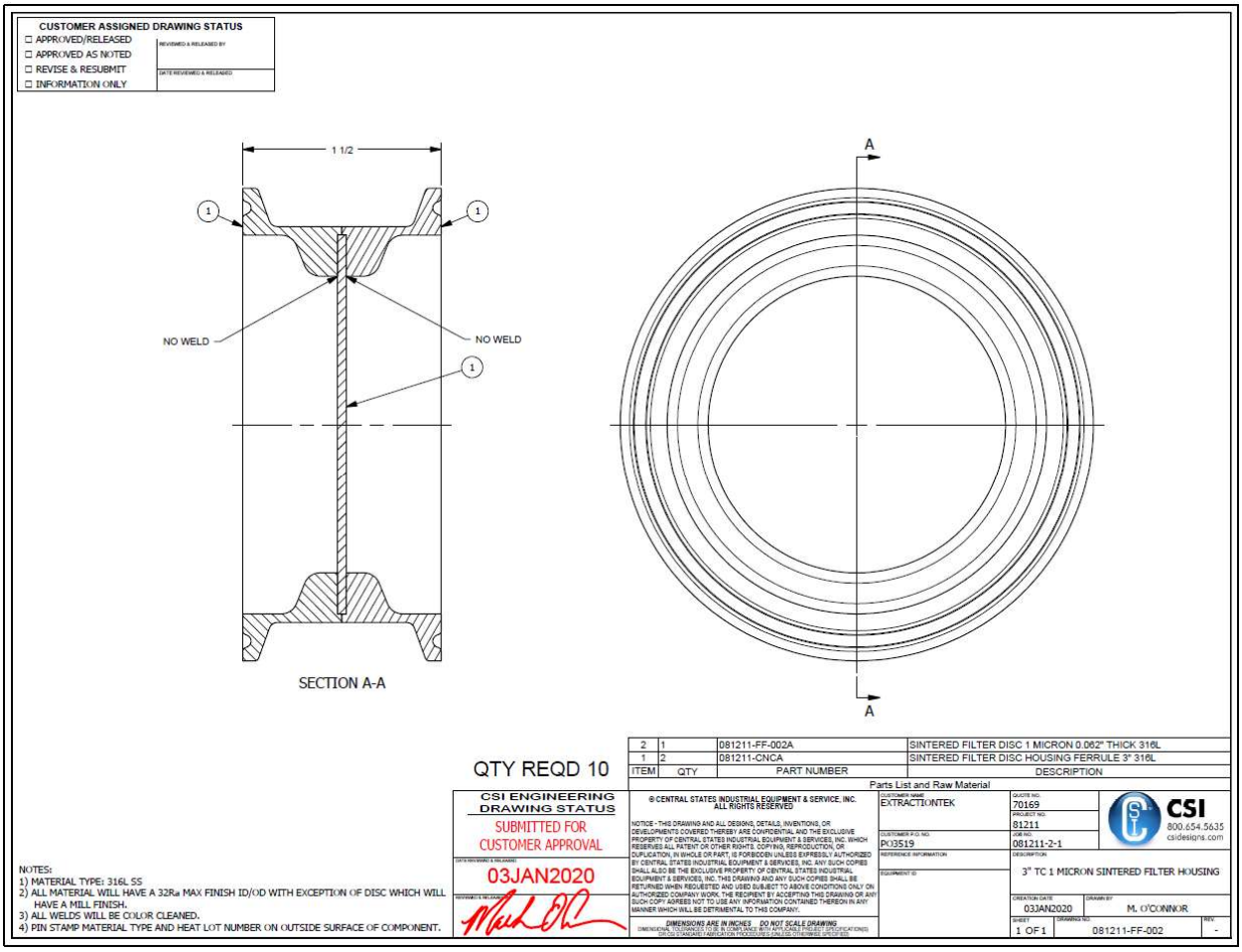


Figure 23: 6-in Dome Cup SG (Optional)

Vessel	Operating Conditions	Design Pressure	Drawing Number
6-in Dome Cup SG (Optional)	250 psig @ 125°F	350 psig @ 125°F	MP-EV-DC-SG-A02, Rev. E

The 6-in Dome Cup SG (Optional) is manufactured by various ExtractionTek Solutions approved manufacturers. The analysis of the Sintered Filter Housing (Optional) is identical to the Collection Vessel Bottom Cup 6-In (drawings MEP-CV-BC-A00, mMeP-CV-BC-A00) performed elsewhere in this report.

Based on the analysis, it is clear that the 6-in Dome Cup SG (Optional) is adequately designed and capable of handling a maximum pressure of 350 psig.

30 Liter Operating Tank (Option 1)

The 30 liter Operating Tank (Drawing Number 1605240-01-01-01, Rev. A) consists of a vessel shell welded to commercial pipe cap heads (see Figure 24). The top head has a sanitary fitting nozzle, which is capped with a modified commercial sanitary cap. The operating tank is also called the "Storage Vessel." The tank is an ASME pressure vessel fabricated by Paul Mueller Company.

This 30 liter operating tank is an optional component of the MeP-HCU/C & mMeP.

Component	**Drawing, Revision**
30-LITER MODEL F STORAGE VESSEL TOP CAP ASSEMBLY	1605240-01-01-01, Rev. A MEP-SV-A01, Rev. A

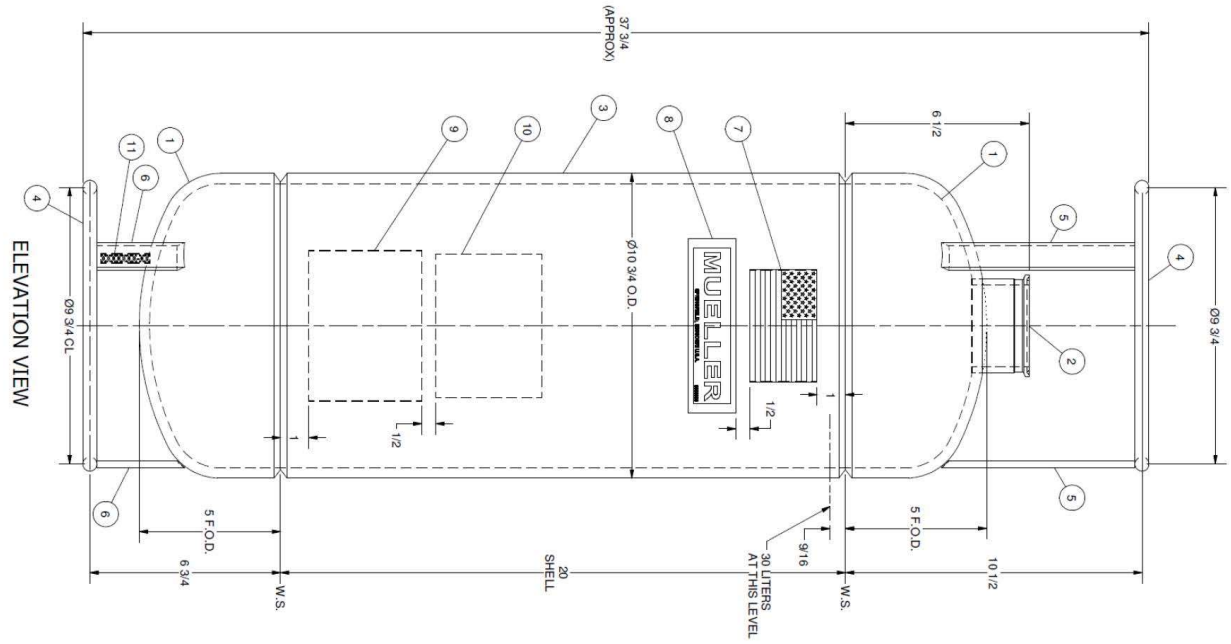


Figure 24: Operating Tank

30 Liter Operating Tank Shell

The operating tank is an ASME pressure vessel and is so stamped. No further analysis is necessary, as the certified Code shop provides the necessary documentation to their Authorized Inspector and the National Board. For this review, its components may still be analyzed per ASME BPVC.

For a 10-inch Schedule 40 pipe, the shell inner diameter (d) is 10.020 in. The joint efficiency (E) for a full penetration butt weld with no radiographic examination per ASME BPVC Table UW-12 is 0.70. The

maximum allowable pressure (P) is calculated per equation (The American Society of Mechanical Engineers, 2017) UG 27 (c) 1:

$$P = \frac{S_1 E t}{\frac{d}{2} + 0.6t}$$

$$P = \frac{(19700)(0.70)(0.365)}{\frac{10.020}{2} + 0.6(0.365)} = 963\ psig$$

The operating tank is connected on one end to the cap using a 3" high pressure sanitary clamp (13MHP). The service rating of the 3" high pressure clamp is 1000 psig @ 70°F and 800 psig @ 250°F.

30 Liter Operating Tank Heads

The operating tank shell is welded to commercial pipe end caps (Schedule 40). These end caps have pressure ratings at least as high as the cylinder and can be approximated to be semi-ellipsoidal heads. The maximum allowable pressure (P) for a semi-ellipsoidal head is calculated per equation (The American Society of Mechanical Engineers, 2017) UG 32 (d) 1:

$$P = \frac{2S_1 E t}{D + 0.2t}$$

$$P = \frac{(2)(19700)(0.70)(0.365)}{10.020 + 0.2(0.365)} = 997\ psig$$

Storage Vessel Top Cap Assembly, MEP-SV-A01

The Storage Vessel Top Cap is a modified 3-inch commercial sanitary tube end cap (16AMP-3). These end caps have pressure ratings at least as high as the cylinder and can be approximated to be a flat head. The most appropriate head analysis is ASME BPVC UG-34 (c).

The end cap is a 0.25" thick flat plate. For the purpose of the plate analysis, it is assumed that the cover attachment factor (C) is per UG-34 (f) or C=0.20. For the allowable stress (S_1) of 19.7 ksi, a cover plate thickness (t) of 0.250 inches, with an inner diameter (d) of 2.870 inches, joint efficiency (E) for a solid plate of 1.0, the maximum allowable pressure (P) for the flat plate is calculated per equation (The American Society of Mechanical Engineers, 2017) UG 34 (c) 2:

$$P = \frac{t^2 S_1 E}{d^2 C}$$

$$P = \frac{(0.250)^2(19700)(1.0)}{(2.870)^2(0.20)} = 747\ psig$$

30 Liter Operating Tank Summary

Based on this analysis, it is clear that the 30 Liter Operating Tank is adequately designed and capable of handling a design operating pressure of 350 psig.

Since the entire assembly is constructed of stainless steel, the weldment is suitable for use in LP-Gas service.

Operating Tank (Option 2)

Manufacturer:	Apache Stainless Equipment Corp. 200 West Industrial Drive Beaver Dam, Wisconsin 53916
Vessel Type:	ASME UM
MAWP:	250 psig @ 125°F
Hydrostatic Test Pressure:	325 psig

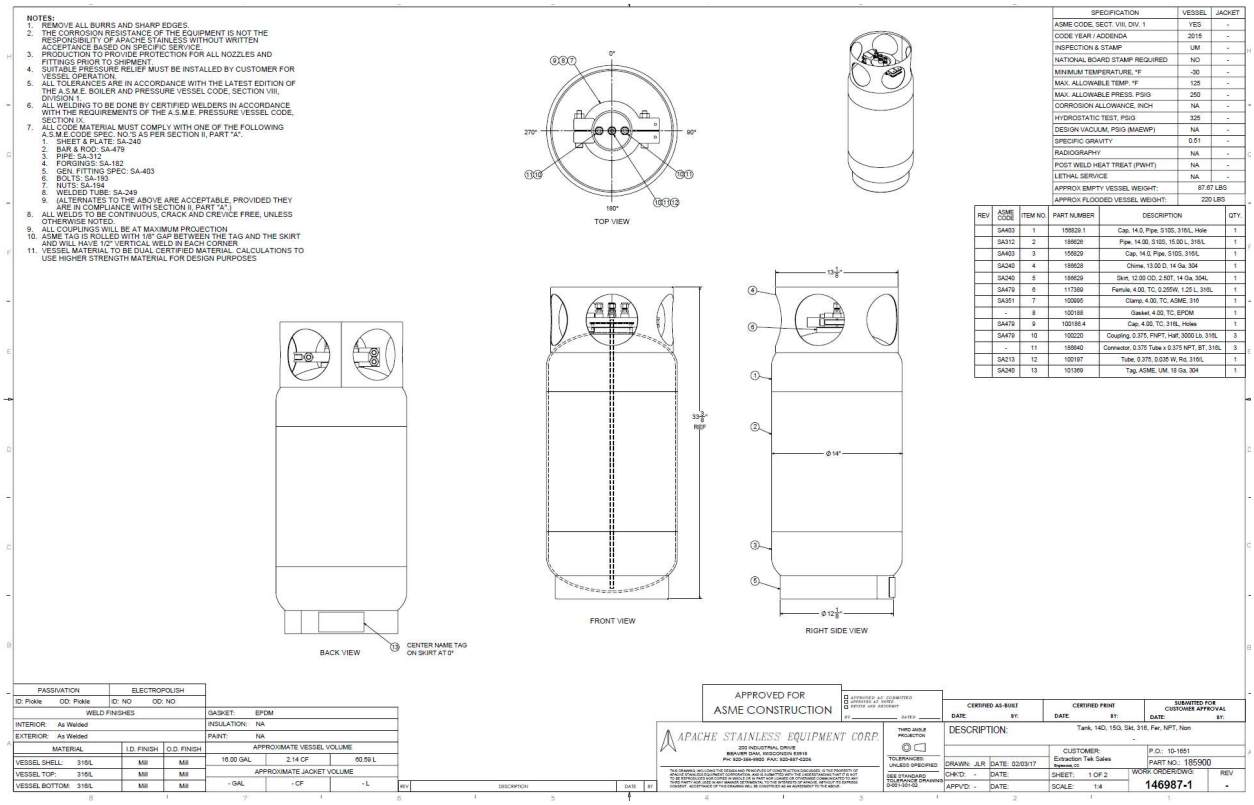


Figure 25: Drawing 146987-1

Vessel	Operating Conditions	Design Pressure	Drawing Number
Operating Tank (Option 2)	250 psig @ 125°F	250 psig @ 125°F	146987-1

The Operating Tank is manufactured by Apache Stainless Equipment Corp. The vessel shell has an inner diameter of 13.624 inches and a nominal wall thickness of 0.188 inches (14" SCH 10S Pipe). Due to its size, this vessel does meet the scope of the *ASME Boiler and Pressure Vessel Code*. The service conditions are 250 psig @ 125°F. The vessel material is 316L stainless steel (UNS: S31603).

Analyzing the Operating Tank shell as a pressure vessel per ASME BPVC Section VIII UG 27, with an inner diameter (d) of 13.624 inches, a wall thickness (t) of 0.188", and a joint efficiency (E) for a full

penetration butt weld with no radiographic examination per ASME BPVC Table UW-12 of 0.70, the maximum allowable pressure (P) is calculated per equation (The American Society of Mechanical Engineers, 2017) UG 27 (c) 1:

$$P = \frac{S_1 E t}{\frac{d}{2} + 0.6t}$$

$$P = \frac{(16700)(0.70)(0.188)}{\frac{13.624}{2} + 0.6(0.188)} = 317\ psig$$

For the Semi-Elliptical Head, the maximum allowable pressure (P) is calculated per equation (The American Society of Mechanical Engineers, 2017) UG 32 (d) 1:

$$P = \frac{2S_1 E t}{D + 0.2t}$$

$$P = \frac{(2)(16700)(0.7)(0.188)}{13.624 + 0.2(0.188)} = 322\ psig$$

Based on this analysis, it is clear that the Operating Tank is adequately designed and capable of handling a maximum pressure of 250 psig.

55-Liter Operating Tank (Option 3)

Manufacturer:	Apache Stainless Equipment Corp. 200 West Industrial Drive Beaver Dam, Wisconsin 53916
Vessel Type:	ASME UM
MAWP:	250 psig @ 125°F
Hydrostatic Test Pressure:	325 psig

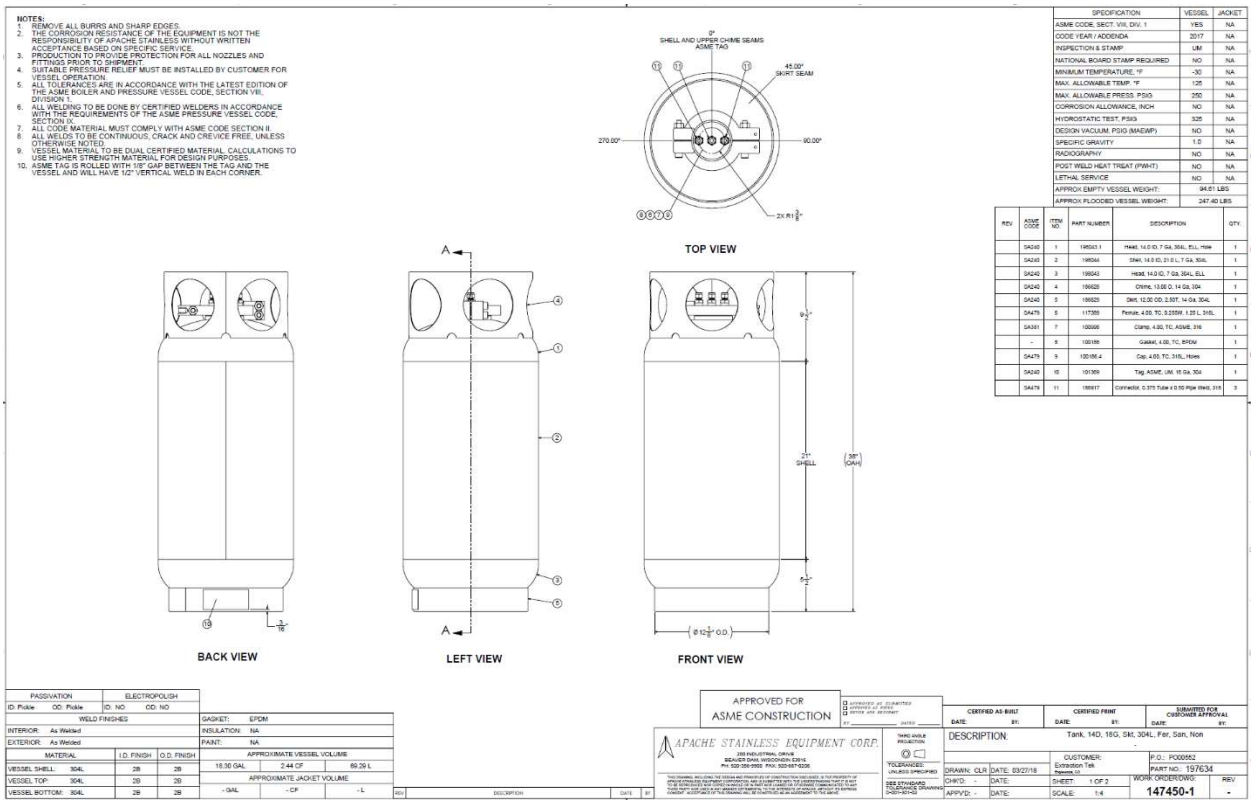


Figure 26: Drawing 147450-1

Vessel	Operating Conditions	Design Pressure	Drawing Number
55-L Operating Tank (Option 3)	250 psig @ 125°F	250 psig @ 125°F	147450-1

The 55 Liter Operating Tank is manufactured by Apache Stainless Equipment Corp. The vessel shell has an inner diameter of 14.00 inches and a nominal wall thickness of 0.1874 inches (7 gauge). Due to its size, this vessel does meet the scope of the *ASME Boiler and Pressure Vessel Code*. The service conditions are 250 psig @ 125°F. The vessel material is 304L stainless steel (UNS: S30403).

The 55 Liter Operating Tank is available with or without two sanitary fitting sight glasses installed on the top semi-elliptical head.

Analyzing the 55 Liter Operating Tank shell as a pressure vessel per ASME BPVC Section VIII UG 27, with an inner diameter (d) of 14.00 inches, a wall thickness (t) of 0.1874 inch, and a joint efficiency (E) for a full penetration butt weld with no radiographic examination per ASME BPVC Table UW-12 of 0.70, the maximum allowable pressure (P) is calculated per equation (The American Society of Mechanical Engineers, 2017) UG 27 (c) 1:

$$P = \frac{S_1 E t}{\frac{d}{2} + 0.6t}$$

$$P = \frac{(16700)(0.70)(0.1874)}{\frac{14.00}{2} + 0.6(0.1874)} = 308\ psig$$

For the Semi-Elliptical Head, the maximum allowable pressure (P) is calculated per equation (The American Society of Mechanical Engineers, 2017) UG 32 (d) 1:

$$P = \frac{2S_1 E t}{D + 0.2t}$$

$$P = \frac{(2)(16700)(0.7)(0.1874)}{14.00 + 0.2(0.1874)} = 312\ psig$$

Based on this analysis, it is clear that the 55 Liter Operating Tank is adequately designed and capable of handling a maximum pressure of 250 psig.

55-Liter Jacketed Operating Tank (Option 4)

Manufacturer:	Apache Stainless Equipment Corp. 200 West Industrial Drive Beaver Dam, Wisconsin 53916
Vessel Type:	ASME UM
MAWP:	250 psig @ 125°F
Hydrostatic Test Pressure:	325 psig

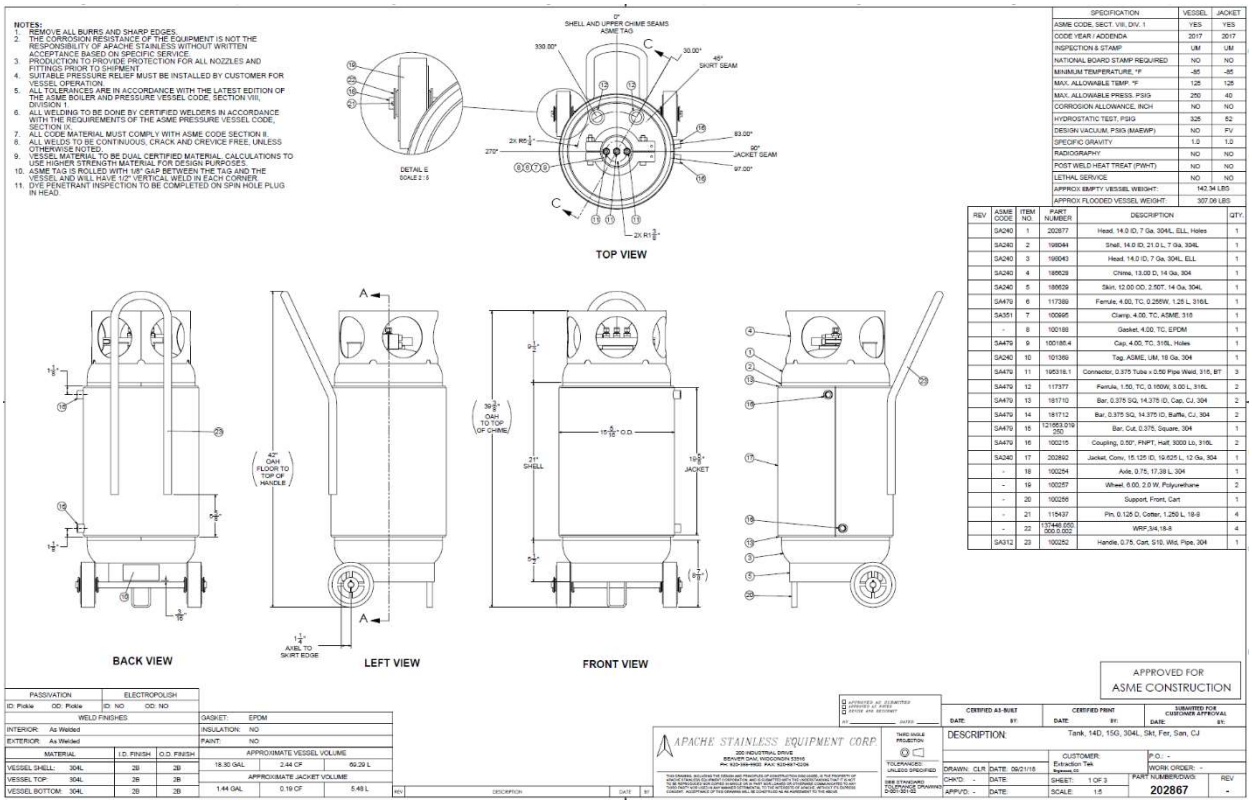


Figure 27: Drawing 202867

Vessel	Operating Conditions	Design Pressure	Drawing Number
55-L Jacketed Operating Tank (Option 4)	250 psig @ 125°F	250 psig @ 125°F	202867

The 55 Liter Jacketed Operating Tank is manufactured by Apache Stainless Equipment Corp. The jacket is not pressurized and no credit is taken for it in the analysis of the solvent pressure boundary. The vessel shell has an inner diameter of 14.00 inches and a nominal wall thickness of 0.1874 inches (7 gauge). Due to its size, this vessel does meet the scope of the *ASME Boiler and Pressure Vessel Code*. The service conditions are 250 psig @ 125°F. The vessel material is 304L stainless steel (UNS: S30403).

Analyzing the 55 Liter Jacketed Operating Tank shell as a pressure vessel per ASME BPVC Section VIII UG 27, with an inner diameter (d) of 14.00 inches, a wall thickness (t) of 0.1874 inch, and a joint efficiency (E) for a full penetration butt weld with no radiographic examination per ASME BPVC Table UW-12 of 0.70, the maximum allowable pressure (P) is calculated per equation (The American Society of Mechanical Engineers, 2017) UG 27 (c) 1:

$$P = \frac{S_1 E t}{\frac{d}{2} + 0.6t}$$

$$P = \frac{(16700)(0.70)(0.1874)}{\frac{14.00}{2} + 0.6(0.1874)} = 308\ psig$$

For the Semi-Elliptical Head, the maximum allowable pressure (P) is calculated per equation (The American Society of Mechanical Engineers, 2017) UG 32 (d) 1:

$$P = \frac{2S_1 E t}{D + 0.2t}$$

$$P = \frac{(2)(16700)(0.7)(0.1874)}{14.00 + 0.2(0.1874)} = 312\ psig$$

Based on this analysis, it is clear that the 55 Liter Jacketed Operating Tank is adequately designed and capable of handling a maximum pressure of 250 psig.

ASME Pressure Relief Device Analysis

The minimum rate of discharge of pressure relief valves installed in ASME containers shall be in accordance with Table 5.9.2.6 or shall be calculated using the following formula:

$$F = 53.632A^{0.82}$$

Where "A" is the surface area of the tank. The calculation results below are based upon conservative approximations of surface area for all ASME containers.

Vessel	**Approximate Surface Area (ft^2)**	**Required Flow (SCFM)**	**PRV**	**PRV Flow (SFCM)**
Extended Collector Vessel	16.7	540	Conrader SRV530-1/2-SS-V-250	940
30L Operating Tank (Option 1)	8.9	323	Conrader SRV390-1/2-SS-V-250	450
Operating Tank (Option 2)	9.5	338	Conrader SRV390-1/2-SS-V-250	450
55 Liter Operating Tank (Option 3)	11.9	409	Conrader SRV390-1/2-SS-V-250	450
55 Liter Jacketed Operating Tank (Option 4)	11.9	409	Conrader SRV390-1/2-SS-V-250	450

Thermal Analysis

The OEM states that the equipment operates between -30°F[3] and 125°F (-22°C and 52°C). This is accomplished by using closed loop recirculating chillers and heaters (see Component Compliance Matrix) which pump heat transfer fluid (water) through the jacketed vessels.

Elastomer Selection

Elastomer performance becomes less predictable when a seal operates near the limits of its service temperature range. At low temperatures:

1. Elastomers become harder and less flexible until, at brittle point, the seal may crack if struck.
2. Elastomers lose their rubber-like properties as the temperature drops.
3. Fluids may penetrate the seal; and act as a plasticizer, effectively lowering the brittle point below the value observed in dry air. In such cases, the seal may operate effectively below its rated service temperature. In this case, fluid penetration of the seal (liquid butane of propane) would not be desirable.
4. Changes in elastomers due to low temperatures are physical, not chemical, and are generally reversible. However, if the geometry of the gland changes while the seal is cold, the seal may be too stiff to adapt to the new shape and may fail. Movement may damage the seal while it is cold and inflexible.

All elastomers used in the equipment, including O-rings and valves shall have elastomers rated by the seal manufacturer for temperatures between -30°F[4] and 125°F.

Elastomer	**Acceptable Temperature Range**	**Exposure Range**	
PTFE	-100°F to 400°F	-30°F to 125°F	Acceptable
Buna-N	-40°F to 250°F	-30°F to 125°F	Acceptable
FKM (Viton)	-30°F to 400°F	-30°F to 125°F	Acceptable
Low Temp Viton	-65°F to 400°F	-55°F to 125°F	Acceptable

The Dewax column and the 55 Liter Jacketed Operating Tank (option 4) may be cooled to -85°F. For cryogenic operations, only PTFE materials are allowed.

[3] Operating temperature may be reduced to -65˚F when using low temperature Viton elastomers.
[4] Operating temperature may be reduced to -65˚F when using low temperature Viton elastomers.

Special Equipment Warning Labels

Due to the temperatures involved, low temperature warning labels should be affixed to the equipment. The labels should describe the potential hazard of surface contact with the equipment and an International Low Temperature Hazard Symbol (See Figure 28) or similar.

Figure 28: Typical Low Temperature Hazard Symbol

Fabrication and Testing Analysis

Welding

Welding should be performed by qualified technicians using approved procedures. ASME Code, Section IX, *Welding, Brazing, and Fusing Qualifications*, can be used as a guide for developing welding procedures, welding procedure qualifications, and welding performance qualifications. Other third-party consensus codes provide similar guidance, such as the American Welding Society.

> ***Observation:*** *Welding should be performed by qualified technicians using written, approved procedures.*

Testing

Completed pressure-containing assemblies should be proof-tested prior shipment. The proof test pressure should be greater than the design pressure of the components (the design pressure is higher than the anticipated maximum pressure). The proof test pressure should account for differences in the material strength at design temperature versus test temperature (the test temperature is often room temperature while the design temperature is higher than the anticipated maximum operating temperature).

ASME Code, Section VIII, Division I, *Rules for Construction of Pressure Vessels*, can be used as a guide for developing an appropriate proof-test pressure. Similar guidance can be found in ASME Code B31.3, *Process Piping*. The test fluid should be clean liquid with controlled chloride content, rather than a gas or air. The test procedure and the results from the test should be documented and those records should be maintained by the manufacturer in accordance with their quality assurance plan.

For a given allowable stress (S_1) at design temperature, a room temperature allowable stress (S), and a design pressure P_d, the minimum proof test pressure P_t can be calculated per equation (The American Society of Mechanical Engineers, 2017) UG 99(b):

$$P_t = \frac{1.3(P_d)(S)}{S_1}$$

> ***Observation:*** *Finished pressure-containing components should be proof-tested by qualified technicians using written, approved procedures.*

Component Compliance Matrix

ExtractionTek MeP-HCU/C & mMeP

Item Number	Component ID Number (Vendor Part Number)	Description	Vendor	Material	Service	Pressure Service	Pressure Rating	LP Gas compatible	Referenced Code	Notes	Finding/ Observation
1	[redacted]	B31-14MP, 6-IN TO 3-IN SANITARY REDUCER	[redacted]	316L SS	LP-Gas	350 psig	613 psig @ 250°F	Yes		CSI p/n 9634-60002 should be 9634-050022 to reflect concentric reducer	Observation
2	[redacted]	40MP-SFY, 1-1/2-IN GASKET	[redacted]	Fluoroelastomer	LP-Gas	350 psig	N/A	Yes		Or Equal	
3	[redacted]	40MP-SFY, 2-IN GASKET	[redacted]	Fluoroelastomer	LP-Gas	350 psig	N/A	Yes		Or Equal	
4	[redacted]	40MP-SFY, 3-IN GASKET	[redacted]	Fluoroelastomer	LP-Gas	350 psig	N/A	Yes		Or Equal	
5	[redacted]	40MO-SFY, 6-IN GASKET	[redacted]	Fluoroelastomer	LP-Gas	350 psig	N/A	Yes		Or Equal	
6	[redacted]	40MP-UP, 6-IN, BUNA-N, 0.033-IN PERFORATIONS	[redacted]	Buna-N, Stainless Steel	LP-Gas	350 psig	N/A	Yes		Or Equal. 40MP-UP designates Buna-N, BOM describes Viton (SFY).	Observation
7	[redacted]	40MP-UP, 6-IN, BUNA-N, 5-MICRON PERFORATIONS	[redacted]	Buna-N, Stainless Steel	LP-Gas	350 psig	N/A	Yes		Or Equal. 40MP-UP designates Buna-N, BOM describes Viton (SFY).	Observation
8	[redacted]	A13MHP, 1-1/2-IN HIGH PRESSURE CLAMP	[redacted]	304 SS	LP-Gas	350 psig	1200 psig @ 250°F	N/A		BOM should be updated to reflect high pressure clamps	Observation
9	[redacted]	A13MHP, 2-IN HIGH PRESSURE CLAMP	[redacted]	304 SS	LP-Gas	350 psig	1000 psig @ 250°F	N/A		BOM should be updated to reflect high pressure clamps	Observation
10	[redacted]	A13MHP, 3-IN HIGH PRESSURE CLAMP	[redacted]	304 SS	LP-Gas	350 psig	800 psig @ 250°F	N/A			
11	[redacted]	6SSH, 6-IN HIGH PRESSURE CLAMP	[redacted]	304 SS	LP-Gas	350 psig	613 psig @ 250°F	N/A			
12	[redacted]	MALE CONNECTOR, 3/8-IN TUBE OD X 1/4-IN MALE PIPE WELD	[redacted]	316 SS	LP-Gas	350 psig	3300 psig @ 72°F	Yes			
13	[redacted]	MALE CONNECTOR, 3/8-IN TUBE OD X 1/4-IN MALE PIPE WELD BORED	[redacted]	316 SS	LP-Gas	350 psig	3300 psig @ 72°F	Yes			
~~14~~	~~1" NPT Metaglas~~	~~1" NPT THREADED METAGLAS S GHTGLASS~~	[redacted]	~~Sta nless Steel, Boros l cate Glass~~	~~LP Gas~~	~~350 ps g~~	~~1450 ps g @ 536°F~~	~~Yes~~		Removed Rev 5	
~~15~~	[redacted]	~~1 1/4" NPT THREADED METAGLAS SIGHTGLASS~~	[redacted]	~~Sta nless Steel, Boros l cate Glass~~	~~LP Gas~~	~~350 ps g~~	~~1450 ps g @ 536°F~~	~~Yes~~		Removed Rev 5	
16	[redacted]	1-1/2" SANITARY METAGLAS SIGHTGLASS	[redacted]	Stainless Steel, Borosilicate Glass	LP-Gas	350 psig	1493 psig @ 212°F	Yes		BOM should be updated to reflect LJ Star sight glass	Observation
17	[redacted]	2" SANITARY METAGLAS SIGHTGLASS	[redacted]	Stainless Steel, Borosilicate Glass	LP-Gas	350 psig	1075 psig @ 212°F	Yes		BOM should be updated to reflect LJ Star sight glass	Observation
18	[redacted]	3" SANITARY METAGLAS SIGHTGLASS	[redacted]	Stainless Steel, Borosilicate Glass	LP-Gas	350 psig	634 psig @ 212°F	Yes		BOM should be updated to reflect LJ Star sight glass	Observation
19	[redacted]	CLASS 1000 1/4-IN HALF COUPLING	[redacted]	304 SS	LP-Gas	350 psig	650 psig @ 350°F	Yes			
20	[redacted]	CLASS 1000 3/8-IN HALF COUPLING	[redacted]	304 SS	LP-Gas	350 psig	650 psig @ 350°F	Yes			
21	[redacted]	CLASS 1000 1-IN HALF COUPLING	[redacted]	304 SS	LP-Gas	350 psig	650 psig @ 350°F	Yes			
22	[redacted]	CLASS 1000 1-1/4-IN HALF COUPLING	[redacted]	304 SS	LP-Gas	350 psig	650 psig @ 350°F	Yes		McMaster-Carr p/n 4464K780 should be 4464K78	Observation
~~23~~	[redacted]	~~#10-32 SS SOC HD CAP SCREW~~	[redacted]	~~18-8 SS~~	~~-~~	~~350 ps g~~	~~N/A~~	~~N/A~~		Removed Rev 5	
~~24~~	[redacted]	~~PLEXIGLASS SHEET~~	[redacted]	~~Plex glass~~	~~LP Gas~~	~~350 ps g~~	~~N/A~~	~~Yes~~		Removed Rev 5	
25	[redacted]	REDUCING TEE, 3/8 x 5/8 x 5/8	[redacted]	316 SS	LP-Gas*	350 psig	3300 psig @ 72°F	Yes		*LP-Gas on 3/8 run, Water on 5/8 run and branch	
26	[redacted]	UNION ELBOW, 3/8-IN TUBE	[redacted]	316 SS	LP-Gas	350 psig	3300 psig @ 72°F	Yes			
27	[redacted]	UNION CROSS, 3/8-IN TUBE	[redacted]	316 SS	LP-Gas	350 psig	3300 psig @ 72°F	Yes			
28	[redacted]	UNION TEE, 3/8-IN TUBE	[redacted]	316 SS	LP-Gas	350 psig	3300 psig @ 72°F	Yes			
29	[redacted]	TUBE REDUCER, 3/8 x 1/4	[redacted]	316 SS	LP-Gas	350 psig	3300 psig @ 72°F	Yes		BOM Calls out SS-600-R-4 (3/8 x 1/4) and describes SS-600-R-8 (1/2 x 3/8)	Observation
30	[redacted]	TUBE REDUCER, 1/2 x 3/8	[redacted]	316 SS	LP-Gas	350 psig	3300 psig @ 72°F	Yes		BOM Calls out SS-600-R-4 (3/8 x 1/4) and describes SS-600-R-8 (1/2 x 3/8)	Observation
31	[redacted]	ADAPTER ELBOW, 3/8 TUBE x 3/8 MALE NPT	[redacted]	316 SS	LP-Gas	350 psig	3300 psig @ 72°F	Yes			
32	[redacted]	ADAPTER, 3/8 TUBE x 3/8 MALE NPT	[redacted]	316 SS	LP-Gas	350 psig	3300 psig @ 72°F	Yes			
33	[redacted]	TUBE, 1/4 OD x 0.028 MIN WALL	[redacted]	304 or 316 SS	LP-Gas	350 psig	4000 psig @ 72°F	Yes	ASTM A269	Seamless tubing. 0.028 minimum wall, thicker wall may be substituted.	
34	[redacted]	TUBE, 3/8 OD x 0.035 MIN WALL	[redacted]	304 or 316 SS	LP-Gas	350 psig	3300 psig @ 72°F	Yes	ASTM A269	Seamless tubing. 0.035 minimum wall, thicker wall may be substituted.	
35	[redacted]	TUBE, 1/2 OD x 0.049 MIN WALL	[redacted]	304 or 316 SS	LP-Gas	350 psig	3700 psig @ 72°F	Yes	ASTM A269	Seamless tubing. 0.049 minimum wall, thicker wall may be substituted.	
36	[redacted]	BALL VALVE, STRAIGHT, 3/8 TUBE, 1.5 Cv	[redacted]	316 SS, PTFE	LP-Gas	350 psig	3000 psig @ 72°F	Yes			
37	[redacted]	BALL VALVE, ANGLE, 3/8 TUBE, 1.5 Cv	[redacted]	316 SS, PTFE	LP-Gas	350 psig	3000 psig @ 72°F	Yes			
38	[redacted]	BALL VALVE, STRAIGHT, 3/8 TUBE, 6.0 Cv	[redacted]	316 SS, PTFE	LP-Gas	350 psig	1500 psig @ 72°F	Yes			
39	[redacted]	BALL VALVE, 3-WAY, 3/8 TUBE, 2.0 Cv	[redacted]	316 SS, PTFE	LP-Gas	350 psig	1500 psig @ 72°F	Yes		Swagelok p/n SS-44XS6 should be SS-44XS6	Observation
40	[redacted]	BALL VALVE, STRAIGHT, 1/2 TUBE, 12 Cv	[redacted]	316 SS PTFE	LP-Gas	350 psig	1500 psig @ 72°F	Yes			

ExtractionTek MeP-HCU/C & mMeP

Item Number	Component ID Number (Vendor Part Number)	Description	Vendor	Material	Service	Pressure Service	Pressure Rating	LP Gas compatible	Referenced Code	Notes	Finding/ Observation
~~41~~	[redacted]	~~PLUG VALVE, STRAIGHT, 3/8 TUBE, 6.4 Cv~~	[redacted]	~~316 SS, PTFE coated fluorocarbon FKM~~	~~LP-Gas~~	~~350 ps g~~	~~3000 ps g @ 72°F~~	~~Yes~~		Removed Rev 5	
~~42~~	[redacted]	~~PLUG VALVE, STRAIGHT, 1/2 TUBE, 6.4 Cv~~	[redacted]	~~316 SS, PTFE coated fluorocarbon FKM~~	~~LP-Gas~~	~~350 ps g~~	~~3000 ps g @ 72°F~~	~~Yes~~		Removed Rev 5	
43	[redacted]	PROPORTIONAL RELIEF VALVE, 1/4 TUBE, B SPRING, 450 PSI SET	[redacted]	316 SS, PTFE coated FKM, FKM	LP-Gas	350 psig	450 psig	Yes		BOM calls out 1/2 tube connections, valve has 1/4 tube connections. Note 2.	Observation
44	[redacted]	HYDROSTATIC RELIEF VALVE, 450 PSI SET	[redacted]	Brass	LP-Gas	350 psig	450 psig	Yes		Note 2	
45	[redacted]	PRESSURE GAUGE, 30-IN HG to 400 PSI, 3/8 CONN	[redacted]	316 SS	LP-Gas	350 psig	400 psig	Yes			
46	[redacted]	HOSE, CONDUCTIVE PTFE CORE, 0.313-IN NOM BORE	[redacted]	Conductive PTFE core	LP-Gas	350 psig	1500 psig	Yes	NFPA-58		
47	[redacted]	RECOVERY PUMP, PNEUMATIC	[redacted]	316 SS, Viton	LP Gas	350 psig	1250 psig	Yes		Modified Haskel 59025-3	
48	[redacted]	PILOT CONTROLLED AIR REGULATOR, 82 PSI OUTPUT MAX	[redacted]	Various	Air	N/A	N/A	N/A			
49	[redacted]	AIR REGULATOR	[redacted]	Various	Air	N/A	N/A	N/A			
50	[redacted]	AIR FILTER	[redacted]	Various	Air	N/A	N/A	N/A			
51	[redacted]	VACUUM PUMP	[redacted]	Alum, CuZn, NBR	Air*	100 psig	100 psig	Yes		*Not intended for pumping LP Gas. Suitable when OEM instructions are followed	Observation
52	[redacted]	WATER CHILLER	[redacted]	Various	Coolant	N/A	N/A	N/A	CE, CSA		
53	[redacted]	WATER HEATER	[redacted]	Various	Coolant	N/A	N/A	N/A	Field Listed	Updated Revision 5. Note 8	
54	[redacted]	INTRINSICALLY SAFE CYLINDER SCALE	[redacted]		-	N/A	N/A	Yes	NFPA-70	Class I, II, III, Division 1, Groups A, B, C, D, E, F & G Class I	
55	[redacted]	RECOVERY CYLINDER, 15 LB	[redacted]	Various	LP Gas	350 psig	400 psig	Yes	DOT 4BA400		
55	[redacted]	RECOVERY CYLINDER, 30 LB	[redacted]	Various	LP Gas	350 psig	400 psig	Yes	DOT 4BA400		
55	[redacted]	RECOVERY CYLINDER, 50 LB	[redacted]	Various	LP Gas	350 psig	400 psig	Yes	DOT 4BA400		
56	[redacted]	RECOVERY CYLINDER, 100 LB	[redacted]	Various	LP Gas	350 psig	350 psig	Yes	DOT 4BW350	Added Revision 1	
57	[redacted]	Chiller	[redacted]	Various	Coolant	N/A	N/A	N/A	UL, CE	Added Revision 1	
58	[redacted]	Chiller	[redacted]	Various	Coolant	N/A	N/A	N/A	Field Listed	Updated Revision 5. Note 8	
59	[redacted]	Heat Bath	[redacted]	Various	Coolant	N/A	N/A	N/A	Field Listed	Updated Revision 5. Note 8	
60		Tank Light		Various	Air	N/A	N/A	N/A	UL CID1	Added Revision 1	
61	[redacted]	ASME Pressure Relief Valve, 1/2", 250 psi Setpoint	[redacted]	SS & Viton	LP-Gas	250 psig	250 psig	Yes	ASME UV	Added Revision 3. Note 1	
62	[redacted]	Recovery Pump, 1HP, 1PH	[redacted]	SS, PTFE, Viton	LP-Gas	350 psig	350 psig	Yes	UL CID1	Added Revision 3	
63	[redacted]	Proportional Relief Valve, 1/4 Tube, 450 psi setpoint	[redacted]	SS/Buna	LP-Gas	350 psig	450 psig	Yes		Added Revision 4. Note 2	
64	[redacted]	Recovery Pump	[redacted]	Various	LP-Gas	350 psig	350 psig	Yes	UL CID1	Added Revision 4	
65	[redacted]	ASME Clamp, 4-in	[redacted]	SS	LP-Gas	250 psig	1015 psig	N/A	ASME	Added Revision 4. Updated Revision 5	
66	[redacted]	Recovery Pump, MVP-150, 2HP, 1PH	[redacted]	SS, PTFE, Viton	LP-Gas	350 psi	375 psi	Yes	UL CID1	Added Revision 5	
67	[redacted]	Recovery Pump, D-91-103	[redacted]	Various	LP-Gas	350 psi	600 psi	Yes	UL CID1	Added Revision 5	
68	[redacted]	Corkin Recovery Pump Motor, 3HP, 1PH	[redacted]	Various	N/A	N/A	N/A	N/A	UL CID1	Added Revision 5	
69	[redacted]	Heater, Corio CD-BC4, 20°C to 150°C	[redacted]	Various	Coolant	N/A	N/A	N/A	Field Listed	Added Revision 5. Note 8	
70	[redacted]	Heater, KISS 202C, 45°C to 200°C	[redacted]	Various	Coolant	N/A	N/A	N/A	Field Listed	Added Revision 5. Note 8	
71	[redacted]	Heater, Chromite 3000, 80°F to 150°F	[redacted]	Various	Coolant	N/A	N/A	N/A	Field Listed	Added Revision 5. Note 8	
72	[redacted]	Heater/Chiller, Unistat 815, -85°C to 250°C	[redacted]	Various	Coolant	N/A	N/A	N/A	Field Listed	Added Revision 5. Note 8	
73	[redacted]	Heater/Chiller, CC-505, -50°C to 200°C	[redacted]	Various	Coolant	N/A	N/A	N/A	Field Listed	Added Revision 5. Note 8	
74	[redacted]	Heater/Chiller, CC-902, -90°C to 200°C	[redacted]	Various	Coolant	N/A	N/A	N/A	Field Listed	Added Revision 5. Note 8	
75	[redacted]	Heater/Chiller, FP50-MA, -50°C to 200°C	[redacted]	Various	Coolant	N/A	N/A	N/A	Field Listed	Added Revision 5. Note 8	
76	[redacted]	Heater/Chiller, FP89-HL, -90°C to 100°C	[redacted]	Various	Coolant	N/A	N/A	N/A	Field Listed	Added Revision 5. Note 8	
77	[redacted]	Fitting, 1/2" Weld to 3/8" Tube Adapter	[redacted]	316 SS	LP-Gas	350 psig	3300 psig	Yes		Added Revision 5	
78	[redacted]	Fitting, Tube, Adapter, 3/8" OD Tube x 3/8" FNPT	[redacted]	316 SS	LP-Gas	350 psig	3300 psig	Yes		Added Revision 5	
79	[redacted]	Coupling, Water Body, High Flow, 3/8" NPT	[redacted]	Various	Coolant	N/A	N/A	N/A		Added Revision 5	
80	[redacted]	ASME Clamp, 6-in	[redacted]	316 SS	LP-Gas	250 psig	493 psig	N/A	ASME	Added Revision 5	

ExtractionTek MeP-HCU/C & mMeP

Item Number	Component ID Number (Vendor Part Number)	Description	Vendor	Material	Service	Pressure Service	Pressure Rating	LP Gas compatible	Referenced Code	Notes	Finding/ Observation
81	[redacted]	Tube, 3/8"OD x 0 035" Min Wall	[redacted]	304 or 316 SS	LP-Gas	350 psig	3100 psi	Yes	ASTM A269	Added Revision 5. 0.035 minimum wall, thicker wall may be substituted.	
82	[redacted]	QC6 Body 3/8" Tube	[redacted]	316 SS, PTFE	LP-Gas	350 psig	1500 psig	Yes		Added Revision 5	
83	[redacted]	Ball Valve, 43G Angle 3/8" Tube	[redacted]	316 SS, PTFE	LP-Gas	350 psig	2500 psig	Yes		Added Revision 5	
84	[redacted]	ASME Pressure Relief Valve, 1/2", 250 psi Setpoint	[redacted]	SS & Viton	LP-Gas	250 psig	250 psig	Yes	ASME UV	Added Revision 5. Note 1	
85	[redacted]	Tube Adapter, 3/8" OD Tube to 1/2" FNPT	[redacted]	SS	LP-Gas	350 psig	3300 psig	Yes		Added Revision 5	
86	[redacted]	Tube Adapter, 3/8" OD Tube to 1/2" MNPT	[redacted]	SS	LP-Gas	350 psig	3300 psig	Yes		Added Revision 5	
87	[redacted]	Heater, Unistat T305, 65°C to 300°C	[redacted]	Various	Coolant	N/A	N/A	N/A	Field Listed	Added Revision 5. Note 8	
88	[redacted]	Air Regulator	[redacted]	Various	Air	N/A	N/A	N/A		Added Revision 5	
89	[redacted]	Heater, CC-315B, -28°C to 300°C	[redacted]	Various	Coolant	N/A	N/A	N/A	Field Listed	Added Revision 5. Note 8	
90	[redacted]	Recovery Cylinder, 100 LB	[redacted]	Various	LP Gas	240 psig	240 psig	Yes	DOT 4BW240	Added Revision 5. Note 7	
91	[redacted]	Corkin Recovery Pump Motor, 2HP, 1PH	[redacted]	Various	N/A	N/A	N/A	N/A	UL CID1	Added Revision 5	
92	[redacted]	Heater, CC-315B, 28°C to 300°C	[redacted]	Various	Coolant	N/A	N/A	N/A	Field Listed	Added Revision 6. Note 8	
93	-	1-1/2-IN GASKET, LOW TEMPERATURE (-65°F)	[redacted]	FKM-Special	LP-Gas	350 psig	N/A	Yes		Added Revision 6	
94	-	2-IN GASKET, LOW TEMPERATURE (-65°F)	[redacted]	FKM-Special	LP-Gas	350 psig	N/A	Yes		Added Revision 6	
95	-	3-IN GASKET, LOW TEMPERATURE (-65°F)	[redacted]	FKM-Special	LP-Gas	350 psig	N/A	Yes		Added Revision 6	
96	-	6-IN GASKET, LOW TEMPERATURE (-65°F)	[redacted]	FKM-Special	LP-Gas	350 psig	N/A	Yes		Added Revision 6	
97	-	RECOVERY CYLINDER, 239 LB	[redacted]	Various	LP Gas	350 psig	400 psig	Yes	DOT 4BW400	Added Revision 6	
98	[redacted]	Recovery Pump, T-91-103	[redacted]	Various	LP-Gas	350 psi	600 psi	Yes	UL CID1	Added Revision 6	
99	[redacted]	Chiller, 12000 BTU/hr	[redacted]	Various	Coolant	N/A	N/A	N/A	Field Listed	Added Revision 6. Note 8	

Notes:

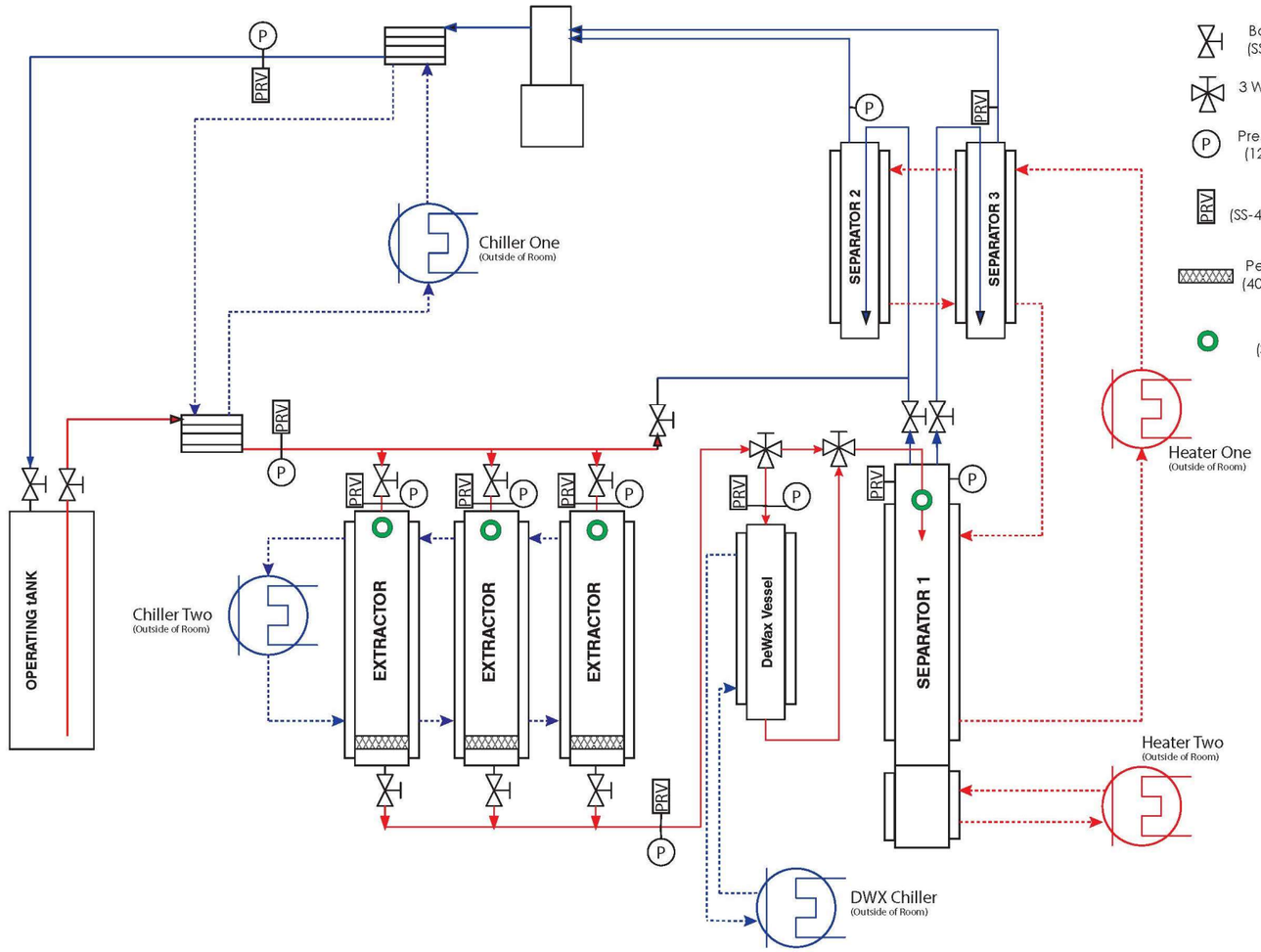
1) All pressure vessels as defined by ASME BPVC must be equipped with direct spring-loaded pressure relief valves conforming with the applicable requirements of ANSI/UL 132, Standard for Safety Relief Valves for Anhydrous Ammonia and LP-Gas, or other equivalent pressure relief valve standards. The pressure relief valves must be set per ASME BPVC
2) A hydrostatic relief valve or a device providing pressure-relieving protection shall be installed in each section of piping and hose in which liquid LP-Gas can be isolated between shutoff valves. Relief valves shall be set between 400 psig and 500 psig as required by NFPA 58.
3) Solvent valves shall be suitable for LP-Gas service and shall have a service pressure rating of 350 psig (NFPA 58: 5.12.2).
4) Hose shall be designed for a working pressure of at least 350 psig (2.4 MPag), with a safety factor of 5 to 1 and comply with ANSI/UL 569, Standard for Pigtails and Flexible Hose Connectors for LP-Gas, or ANSI/UL 21, Standard for LP-Gas Hose (NFPA 58: 5.9.6).
5) Piping that can contain liquid LP-Gas and that can be isolated by valving shall have an operating pressure of 350 psig (NFPA 58: 5.9.1.4).
6) Vacuum pump is only intended to be used to remove air from the system prior to the introduction of LP Gas
7) NFPA 58 ANNEX C: The term service pressure is analogous to, and serves the same purpose as, the ASME design pressure. However, it is not identical, representing instead the highest pressure to which the cylinder will normally be subjected in transit or in use, but not necessarily the maximum pressure to which it might be subjected under emergency
8) Ancillary heaters, chillers, and heater/chillers shall be listed by an OSHA-approved Nationally Recognized Testing Laboratory (NRTL) by the equipment OEM.

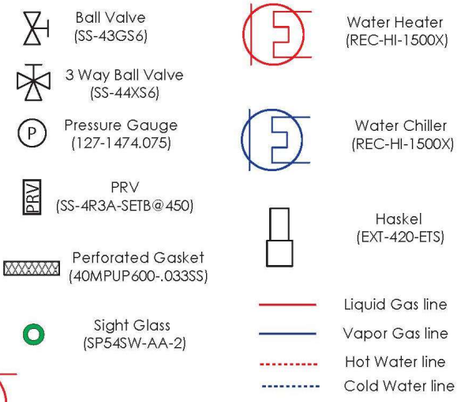
Process Flow Diagram

Observation: *The Process Flow Diagrams should be updated to reflect current sight glass part numbers. This discrepancy does not impact the safe operation of this equipment.*

Observation: *The Process Flow Diagrams should be updated to reflect the current Operating Tank relief valve. This discrepancy does not impact the safe operation of this equipment.*

ExtractionTek - Modular Extraction Platform (MeP)

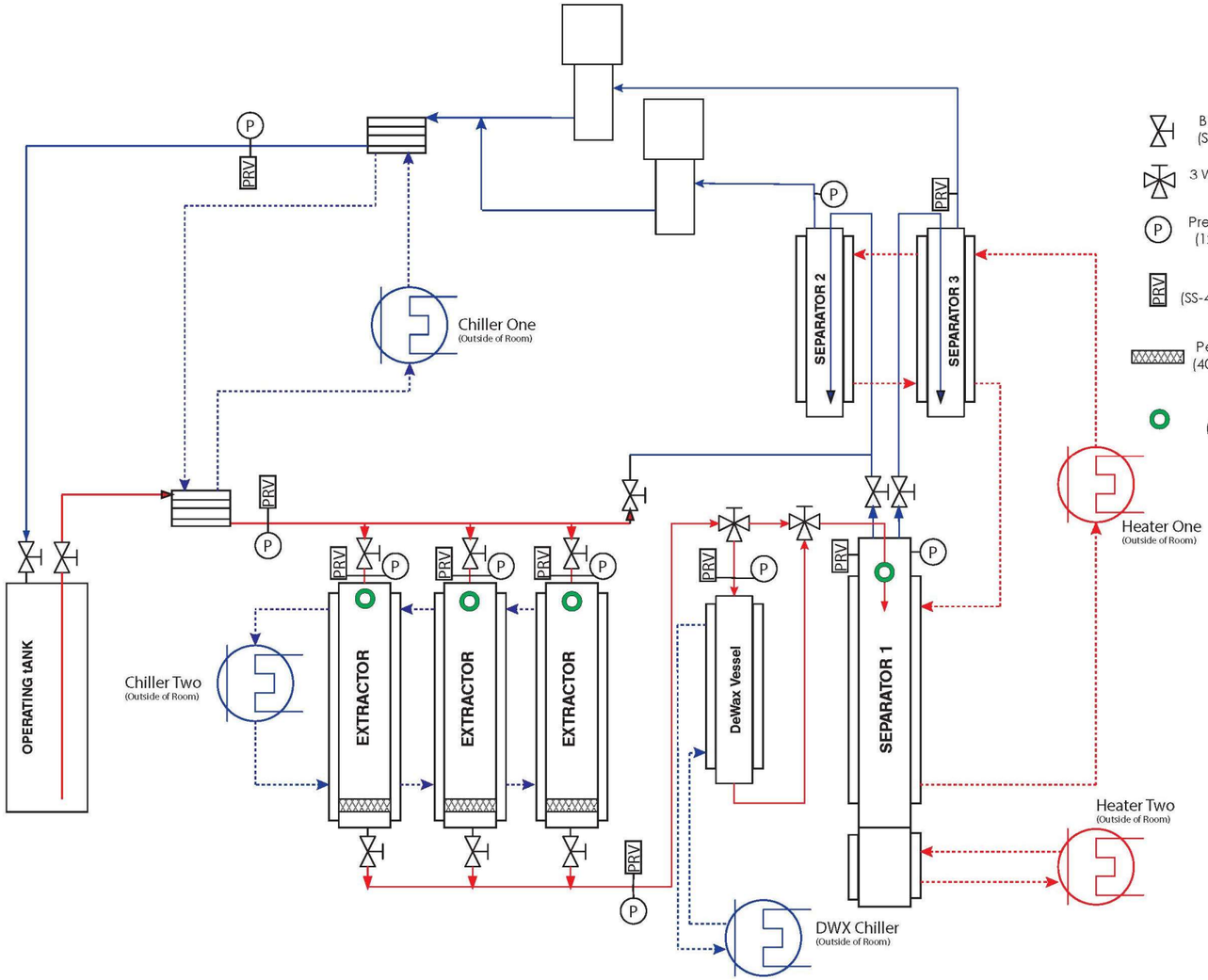




Machine information

Model Number : MePHCU/C
Max Pressure: 350 psi
Max High Temperature: 125° F
Max Low Temperature: -20° F

ExtractionTek - Modular Extraction Platform (MeP)

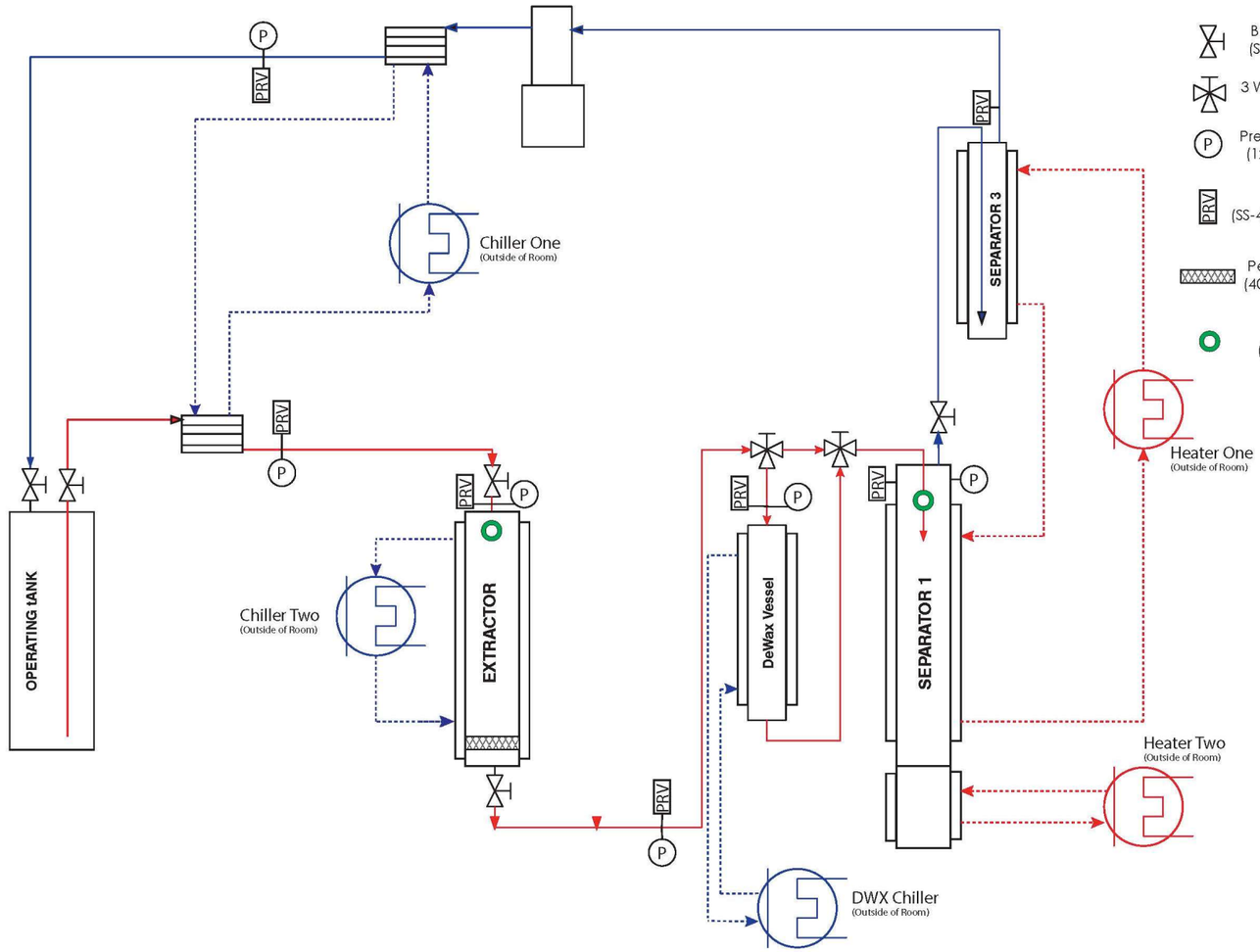


- Ball Valve (SS-43GS6)
- 3 Way Ball Valve (SS-44XS6)
- Pressure Gauge (127-1474.075)
- PRV (SS-4R3A-SETB@450)
- Perforated Gasket (40MPUP600-.033SS)
- Sight Glass (SP54SW-AA-2)
- Water Heater (REC-HI-1500X)
- Water Chiller (58603T67A2701)
- Haskel (EXT-420-ETS)
- Liquid Gas line
- Vapor Gas line
- Hot Water line
- Cold Water line

Machine information

Model Number : MePHCU/C
Max Pressure: 350 psi
Max High Temperature: 125° F
Max Low Temperature: -20° F

ExtractionTek - mini Modular Extraction Platform (mMeP)



Ball Valve
(SS-43GS6)

3 Way Ball Valve
(SS-44XS6)

Pressure Gauge
(127-1474.075)

PRV
(SS-4R3A-SETB@450)

Perforated Gasket
(40MPUP600-.033SS)

Sight Glass
(SP54SW-AA-2)

Water Heater
(REC-HI-1500X)

Water Chiller
(58603T67A2701)

Haskel
(EXT-420-ETS)

Liquid Gas line
Vapor Gas line
Hot Water line
Cold Water line

Machine information

Model Number : mMeP/C
Max Pressure: 350 psi
Max High Temperature: 125° F
Max Low Temperature: -30° F

Findings

A Finding is defined as anything that could adversely affect safety as related to products, persons or property; or impact the usability of the product. Any unresolved Findings described in this report will need to be resolved either through testing (by others) or replacement of affected components (by others) for the equipment to be considered safe for use.

1. None.

Observations

An Observation is defined as a recommendation for process or design improvements, but does not adversely affect safety of the system. Any unresolved Observations described in this report will not need to be resolved for the equipment to be considered safe for use.

1. The ExtractionTek Solutions extractor system is 2.6-48 gallon water capacity and must be equipped with "Not Odorized" warning labels with letter heights of at least 3/4-inch and in accordance with NFPA Table 5.2.8.5(A).

2. Purge gas cylinders must be secured in accordance with Compressed Gas Association (CGA) guideline P 1, "Safe Handling of Compressed Gases."

3. Carbon dioxide purge gas supply should be regulated to no more than 250 psig; however, may be set as low as practical for the intended operation.

4. ASME vessels may need to be registered with the National Board of Boiler and Pressure Vessel Inspectors per Boiler and Pressure Vessel Regulations of the State in which the equipment is installed.

5. Certain AHJs may require additional structural analysis and or additional restraints, such as seismic. This report does not include analysis by a licensed structural Professional Engineer.

6. The commercial 6x3 sanitary reducer part number should be updated to reflect a concentric reducer (CSI part number 9634-60002 should be 9634-050022). This discrepancy does not impact the safe operation of this equipment.

7. The 6-In Dome Cup Assembly with Sight Glass detail drawings should be updated to reflect current high pressure sanitary clamp and sight glass part numbers. This discrepancy does not impact the safe operation of this equipment.

8. The Collector Vessel Dome Cap with Sight Glass detail drawings should be updated to reflect current high pressure sanitary clamp and sight glass part numbers. This discrepancy does not impact the safe operation of this equipment.

9. Welding should be performed by qualified technicians using written, approved procedures.

10. Finished pressure-containing components should be proof-tested by qualified technicians using written, approved procedures.

11. Sanitary Gaskets, 40MP-UP designates Buna-N, BOM describes Viton (SFY).

12. 1-1/2 inch Half Coupling, McMaster-Carr p/n 4464K780 should be 4464K78.

13. Tube Reducer, BOM Calls out SS-600-R-4 (3/8 x 1/4) and describes SS-600-R-8 (1/2 x 3/8).

14. 3-Way Ball Valve, Swagelok p/n SS-44X56 should be SS-44XS6.

15. Relief Valve, BOM calls out 1/2 tube connections, valve has 1/4 tube connections.

16. Vacuum pump is only intended to be used to remove air from the system prior to the introduction of LP Gas.

17. The Process Flow Diagrams should be updated to reflect current sight glass part numbers. This discrepancy does not impact the safe operation of this equipment.

18. The Process Flow Diagrams should be updated to reflect the current Operating Tank relief valve. This discrepancy does not impact the safe operation of this equipment.

References

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Appendix A – Equipment Photographs

Figure 29: MeP

Figure 30: MeP

Figure 31: mMeP

Figure 32: mMeP

Figure 33: mMeP

Figure 34: mMeP

Appendix B – OEM Manual

All ExtractionTek Solutions units are supplied with an operation and maintenance manual. The manual clearly describes the safe installation, operation, and maintenance of the system and periodic maintenance requirements. Adequate safety warnings are provided.

The OEM manuals are too large to include in this document. Manuals may be requested directly from ExtractionTek Solutions.