CO-SOLVENT PUMP

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1 INTRODUCTION

1.1 About SCFE

The Supercritical CO2 Fluid Extractor is a unique and state of the art, custom built equipment designed, developed & manufactured by Buffalo Extraction System for extraction of natural oils fromvarious organic materials.

Supercritical Fluid Extraction (SFE) of Solids is the process of separating one component (the extractant) from another (the matrix) using supercritical fluids that is CO2 as the extracting solvent.Extraction conditions for supercritical CO2 are above the critical temperature of 31°C and a criticalpressure of 74 bars.

- SFE of solids is, generally operated in batch mode on milled Organic materials.
- The system consists of two high-pressure autoclaves (called extractors) with fast-openingsystems in which the organic material to be treated filled in.
- Additionally, it consists of a separation section with two separators for the organic extractand one water separator; where extract and fluid are separated prior to the fluid recycle through the condenser and high-pressure liquid pump.
- As it is a batch-type process, the extractors need to be emptied out after completion of every batch following by a cleaning cycle.
- The effectiveness of the CO_2 extraction can be modulated by controlling the pressure.

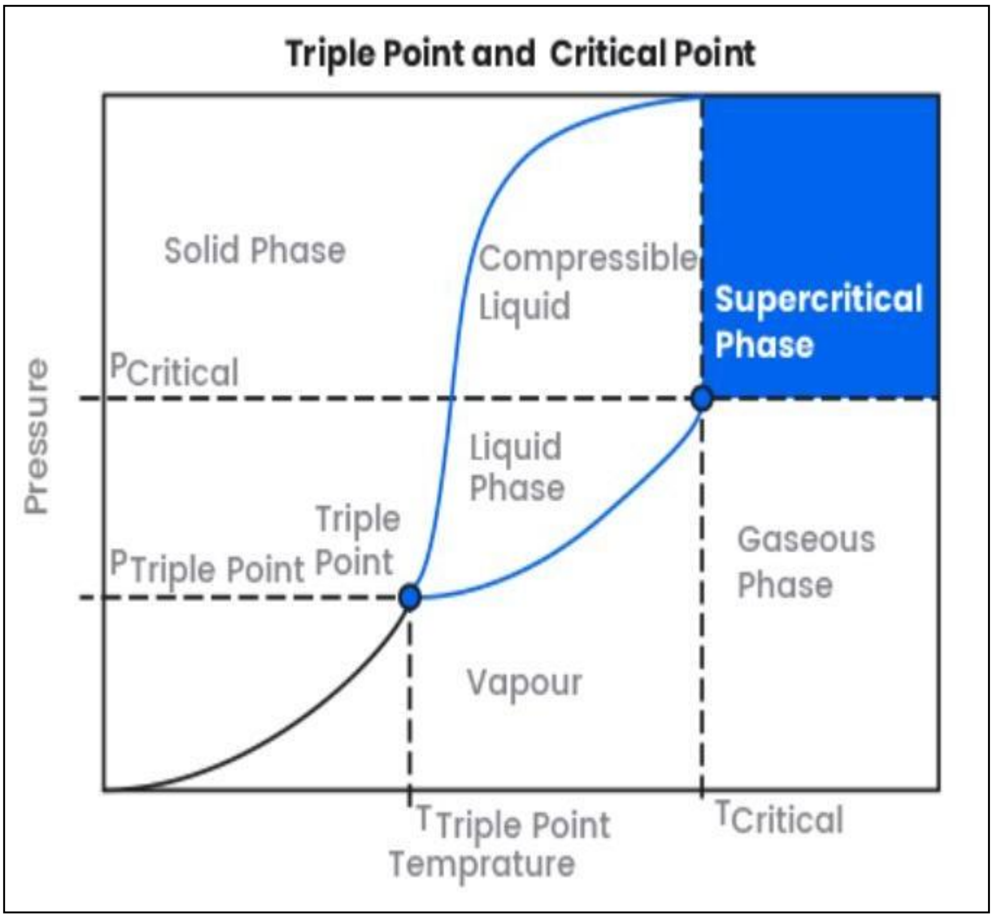


Figure 1 : Phase diagram of CO_2

1.2 Features of SCFE Plant

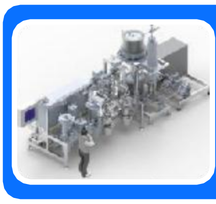
Efficient and consistent extraction through precise control of critical pressure and flow parameters

High performance engineering for system durability and minimized downtime

For intuitive usage and maintenance of the system using HMI control and tablet based remote monitoring and preventive maintenance

Multi-level safety systems for a safe and tamper-proof operation

Conformance and documentation support for cGMP, EU-GMP, CE, ASME and other global standards



Customizable layout, components and design for a truly personalized

system

High performance engineering for system durability and minimized downtime

1.3 Applications of SCFE System

Flavors and Fragrances: Extracts for solvent-free Food additives, natural perfumes and fragrances

Cannabis and Hemp extraction for CBD/THC extraction for medical and recreational cannabis industry

Herbal Medicines: Bioactive extracts for the herbal medicine industry

Spice Extracts: Essential oils and oleoresins

Nutraceuticals and Aromatherapy: Extraction of natural products for nutraceutical industry

Beer and Alcohol: Hops and flavor extraction for beer and blended alcohol industry

Decaffeination of coffee and tea

Phytochemicals: Specialty phytochemical extraction for food and consumer industries

Algae extractions: for getting clean carotenoids, antioxidants, fatty acids, peptides, and sterols

- Table shows the various applications of the SCFE system.

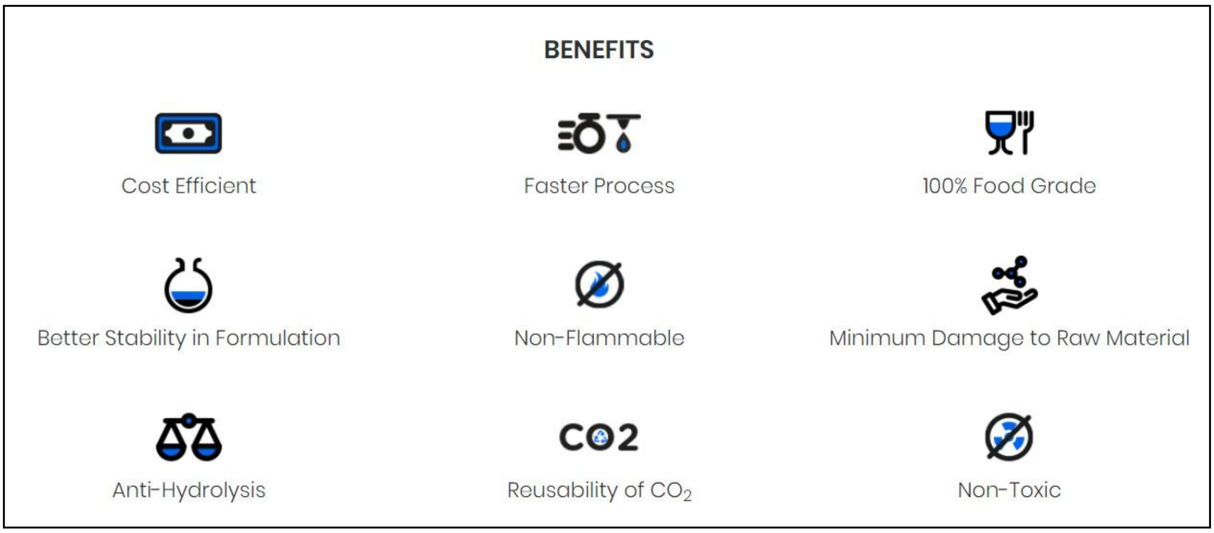


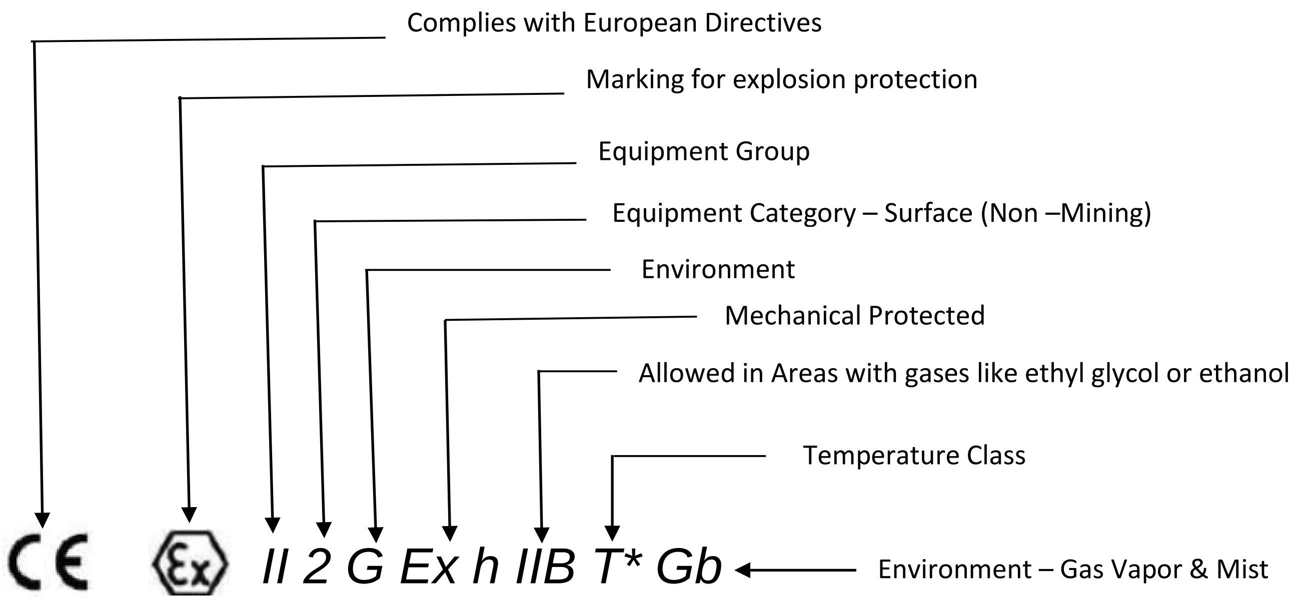
Figure 2 : Benefits of SCFE plant

2 General Safety

2.1 Identify the Safety

WARNING	DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE IS PRESENT

2.2 ATEX Marking



2.3 Safety Equipment

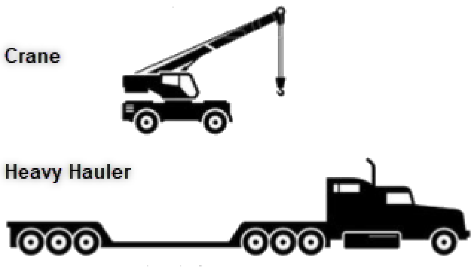
Use the following safety equipment within the work area:

- Safety Helmet, Safety goggles, preferably with side shields, Protective shoes and gloves, First-aid kit, Fire extinguisher

2.4 Transport the System Safely

A disassembled system is best transported on a flatbed carrier. Use crane to lift the system assemblies and load it on a heavy hauler for transportation.

Before transporting the system, make sure that the sub-assemblies are having suitable attachment points. Use chains to secure the system assemblies to the carrier.



3 Introduction

3.1 About

The Co-Solvent Pump is a unique and state-of-the-art, custom-built equipment designed, developed & manufactured by Buffalo Extraction System.

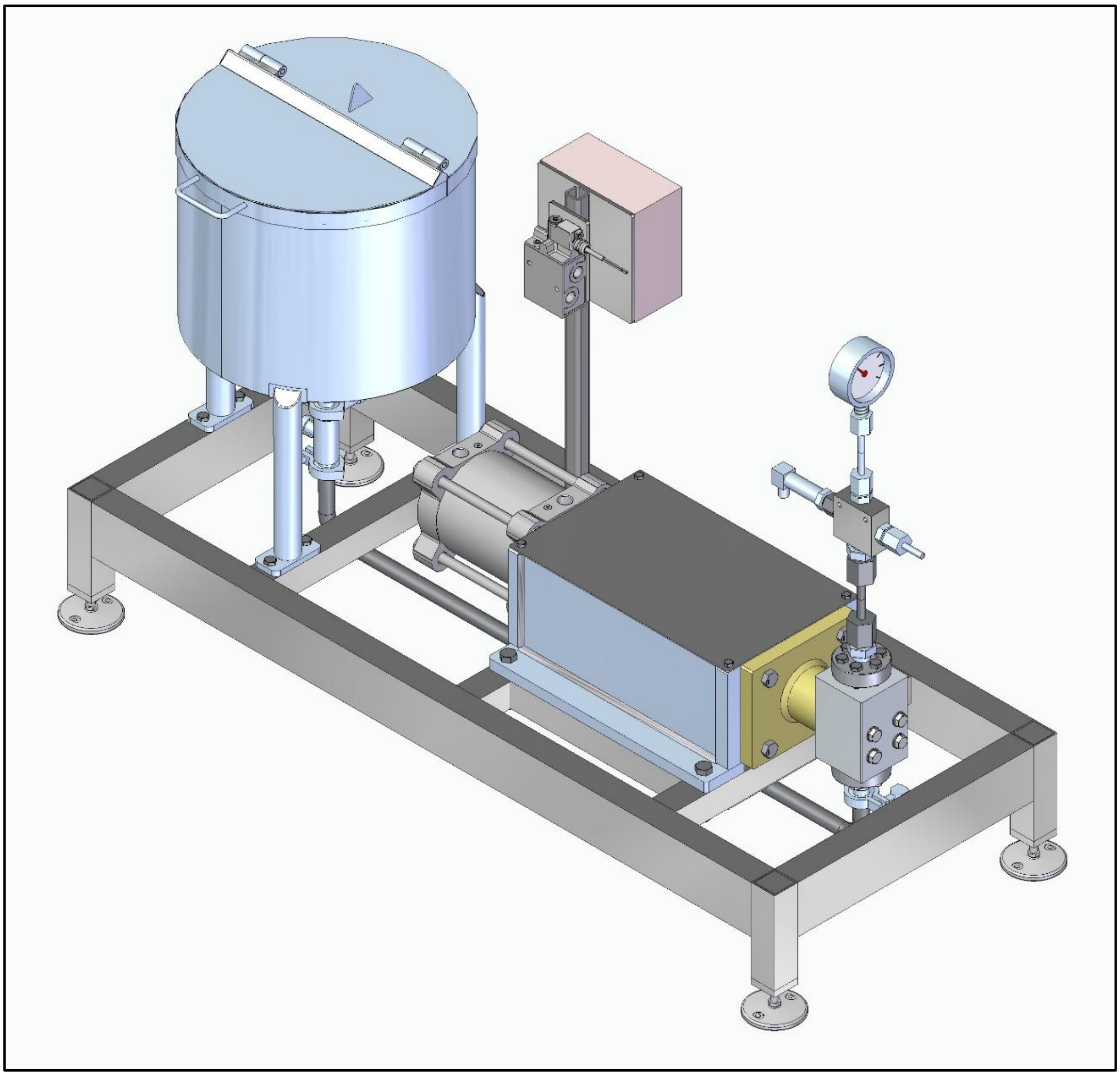


Figure 3: Isometric Views

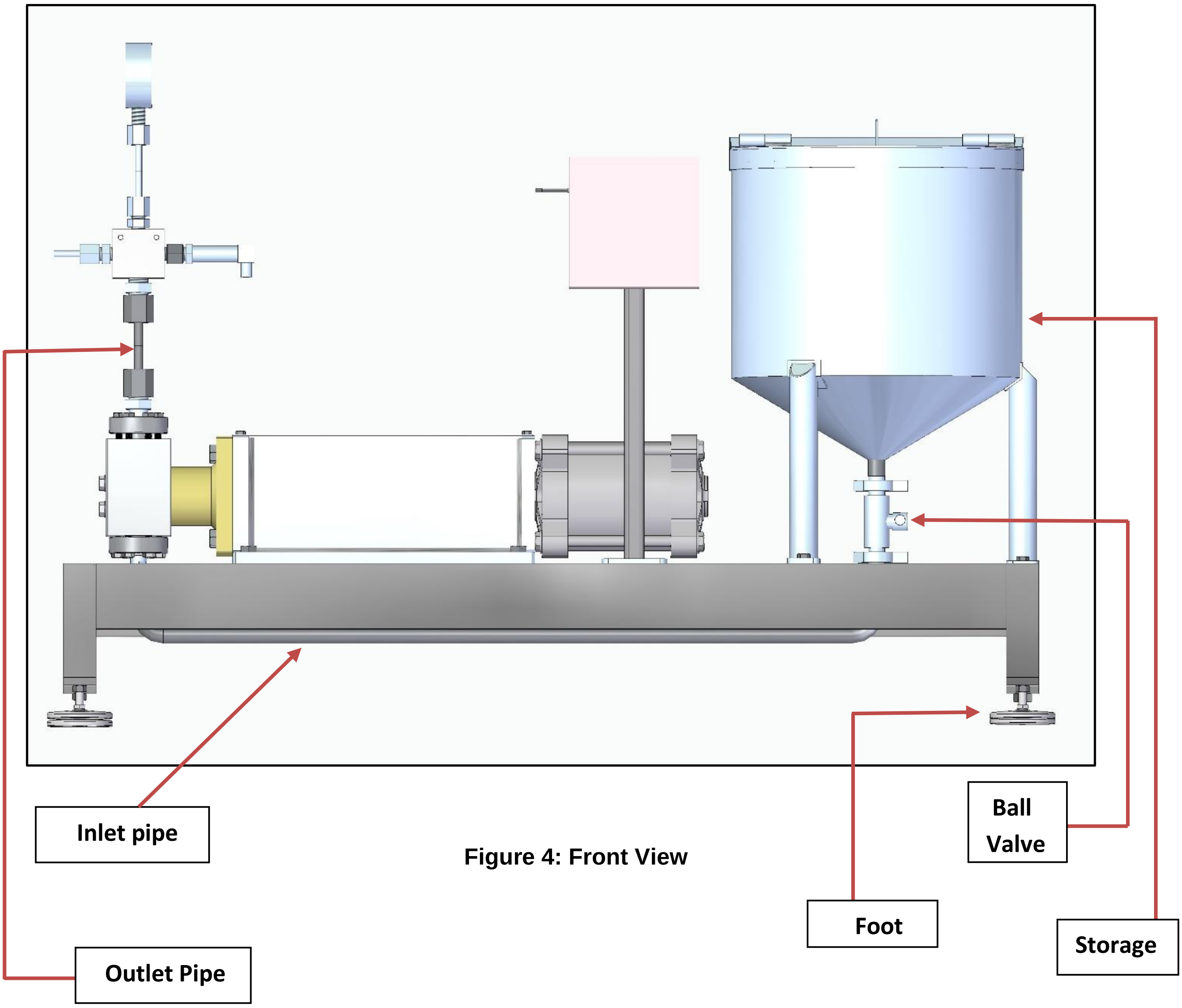


Figure 4: Front View

3.2 Installation and Operation

- Attach foot to the SS frame.
- Connect inlet and outlet pipeline.
- Insert Co-solvent in the storage tank.
- Open inlet Ball Valve (Low Pressure).
- Start the Co-Solvent from HMI in Auto Mode.

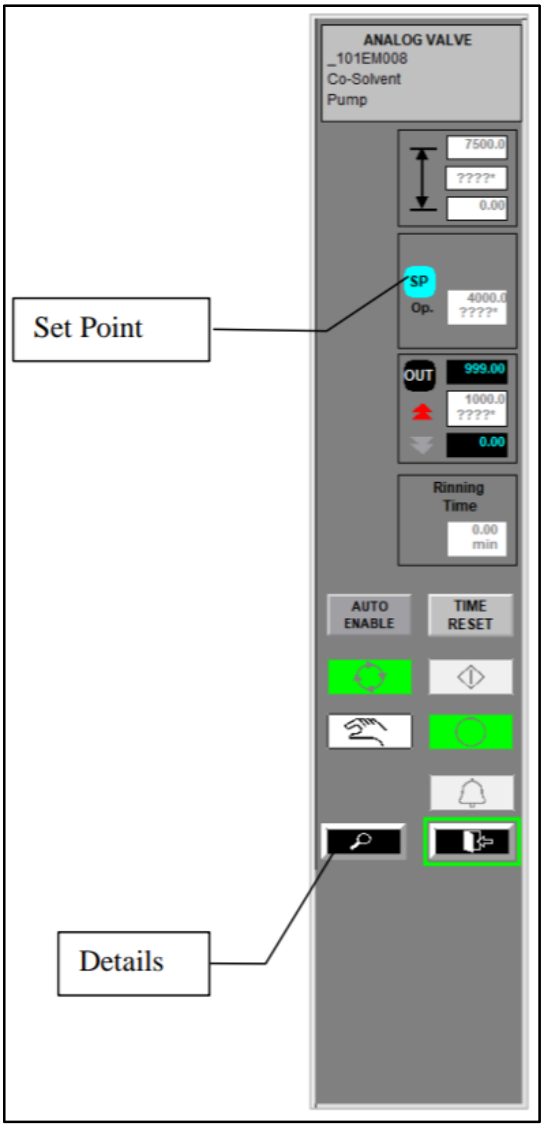


Figure 5: HMI Screen

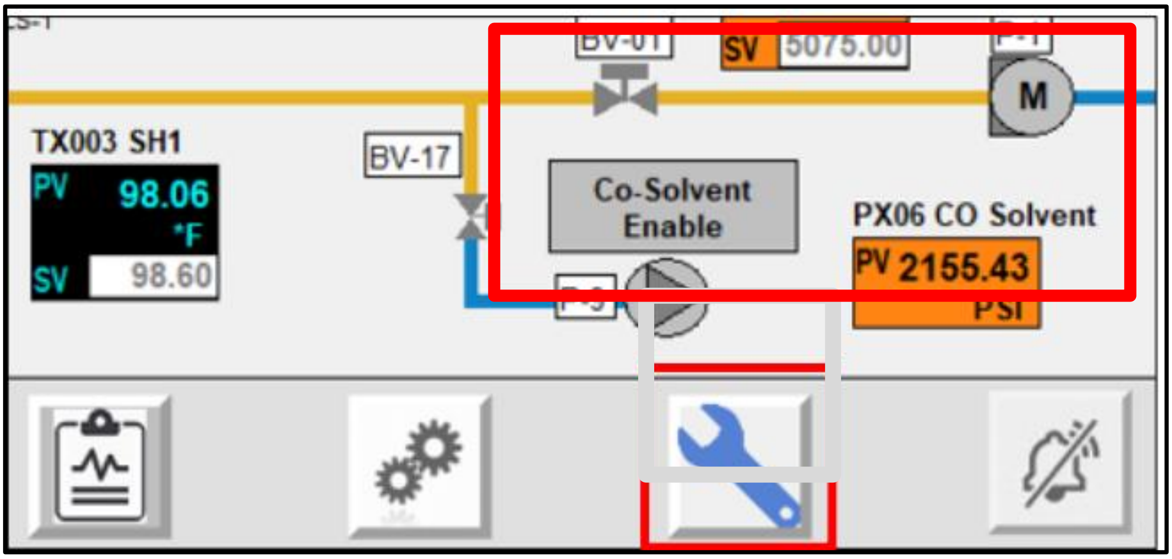


Figure 6: HMI Screen

3.3 When Working in Auto Mode.

- **Ethanol Reservoir Process**: The process begins by filling the Reservoir Tank with ethanol, which serves as the initial step in the system's operation. This tank, represented in Figure below, acts as the primary source from which the liquid is drawn

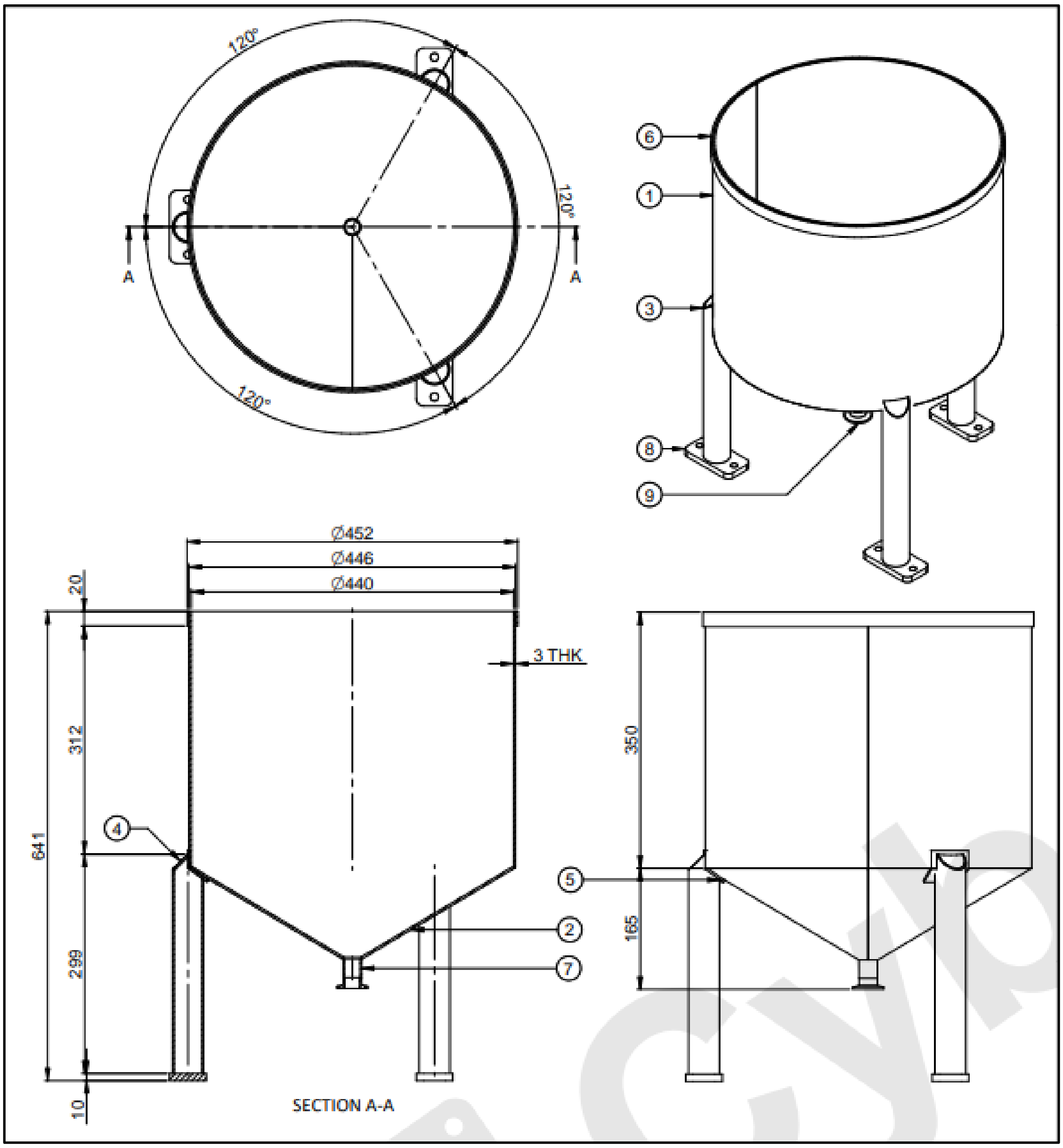


Figure 7: Reservoir Tank

- **Piping Pathway:** Following the addition of ethanol, a network of small pipes facilitates the movement of the liquid towards the subsequent components. These pipes serve as conduits, guiding the ethanol towards its next destination.

- **Ball Valve Control**: Once the ethanol reaches a certain point in the system, it encounters the Ball Valve, depicted in Figure below. This valve serves as a mechanism to control the flow of the liquid. It can be manually opened to allow the ethanol to progress further along the system.

Figure 8: Ball Valve

- **NRV Functionality**: The ethanol then encounters the NRV, as illustrated in Figure below. The NRV, or Non-Return Valve, is designed to ensure that the liquid can only move in one direction. This feature is crucial for maintaining the integrity of the system's operation and preventing any backflow of the ethanol.

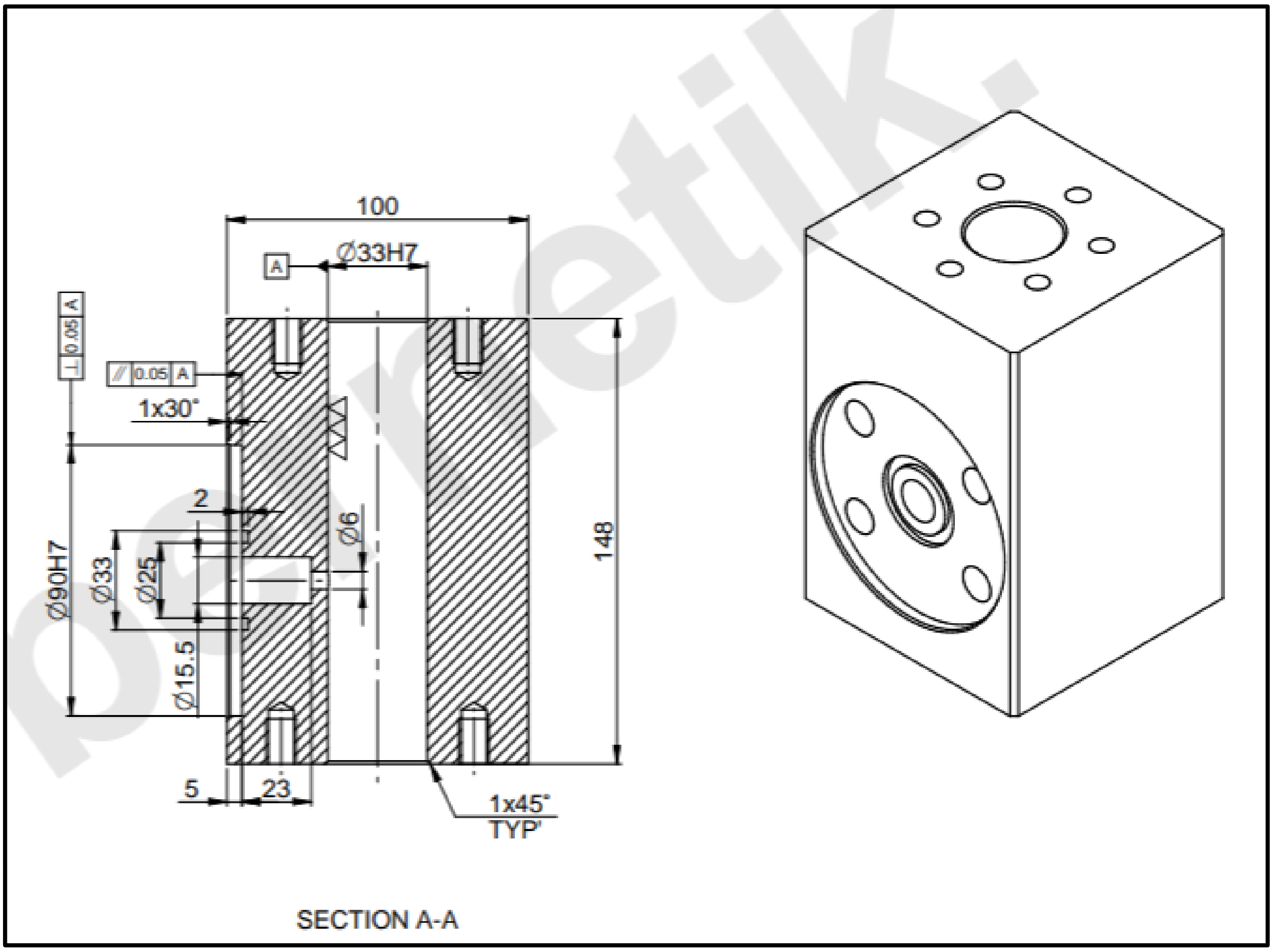


Figure 9: NRV

- **Plunger Dynamics**: The movement of the Plunger is a key aspect of the system's functionality. As it moves backward, it initiates a suction effect, drawing the ethanol through the system. Conversely, when the Plunger moves forward, it triggers a discharge, pushing the ethanol forward in the system's process

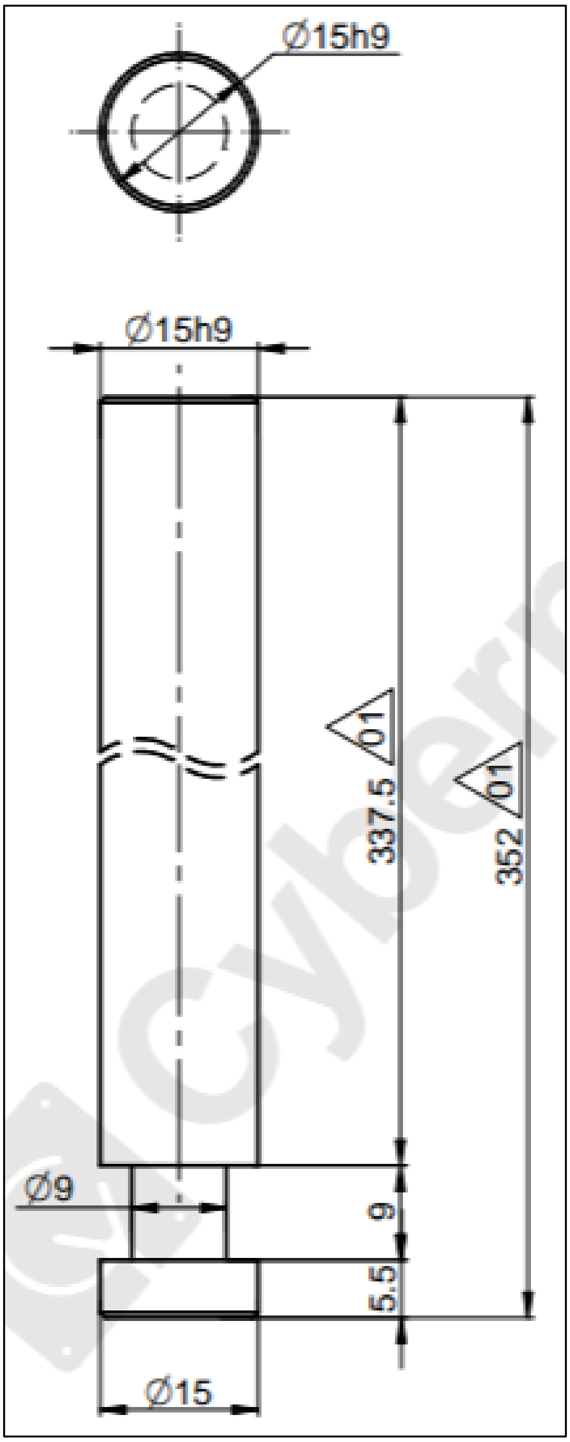


Figure 10: Plunger

4 Mechanical Maintenance

1. To change the seal of the co-solvent (user/BES)

- Close outlet ball valve
- De-pressurize the co-solvent pump.
- Disconnect plunger pin from pneumatic cylinder.
- Remove plunger and plunger housing from mounting frame.
- Remove cylinder cap and pull-out the plunger.
- Remove plunger seal and assembly from plunger housing and change the seal.
- Again reassemble it as before.

2. To clean NRV (user/BES)

- De-pressurize the system
- Remove top and bottom caps of NRB.
- Remove NRB assembly
- Clean with IP or hot water and reassemble the assembly.

3. Cleaning of storage tank (user)

- Close inlet valve (low pressure).
- Flush the fluid and clean from inside with hands.

5 Lifecycle of Material

The definition of life cycle is 'Consecutive and interlinked stages of a product (or service) system, from raw material acquisition or generation from natural resources to final disposal. Life cycle stages include acquisition of raw materials, design, production, transportation/delivery, use, end-of-life treatment and final disposal.'

Table 1: Life cycle of material

Raw Material	Life	Recycle
SS 304 / S.S.316 / S.S.316L	50 Years	Recycle by sorting, Melting and Purification
PEEK	Up to 10 Years	Breaking down the high-performance thermoplastic into smaller particles or powder
UHMW	20 Years	Recycled Through grinding and melting
CFT	More than 10 years	recovering and reprocessing carbon fiber reinforced polymers

Note: Disposal to be done as per local rules and regulations.