1. INTRODUCTION

1.1. General Overview

This manual, provides operating and maintenance instructions for different BBS pumps. The below table shows some of the pumps at various working pressures and flow rates which are designed to inject fluid to systems.

Model	Max. Pressure	Min. Flow Rate*	Max Flow Rate*	Status**
HB-63-DB	6,000 psi	0.001 cc/min	30 cc/min	Double Bench
HB-85-DB	8,000 psi	0.001 cc/min	50 cc/min	Double Bench
HB-108-SB	10,000 psi	0.001 cc/min	80 cc/min	Single Bench
HB-1510-SB	15,000 psi	0.001 cc/min	100 cc/min	Single Bench

* Min. and Max. flow rate can be changed upon the request
** Status of the pumps can be Single/Double and Fix/Bench upon the request.

The pumps provide continuous, pulse–free fluid flow for use in core analysis and related research. Key features of the system include the following:

- The pumps provide the minimum flow rate of 0.001 cc/min.
- The pumps are designed for pumping fluids at high pressure and provides precise pressure control.
- The system works well with water or low viscosity oil. Fluid-wetted parts are stainless steel 316 (SS-316).
- Sophisticated electronics provide highly accurate fluid flow rates and volume measurement.
- The system is operated using MMI (Man Machine Interface) software which runs on a PC-compatible computer using Windows XP operating system. The software provides the user with complete control over all operating parameters.
- The pump system can be operated in two different operating modes, including constant rate and constant pressure. The system can operate in both directions: either backward or forward.
- The standard pump cylinder is constructed of stainless steel (SS–316). If the Hastelloy option is specified, all metal pump cylinder parts that come in contact with the pumped fluid are constructed of Hastelloy. Hastelloy is highly corrosion-resistant and will extend the life of the pump substantially if you are pumping highly corrosive fluids

1.2. Pumps' Components

The pump cylinders are the basic building block of the system. The pumps include different components that is listed as below:

- Servo system
- Pump cylinder
- Needle valve
- Relief valve
- Proximity sensors
- Pressure transducer
- Pressure gauge
- Plumbing
- Pump software and PC-panel
- Support Stand

Some of these components are described as below

1.2.1. Servo System

For a high precision control of the cylinders, it is used a Servo system which includes the PLC (Programmable Logic Controller), motor driver, servo motor, Gears box. These parts will be described in later sections.

1.2.2. Pump Cylinder

There are different standard cylinder models that are designed for using of the pump.

The presented table at beginning of this user manual shows pump's model for varying test conditions.

All designed cylinders have the same basic design, and all are servo motor-driven and positive displacement pumps with precision ball screws.

The basic operation of the pump cylinder is as follows:

- When the piston retracts, the pump cylinder fills with fluid through the valve connected to supply reservoir.
- With both valves closed, the piston extends slightly and pre-pressurizes the fluid.
- When the piston extends, fluid is pushed out of the pump cylinder through the deliver valve.

HIGH PRECISION HIGH PRESSURE INJECTION PUMP

1.2.3. Needle Valve

For pump cylinders, the system includes valves for charging the cylinder and delivering the fluid to other systems. There are 2 types of needle valves placed on the pump. Two 1/4˝ straight valves connected to the supply reservoir, and two 1/8˝ straight valves are installed for fluid delivery.

1.2.4. Relief Valve

Relief valve as a mechanical part will operate and release the pressure. The relief valve is adjusted to open at a predetermined set pressure to protect pressure vessels and other equipment from being subjected to pressure that exceed their design limits.

1.2.5. Proximity Sensor

These sensors activates when a metal object get closed to them. They are placed on the pump's box at the beginning and end of the cylinder's course in order to stop further movement of the cylinders.

1.2.6. Pressure Transducer

Each pump cylinder is plumbed to a pressure transducer. The pressure transducer measures the fluid pressure inside the cylinder barrel and converts this pressure measurement to an electric signal. This electric signal is then sent to the pump controller through a transducer cable. The transducer cable has a 4–pin connector at the pump controller end. The pressure transducers must be calibrated properly for the pump system to provide pulse less flow. If you plan to operate your pump at a pressure under 500 psi it will perform better with a pressure transducer with a lower pressure range (optional)

1.2.7. Pressure Gauge

There are two gauges connected to the pump cylinders. These gauges are prepared based on the working pressure of the system.

1.2.8. Plumbing

The pump cylinders use 1/4" tubing for fluid flow plumbing and 1/8" tubing for the pressure transducer connections.

1.2.9. Pump Software and PC-panel

The pump system includes pump software, which runs on a PC-compatible computer, using Windows XP operating system. The software allows the user to set operating parameters, such as fluid flow rate, pressure, injected volume and limitation for pressure. Pump provides the user with full system status information at all times. Data logging capabilities are available, allowing the user to automate data collection.

2. SYSTEM CHECKOUT AND OPERATION

This section provides important checkout procedures designed to help ensure the safe operation of the pump as below:

- When to perform the system checkout
- Verification of all cable and plumbing connections
- Valve and connection check
- Pump cylinder check
- Air removal procedure
- Pressure transducer check

NOTE: SAFETY PROCEDURES ARE ESSENTIAL TO SAFE OPERATION OF THE BBS PUMP. FOLLOW THEM CAREFULLY.