WELKER

INSTALLATION, OPERATION, AND MAINTENANCE MANUAL FOR WELKER® LIGHT LIQUID SAMPLING SYSTEM

PART NUMBER
LS15E03B0000

DRAWING NUMBER
AD245CW.3

MANUAL NUMBER
IOM-256

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SAFETY

IMPORTANT SAFETY INFORMATION
READ ALL INSTRUCTIONS

NOTES emphasize information and/or provide additional information to assist the user.

CAUTION messages appear before procedures that could result in damage to equipment if not observed.

WARNING messages appear before procedures that could result in personal injury if not observed.

This manual is intended to be used as a basic installation of operation guide for the Welker® Light Liquid Sampling System, Part #LS15E03B0G00. For further information and instructions, please refer to the Installation, Operation, and Maintenance *(IOM)* Manuals *for each individual component. A list of relevant component* IOM Manuals *is provided in the* Appendix *to this manual.*

The information in this manual has been carefully checked for accuracy and is intended to be used as a guide for the installation, operation, and maintenance of the Welker® equipment described in this manual. Correct installation, operation, and maintenance, however, are the responsibility of the end user. Welker® reserves the right to make changes to this manual and all products in order to improve performance and reliability.

BEFORE YOU BEGIN

Read these instructions completely and carefully.

IMPORTANT – Save these instructions for local inspectors' use.

IMPORTANT – Observe all governing codes and ordinances.

Note to Installer – Leave these instructions with the end user.

Note to End User – Keep these instructions for future reference.

Installation of this Light Liquid Sampling System is of a mechanical and electrical nature.

Proper installation is the responsibility of the installer. Product failure due to improper installation is not covered under the warranty.

If you received a damaged Light Liquid Sampling System, please contact a Welker® representative immediately.

Phone: 281.491.2331
Address: 13839 West Bellfort Street
Sugar Land, TX 77498

SECTION 1: PRODUCT INFORMATION

1.1 Introduction

We appreciate your business and your choice of Welker® products. The installation, operation, and maintenance liability for this equipment becomes that of the purchaser at the time of receipt. Reading the applicable *Installation, Operation, and Maintenance* (IOM) *Manuals* prior to installation and operation of this equipment is required for a full understanding of its application and performance prior to use.*

If you have any questions, please call Welker® at 1.281.491.2331.

**The following procedures have been written for use with standard Welker® parts and equipment. Assemblies that have been modified might have additional requirements and specifications that are not listed in this manual.*

1.2 Product Description

The Welker® *LS-15 Light Liquid Sampling System* is designed to collect, retain, and mix large volumes of representative composite sample. The LS-15 incorporates engineered features that ensure the sample is retained in a state representative of its constituent liquids, suitable for reliable laboratory analysis results.

The complete LS-15 system is skid-mounted along with a bolted-on center support/lifting column, a custom electrohydraulic unit (EHUC), and an inert gas tank. The EHUC drives the incorporated sample pump, and the connected inert gas supply applies and maintains constant pressure on the sample in the LS-15 to prevent vaporization and the escape of entrained gases. The LS-15 is designed with a mixing plate—that can be manually actuated by the operator—to thoroughly mix the sample prior to transfer to a transportable container for laboratory analysis.

The EHUC—also known as a hydraulic power unit or HPU—is designed to generate hydraulic pressure to use for actuating the sampling equipment. When pneumatic supply is impractical or unavailable, the EHUC can be used instead. It is powered by a 1-phase, AC 115/230 V, 60 Hz motor, actuated by a 4-way DC 24 V solenoid.

Optional equipment can be added to enable remote operation: a controller to take samples automatically, a magnetostrictive level indicator to communicate product level to a Programmable Logic Controller (PLC), and a proximity switch to signal the PLC when the desired volume of sample has been collected.

For this manual, the term "Programmable Logic Controller" (PLC) will refer to the PLC, DCS, or other signal control used by the customer.

Welker® might custom design the LS-15 Light Liquid Sampling System to suit the particular application and specifications of each customer.

1.3 Specifications

The specifications listed in this section are generalized for this equipment. Welker® can modify the equipment according to your company's needs. **Please note that the specifications may vary depending on the customization of your equipment.**

Table 1: Welker® LS-15 Light Liquid Sampling System Specifications	
Products Sampled	Condensate, Light Crude Oil, Light Liquid Hydrocarbons, Liquid Petroleum Gas, Natural Gas Liquids, and Refined Products
Materials of Construction	316/316L Stainless Steel, Aluminum, Carbon Steel, PTFE, and FKM
Maximum Allowable Operating Pressure	2160 psig @ -20 °F to 100 °F (148 barg @ -28 °C to 37 °C) Others available
Connections	Drain: ¼" FNPT (Plugged) Hydraulic Pressure Inlet: ½" FNPT (Plugged) Manifold Pressure Test Port: ¼" FNPT (Plugged) Pre-Charge Fill Inlet: ¼" FNPT Relief Outlets (Qty = 2): ¼" FNPT Sample Draw-Off: ¼" FNPT Sample Inlet: ¼" FNPT Sample Pump Actuation Hydraulic Connection: $^3/_8$" FNPT (Plugged) Tank Return: ½" FNPT (Plugged)
Utility Requirements	4 US Gallon Hydraulic Oil Reservoir Inert Gas Supply
Electrical Connections	Electrohydraulic Unit (EHUC): AC 115/230 V
Motor—Power	**EHUC:** 1-Phase, AC 115/230 V, 1800 RPM @ 60 Hz
Motor Starter	1-Phase
Sample Volume	5 US Gallons at 80%
Operation	Hydraulic or Manual Mixer Actuation
Mounting	Skid-Mounted With Bolted-On Center Support Lifting Column With Lifting Eye
Approximate Weight	900 lb
Approximate Dimensions	36" x 31" x 91" (Length x Width x Height)
Features	Composite Sample Draw-Off Port/Valve EHUC Explosion-Proof Motor Electrohydraulic Unit (EHUC) With 4 US Gallon Hydraulic Oil Reservoir Inert Gas Supply Tank Insert Gas Supply Tank Port/Valve Manifold Block Mixer Actuation Solenoid Plate Mixer Pressure Gauges Product Return Port / Check Valve Skid Weld Assembly Visual Magnetic Volume Indicator
Industry Standards / Product Certifications	UL/CSA Components (EHUC Motor and Solenoid Valve) Welker® Manufactured Traceable Components (Certificates Available for Separate Purchase)
Electrical Area Classification	NEC Class I, Div. 1, Groups C&D

Table 1: Welker® LS-15 Light Liquid Sampling System Specifications, *Continued*	
Options	Digital Controller Flow Switch Magnetostrictive Level Indicator Pneumatic Supply Conditioning System Proximity Switch Solenoid(s) Welker® AVE-2 Volume Analyzer Welker® InLoop™ Crude Oil Sampler Welker® MPS-2 Gas Sampler Welker® SSO-9M Mini Injection Pump Welker® SSO-9MED Injection Pump CRN Certification

1.4 Equipment Diagrams

Figure 1: Light Liquid Sampling System Schematic Diagram

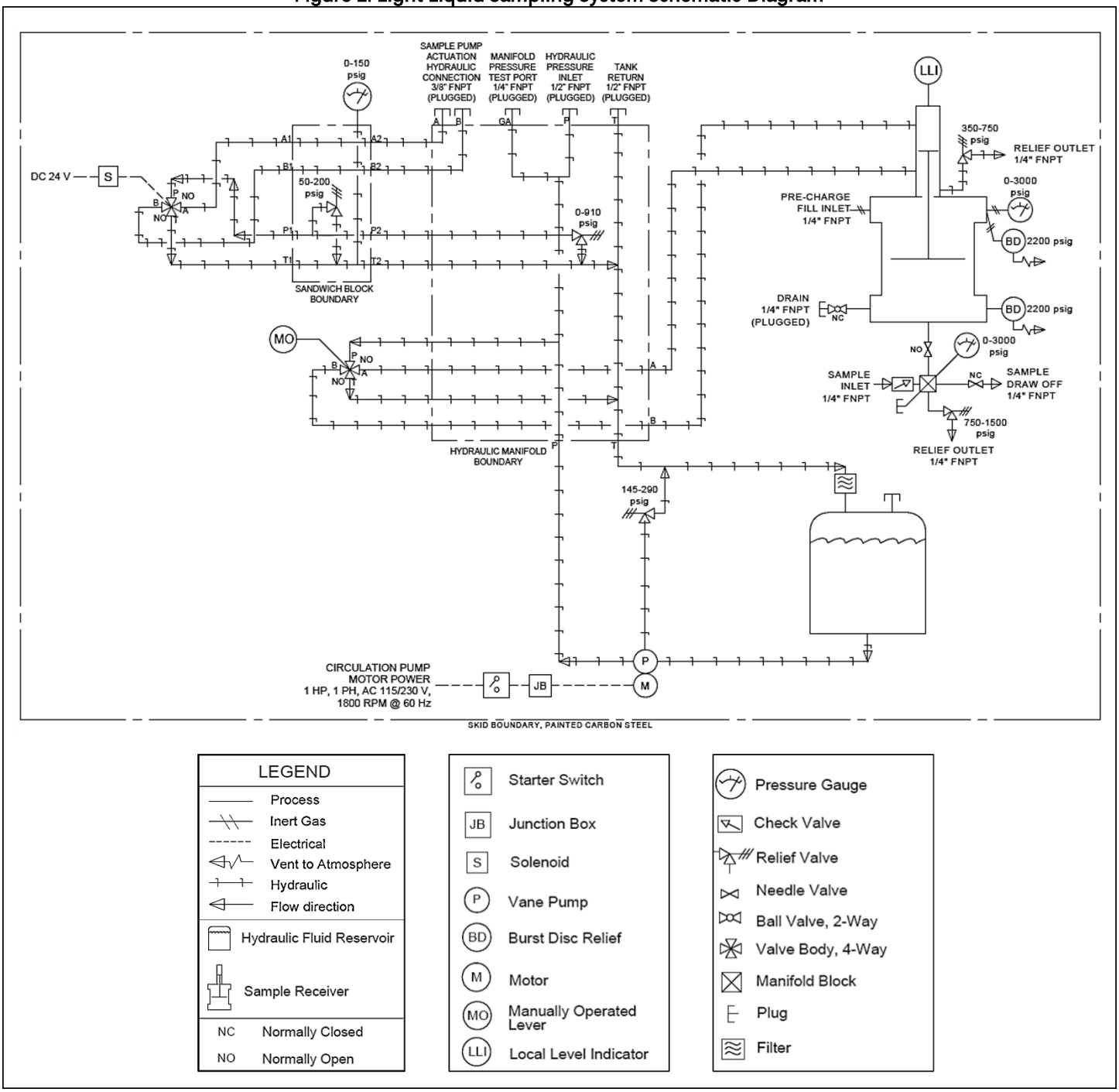
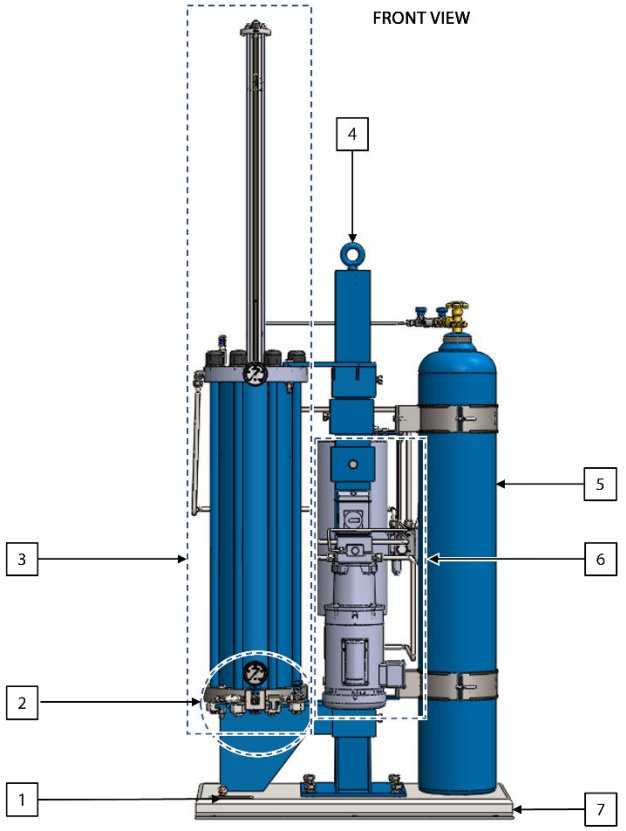
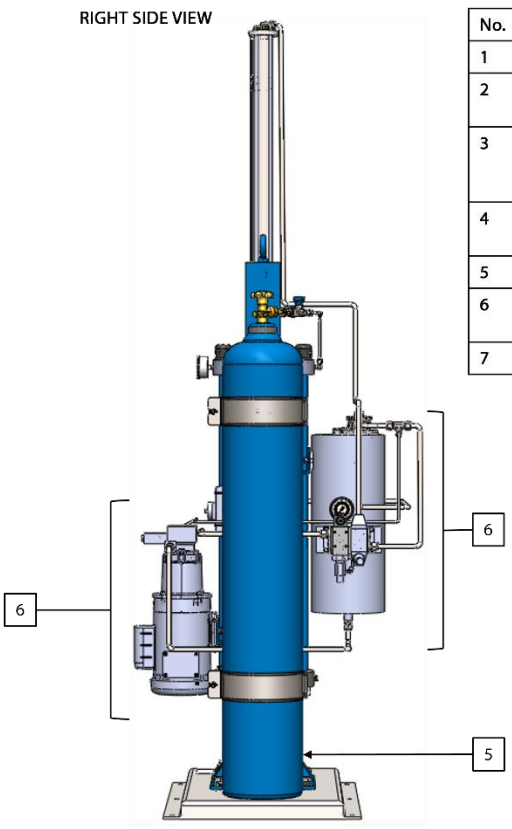
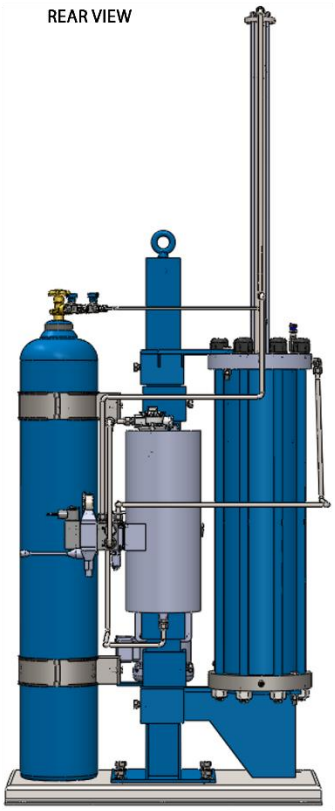


Figure 2: LS-15 Light Liquid Sampling System General Arrangement Diagram





No.	Description
1	Grounding Lug
2	Detail B – LS-15 Manifold Block (See *Figure 7*)
3	Detail A – LS-15 Constant Pressure Cylinder (See *Figure 4*)
4	Lifting Eye on Bolted-On Center Column
5	220 cu ft Nitrogen Cylinder
6	Detail C – Electrohydraulic Unit (EHUC) (See *Figure 8*)
7	Skid – Painted, Anodized



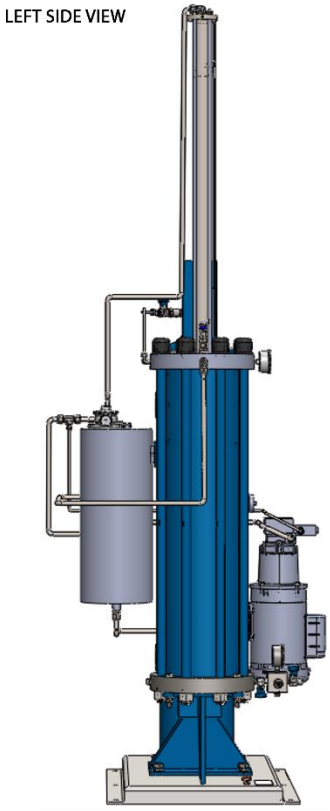
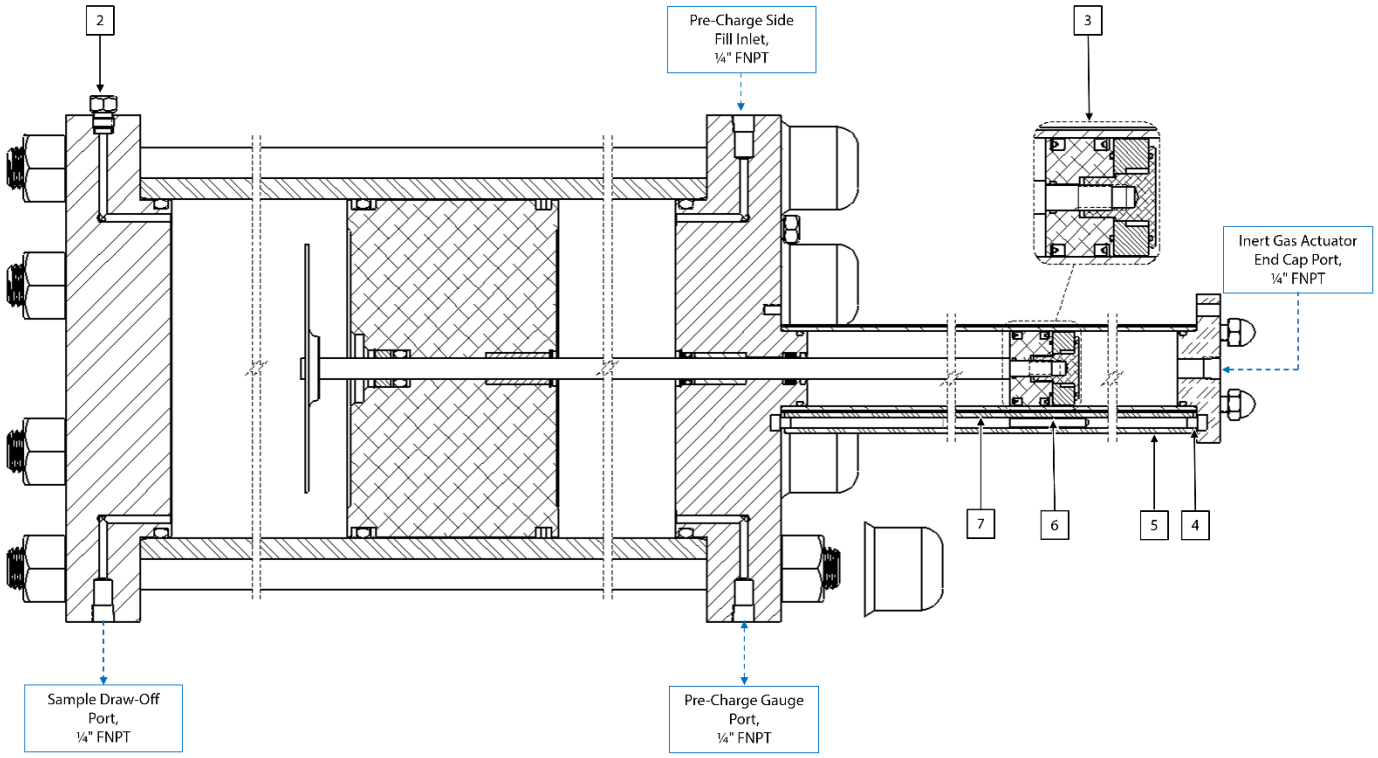
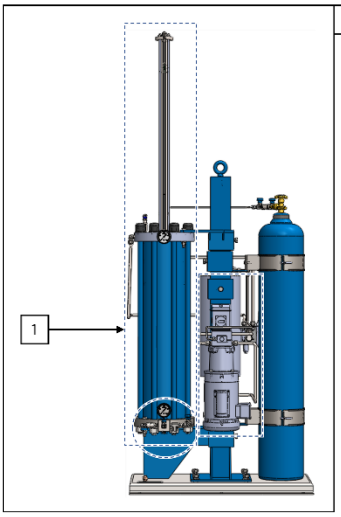


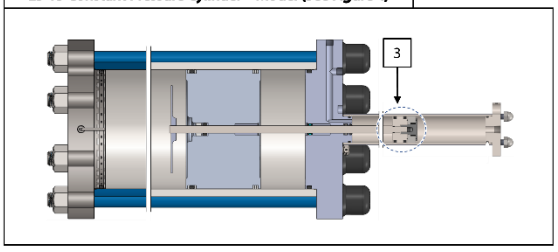
Figure 3: LS-15 Constant Pressure Cylinder Connections Diagram – Detail A



LS-15 Light Liquid Sampling System, General Arrangement

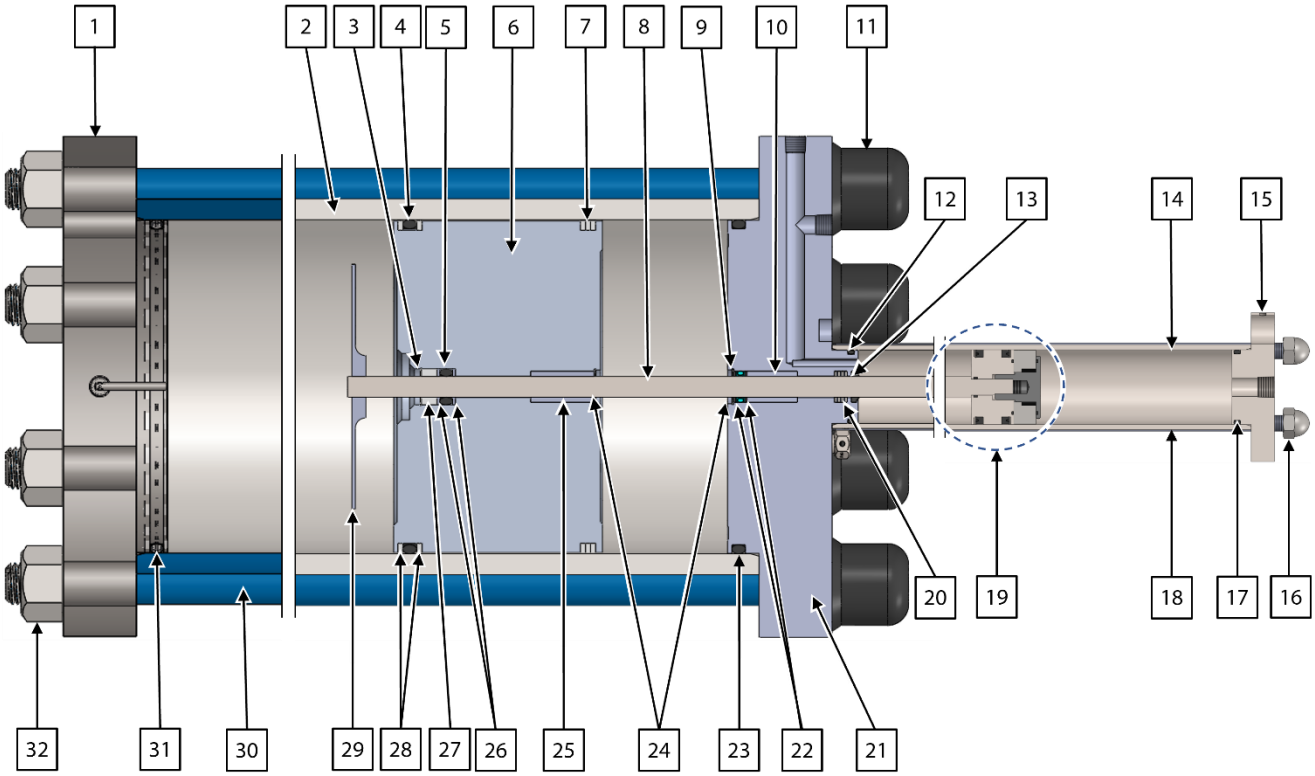


LS-15 Constant Pressure Cylinder – Model (See *Figure 4*)



No.	Description
1	Detail A – Shown Above and in *Figure 4* and *Figure 5*
2	Rupture Disk With Bursting Relief Cap
3	Magnet/Piston Assembly Detail (See *Figure 5*)
4	Tracker Tube Pin
5	Tracker Tube
6	Pin Tracker
7	Tracker Tube Pin

Figure 4: LS-15 Constant Pressure Cylinder Diagram – Detail A

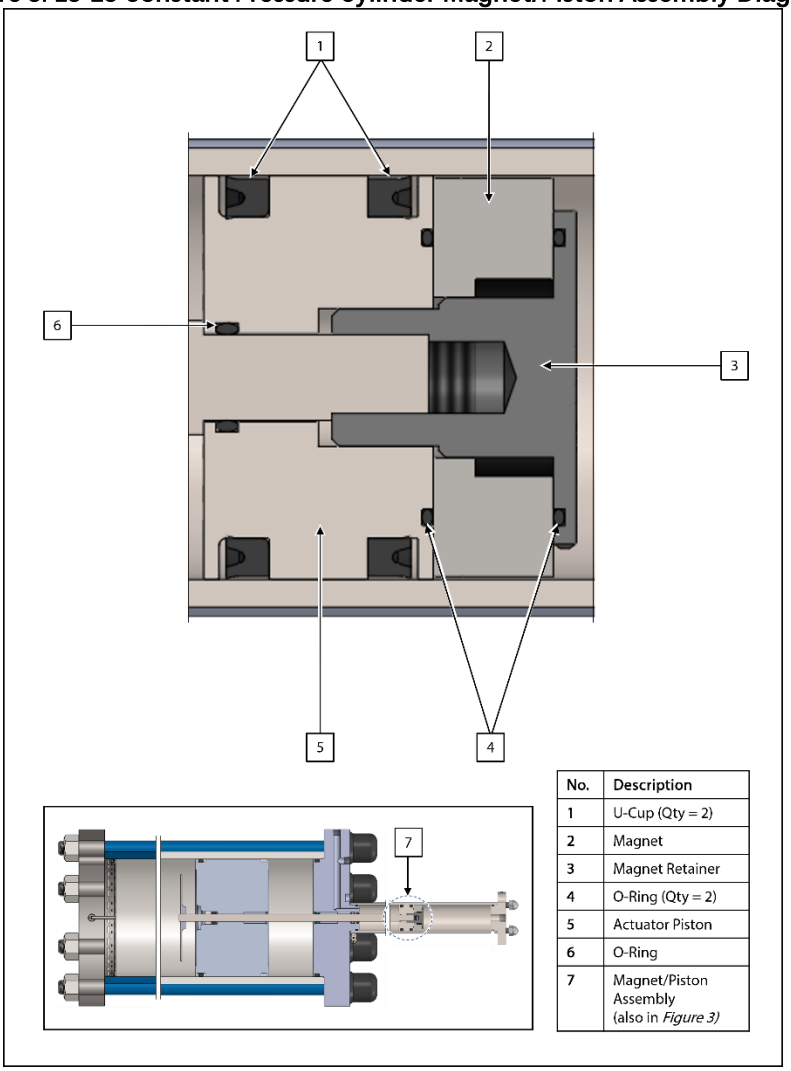


No.	Description
1	Bottom Flange
2	Receiver Cylinder LS-14, 5-Gallon
3	Retaining Ring
4	O-Ring
5	O-Ring
6	Aluminum Receiver Piston
7	Backup Split (Qty = 3)
8	Mixing Shaft
9	Crown Seal
10	Bearing
11	Receiver Cylinder Heavy Hex Nut & Nut Cover (Qty = 8 Each)

No.	Description
12	O-Ring (Qty = 2)
13	Wiper Ring
14	Actuator Cylinder
15	Actuator End Cap
16	Crown Nut & Bolt (Qty = 4 Each)
17	O-Ring
18	Tracker Tube
19	Magnet/Piston Assembly (See *Figure 5 for Detail*)
20	Backup Spiral (Qty = 4)
21	Midsection Cap

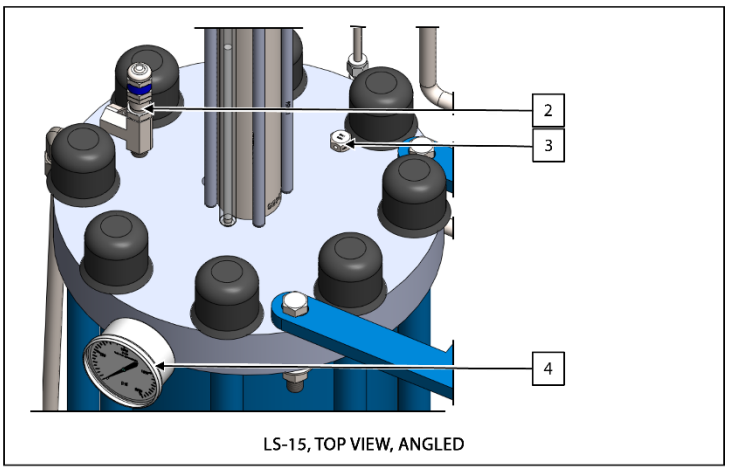
No.	Description
22	Backup Ring Solid (Qty = 2)
23	O-Ring
24	Snap Ring (Qty = 2)
25	Bearing
26	Backup (Qty = 2)
27	Bearing
28	Backup Spiral (Qty = 2)
29	Mixing Plate, 5-Gallon
30	Tie Bolt (Qty = 8)
31	O-Ring
32	Receiver Cylinder Heavy Hex Nut (Qty = 8)

Figure 5: LS-15 Constant Pressure Cylinder Magnet/Piston Assembly Diagram



No.	Description
1	U-Cup (Qty = 2)
2	Magnet
3	Magnet Retainer
4	O-Ring (Qty = 2)
5	Actuator Piston
6	O-Ring
7	Magnet/Piston Assembly (also in *Figure 3)*

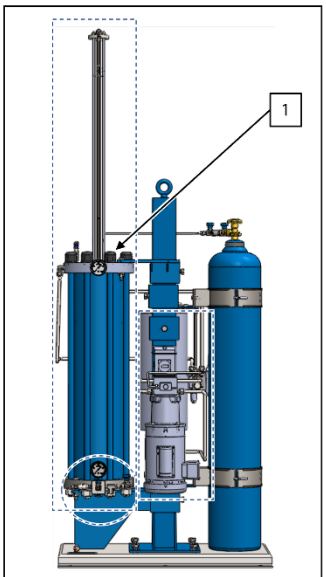
Figure 6: LS-15 – Top View Detail



LS-15, TOP VIEW, ANGLED

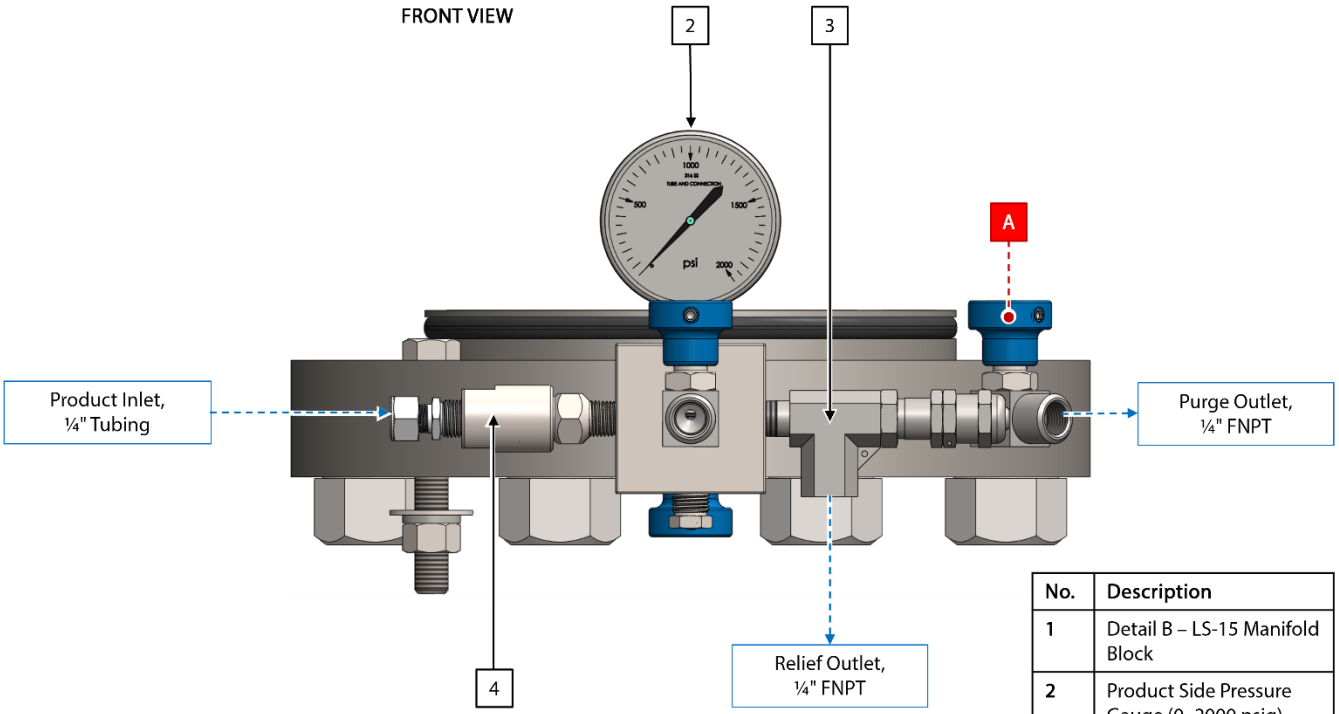
No.	Description
1	Detail – LS-15 Top View
2	External Relief, 350–750 psig

No.	Description
3	Rupture Disc, ¼" 2200 psig, With Bursting Relief Cap
4	Pre-Charge Side Pressure Gauge, 0–2000 psig

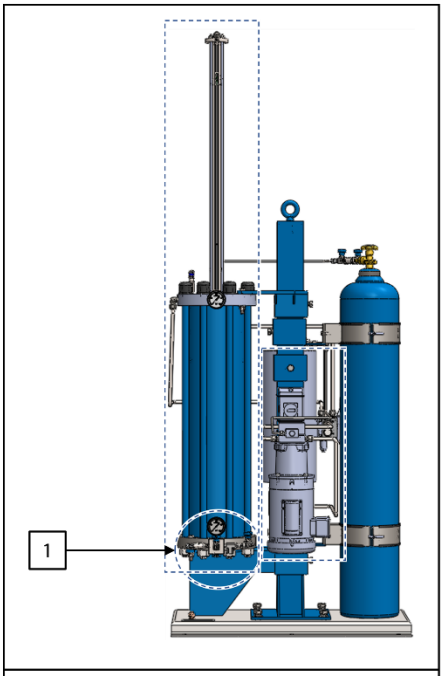


LS-15 Light Liquid Sampling System, General Arrangement

Figure 7: Welker® LS-15 Constant Pressure Cylinder Manifold Block – Detail B



No.	Description
1	Detail B – LS-15 Manifold Block
2	Product Side Pressure Gauge (0–2000 psig)
3	External Relief
4	Check Valve
5	Manifold Block
A	Purge/Return Valve
B	Composite Sample Draw-Off Valve
C	Sample Container Isolation Valve



LS-15 Light Liquid Sampling System, General Arrangement

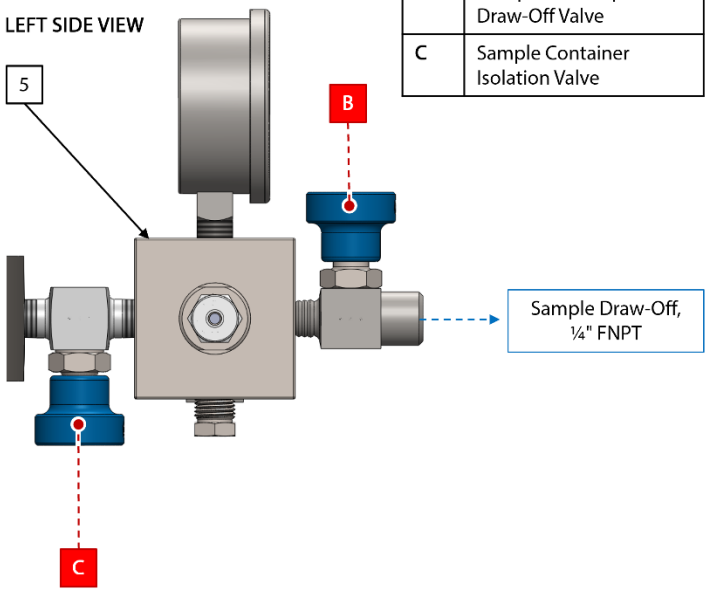
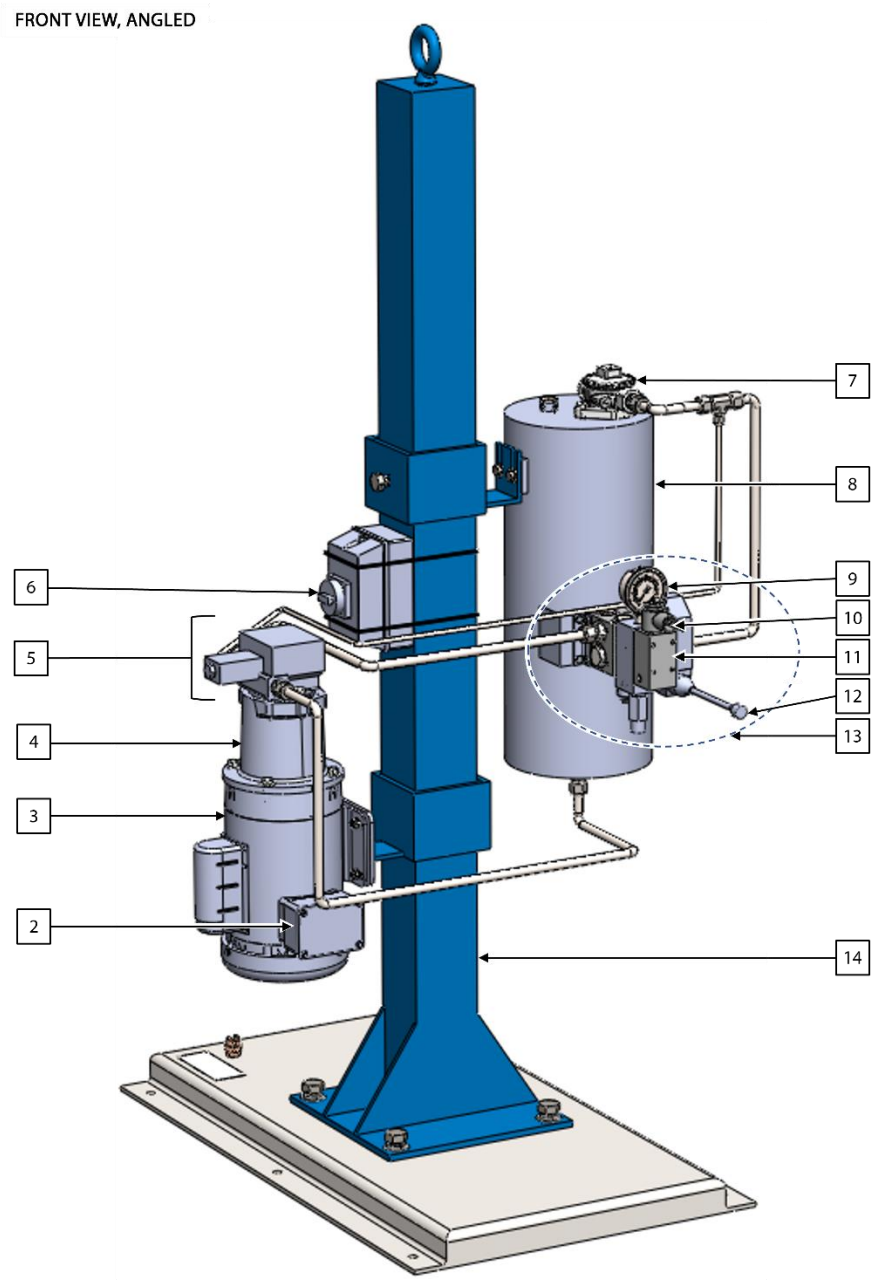
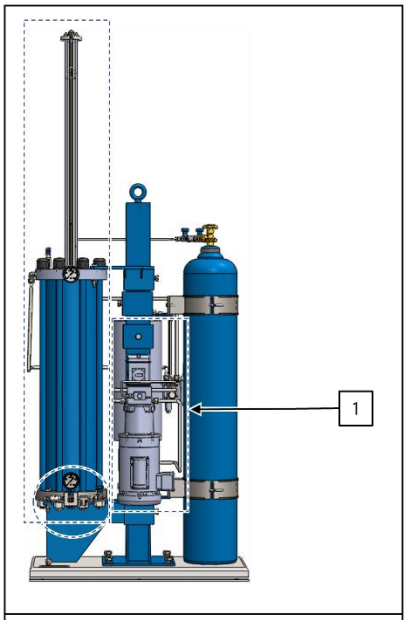


Figure 8: Welker® Electrohydraulic Unit Diagram – Detail C

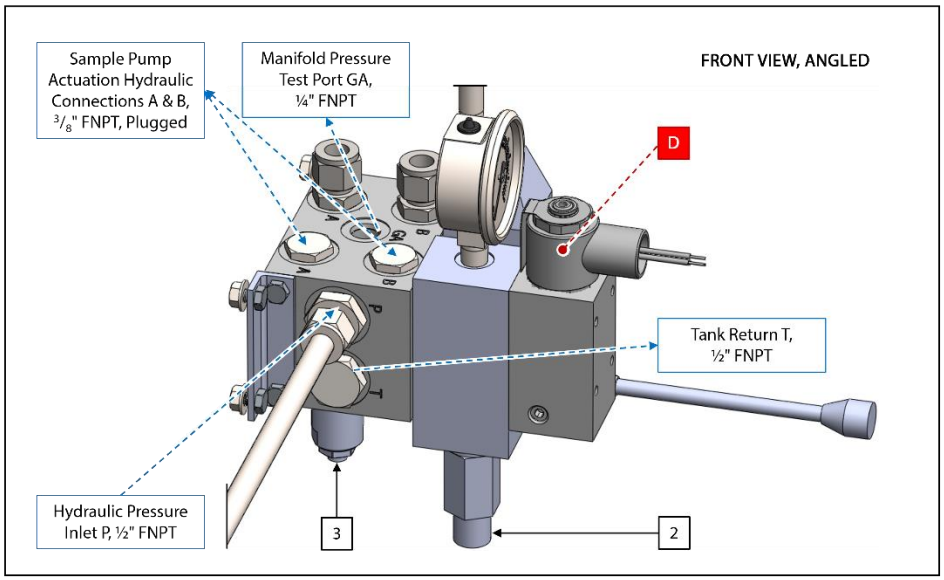


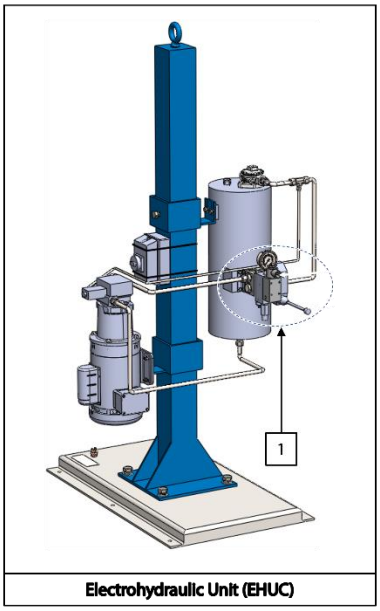


LS-15 Light Liquid Sampling System, General Arrangement

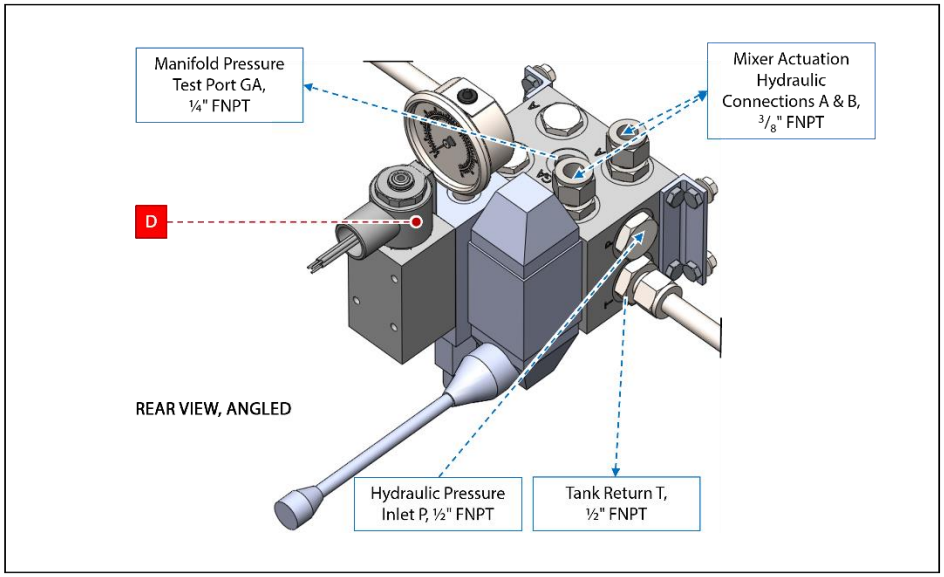
No.	Description
1	Detail C – Electrohydraulic Unit (EHUC)
2	EHUC Motor Electrical Housing
3	Explosion-Proof Motor
4	Pump Mount
5	Vane Pump
6	Motor Starter (ON/OFF Button)
7	Fluid Filter Assembly
8	4 US Gallon Hydraulic Tank
9	Differential Pressure Gauge
10	4-Way Solenoid
11	Manifold Block
12	Manually Operated Mixer Lever
13	Solenoid Assembly Manifold Block (See *Figure 9*)
14	Center Mounting Post

Figure 9: Welker® Electrohydraulic Unit Solenoid Assembly Manifold Block Diagram



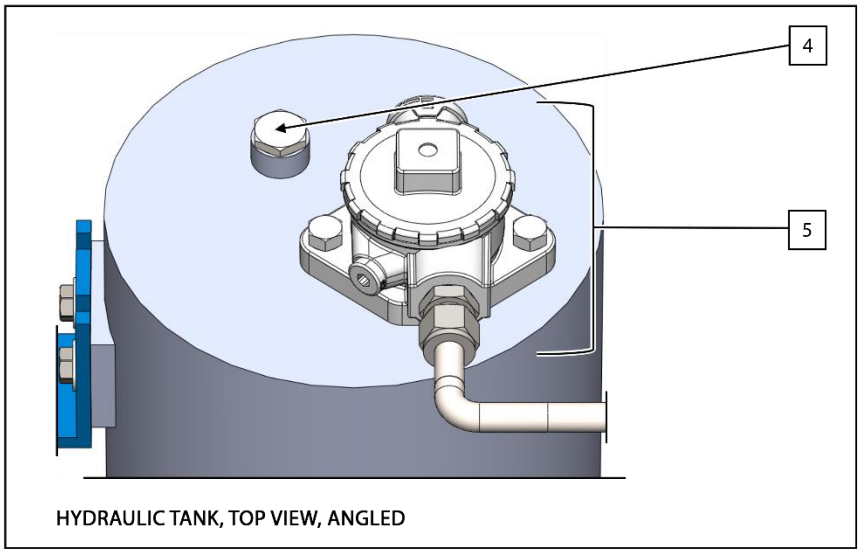


Electrohydraulic Unit (EHUC)



No.	Description
1	Detail – Solenoid Assembly Manifold Block
2	Relief Valve
3	Relief Valve
D	4-Way Solenoid Valve

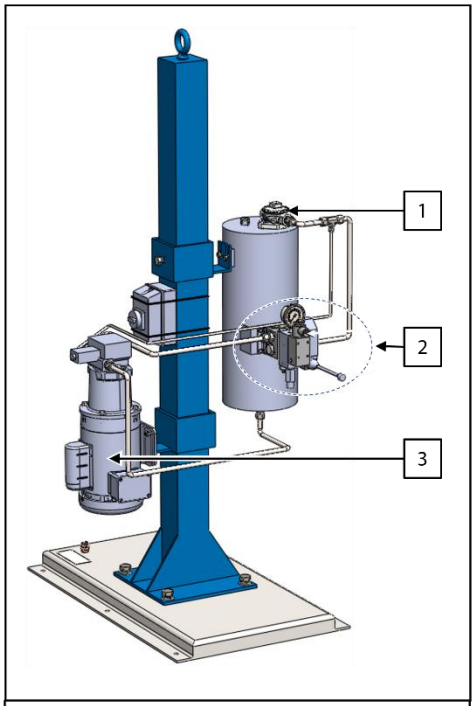
Figure 10: Electrohydraulic Unit Hydraulic Tank and Motor Alternate Views Diagram



HYDRAULIC TANK, TOP VIEW, ANGLED

No.	Description
1	EHUC Fluid Filter Assembly
2	Detail – Solenoid Assembly Manifold Block and Vane Pump (See *Figure 8*)

No.	Description
3	Explosion-Proof Motor
4	Hydraulic Oil Fill Cap
5	EHUC Fluid Filter Assembly



Electrohydraulic Unit (EHUC)

SECTION 2: INSTALLATION & OPERATION

2.1 Before You Begin

After unpacking the Welker® Light Liquid Sampling System, check it for compliance and any damage that might have occurred during shipment. Immediately contact a Welker® representative if you received a damaged Light Liquid Sampling System.

When sealing fittings with PTFE tape, refer to the proper sealing instructions for the brand used.

The Welker® Light Liquid Sampling System will ship "hard-tube" connected with manufacturer-supplied fittings and hardware. However, the customer will need to supply tubing in order to complete the installation of the system.

All electrical connections must meet local and national electric codes, and excessive weight added to the conduit run must be supported.

2.2 Installation

1. Locate the skid as close as possible to the sample point.
2. Mount the skid to a flat, level surface, such as a concrete slab.
3. Connect a grounding wire to the grounding lug on the skid to safely ground the system (*Figure 2*).
4. Ensure that all valves—including the pipeline isolation valve—are closed.
5. Using appropriately sized tubing, connect from purge/return valve A (*Figure 7*) to the pipeline.
6. As necessary, connect a sampler to the product inlet on the manifold block.
7. As necessary, connect from the solenoid to the sampler.
8. Apply pressure from the sampler to the manifold block. Check for leaks and repair or replace as necessary.
9. Open the reservoir cap on the electrohydraulic unit (EHUC). Then fill the reservoir with the appropriate volume of ISO 46 hydraulic fluid. Refer to the *Installation, Operation, and Maintenance* (IOM) *Manual* for the EHUC for instructions on filling the reservoir and for recommendation regarding the type of hydraulic fluid to use.
10. Connect an appropriate electrical supply to the EHUC motor.
11. As necessary, connect a DC 24 V electrical supply to the level indicator.
12. As necessary, connect the solenoid to the PLC. Refer to industry standards for appropriate electrical connections to interface with the PLC.
13. As necessary, set the PLC to the desired timed or proportional-to-flow sampling frequency based on the sampling actuation equations provided (*Figure 11*).

Figure 11: Sampling Frequency Equations

Liquid Sampling, Proportional-to-Flow Collection

Equation 1: Number of Samples Needed

$$\text{Number of Samples Needed to Fill to 80\%} = \frac{\text{(Container Size (cc) * 0.8)}}{\text{Bite Size (cc)}}$$

Equation 2: Proportional-to-Flow

$$\text{Volume of Flow Between Sample Grabs} = \frac{\text{Batch Size (Total Volume to Be Sampled)}}{\text{Number of Samples Needed (Eq. 1)}}$$

Use Equation 1 to determine the number of actuations needed.
Use Equation 2 to determine how often (after what volume of flow) to take each sample.

Liquid Sampling, Timed Collection

Equation 1: Number of Samples Needed

$$\text{Number of Samples Needed to Fill to 80\%} = \frac{\text{(Container Size (cc) * 0.8)}}{\text{Bite Size (cc)}}$$

Equation 2: Proportional-to-Flow

$$\text{Time Between Sample Grabs} = \frac{\text{Total Time in Sample Period}}{\text{Number of Samples Needed (Eq. 1)}}$$

Use Equation 1 to determine the number of actuations needed.
Use Equation 2 to determine how often (after what volume of flow) to take each sample.

NEVER fill the cylinder above 80% of its capacity. Allow AT LEAST 20% room for product expansion should the cylinder be exposed to increased temperatures.

Note that there are 3,785 cc in 1 US gallon. The LS-15 contains 5 US gallons at 80%, which is the equivalent of 18,925 cc.

Filling the Inert Gas Supply Tank

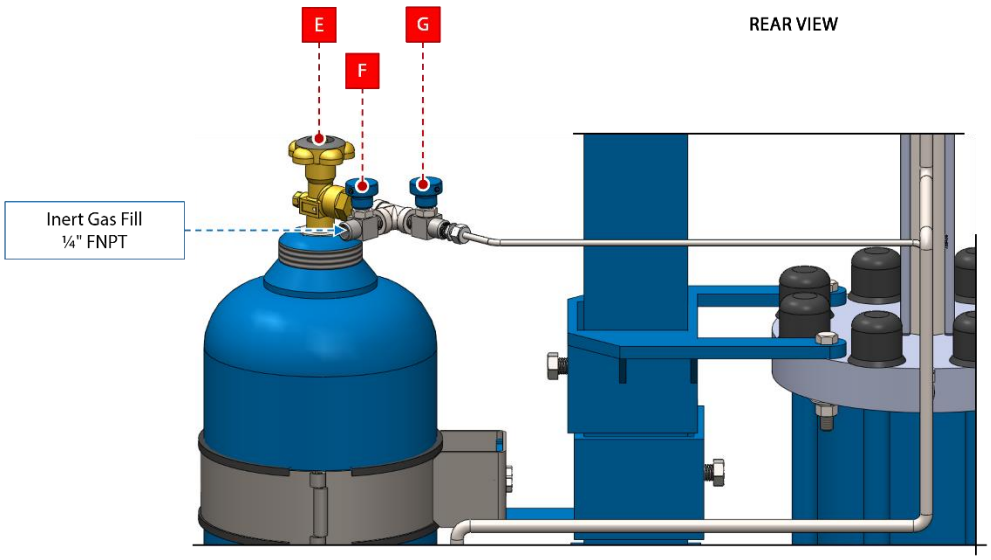
The inert gas being used to pre-charge the LS-15 must be compatible with the seals in the LS-15. Welker® recommends using nitrogen or helium as the inert gas supply.

The relief valves and gauges must be adequate for the pressure used to pre-charge the LS-15.

Pre-charging must be complete before product is supplied to the system.

Inert gas tanks are shipped empty from the manufacturer.

Figure 12: Inert Gas Supply Valve Configuration and Connection Diagram



No.	Description
E	Inert Gas Supply Tank Valve
F	Inert Gas Supply Tank Fill Valve
G	Inert Gas Supply Tank Isolation Valve

1. Connect an appropriate customer-supplied nitrogen or other inert gas supply container to the inert gas fill ¼" FNPT connection (*Figure 12*).
2. Open valves E and G. Then slowly open valve F (*Figure 12*).
3. Allow the inert gas supply tank to fill.
4. While filling the inert gas supply tank, refer to the pre-charge side pressure gauge to monitor the pressure of the tank (*Figure 6*).
5. If the product side pressure gauge shows pressure, open purge / return valve A to lower the piston and relieve pressure within the LS-15 (*Figure 7*).
6. Fill the inert gas supply tank until the pre-charge side pressure gauge reads 50–100 psig above pipeline operating pressure—not to exceed the maximum allowable operating pressure of the LS-15.
7. When the inert gas supply tank is full, close valve F and disconnect the customer-supplied inert gas supply container. Valves E and G must remain open (*Figure 12*).
8. Plug the inert gas fill connection by wrapping the threads of a male hex plug with PTFE tape and screwing it into the port of valve F (*Figure 12*). Valve F must remain plugged at all times EXCEPT when adding inert gas to the inert gas supply tank.
9. Check all connections between the inert gas supply tank and the receiver cylinder for leaks. Repair or replace as necessary.
10. Proceed to *Section 2.3, Preparing for Sampling*, for instructions on using the electrohydraulic unit (EHUC) for mixer actuation.

2.3 Preparing for Sampling

1. Open the pipeline connection.
2. As necessary, adjust the sample volume on the sampler. Refer to the *Installation, Operation, and Maintenance* (IOM) *Manual* for the sampler for instructions on adjusting the sample volume.
3. Turn ON power to the system.
4. Manually turn ON the motor starter for the EHUC *Figure 8* shows the location of the EHUC motor ON/OFF (i.e., starter) button.
5. Purge the LS-15 prior to beginning composite sampling.

Purging the LS-15

Welker® recommends that the LS-15 be evacuated or purged prior to each sample batch to prevent cross-contamination between samples.

6. Open sample container isolation valve C (*Figure 7*). Ensure that composite sample draw-off valve B is closed.
7. Begin product flow through the system.
8. Open purge / return valve A (*Figure 7*).
9. Manually or remotely actuate the sampler to purge the line of air or previous product.
10. When all previous product has drained from the LS-15, close purge / return valve A (*Figure 7*).

Verifying Sampler Operation

11. Close sample container isolation valve C (*Figure 7*).
12. Manually actuate the customer-supplied sampler using the manual override on the customer-supplied solenoid.
13. Observe the product side pressure gauge on the LS-15 (*Figure 7*). If the sampler is operating correctly, a spike in pressure will be shown.
14. When sampler operation has been verified, open sample container isolation valve C on the manifold block (*Figure 7*).

Valve C on the manifold block MUST remain open for the duration of composite sampling.

2.4 Composite Sampling

1. Ensure that valves E and G on the inert gas supply tank are open (*Figure 12*).

> Valves E and G on the inert gas supply tank (*Figure 12*) MUST remain open for the duration of composite sampling.

2. Ensure the sample container isolation valve C is open (*Figure 7*).

> If sample container isolation valve E is not open, product will vent through the relief valve instead of entering the LS-15.

3. Ensure that the EHUC is ON (*Figure 8*)
4. Ensure that the pipeline connection is open and sample is flowing to the sample receiver.
5. For sampling operation procedures, refer to the *Installation, Operation, and Maintenance* (IOM) *Manual* for the sampler.
6. The magnetic pin tracker on the LS-15 (*Figure 3*) should begin to rise as product fills the LS-15.
7. Allow the LS-15 to fill to the desired volume—not to exceed 80% (i.e., 5 US gallons).

> STOP
>
> NEVER fill the cylinder above 80% of its capacity. Allow AT LEAST 20% room for product expansion should the cylinder be exposed to increased temperatures.

Withdrawing Product for Transportation After Composite Sampling

> Welker® recommends the following transportable containers for use with this unit:
>
> - Welker® Constant Pressure Cylinders for light liquid products.
> - Welker® Constant Pressure Cylinders or chilled containers for Reid vapor pressure (RVP) testing.
> - Capped metal or amber glass containers of the appropriate volume for retaining samples.

8. As necessary, turn OFF and isolate the sampler from the LS-15.
9. To transfer sampled product to a constant pressure cylinder for laboratory analysis, connect the product side of the constant pressure cylinder to composite sample draw-off valve B (*Figure 7*). The cylinder should have a pre-charge pressure of approximately 100 psig above the product pressure in the LS-15. Refer to the *Installation, Operation, and Maintenance* (IOM) *Manual* for the constant pressure cylinder for pre-charging instructions.
10. Prior to withdrawing sample product from the LS-15, the operator should manually cycle the mixer four to five (4 to 5) times. Alternately hold up and release the manually operated mixer lever on the EHUC (*Figure 8*).
11. With sample container isolation valve C open, open composite sample draw-off valve B on the LS-15 (*Figure 7*). Then open the inlet valve on the constant pressure cylinder.
12. Slowly open the product purge valve on the constant pressure cylinder to purge any air. Shut the valve completely when liquid begins to purge.
13. Actuate the hydraulic mixer (*Figure 8*) for another three to four (3 to 4) complete cycles.
14. Slowly open the pre-charge valve on the constant pressure cylinder and allow the constant pressure cylinder to fill to the desired volume—not to exceed 80%

> STOP
>
> NEVER fill the cylinder above 80% of its capacity. Allow AT LEAST 20% room for product expansion should the cylinder be exposed to increased temperatures.

15. After the transfer is complete, close composite sample draw-off valve B on the LS-15 (*Figure 7*) and the inlet valve on the constant pressure cylinder.
16. Disconnect the constant pressure cylinder from composite sample draw-off valve B (*Figure 7*).

17. Tag the constant pressure cylinder and prepare it for transportation to the testing laboratory in accordance with company policy.
18. If desired, repeat steps 9–17 to transfer any sampled product remaining in the LS-15 to additional constant pressure cylinders for laboratory analysis.

Draining the LS-15

Any sample remaining in the LS-15 MUST be eliminated prior to the start of the next round of composite sampling.

19. Open purge / return valve A on the LS-15 to return any remaining product to the pipeline (*Figure 7*).
20. Purge the LS-15 prior to beginning a new round of composite sampling. See *Section 2.3, Preparing for Sampling*, for instructions on purging the LS-15.
21. When the LS-15 has been purged, a new round of composite sampling may begin.

SECTION 3: MAINTENANCE

3.1 Before You Begin

1. **Welker® recommends that the unit have standard yearly maintenance under normal operating conditions.** In cases of severe service, dirty conditions, excessive usage, or other unique applications that might lead to excess wear on the unit, a more frequent maintenance schedule might be appropriate.
2. Prior to maintenance or disassembly of the unit, it is advisable to have a repair kit available for repairs to the system in case of unexpected wear or faulty seals.

New seals supplied in spare parts kits should be lightly lubricated before being installed to ease the installation of the seals and reduce the risk of damage when positioning them on parts. Wipe excess lubricant from the seals, because it might adversely affect analytical instrument results.

For sample-exposed seals, Welker® recommends non-hydrocarbon-based lubricants, such as Krytox®.
For non-sample-exposed seals, Welker® recommends either non-hydrocarbon-based lubricants or silicone-based lubricants, such as Molykote® 111.

After the seals are installed, the outer diameter of shafts and inner diameter of cylinders may be lubricated to allow smooth transition of parts.

2. All maintenance and cleaning of the unit should be performed on a smooth, clean surface.
3. Welker® recommends having the following tools available for maintenance. Please note that the exact tools required might vary by model.
    a. Channel Lock Pliers
    b. Large Crescent Wrench
    c. Seal Pick
    d. Small Crescent Wrench
    e. Torque Wrench

3.2 Maintenance

1. Turn OFF all electrical power to the system and completely shut down the system.

Check valves for leaks and repair or replace as necessary during reinstallation.

2. Close inert gas supply tank valve E to preserve the inert gas in the tank (*Figure 12*).
3. Depressurize the LS-15 by removing the plug from inert gas supply tank fill valve F and then opening inert gas supply tank fill valve F (*Figure 12*). Open inert gas supply tank isolation valve G (*Figure 12*).
4. Open purge / return valve A (*Figure 7*) to drain the LS-15 to the pipeline or to an environmentally clean and safe system.

Disassembling the LS-15

1. Disconnect the tubing from the actuator end cap (*Figure 4*).
2. Disconnect the tubing between the inert gas supply tank and the pre-charge fill inlet (*Figure 3*).
3. Remove the crown nuts and bolts from the actuator end cap (*Figure 4*). Then remove the end cap.
4. Remove the tracker tube and tracker magnet (*Figure 5*). Set them aside. Take care not to misplace the tracker tube pins inside the tracker tube.
5. Slowly slide the actuator cylinder (*Figure 4*) up and off the actuator piston (*Figure 5*).
6. Remove the magnet retainer, magnet, and actuator piston from the mixing shaft (*Figure 4*).
7. Remove the heavy hex nut covers and loosen the receiver cylinder heavy hex nuts on the midsection and their respective receiver cylinder hex nuts on the bottom flange.
8. Fully unscrew the eight (8) receiver cylinder heavy hex nuts on the midsection and their respective receiver cylinder hex nuts on the bottom flange (*Figure 4*).
9. Remove the eight (8) receiver cylinder tie bolts (*Figure 4*) by pulling them up and out of the midsection.
10. Remove the midsection from the LS-15.
11. Carefully lift the actuator end cap straight up and off the mixer shaft (*Figure 4*).
12. With the receiver piston still inside, carefully lift the receiver cylinder off the bottom flange.

The receiver cylinder is extremely heavy. It might be necessary to have a partner assist in removing the cylinder. Use appropriate personal protective equipment (PPE) and follow appropriate company policies for heavy lifting.

13. Gripping the mixing shaft above the mixing plate, gently pull the mixing shaft out through the bottom of the receiver piston, taking care not to scratch the mixing shaft because scratches might cause seals to leak. If scratches are present, the unit might need to be repaired or replaced. Contact Welker® for service options.
14. From the midsection top, slowly push the receiver piston out of the receiver cylinder (*Figure 4*). Note the position of the top and bottom of the piston and cylinder for ease of reassembly.

As necessary, use a lean wooden dowel or PVC pipe to gently push the piston out of the receiver cylinder. DO NOT use metal objects because they might scratch and damage the unit.

Receiver Cylinder Maintenance

1. Closely examine the polished and honed surfaces of the receiver cylinder, because scratches or pits might cause the seals to leak. If scratches or pits are present, the unit might need to be repaired or replaced. Contact Welker® for service options.
2. Lightly lubricate the inside of the receiver cylinder.

> DO NOT use a hydrocarbon-based lubricant, because it can leave a residue that can skew laboratory analysis results.

3. Ensure that the bearing in the receiver piston (*Figure 4*) is clean and smooth. Replace as necessary.
4. Replace the backups, O-rings, retaining ring, and snap ring on the receiver piston (*Figure 4*).
5. Closely examine the polished and honed surfaces on the mixing shaft, because scratches or pits might cause the seals to leak. If scratches or pits are present, the unit might need to be repaired or replaced. Contact Welker® for service options.
6. Lightly lubricate the mixing shaft.

> DO NOT use a hydrocarbon-based lubricant, because it can leave a residue that can skew laboratory analysis results.

7. Insert the mixing shaft into the receiver piston, taking care not to damage the seals. Gently rotate the threads through the seals.
8. Insert the receiver piston into the receiver cylinder.

Bottom Flange Maintenance

1. Replace the O-ring on the bottom flange (*Figure 4*).
2. Replace the burst relief disc on the bottom flange (*Figure 3*). Refer to the *Installation, Operation, and Maintenance* (IOM) *Manual* for the burst relief disc for instructions on installing replacement discs.
3. Tighten the burst relief cap to 25 ft·lb once the replacement burst relief disc has been installed.
4. Maintain the external relief (on the manifold block—*Figure 7*). Refer to the *Installation, Operation, and Maintenance* (IOM) *Manual* for the external relief for maintenance instructions.

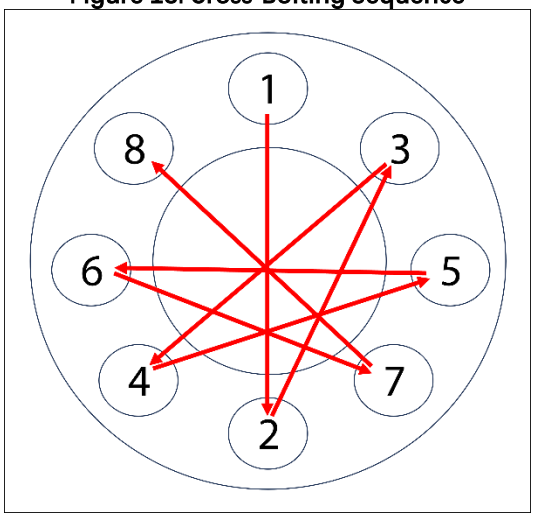
Midsection Cap Maintenance

1. Ensure that the bearing in the midsection cap is clean and smooth (*Figure 4*). Replace as necessary.
2. Replace the wiper ring, O-rings, backups, snap ring, and crown seal on the midsection cap (*Figure 4*).
3. Replace the burst relief disc (*Figure 6*). Refer to the *Installation, Operation, and Maintenance* (IOM) *Manual* for the burst relief disc for instructions on installing replacement discs.
4. Tighten the burst relief cap to 25 ft·lb once the replacement burst relief disc has been installed.
5. Maintain the external relief (*Figure 6*). Refer to the *Installation, Operation, and Maintenance* (IOM) *Manual* for the external relief for maintenance instructions.

Reassembling the Receiver Cylinder

1. Place the receiver cylinder onto the bottom flange (*Figure 4*).
2. Carefully place the midsection cap onto the receiver cylinder. The gauge port on the midsection cap should align with the gauge port on the bottom flange (i.e., manifold block).
3. Insert the receiver cylinder tie bolts into the bottom flange (*Figure 4*).
4. Following a cross-bolting sequence, first screw the receiver cylinder heavy hex nuts down two (2) threads on the top of each bolt. Then screw the heavy hex nuts up two (2) threads on the bottom of each bolt (*Figure 13*).

Figure 13: Cross-Bolting Sequence



5. Push each tie bolt up from the bottom. Then hand-tighten the heavy hex nuts on each top bolt.
6. Tighten all tie bolts to the correct torque (*Table 2*)—carefully using a torque wrench.

Table 2: Torque Specifications for Tie Bolts

Tie Bolt Diameter	Foot-Pounds (ft·lb)	Kilograms per Meter (kg/m)
⅜"	5–6	0.69–0.82
½"	15–20	2.07–2.76
⅝"	25–30	3.45–4.14
⅞"	55–65	7.60–8.98

Actuator Piston Maintenance

1. Replace the O-rings and U-cups on the actuator piston (*Figure 5*).
2. Replace the O-ring on the magnet retainer (*Figure 5*).

Reassembling the Actuator

1. Assemble the actuator piston, magnet, and magnet retainer (*Figure 5*).
2. Ensure that the tracker magnet and tracker tube pins are inside the tracker tube (*Figure 3*). Then carefully attach the volume indicator to the actuator cylinder.

If the tracker tube pins are not inside the tracker tube, the tracker magnet will fall below 0%, yielding an inaccurate reading.

3. Slide the actuator cylinder down into place over the mixing shaft.

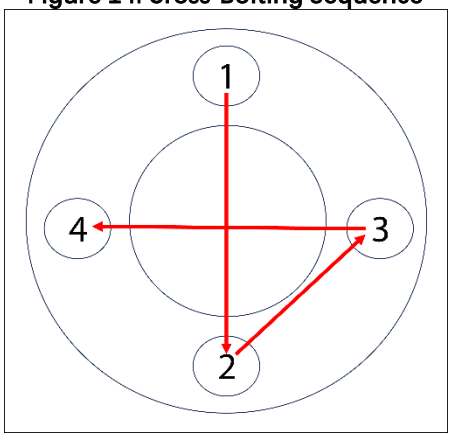
Actuator End Cap Maintenance

1. Replace the O-ring on the actuator end cap (*Figure 4*).

Reassembling the LS-15

1. Place the actuator end cap onto the actuator cylinder (*Figure 4*).
2. Following a cross-bolting sequence, hand-tighten the actuator crown nuts (*Figure 14*).

Figure 14: Cross-Bolting Sequence



3. Tighten all actuator crown nuts to the correct torque (*Table 2*).
4. Connect the tubing to the actuator end cap.
5. Connect the tubing between the inert gas supply tank and the pre-charge fill inlet (*Figure 3*).
6. Check the system for loose fittings. Tighten any loose fittings and replace ferrules where necessary.

Check valves for leaks and repair or replace as necessary.

Electrohydraulic Unit Maintenance

1. Refer to the *Installation, Operation, and Maintenance* (IOM) *Manual* for the electrohydraulic unit for maintenance instructions.

Placing the Light Liquid Sampling System Back Into Operation

1. Install and prepare the system according to the instructions in *Section 2.2, Installation*, and *Section 2.3, Preparing for Sampling*.

3.3 Troubleshooting Guidelines

Table 3: Welker® Light Liquid Sampling System Troubleshooting Guidelines		
Issues	**Possible Causes**	**Solutions**
The LS-15 will not fill to 80%.	Pre-charge pressure might not be relieving back to the inert gas supply tank.	Ensure that valve E and valve G on the inert gas supply tank are open during composite sampling. This allows pressure to be relieved back to the inert gas supply tank from the pre-charge side as product enters the LS-15 (*Figure 12*).
The LS-15 is filling too quickly.	Pre-charge pressure might not be supplied to the LS-15 at the appropriate pressure.	Apply additional pre-charge pressure to the LS-15 until the pre-charge pressure reaches 50–100 psig above pipeline operating pressure—not to exceed the maximum allowable operating pressure of the equipment.
	The sample might be set at a faster sampling frequency than desired.	Adjust the PLC to sample at the desired rate. Ensure that the calculations used to determine the sample frequency are correct (*Figure 11*).
The tracker magnet is not moving.	The hydraulic supply might not be directed below the actuator piston.	Ensure that the mixer actuation hydraulic connection is tubed to the bottom of the actuator cylinder.
	Sample is leaking from the receiver cylinder.	Ensure that purge / return valve A (*Figure 7*) is closed. Check for leaks between the sampler and the receiver cylinder and repair or replace as necessary.
The burst disc on the product side of the LS-15 is leaking.	The lifespan of the burst disc might have been exceeded.	Ensure that valve E and valve G on the inert gas supply tank are open during composite sampling to allow pressure to be relieved back to the inert gas supply tank from the pre-charge side as product enters the LS-15 (*Figure 12*).
	The lifespan of the burst disc might have been exceeded.	Replace the burst disc. A more frequent preventative maintenance schedule might be required for the burst disc.

Table 3: Welker® Light Liquid Sampling System Troubleshooting Guidelines, *Continued*		
Issues	**Possible Causes**	**Solutions**
The mixer is not working properly.	The hydraulic supply might be too low or not operating.	Inspect the electrohydraulic unit (EHUC). Add hydraulic oil as necessary. Ensure that hydraulic power is supplied at the appropriate pressure. If the EHUC is not operating, refer to the *Installation, Operation, and Maintenance* (IOM) *Manual* for the EHUC.
	The relief and check valve in the hydraulic line have failed.	Maintain the relief and check valve. Refer to the *Installation, Operation, and Maintenance* (IOM) *Manuals* for the relief and check valve for instructions.

APPENDIX: REFERENCED OR ATTACHED DOCUMENTS

Welker® Installation, Operation, and Maintenance (IOM) Manuals suggested for reference or for use with this unit:

- IOM-001: Welker® 4P Sample Frequency Controller
- IOM-002: Welker® 6Tc Timer / Controller
- IOM-011: Welker® CP-2G, CP-5G, CP-35G, and CP-2G With Premium Purge Constant Pressure Sample Cylinders With Tracker Tube
- IOM-029: Welker® InLoop™ Crude Oil Sampler
- IOM-033: Welker® RV-1, RV-2, RV-2CP, and RV-3 Relief Valves
- IOM-047: Welker® inFlow™ Crude Oil Sampler – Fixed Insertion
- IOM-105: Welker® NV-1 and NV-2 Instrument Valves
- IOM-112: Welker® Electrohydraulic Unit
- IOM-182: Welker® CV-K Check Valve

Other *Installation, Operation, and Maintenance* (IOM) *Manuals* suggested for reference or for use with this unit:

- Continental Disc Corporation Preparation and Installation of the ½" Standard Type Rupture Disc/Screw Type Holder Assembly (Welker® IOM-V301)
- Hy-Lok RV Series Relief Valves (Welker® IOM-V362)
- Kepner Products Company Kepsel® Cartridge Insert Valves (Welker® IOM-V078)
- WIKA Instrument Corporation Bourdon Tube Pressure Gauges Type 232.53 and Type 233.53 (Welker® IOM-V171)

Welker® drawings and schematics suggested for reference or for use with this unit:

- Assembly Drawing: AD245CW.3 (Welker® Constant Pressure Sample Cylinder Style: CPLS-15E, 5 US Gallons @ 80% Volume With 200 ft^3 Volume Bottle, and Welker® Electrohydraulic Unit)

NOTES

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