WELKER

INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

WELKER LIQUID KNOCKOUT SYSTEM

DRAWING NUMBERS
AD612BA
GS1516

MANUAL NUMBER
IOM-092

REVISION
Rev. C, 4/23/2019

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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 and operation guide for the Welker Liquid Knockout System. For comprehensive instructions, please refer to the IOM Manuals for each individual component. A list of relevant component IOM Manuals is provided in Appendix A of 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 and operation, 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 inspector's 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 Liquid Knockout System is of a mechanical 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 Liquid Knockout System, please contact a Welker representative immediately.

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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 may have additional requirements and specifications that are not listed in this manual.*

1.2 Product Description

The Welker *Liquid Knockout System* is a four-stage liquid separation system designed to remove liquids from a gaseous flow in the pipeline. The result of this process is an output of gas with no free liquids, which allows for optimal analysis of the pipeline components.

Welker may custom design the Liquid Knockout 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.**

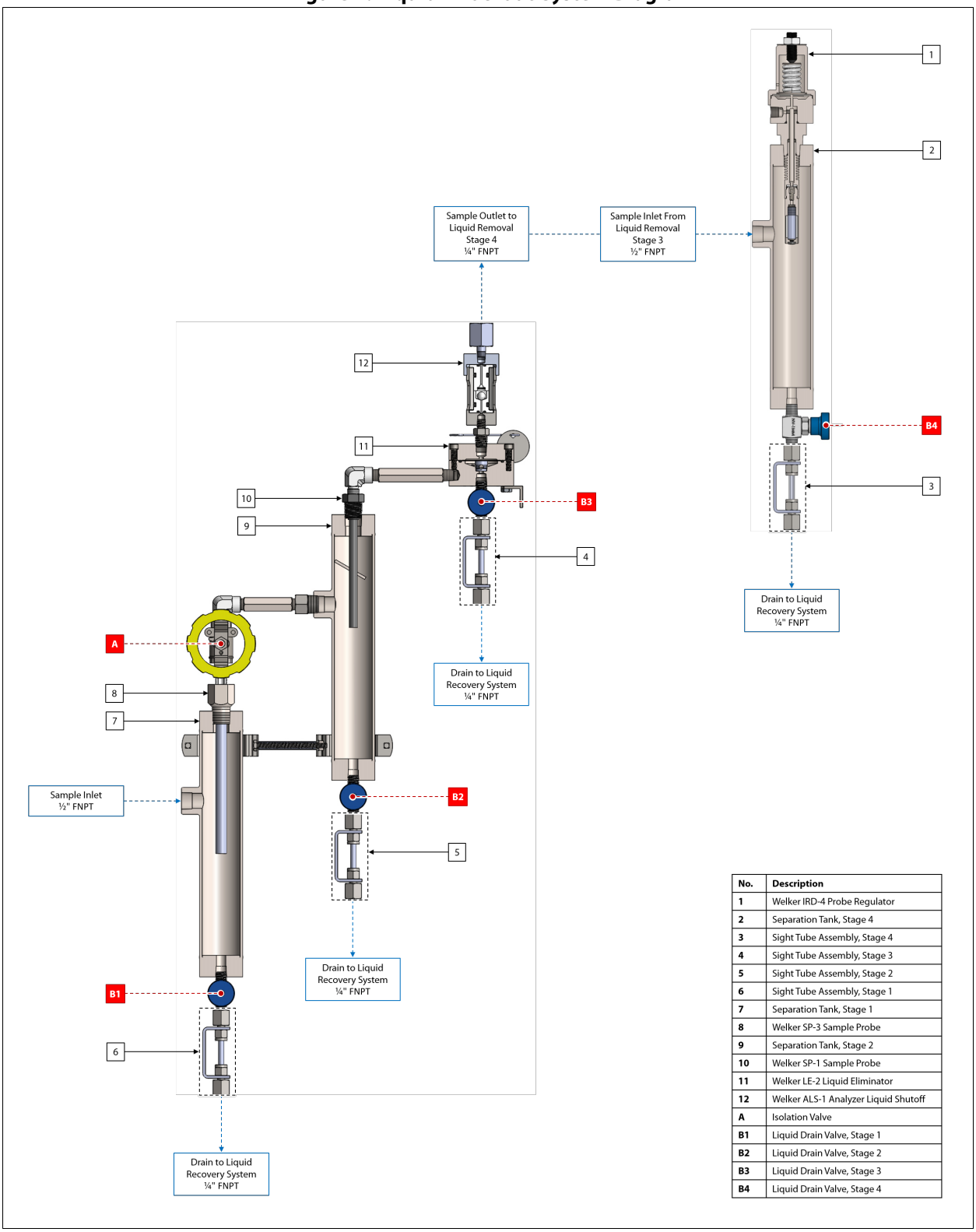
Table 1: Liquid Knockout System Specifications	
Application	Liquid Removal
Materials of Construction	304 Stainless Steel, 316 Stainless Steel, 316/316L Stainless Steel, Aluminum, Delrin®, Glass, LEXAN™, PTFE, Teflon®, and Viton®
Maximum Allowable Operating Pressure	275 psig @ 70 °F (*18 barg @ 21 °C*) 245 psig @ 100 °F (*16 barg @ 37 °C*) 145 psig @ 200 °F (*9.9 barg @ 93 °C*) 87 psig @ 300 °F (*5.9 barg @ 148 °C*) 47 psig @ 400 °F (*3.2 barg @ 204 °C*)
Connections	**Drains:** ¼" FNPT **Inlets:** ½" FNPT **Outlets:** ¼" FNPT (to Analyzer) and ½" FNPT (to Stage 4)
Output Range	0–50 psig (*0–3.4 barg*)
Filter Media	25 Micron Copolymer Filer Element 304 Stainless Steel Mesh Screen
Features	4-Stage Liquid Removal Stage 1: Welker SP-3 Sample Probe and Separation Tank Stage 2: Welker SP-1 Sample Probe and Separation Tank Stage 3: Welker LE-2 Liquid Eliminator and Welker ALS-1 Analyzer Liquid Shutoff Stage 4: Welker IRD-4 Probe Regulator and Separation Tank

STOP

The maximum allowable operating pressure (MAOP) of the Liquid Knockout System is limited by the sight tube assemblies.

1.4 Equipment Diagram

Figure 1: Liquid Knockout System Diagram



No.	Description
1	Welker IRD-4 Probe Regulator
2	Separation Tank, Stage 4
3	Sight Tube Assembly, Stage 4
4	Sight Tube Assembly, Stage 3
5	Sight Tube Assembly, Stage 2
6	Sight Tube Assembly, Stage 1
7	Separation Tank, Stage 1
8	Welker SP-3 Sample Probe
9	Separation Tank, Stage 2
10	Welker SP-1 Sample Probe
11	Welker LE-2 Liquid Eliminator
12	Welker ALS-1 Analyzer Liquid Shutoff
A	Isolation Valve
B1	Liquid Drain Valve, Stage 1
B2	Liquid Drain Valve, Stage 2
B3	Liquid Drain Valve, Stage 3
B4	Liquid Drain Valve, Stage 4

2.1 Before You Begin

After unpacking the unit, check the equipment for compliance and any damage that may have occurred during shipment. Immediately contact a Welker representative if you received damaged equipment.

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

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

2.2 Principles of Operation

Stage One

1. Gaseous fluids enter the system at the inlet of the stage one separation tank.
2. As product fills the separation tank, free liquids drop to the bottom and drain to the connected liquid recovery system through the sight tube assembly.
3. Once the separation tank is full, the gases pass through the Welker SP-3 Sample Probe. This slows the velocity, allowing heavy aerosols and free liquids to fall to the bottom of the separation tank while the gases flow to the stage two separation tank.

Stage Two

4. Gases and any residual liquids flow from the stage one separation tank to the inlet of the stage two separation tank.
5. As product fills the separation tank, free liquids drop to the bottom and drain to the connected liquid recovery system through the sight tube assembly. Any liquids that travel upward are blocked by the sloped baffle inside the separation tank.
6. Once the separation tank is full, the gases pass through the Welker SP-1 Sample Probe.

Stage Three

7. If any liquids remain as the gases flow to the Welker LE-2 Liquid Eliminator, they are separated from the sample stream by centripetal force, a copolymer filter element, and a mesh screen and drained to the liquid recovery system through the sight tube assembly.
8. Gases flow freely through the Welker ALS-1 Analyzer Liquid Shutoff, but if liquid tries to pass through, the internal floating ball will seal, shutting off flow to stage 4 and the downstream analyzer.
9. The gases flow from the ALS-1 to the inlet of the stage four separation tank.

Stage Four

10. Any remaining aerosols will coalesce at the tip of the Welker IRD-4 Probe Regulator, drop to the bottom, and drain to the connected liquid recovery system through the sight tube assembly, while the gases flow to the downstream analyzer.

2.3 Installation and Operation

1. Install the Liquid Knockout System in the desired location. To function correctly the Liquid Knockout System must be installed vertically with the drains pointing down and above the customer-supplied Welker liquid recovery system.
2. Ensure that all valves on the Liquid Knockout System are closed (*Figure 1*).
3. Using ¼" tubing, connect from the drain of the first stage sight tube assembly to the customer-supplied Welker liquid recovery system (*Figure 1*). Repeat for the second, third, and fourth stage sight tube assemblies (*Figure 1*).

Welker recommends the recovery system include a rotameter with a metering valve.

Welker recommends the Welker liquid recovery system for use with this unit.

4. Using ½" tubing, connect from the outlet of the customer-supplied sample probe to the stage one inlet on the Liquid Knockout System (*Figure 1*).

Welker recommends that the probe be installed in the top of the pipe and inserted into the center one-third (⅓) of the pipeline in a location where the product is well-mixed and will yield an accurate and representative sample. The sample probe should be located in the least turbulent area of the flowing stream available (i.e., not in a header or blow-down stack and away from obstructions, elbows, and partially closed valves).

5. Using ¼" tubing, connect from the stage four outlet to the analyzer (*Figure 1*).
6. Fully open liquid drain valves B1, B2, B3, and B4 (*Figure 1*).

If the liquid drain valves are not fully open, the floating ball inside the ALS-1 could seal, shutting off flow to the analyzer, or liquids could enter the analyzer.

7. Open the flow from the pipeline to the Liquid Knockout System.
8. Slowly open isolation valve A (*Figure 1*).
9. Check the Liquid Knockout System for leaks and repair as necessary.
10. The Liquid Knockout System is now operational.
11. If liquids are present at the copolymer filter element of the Welker LE-2 Liquid Eliminator, or if liquids reach the Welker ALS-1 Analyzer Liquid Shutoff and flow to the analyzer is shut off, the Liquid Knockout System requires maintenance. See *Section 3.2, Maintenance,* for instructions.

3.1 Before You Begin

1. **Welker recommends that the unit have standard maintenance every six (6) months under normal operating conditions.** In cases of severe service, dirty conditions, excessive usage, or other unique applications that may lead to excess wear on the unit, a more frequent maintenance schedule may be appropriate.
2. Prior to maintenance or disassembly of the unit, it is advisable to have a repair kit available for repairs of 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, as it may 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.

3. All maintenance and cleaning of the unit should be performed on a smooth, clean surface.
4. Welker recommends having the following tools available for maintenance. Please note that the exact tools required may vary by model.
    a. Adjustable Wrenches
    b. Disposable Gloves
    c. Hex Key Set
    d. Seal Pick

3.2 Maintenance

1. During operation, monitor the system for leaks. If leaks are present, halt operation and repair as necessary.
2. During operation, monitor flow to the analyzer. If flow is shut off, halt operation and repair as necessary.
3. Occasionally, a system component may need to be repaired or removed for manufacturer recommended maintenance. To perform maintenance on components:
    a. Depressurize the system and close all valves.
    b. Drain the contents of the system to the customer-supplied Welker liquid recovery system.
    c. Disconnect the tubing and/or fittings and remove individual system components for maintenance.
    d. For complete and proper maintenance on system components, refer to their respective *Installation, Operation, and Maintenance* (IOM) *Manual*. A list of components is available in *Appendix A, Referenced or Attached Documents,* in this manual.
    e. After performing necessary maintenance on component parts, reconnect all instrument tubing and/or fittings.
    f. Reinstall the system according to the instructions in *Section 2.3, Installation and Operation*.

Check valves for leaks and repair as necessary during reinstallation.

3.3 Troubleshooting

Table 2: Liquid Knockout System Troubleshooting		
Issues	**Possible Causes**	**Solutions**
No liquids are draining from the liquid drain valves.	There is no product flow to the Liquid Knockout System.	Ensure that product is flowing from the customer pipeline connection and that isolation valve A on the Liquid Knockout System is open.
	The valves are closed.	Ensure that liquid drain valves B1, B2, B3, and B4 are open.
	A drain valve is clogged.	Halt flow to the Liquid Knockout System, depressurize the system, and then remove and clean the appropriate drain valve.
There is no output to the analyzer.	Liquid has passed through the LE-2, causing the ALS-1 to shut off flow to the analyzer.	Maintain the LE-2 and ALS-1. See *Section 3.2, Maintenance,* for instructions on preparing the system for maintenance. Refer to the *Installation, Operation, and Maintenance* (IOM) *Manual* for the LE-2 for instructions on replacing the copolymer filer element and the *Installation, Operation, and Maintenance* (IOM) *Manual* for the ALS-1 for instructions on purging the ALS-1.
The separation tanks for stages one–four are sweating or have excess condensation.	The bleed rate from the customer-supplied Welker liquid recovery system is too fast, causing the Joule-Thomson effect.	Adjust the metering valve on the customer-supplied Welker liquid recovery system so that the flow is approximately 100–120 cc per minute.
The sight tubes have turned black.	The separated liquids contain oil or carbon deposits.	Replace the tubing in the sight tube assembly.

APPENDIX A: REFERENCED OR ATTACHED DOCUMENTS

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

- IOM-035: Welker SP-1, SP-1W, SP-2, SP-3, SP-5, and SP-F Sample Probes
- IOM-061: Welker LE-2 Liquid Eliminator
- IOM-070: Welker IRD-1, IRD-2, IRD-4, and IRD-6 Probe Regulators
- IOM-077: Welker ALS-1 Analyzer Liquid Shutoff
- IOM-105: Welker NV-1 and NV-2 Instrument Valves

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

- None

Welker drawings and schematics suggested for use with this unit:

- Assembly Drawing: AD612BA (Liquid Removal Stage 4)
- System Drawing: GS1516 (Liquid Removal Stages 1–3)

APPENDIX B: MAINTENANCE SCHEDULE

Welker recommends keeping high-wear parts on hand and replacing these parts immediately when worn or damaged.

Refer to the *Installation, Operation, and Maintenance* (IOM) *Manual* for each component for maintenance instructions.

Table B1: Liquid Knockout System Maintenance Schedule

Action	Every 6 Months	Every 12 Months	Liquid Passed Through the LE-2	If a Leak Occurs	As Necessary
Rebuild the LE-2 using a Welker repair kit. • Clean the screen and separator body. • Replace the copolymer filter element.	X		X		
Rebuild the ALS-1 using a Welker repair kit. • Replace O-rings. • Inspect the ball for scratches or wear.		X	X		
Rebuild the IRD-4 using a Welker repair kit. • Maintain the relief. • Replace the diaphragm. • Replace the O-rings. • Replace the shredded PTFE on the probe tip.		X			
Rebuild the NV-1s using a Welker repair kit. • Replace the seat and retaining ring.				X	
Rebuild the SP-1 using a Welker repair kit. • Maintain the valve.				X	
Replace the tubing in the sight tube assemblies.					X

NOTES

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