



# Oil Level Control System

SPORLAN



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## **FOR USE ON AIR CONDITIONING AND REFRIGERATION SYSTEMS ONLY**

Bulletin 110-10, April 2014 supersedes Bulletin 110-10, May 2013 and all prior publications.

## OIL LEVEL CONTROL SYSTEM

Sporlan's **Oil Level Control System** components were developed to offer the refrigeration industry an oil level control system of the highest quality. The heart of the system is the Oil Level Control which, when matched with the Oil Reservoir, Check Valve, OF Oil Filter and perhaps the Y1236-C Pressure Differential Valve, maintains a minimum oil level in the compressor crankcase during all phases of system operation.

## FEATURES AND BENEFITS

- Externally adjustable oil level controls
- Oil Level Control – Suitable for up to 90 psi differential pressure, optional oil level equalization connection
- High performance oil filters
- Choice of settings on Pressure Differential Check Valve
- Externally adjustable Y1236-C allows for desired differential above suction pressure
- Oil Reservoirs, and OF Oil Filters – UL Listed
- Oil Level Controls - UL Recognized
- Numerous adaptors available for various types of compressors

## DESIGNING THE LOW PRESSURE OIL RETURN SYSTEM

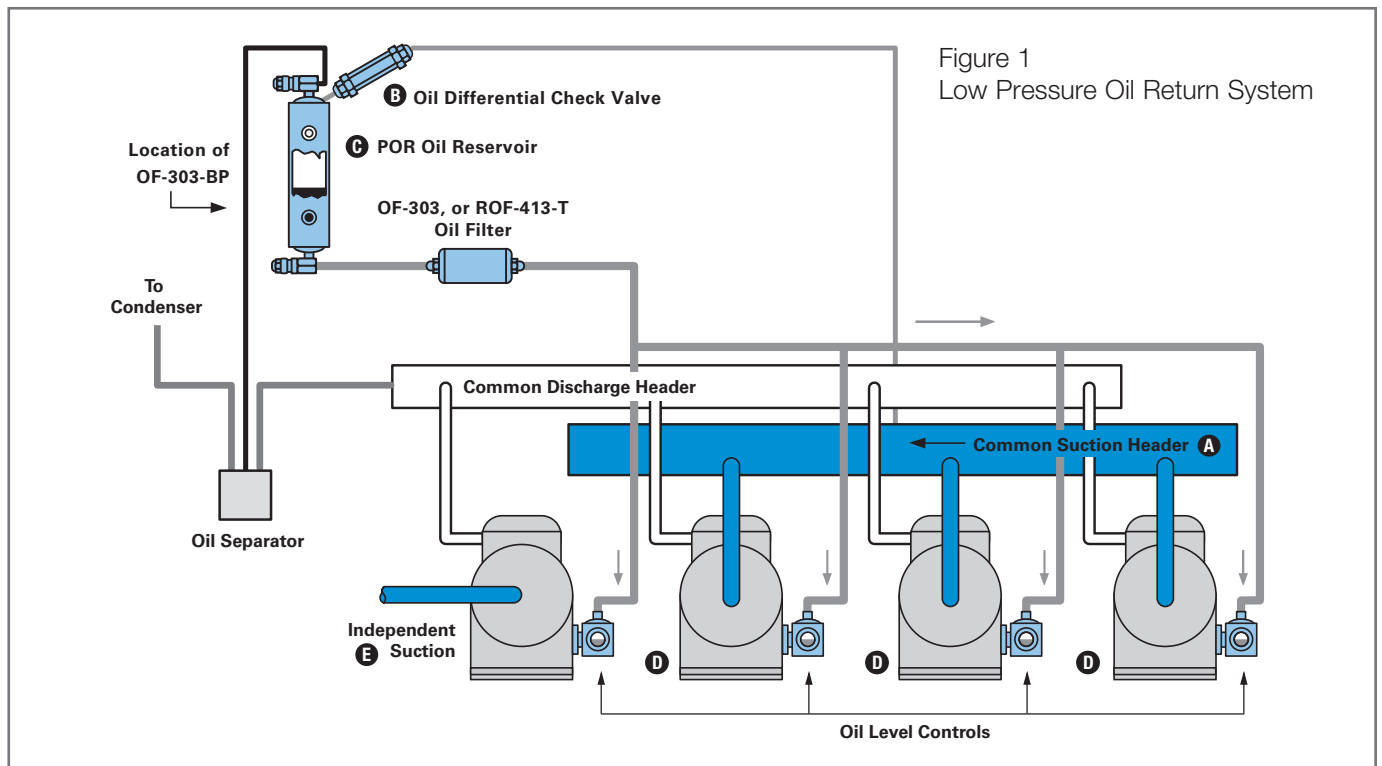
Oil must be present to lubricate the compressor. However, oil becomes a detriment to system performance if present in large quantities in the evaporator. Therefore, it's necessary to control the distribution of oil within the system.

In multi-compressor parallel systems, oil levels must be maintained in each compressor regardless of the individual compressor's oil consumption rate. Oil pumped by compressors may vary considerably, depending on the compressor model, age and operating conditions.

When oil is pumped by the compressor, it flows through the common discharge header to an oil separator. The oil separator's function is to separate the oil from the discharge gases. Because the oil separator does not have a large holding capacity, the oil is transferred to an oil reservoir.

As it passes from the oil separator to the oil reservoir, the oil is at a high discharge pressure. This pressure must be reduced to a pressure slightly higher than the compressor crankcase. The pressure in the oil reservoir is reduced by boiling the refrigerant in the oil, and relieving the pressure above the oil through a vent line to the suction header. The pressure in the oil reservoir is maintained, slightly above the suction header pressure, by means of an Oil Differential Check Valve installed in the vent line. At its reduced pressure the oil is then fed to the Oil Level Control which meters the oil to the compressor equal to its pumping rate, and thereby maintains the oil level specified by the compressor manufacturer. The Oil Level Control functions by adding oil when the level is low – it cannot correct an oil level that is too high.

To obtain proper oil return, each of the oil system components must be selected according to the requirements of the overall oil control system.



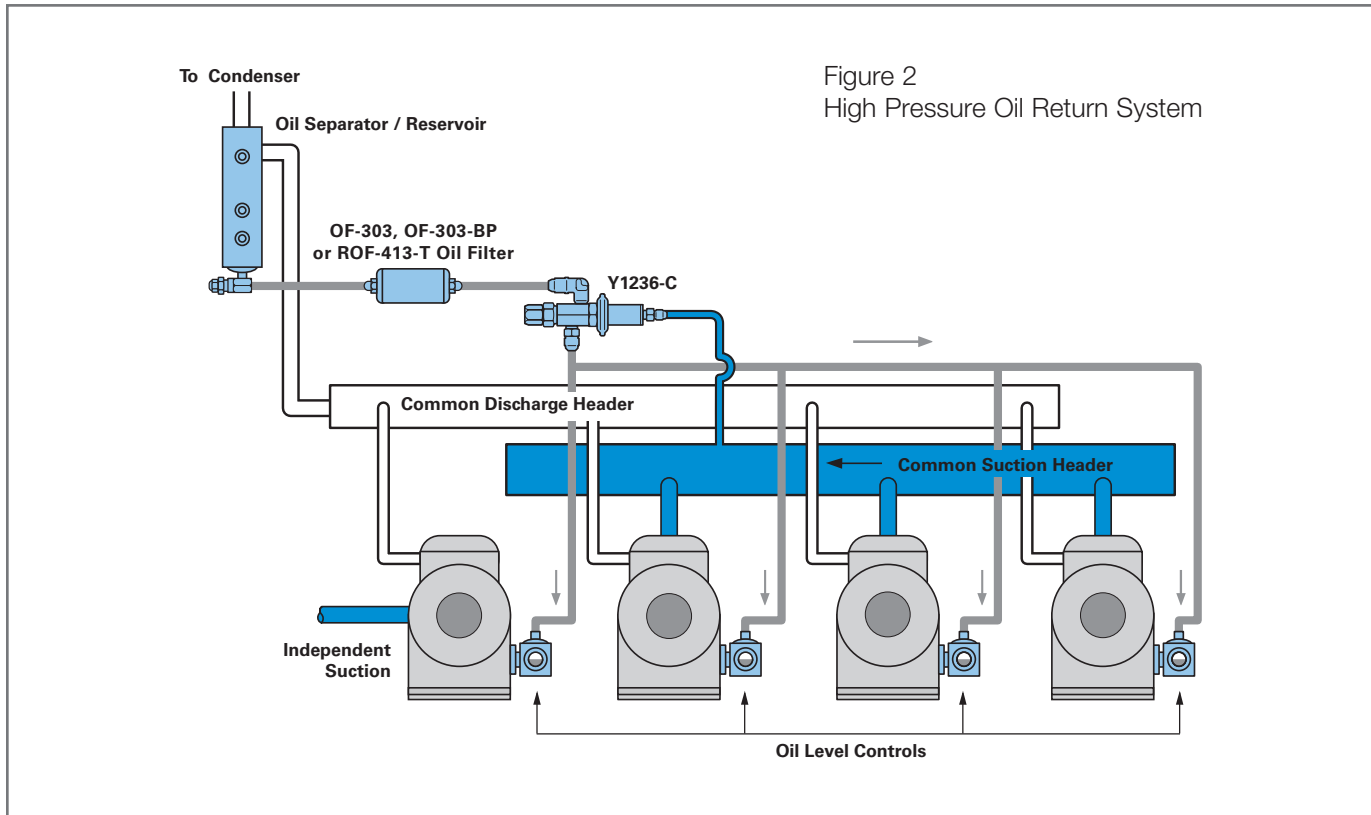


Figure 2  
High Pressure Oil Return System

## DESIGNING THE HIGH PRESSURE OIL RETURN SYSTEM

High pressure oil return systems are fabricated slightly different than low pressure oil systems, but they achieve the same result of supplying oil to the compressor. Both types of systems are used within the industry.

The oil separator used on the high pressure systems is designed to also serve as an oil reservoir. The oil in the reservoir is at a discharge pressure. This pressure must be reduced to a pressure slightly higher than the compressor crankcase so that it can be managed by the oil level control. This can be accomplished by using the Y1236-C Pressure Differential Valve.

## SYSTEM COMPONENTS

### Y1236-C PRESSURE DIFFERENTIAL VALVE

The Sporlan Y1236-C Pressure Differential Valve is designed for use on high pressure oil return systems or others applications where a differential pressure regulator is required. The valve permits the Oil Level Control mounted at the compressor to feed at any specified level because the pressurized oil at the control is slightly greater than crankcase pressure. Without the Y1236-C, excessive pressure drop across the mechanical oil level control would cause the control to overfeed the compressor. This occurs because more force is required on the float ball, thereby a higher oil level, to overcome the pressure drop through the port to close the oil level control.

The Y1236-C reduces the inlet pressure by controlling a differential across the valve outlet and the force supplied to the valve's element. With high pressure oil return systems, suction pressure is supplied to the element when located between the oil separator/reservoir and the oil level control. The valve is adjustable from

a 10 to 25 psi (0.69 to 1.7 bar) differential. Turning the adjustment stem counterclockwise reduces the differential. One turn of adjustment is equal to 2.5 psi (0.18 bar) change. The standard differential setting from the factory is 17 psi (1.2 bar).

The Y1236-C includes a removable 100 mesh inlet strainer to protect the valve from circulating contaminants. The removable strainer can be purchased separately (p/n: 1538-000).

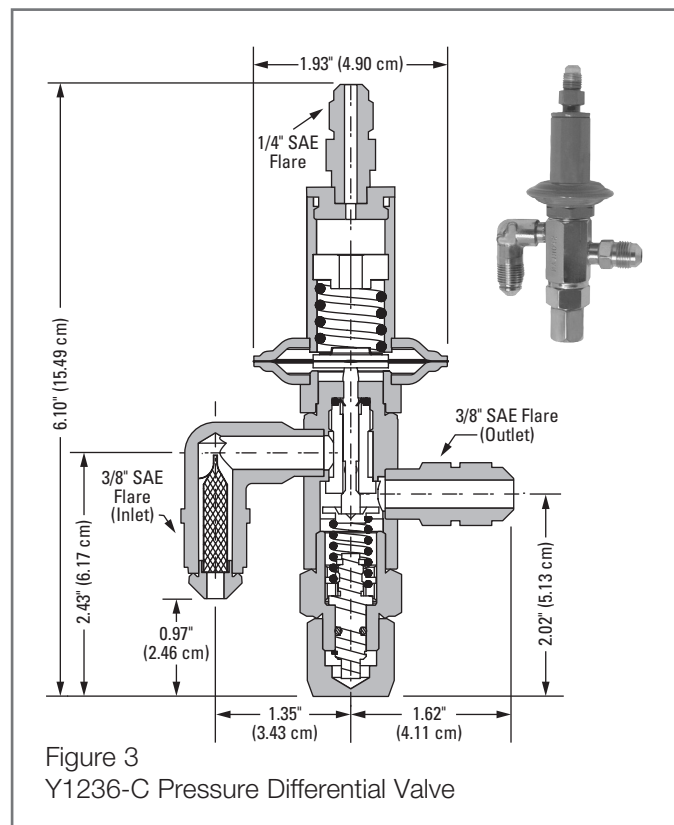


Figure 3  
Y1236-C Pressure Differential Valve


## OIL RESERVOIR - TYPE POR

The Sporlan Oil Reservoirs (POR-2, 3 and 4) contain the oil that is not within the crankcase, the oil separator, or in circulation. The reservoirs have an inlet and an outlet service valve so it can be isolated from the rest of the system. Or the oil supply from the oil reservoir to the Oil Level Control can be interrupted for servicing.

When adding an Oil Reservoir to an existing system or replacing an oil reservoir on an existing system, it should only be filled to the top of the lower sightglass. As the system is placed into operation, the oil level should be observed. If the oil level rises above the upper sightglass, some oil should be drained from the reservoir.


**The level of oil should never be allowed to drop below the bottom of the lower sightglass.**

On new system start-ups the reservoir should be filled to the top of the upper sightglass. As the system runs, oil should be added to maintain a level between the two sightglasses for the POR-2. For the POR-3 and 4, the level should be somewhere between the top and middle sightglasses. This procedure may require several charges as the oil is absorbed in the refrigerant and coats the low side tubing.




### TYPE POR FEATURES AND BENEFITS

- Sightglass ports with float ball indicators for oil level monitoring
- 3/8" male flare rotalock valves shipped with oil reservoir allow for easy adjustment when piping into system
- 3/8" male flare vent port – for connection to the suction line
- Mounting studs and brackets
- Powder coating passes 500 hour ASTM salt spray



**UL Listed SORT/SORT7 for the USA and Canada with a Maximum Rated Pressure (MRP) of 500 psi (34 bar).**

## OIL DIFFERENTIAL CHECK VALVE – TYPES OCV-5, OCV-10, OCV-20, OCV-30



### OCV-20

All check valves have 3/8" SAE connections.  
All brass construction.

The Sporlan Oil Differential Check Valve (OCV) is installed on the 3/8" SAE fitting on the top of the Oil Reservoir. It allows pressure to be relieved from the reservoir to the suction as required to maintain a pressure in the reservoir at a preset level above the suction pressure. The pressure differential created by the OCV assures oil flow from the reservoir to the Oil Level Control, providing there is adequate oil in the reservoir.

The OCV will only relieve pressure from the reservoir in excess of its fixed set point. Systems with fluctuating suction pressure, as a result of compressor unloaders, staging or other suction line controls, must be fitted with an OCV with a differential greater than the suction pressure fluctuation. This assures oil flow from the reservoir through the oil level control to the compressor crankcase.

Sporlan offers OCVs with a 5, 10, 20, and 30 psi (0.34, 0.69, 1.4, and 2.1 bar) fixed differential setting with a Maximum Rated Pressure (MRP) of 700 psi (48 bar). However, Sporlan recommends the use of an OCV-20 on all field built-up applications. Equipment manufacturers may, after extensive tests, employ an OCV with a different pressure setting. Example: OCV-5

## OIL LEVEL CONTROLS

The purpose of the Sporlan Oil Level Control is to regulate the flow of oil to the compressor crankcase and maintain a minimum oil level as specified by the compressor manufacturer for a given application. The Oil Level Control is adjustable between 1/2 sightglass and 1/4 sightglass at any pressure differential between 5 and 90 psi (0.34 and 6.2 bar). As the level of oil drops in the compressor crankcase, the float of the Oil Level Control is lowered and opens a needle valve. This allows oil to flow from the oil reservoir to the compressor crankcase, see Figure 4.



**OL-60FH**

**UL Recognized under SA5460-SFJQ2/SFJQ8 with a Maximum Rated Pressure (MRP) of 650 psi (45 bar).**

## TYPE POR - SPECIFICATIONS

MODEL NUMBER	TOTAL CAPACITY Gallons (Liters)	'A' CAPACITY Gallons (Liters)	'B' CAPACITY Gallons (Liters)	NUMBER OF SIGHTGLASSES	LENGTH Inches (mm)	SHELL DIAMETER Inches (mm)
POR-2	2 (7.6)		3/4 (2.8)	2	18 (457)	
POR-3	3 (11.4)	3/4 (2.8)	1-1/2 (5.7)	3	23 (584)	6.0 (152)
POR-4	4 (15.1)		2-3/4 (10.4)	3	36 (914)	

*'A' capacity is the capacity to the first sightglass.*

*'B' capacity is the capacity between the two sightglasses for the POR-2 and the top and bottom sightglasses for the POR-3 and POR-4.*

Several Oil Level Controls have a 3/8" SAE oil equalization fitting. The equalization fitting allows the Oil Level Controls to be interconnected, permitting oil transfer between a series of compressors. This transfer is sometimes necessary due to a sudden increase in oil level resulting from oil returning down the suction line. If an equalizer is not required, a cap must be installed.

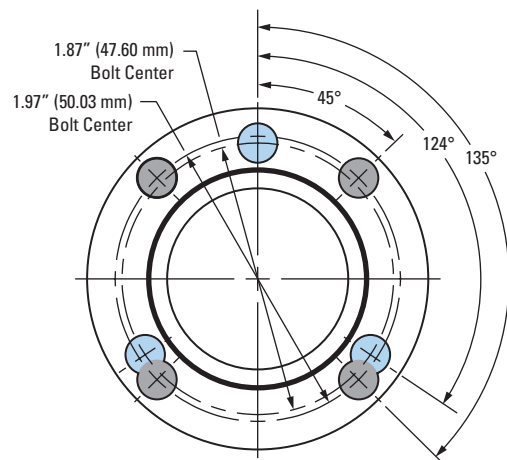
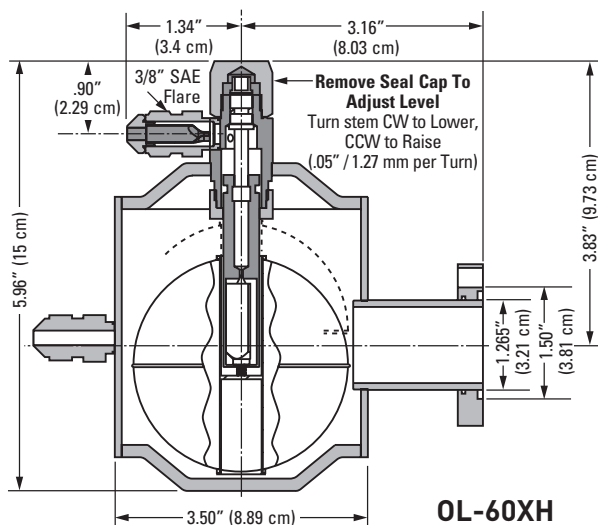
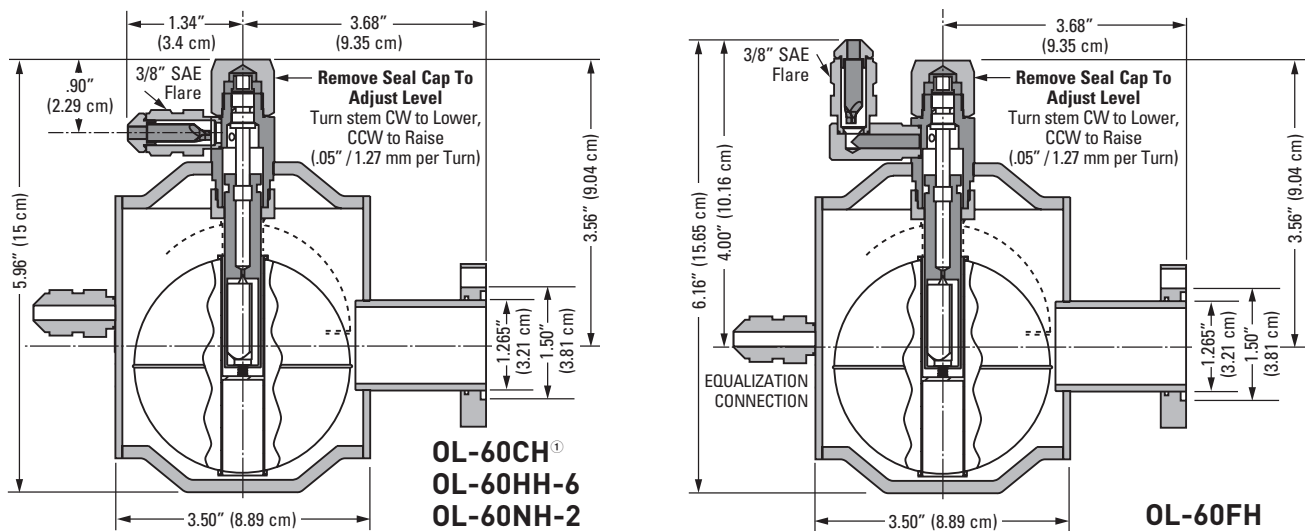
**CAUTION:** If a sudden load increase, or system defrost, causes a large amount of oil to return through the suction line, the Oil Level Control will not prevent the oil level from rising above the control point.

The Sporlan Oil Level Control may be bolted either directly to the compressor crankcase or, depending on the compressor model, may be adapted to the crankcase by means of one of the adaptors available, see table on page 8. **Care must be taken when installing an Oil Level Control to make sure the compressor is leveled, and the Oil Level Control compressor fitting and sightglass fitting are on the same elevation.**

A slight amount of tolerance is provided in the bolt holes to allow for rotating the Oil Level Control to make sure that the sightglass is on the same level as the compressor connection. If the compressor and Oil Level Control are not level, a false reading may be given in the sightglass.

## OIL LEVEL CONTROL, 7 BOLT HOLE UNIVERSAL MOUNTING FLANGE - SELECTION & SPECIFICATIONS

Figure 4



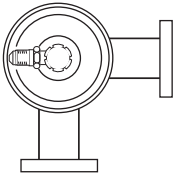
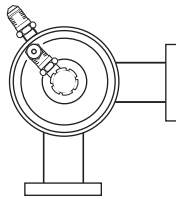
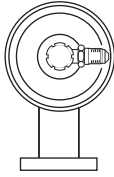
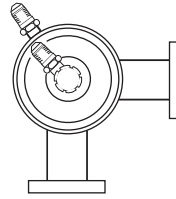
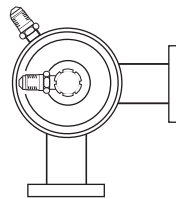
### 7 Bolt Universal Mounting Flange and Oil Sightglass (S-OL)

Bolt holes are 0.272" (6.9 mm) diameter. The above hole configuration fits typical 3 and 4 bolt compressor sightglass and oil level control connections.

- 3 Bolt Configuration
- 4 Bolt Configuration

① OL-60CH and OL-60HH-6 are supplied less the equalization fitting.



MODEL NUMBER					
	OL-60CH	OL-60FH	OL-60HH-6	OL-60NH-2	OL-60XH
ADJUSTMENT RANGE	5 - 90 psi (0.34 - 6.2 bar) Differential	5 - 90 psi (0.34 - 6.2 bar) Differential	5 - 90 psi (0.34 - 6.2 bar) Differential	5 - 90 psi (0.34 - 6.2 bar) Differential	5 - 90 psi (0.34 - 6.2 bar) Differential
FLANGE DESIGN FOR COMPRESSOR ATTACHMENT	3 bolt, 1-7/8" B.C. (47.6 mm B.C.)	3 bolt, 1-7/8" B.C. (47.6 mm B.C.)	3 bolt, 1-7/8" B.C. (47.6 mm B.C.)	3 bolt, 1-7/8" B.C. (47.6 mm B.C.)	3 bolt, 1-7/8" B.C. (47.6 mm B.C.)
NUMBER OF ARMS AND LENGTH	Two arms - standard length	Two arms - standard length	One arm - standard length	Two arms - standard length	Two arms - short length
EQUALIZATION FITTING PLACEMENT OPTION	None	Yes - bottom of drill hole at centerline of sightglass	None	Yes - fitting is 0.375" (0.953 mm) above standard location	Yes - bottom of drill hole at centerline of sightglass

**NOTES:** Model OL-60XH-1 is identical to OL-60XH but less equalization fitting.

All Sporlan oil level controls now incorporate the OL-60 design for product simplification. The OL-60 Series are designed to handle a large operating range and replaces the OL-1 and 2 Series oil level controls.

## DETERMINING PRESSURE DIFFERENTIAL

The following information must be considered before selecting an oil level control for a system. See Figure 1 on the low pressure oil return system for pressure locations.

- A** Common suction header pressure – psig / bar
- B** Differential Check Valve setting (OCV) – psi / bar
- C** Oil Reservoir pressure (sum of **A** and **B**) – psig / bar
- D** Crankcase pressure (compressor on common header) – psig / bar
- E** Crankcase pressure (compressor on independent suction - if applicable) – psig / bar

The first step is to determine the pressure differential requirement of the oil level control. This can be determined on compressors with a common suction header by subtracting the pressure in the compressor crankcase **D** from the Oil Reservoir pressure **C**. For a compressor with an independent suction, the differential requirement is determined by subtracting crankcase pressure **E** from pressure **C**.

## ADJUSTMENT

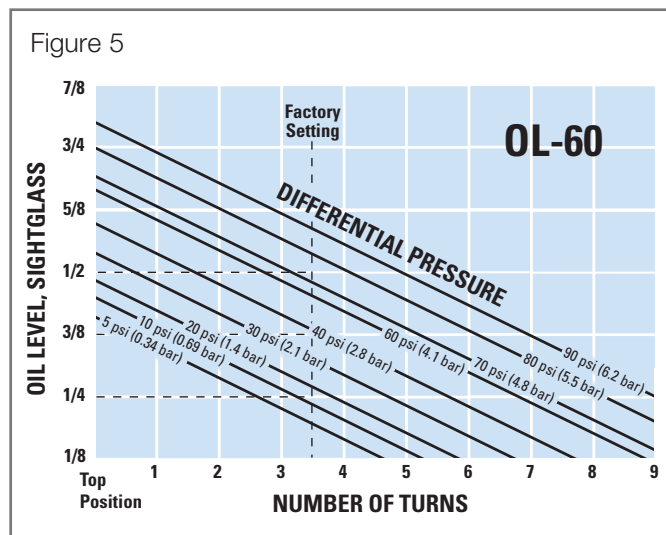
The oil level control is factory set 3-1/2 turns clockwise from the top stop. To set the oil level, remove the seal cap on top of the control. Turn the adjustment stem clockwise to lower and counter-clockwise to raise. The proper adjustment can be determined from Figure 5. The oil level is given in eighths of the sightglass at various

differential pressure conditions. **Make adjustment (if necessary) prior to installing the control on the system.**

The oil level control is designed to operate up to 9 turns. Under no circumstance adjust beyond 9 turns down from the top stop or the control may be damaged. With care a person can feel the top and bottom stops. One of the symptoms of over-adjustment of the oil level control is a totally full sightglass.

Data obtained using POE lubricant at 75°F (24°C) with a one inch (25.4 mm) sightglass.

If a sudden load increase or system defrost causes a large amount of oil to return through the suction line the control will not prevent the oil level from rising above the control point.



**COMPRESSOR ADAPTOR REQUIREMENTS**

COMPRESSOR MANUFACTURER	COMPRESSOR MODEL NUMBER	COMPRESSOR ATTACHMENT PATTERN	SPORLAN ADAPTOR KIT NUMBER	SEALING METHOD	SIGHTGLASS
<b>Bitzer</b>	2KC, 2JC, 2HC, 2GC, 2 FC, 2EC, 2DC, 2CC, 4FC, 4EC, 4DC, 4CC	1-1/8" Thread	AOL-MA/TE	Use seal provided	Use sightglass provided with adaptor
	4VC, 4TC, 4PC, 4NC	3 Bolt, 1-7/8" B.C. (47.6 mm B.C.)	None	Use seal provided	Use sightglass from compressor
	4J, 4H, 4G, 6J, 6H, 6G, 6F	4 Bolt, 50 mm B.C.	None	Use seal provided with control	Use sightglass from compressor
	8GC, 8FC	3 Bolt, 1-7/8" B.C. (47.6 mm B.C.)	AOL-R-1	Use seal provided	Use sightglass from compressor
<b>Bock</b>	F...	3 Bolt, 1-7/8" B.C. (47.6 mm B.C.)	AOL-R-1	Use seal provided	Use sightglass from compressor
<b>Carrier</b>	06EA, 06ER	3 Bolt, 1-7/8" B.C. (47.6 mm B.C.)	AOL-R-1	Use seal provided	Use sightglass from compressor
	06DA, 06DR, 5F, 5H	1-1/2" – 18 Thread	AOL-C		Use sightglass provided with adaptor
<b>Copeland</b>	Over 5 Ton	3 Bolt, 1-7/8" B.C. (47.6 mm B.C.)	AOL-R-1	Use seal provided	Use sightglass from compressor
	Under 5 HP ①	1-1/8" – 12 Thread	AOL-A	Use seal from compressor	Use sightglass provided with adaptor
	8R, 3D Front, 2D, 4D, 6D	3 Bolt, 1-7/8" B.C. (47.6 mm B.C.)	AOL-R-1	Use seal provided	Use sightglass from compressor
	8D	3 Bolt, 1-7/8" B.C. (47.6 mm B.C.)	Use control with standard length arms with AOL-R-1 adaptor. Use sightglass from compressor		
<b>Dorin</b>	4 cyc-15 HP	3 Bolt, 1-7/8" B.C. (47.6 mm B.C.)	Contact Sporlan		
<b>Dunham-Bush</b>	Big 4	3 Bolt, 1-7/8" B.C. (47.6 mm B.C.)	AOL-R-1	Use seal provided	Use sightglass from compressor
<b>Frascold</b>	All models	3 Bolt, 1-7/8" B.C. (47.6 mm B.C.)	AOL-R-1	Use seal provided	Use sightglass from compressor
<b>Maneurop</b>	MT..., LT...	1-1/8" – 18 Thread	AOL-MA/TE	Use seal provided	Use sightglass provided with adaptor
<b>Tecumseh</b>	P, R, S, PA, RA, SA, CK, CM, CH, CG	1-1/8" – 12 Thread	AOL-A	Use seal from compressor	Use sightglass provided with adaptor
	—	1-1/8" – 18 Thread	AOL-MA/TE	Use seal provided	
	VS	3/4" – 14 Thread	AOL-K-1	Use seal provided	
<b>Trane</b>	M, R	3 Bolt, 1-7/8" B.C. (47.6 mm B.C.)	AOL-R-1	Use seal provided	Use sightglass from compressor
	K	3/4" NPT	AOL-K-1	Use Teflon tape	Use sightglass provided with adaptor
<b>York</b>	GC, GS, JS	3 Bolt, 1-7/8" B.C. (47.6 mm B.C.)	AOL-R-1	Use seal provided	Use sightglass from compressor

**NOTE:** Shipping weight is 4 lbs. (1.8 Kg) for oil level controls and 1 lb. (0.45 Kg) for adaptors.

① Some compressor models have a smaller diameter port than the arm diameter of the oil level control. This situation can mislead the control in the amount of oil that is actually in the compressor. It is advisable the selection and adjustment of the control be reviewed in this situation.



## OF SERIES OIL FILTERS

### DESIGN BENEFITS

The Sporlan Catch-All or SF-283-F Suction Filter has been used for many years as an oil filter in systems using mineral or alkylbenzene oil.

With the use of the new polyolester (POE) oils, system chemistry has changed. POE oil has solvent-like tendencies and can suspend and recirculate small, solid contaminants. POE oil suspends and recirculates a high concentration of 2-20 micron sized particles, with the largest percentage between 2-10 microns. Although some particles are smaller than bearing tolerances, studies have shown bearing life can still be affected. Bearing wear depends upon the size, hardness, and concentration of particles in circulation. To effectively remove these small particles, Sporlan developed the OF Oil Filters.

The OF Series Oil Filters are designed to be 99% efficient in removing 3 micron sized particles, and yet have sufficient flow capacity at a low pressure drop. The unsurpassed filtration ability assures clean POE, mineral, or alkylbenzene oil is returned to the compressors. Clean oil ensures proper operation of the oil level control and minimizes compressor wear. The Sporlan OF Series Oil Filters were designed to virtually eliminate the need for oil changes resulting from suspended solid contaminants in circulation.

### OF-303-BP OIL FILTER

The OF-303-BP illustration in Figure 6 shows the normal flow pattern of oil through the filter.

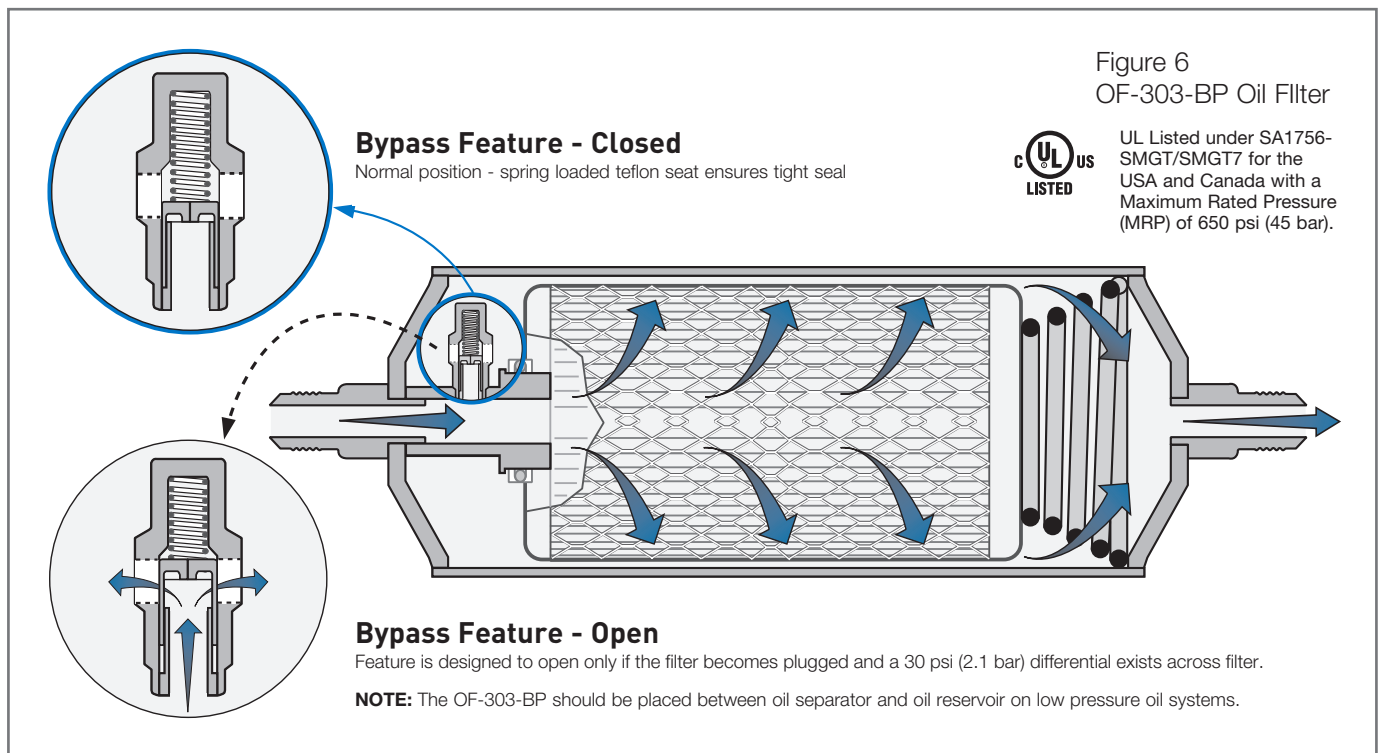
The design of the OF-303 is similar to the OF-303-BP, but the OF-303 is supplied **without** the bypass feature. The OF-303-T is similar to the OF-303 except an access fitting is added to assist with pressure drop monitoring. OF Series Oil Filters can be installed in a horizontal or vertical position.



### ROF-413-T REPLACEABLE OIL FILTER

The illustration in Figure 7 shows the flow pattern of oil through the ROF-413-T Replaceable Oil Filter. The ROF-413-T utilizes the replaceable OFE-1 Oil Filter Element.

The ROF-413-T must be installed **vertically**, with the end plate in the “up” position. A refrigeration clamp or a Sporlan **A-175-1 Mounting Bracket** should be used for easy installation. Removal of mounting bracket, or connection of refrigerant grade hoses to inlet and outlet fittings on the filter end plate, allow for flexibility in changing the OFE-1 Filter Element.



**OF OIL FILTER - SPECIFICATIONS**

UNIT	DESCRIPTION	CONNECTIONS	FILTERING AREA Square Inches (Square cm)	OVERALL LENGTH Inches (mm)	SHELL DIAMETER Inches (mm)	UL RATED WORKING PRESSURE psi (bar)
OF-303	Oil Filter	3/8" SAE Flare	325 (2100)	9.69 (246)	3.00 (76)	650 (45)
OF-303-BP	Oil Filter with Bypass Feature			10.63 (270)		
OF-303-T	Oil Filter with Access Fitting	3/8" SAE Flare		9.62 (244)	3.00 (76)	
ROF-413-T	Replaceable Oil Filter	Field Supplied		8.77 (223)	3.50 (89)	

**NOTE:** The OF Series Oil Filters are not suitable for use in ammonia systems.

Because of numerous piping schemes, inlet and outlet fittings are **not** supplied with the ROF-413-T. PURCHASE END PLATE FITTINGS SEPARATELY. Installation requires **two** fittings that connect to the 3/8" pipe threaded holes in the aluminum end plate. A Schrader type access valve is **supplied** with the ROF-413-T. The access valve in the end plate allows for pressure relief within the canister when changing the OFE-1 Filter Element. The ROF-413-T is recommended for highly contaminated systems and/or applications where the filter would be routinely changed. This may result in a cost savings over the life of the system. An access valve at the bottom of the shell aids with oil draining during the element change out.

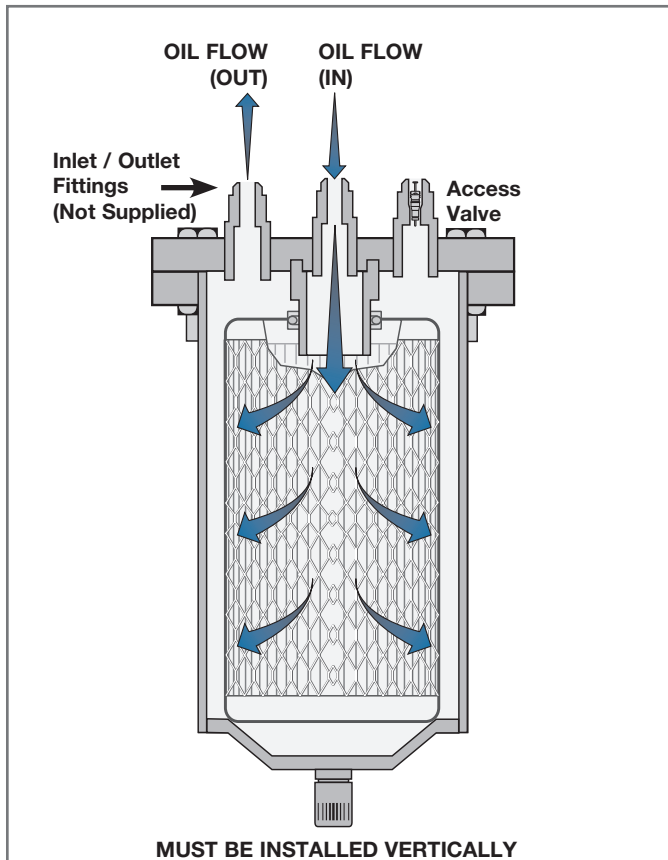


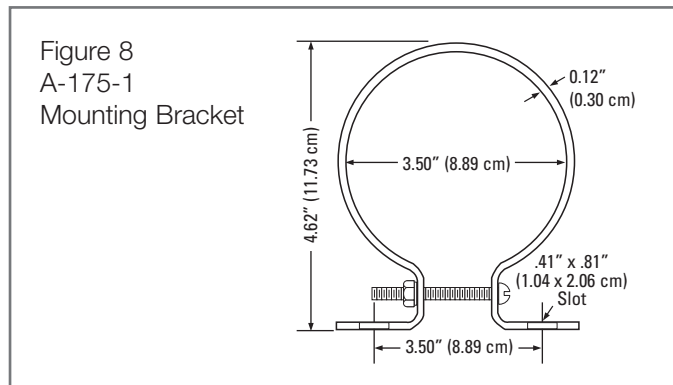
Figure 7  
ROF-413-T Replaceable Oil Filter



UL Listed under SA1756-SMGT/SMGT7 for the USA and Canada with a Maximum Rated Pressure (MRP) of 650 psi (45 bar).

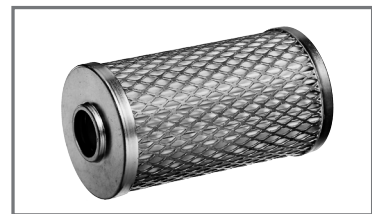
**A-175-1 MOUNTING BRACKET - ORDER SEPARATELY**

The A-175-1 Mounting Bracket can be used for the ROF-413-T Replaceable Oil Filter. **One** bracket per package. All brackets are supplied with a bolt, nut, and washer. One bracket is adequate for mounting the ROF-413-T. The A-175-1 mounting bracket is **NOT** supplied with the ROF-413-T.



**OFE-1 FILTER ELEMENT - ORDER SEPARATELY**

The OFE-1 is a replaceable filter element for the ROF-413-T Oil Filter. The element can be installed by completely sliding the filter over the post on the aluminum end plate of ROF-413-T Oil Filter. The O-ring seal on the element OFE-1 prevents contaminant bypass. The OFE-1 Filter Element is **NOT** supplied with the ROF-413-T.



**LOCATION**

The OF Series Oil Filters are designed to be installed in the oil line between the oil reservoir and the oil header on a low pressure oil return system. If the OF-303-BP is used on this type of system, it should be installed between the oil separator and oil reservoir so ample pressure drops exists to engage the bypass feature if required (see Figure 1). On a high pressure oil return system, the oil filter would be installed between the oil separator/reservoir and the oil header (see Figure 2).

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The items described in this document and other documents and descriptions provided by Parker Hannifin Corporation, its subsidiaries and its authorized distributors (“Seller”) are hereby offered for sale at prices to be established by Seller. This offer and its acceptance by any customer (“Buyer”) shall be governed by all of the following Terms and Conditions. Buyer’s order for any item described in its document, when communicated to Seller verbally, or in writing, shall constitute acceptance of this offer. All goods, services or work described will be referred to as “Products”.

**1. Terms and Conditions.** Seller’s willingness to offer Products, or accept an order for Products, to or from Buyer is subject to these Terms and Conditions or any newer version of the terms and conditions found on-line at [www.parker.com/saleterms/](http://www.parker.com/saleterms/). Seller objects to any contrary or additional terms or conditions of Buyer’s order or any other document issued by Buyer.

**2. Price Adjustments; Payments.** Prices stated on Seller’s quote or other documentation offered by Seller are valid for 30 days, and do not include any sales, use, or other taxes unless specifically stated. Unless otherwise specified by Seller, all prices are F.C.A. Seller’s facility (INCOTERMS 2010). Payment is subject to credit approval and is due 30 days from the date of invoice or such other term as required by Seller’s Credit Department, after which Buyer shall pay interest on any unpaid invoices at the rate of 1.5% per month or the maximum allowable rate under applicable law.

**3. Delivery Dates; Title and Risk; Shipment.** All delivery dates are approximate and Seller shall not be responsible for any damages resulting from any delay. Regardless of the manner of shipment, title to any products and risk of loss or damage shall pass to Buyer upon placement of the products with the shipment carrier at Seller’s facility. Unless otherwise stated, Seller may exercise its judgment in choosing the carrier and means of delivery. No deferral of shipment at Buyers’ request beyond the respective dates indicated will be made except on terms that will indemnify, defend and hold Seller harmless against all loss and additional expense. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer’s acts or omissions.

**4. Warranty.** Seller warrants that the Products sold hereunder shall be free from defects in material or workmanship for a period of twelve months from the date of delivery to Buyer or 2,000 hours of normal use, whichever occurs first. The prices charged for Seller’s products are based upon the exclusive limited warranty stated above, and upon the following disclaimer: **DISCLAIMER OF WARRANTY: THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO PRODUCTS PROVIDED HEREUNDER. SELLER DISCLAIMS ALL OTHER WARRANTIES, EXPRESS AND IMPLIED, INCLUDING DESIGN, MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**

**5. Claims; Commencement of Actions.** Buyer shall promptly inspect all Products upon delivery. No claims for shortages will be allowed unless reported to the Seller within 10 days of delivery. No other claims against Seller will be allowed unless asserted in writing within 30 days after delivery. Buyer shall notify Seller of any alleged breach of warranty within 30 days after the date the defect is or should have been discovered by Buyer. Any action based upon breach of this agreement or upon any other claim arising out of this sale (other than an action by Seller for an amount due on any invoice) must be commenced within 12 months from the date of the breach without regard to the date breach is discovered.

**6. LIMITATION OF LIABILITY.** UPON NOTIFICATION, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE A DEFECTIVE PRODUCT, OR REFUND THE PURCHASE PRICE. **IN NO EVENT SHALL SELLER BE LIABLE TO BUYER FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF, OR AS THE RESULT OF, THE SALE, DELIVERY, NON-DELIVERY, SERVICING, USE OR LOSS OF USE OF THE PRODUCTS OR ANY PART THEREOF, OR FOR ANY CHARGES OR EXPENSES OF ANY NATURE INCURRED WITHOUT SELLER’S WRITTEN CONSENT, EVEN IF SELLER HAS BEEN NEGLIGENT, WHETHER IN CONTRACT, TORT OR OTHER LEGAL THEORY. IN NO EVENT SHALL SELLER’S LIABILITY UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE OF THE PRODUCTS.**

**7. User Responsibility.** The user, through its own analysis and testing, is solely responsible for making the final selection of the system and Product and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects

of the application and follow applicable industry standards and Product information. If Seller provides Product or system options, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products or systems.

**8. Loss to Buyer’s Property.** Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which become Buyer’s property, will be considered obsolete and may be destroyed by Seller after two consecutive years have elapsed without Buyer ordering the items manufactured using such property. Seller shall not be responsible for any loss or damage to such property while it is in Seller’s possession or control.

**9. Special Tooling.** A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture Products. Such special tooling shall be and remain Seller’s property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the Products, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

**10. Buyer’s Obligation; Rights of Seller.** To secure payment of all sums due or otherwise, Seller shall retain a security interest in the goods delivered and this agreement shall be deemed a Security Agreement under the Uniform Commercial Code. Buyer authorizes Seller as its attorney to execute and file on Buyer’s behalf all documents Seller deems necessary to perfect its security interest.

**11. Improper use and Indemnity.** Buyer shall indemnify, defend, and hold Seller harmless from any claim, liability, damages, lawsuits, and costs (including attorney fees), whether for personal injury, property damage, patent, trademark or copyright infringement or any other claim, brought by or incurred by Buyer, Buyer’s employees, or any other person, arising out of: (a) improper selection, improper application or other misuse of Products purchased by Buyer from Seller; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller’s use of patterns, plans, drawings, or specifications furnished by Buyer to manufacture Product; or (d) Buyer’s failure to comply with these terms and conditions. Seller shall not indemnify Buyer under any circumstance except as otherwise provided.

**12. Cancellations and Changes.** Orders shall not be subject to cancellation or change by Buyer for any reason, except with Seller’s written consent and upon terms that will indemnify, defend and hold Seller harmless against all direct, incidental and consequential loss or damage. Seller may change product features, specifications, designs and availability with notice to Buyer.

**13. Limitation on Assignment.** Buyer may not assign its rights or obligations under this agreement without the prior written consent of Seller.

**14. Force Majeure.** Seller does not assume the risk and shall not be liable for delay or failure to perform any of Seller’s obligations by reason of circumstances beyond the reasonable control of Seller (hereinafter “Events of Force Majeure”). Events of Force Majeure shall include without limitation: accidents, strikes or labor disputes, acts of any government or government agency, acts of nature, delays or failures in delivery from carriers or suppliers, shortages of materials, or any other cause beyond Seller’s reasonable control.

**15. Waiver and Severability.** Failure to enforce any provision of this agreement will not waive that provision nor will any such failure prejudice Seller’s right to enforce that provision in the future. Invalidation of any provision of this agreement by legislation or other rule of law shall not invalidate any other provision herein. The remaining provisions of this agreement will remain in full force and effect.

**16. Termination.** Seller may terminate this agreement for any reason and at any time by giving Buyer thirty

(30) days written notice of termination. Seller may immediately terminate this agreement, in writing, if Buyer: (a) commits a breach of any provision of this agreement (b) appoints a trustee, receiver or custodian for all or any part of Buyer’s property (c) files a petition for relief in bankruptcy on its own behalf, or by a third party (d) makes an assignment for the benefit of creditors, or (e) dissolves or liquidates all or a majority of its assets.

**17. Governing Law.** This agreement and the sale and delivery of all Products hereunder shall be deemed to have taken place in and shall be governed and construed in accordance with the laws of the State of Ohio, as applicable to contracts executed and wholly performed therein and without regard to conflicts of laws principles. Buyer irrevocably agrees and consents to the exclusive jurisdiction and venue of the courts of Cuyahoga County, Ohio with respect to any dispute, controversy or claim arising out of or relating to this agreement.

**18. Indemnity for Infringement of Intellectual Property Rights.** Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Section. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets (“Intellectual Property Rights”). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that a Product sold pursuant to this Agreement infringes the Intellectual Property Rights of a third party. Seller’s obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If a Product is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using the Product, replace or modify the Product so as to make it noninfringing, or offer to accept return of the Product and return the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to Products delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any Product sold hereunder. The foregoing provisions of this Section shall constitute Seller’s sole and exclusive liability and Buyer’s sole and exclusive remedy for infringement of Intellectual Property Rights.

**19. Entire Agreement.** This agreement contains the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of sale. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter are herein merged.

**20. Compliance with Law, U. K. Bribery Act and U.S. Foreign Corrupt Practices Act.** Buyer agrees to comply with all applicable laws and regulations, including both those of the United Kingdom and the United States of America, and of the country or countries of the Territory in which Buyer may operate, including without limitation the U. K. Bribery Act, the U.S. Foreign Corrupt Practices Act (“FCPA”) and the U.S. Anti-Kickback Act (the “Anti-Kickback Act”), and agrees to indemnify and hold harmless Seller from the consequences of any violation of such provisions by Buyer, its employees or agents. Buyer acknowledges that they are familiar with the provisions of the U. K. Bribery Act, the FCPA and the Anti-Kickback Act, and certifies that Buyer will adhere to the requirements thereof. In particular, Buyer represents and agrees that Buyer shall not make any payment or give anything of value, directly or indirectly to any governmental official, any foreign political party or official thereof, any candidate for foreign political office, or any commercial entity or person, for the purpose of influencing such person to purchase products or otherwise benefit the business of Seller.

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