

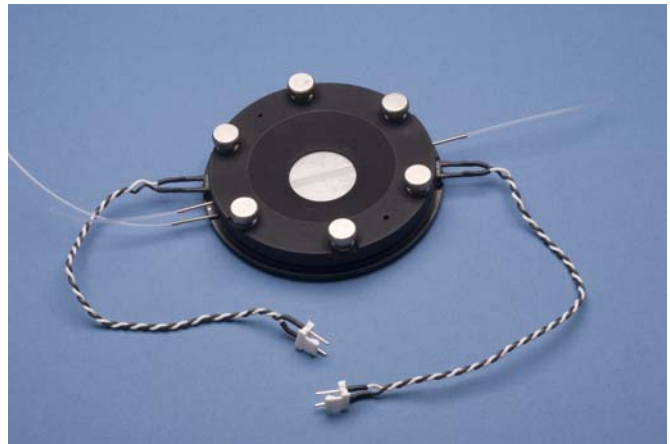
## WARNER SERIES 30 IMAGING CHAMBERS

A feature in common with Warner **RC-30 Series** chambers is the use of glass coverslips as the top and bottom of the chamber. In many cases, the bottom coverslip will contain the imaging sample. When viewed with an inverted microscope, images are visualized through a glass thickness of 0.13-0.17 mm.

### THE RC-31 CHAMBER

The **RC-31** is a low profile chamber incorporating special features for confocal imaging. These features include user defined bath geometry and volume, and a large viewing area.

The **RC-31** uses glass coverslips to form both the top and bottom of the chamber. This feature facilitates its use with both inverted and upright microscopes. Furthermore, the two-piece design and the six-point attachment screws of the **RC-31** allow for easy assembly and disassembly while applying uniform pressure across the gasket.



Variable Bath Volume/Fast Exchange - The chamber bath side wall is formed using a silicone gasket sandwiched between the upper and lower coverslips. Wall height (or spacing between the upper and lower coverslips) can range from 50 $\mu$ m to >350 $\mu$ m and is defined by the number and thickness of the gasket(s) used. Pre-cut gaskets are supplied with the chamber; one cut wide to allow full use of the large diameter aperture window, and a narrow, slotted version targeted towards fast solution exchange. Blank gaskets are also supplied and allow the development of customized bath geometries as required by your application

Large Viewing Area – The viewing aperture in the chamber housing is 23 mm in diameter. The chamber bottom is beveled to permit greater access to the bottom coverslip.

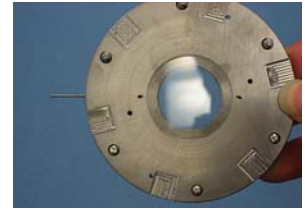
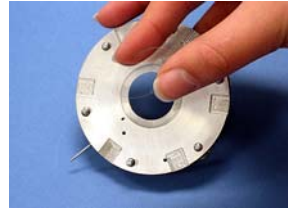
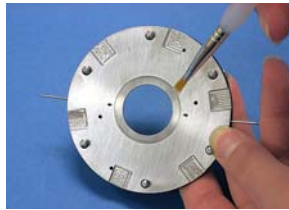
Heated Platform – The **RC-31** includes a pair of resistive heater elements mounted into the chamber base. Heater elements are compatible with Warner's TC-324B or TC-344B Temperature Controllers.

### ASSEMBLY

The general procedure for assembling the **RC-31** is to first mount a 30mm glass coverslip to the platform **TOP PLATE**. This is followed by mounting the **CHAMBER FORMING GASKET** onto the coverslip in the **TOP PLATE**. Next, a sample-containing coverslip is mounted onto the **PLATFORM BASE**. Finally, the **TOP PLATE** and **BASE** are assembled together resulting in a single, sealed unit. The assembled chamber is mounted onto the microscope, usually via a stage adapter.

1. Begin by placing a 30 mm coverslip into the **TOP PLATE**.
  - a. First, locate the 30 mm indentation on the underside of the **TOP PLATE**.

b. Using a small paintbrush, apply a thin layer of vacuum grease to the outside edge of this indentation.

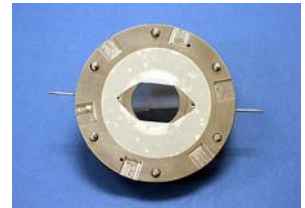
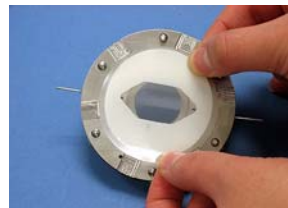


c. Next, secure a clean, 30 mm round, #1 thickness coverslip into the indentation making sure there is no excess grease at the edges.

**NOTE:** Total coverage is not important since the vacuum grease serves only to hold the coverslip in place during the assembly process. If the chamber develops a leak around one of the coverslips, then a more thorough application of vacuum grease should be used.

2. The next task is to place the **CHAMBER FORMING GASKET** on top of the coverslip nested into the underside of the **TOP PLATE**.

a. Select the gasket to be used and remove the polyethylene cover from the side that will face the **TOP PLATE**.



b. Position the gasket so that the perfusion inlet and outlet ports, as well as the alignment holes, are centered within the gasket cutout.

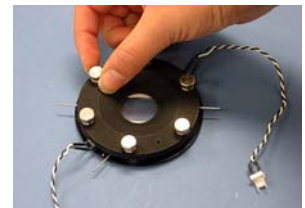
c. Press the chamber forming gasket into place. The silicone gasket material should make a clean seal with the coverslip without the need to use grease. Take a moment to press out any trapped air bubbles.

d. Carefully remove the polyethylene cover from the exposed bottom of the gasket taking care to not disturb the existing seal

3. Next, locate the 40 mm indentation on the **PLATFORM BASE**. As described above, apply a thin film of vacuum grease to the outer edge of this indentation and secure your 40mm diameter culture-containing coverslip into place. Leave a small drop of buffer on the coverslip to cover your sample.

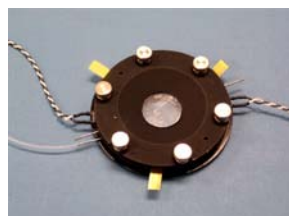


4. Place the coverslip **TOP PLATE**, with attached gasket, into the **PLATFORM BASE** while aligning the heater block cutouts (indentations) with the heater blocks in the base. Check for proper fit.



### Shimming for a thinner gasket

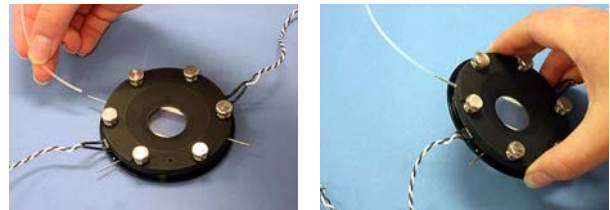
For applications requiring a gasket thickness less than 100  $\mu\text{m}$ , two sets of metal shims (75  $\mu\text{m}$  and 50  $\mu\text{m}$  thick) have been included with the RC-31 chamber.



5. Assemble the chamber using a 100  $\mu\text{m}$  gasket as described in steps 1-4.
6. Select the desired set of shims (75 or 50  $\mu\text{m}$ ) and insert each shim to a depth of approximately 5 mm around the periphery of the **PLATFORM BASE**. Place the shims between the top and bottom halves of the chamber at 3 locations equal distances apart.
7. Tighten the pressure plates so that the shims are clamped into place. The gasket thickness will then be the same thickness as that of the shim.

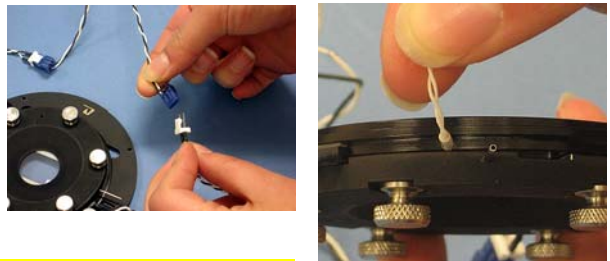
### General assembly (continued)

8. Screw the **PRESSURE PLATE** screws, loosely at first, onto the assembly using a criss-cross pattern technique similar to tightening a tire to a car. (In other words, work your way around the perimeter, skipping every other screw until all screws have been tightened.)
  9. Connect the input perfusion tube to the chamber input port and completely fill the bath with solution. Tilt the chamber output port up while filling to help avoid the occurrence of a trapped air pocket in the bath. Once the chamber is filled, wipe away any excess moisture and place the chamber onto a flat surface. Check for leaks and tighten the **TOP PLATE** as necessary.
- a. Once the chamber has been verified as liquid-tight it may be mounted onto the microscope. Connect the perfusion outlet tube before mounting the chamber to the microscope to avoid spilling solution on the optics.



### Connecting to the heating elements

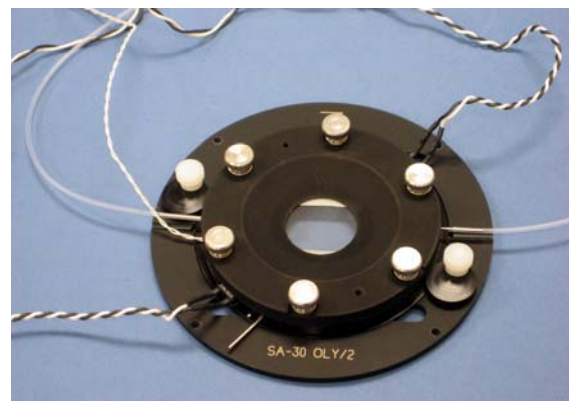
Prior to mounting the **RC-31** onto the microscope, you will want to attach the power and feedback lines from the heater controller to the platform. The two blue-ended heater cables simply connect to the two-prong heater blocks. The white feedback thermistor is inserted into the 2mm hole located on the side of the platform base between tightening screws.



**NOTE:** Place a drop of oil (immersion or mineral), or alternatively a small amount of vacuum grease on the thermistor before insertion to aid in thermal transfer between the thermistor and platform.

### Mounting onto the microscope

The **RC-31** can be mounted directly onto a microscope stage if the stage is both flat and has a cutout which fits or is smaller than the platform. In most cases, however, the stage cutout will be larger than the platform necessitating the use of a stage adapter. Warner Instruments has stage adapters for most popular microscopes (see Appendix A) and we can custom manufacture an adapter for a special application. Contact our Sales Department for details.



### PERFUSION

Perfusate is delivered to the chamber through PE-90 tubing. We recommend pre-filling all perfusion lines before attachment to reduce the occurrence of bubbles in the flow path.

**NOTE:** PE-90 tubing fits neatly inside PE-160 tubing. This allows the **RC-31** to be used with an in-line solution heater such as the SH-27B.

## Fluid control

Selection of solution source and rate of delivery can be of either manual or automatic design and is left to the user. However, Warner manufactures several perfusion control systems (such as the valve-driven VC-8 and VC-8M Control Systems) which can be used with this application. The solution delivery can be pumped or gravity-fed. While these approaches allow control over the flow rate, Warner also offers dedicated solution flow regulators (FR-50 and FR-55S) which can be used in conjunction with the VC Systems. Finally, a reference by Trese Leinders-Zufall describing the advantages of different perfusion control systems is available for download from our website: [http://www.warneronline.com/pdf/whitepapers/perfusion\\_strategies.pdf](http://www.warneronline.com/pdf/whitepapers/perfusion_strategies.pdf).

## Multiple perfusion solutions

Warner Instruments' multi-port manifolds (MM, ML, MP, or MPP Series) can be used to connect from 2-8 solution lines to the **RC-31**. Air should be removed from each feed line by pre-filling with its appropriate solution. The manifold output tube is attached to the input port of the chamber. We recommend making the connection between the manifold and chamber as short as possible to minimize solution exchange times.

## PLATFORM HEATING

A general discussion regarding issues surrounding heating of solutions and platforms is available for download from our website: [http://www.warneronline.com/product\\_info.cfm?id=747](http://www.warneronline.com/product_info.cfm?id=747).

## Monitoring the heat

Heat is transferred to the aluminum platform from a pair of 20  $\Omega$  power resistors mounted on the underside of the platform. The temperature of the platform is monitored and controlled by measuring the platform thermistor resistance and adjusting the voltage to the heaters.

Automatic heat control is achieved by using a Warner Temperature Controller (TC-324B or TC-344B). These devices allow the desired temperature to be set and automatically maintained at less than 1°C deviation. The maximum temperature rating of the supplied thermistor is 60°C.

## MAINTENANCE

Cleaning of the **TOP PLATE** should be performed using a dilute detergent solution. Alternatively, Warner has developed a trisodium phosphate (TSP) wash protocol which is effective in cleaning anodized metal and plastic parts. Contact our Technical Support staff or download the protocol in PDF format from our website: ([http://www.warneronline.com/pdf/whitepapers/cleaning\\_plastic.pdf](http://www.warneronline.com/pdf/whitepapers/cleaning_plastic.pdf)).

## APPENDIX

### A. Specifications

<b>Physical Dimensions (H X D)</b>	11.5 x 82 mm
<b>Viewing Area</b>	23 mm in diameter
<b>Weight</b>	0.22 kg, assembled with optional heaters
<b>Construction</b>	Aluminum, black anodized
<b>Gaskets</b>	Silicone rubber
<b>Input/Output Tubing</b>	PE-90
<b>Coverslips</b>	Top: 30 mm round, #1.5 Thickness Bottom: 40 mm round, #1 Thickness
<b>Microscope Stage Adapters*</b>	All major models: Leica, Nikon, Zeiss, Olympus, Prior, Ludl, Burleigh

\*Note: Uses Series 30 stage adapters. For exterior dimensions use exterior dimension information for corresponding Series 20 adapters

### B. Warner Stage Adapters

Warner Instruments carries an extensive line of stage adapters for our chambers and we frequently add new adapters as microscope manufacturers add to or modify their product lines. Contact our offices if you do not find an adapter for your microscope below. You may also want to check our website (<http://www.warneronline.com>) to see if an adapter has been added since this manual was printed.

Manufacturer	Microscope Model	Stage Adapter	Order Number
Nikon	Nikon Diaphot/TE200/TE300/TE2000	SA-30NIK	64-0322
	Nikon TMS with 9 x 13 cm Cut-Out	SA-30TMS/9	64-0324
	Nikon E400/E600/E800 Stage	SA-30UU	64-0380
Olympus	Olympus IMT-2/IX-50/IX-70/BX-50WI	SA-30/OLY2	64-0325
Leica	Leica Galvo Z Inverted Stage	SA-30GALVZi	64-1456
	Leica Dmirb/E with 3-Plate Mechanical Stage	SA-30L3P	64-0328
	Leica Galvo Z Upright Stage	SA-30GALVOZ	64-0377
Prior & Ludl	Prior & Ludl Motorized Stage	SA-30PLI	64-0329
Zeiss	Zeiss Axiovert 211 x 230	SA-30LZ	64-0326
	Zeiss LSM510 Stage	SA-30UUZ	64-0379
	Zeiss Axiovert 85 x 130 Mechanical (K) Stage	SA-30KZ	64-0327

**NOTE:** Warner Instrument **Series P** platforms are designed to fit the Zeiss 76x26 microscope slide frame (#471719) without a stage adapter. Heater platforms will require an insulating material between the platform and frame.

### C. Chamber supplies/spare parts

We stock the following supplies for your convenience. Contact our Sales Department for prices.

Part Number	Order Number	Description	Qty/pkg
<b>#1 Coverslips</b>			
CS-30R	64-1499	30mm diameter #1.5 Thickness	90
CS-40R	64-1500	40mm diameter #1 Thickness	60
CS-15R	64-0703	15mm diameter (fits RC-25F chamber)	100
CS-22S	64-0704	22mm x 22mm square (fits RC-21B chamber)	100
CS-25R	64-0705	25mm diameter (fits RC-21R chamber)	100
CS-22/30	64-0706	22mm x 30mm rectangle (fits RC-30 chamber)	100
CS-22/40	64-0707	22mm x 40mm rectangle (fits RC-22, 22C, 24, 24E, 26 & 26G, 30 chambers)	50
<b>Gaskets</b>			
GS30L/10	64-0330	Large Bath Gasket 250 µm	10
GS30L/15	64-0331	Large Bath Gasket 375 µm	10
GS30S/10	64-0332	Slotted Gasket 250 µm	10
GS30S/15	64-0333	Slotted Gasket 375 µm	10
GS30B/10	64-0334	Blank Gasket 250 µm	10
GS30B/15	64-0335	Blank Gasket 375 µm	10
GS-30B/4	64-0341	Blank Gaskets 125 µm	10
GS-30L/4	64-0342	Large Bath Gasket 125 µm	10
GS-30S/4	64-0343	Slotted Bath Gasket 125 µm	10
<b>Polyethylene Tubing</b>			
PE-90/10	64-0754	1.27 mm OD x 0.86 mm ID tubing	10 ft. (3.3 M)
<b>Replacement/Spare Parts for Heater Platforms</b>			
RH-2	64-0274	Heater elements	2
TS-60P	64-0269	Probe Thermistor	1
<b>Multi-Perfusion Zero Dead Space Manifolds</b>			
MM-2 or ML-2	64-0203 or 64-0200	2 input, 1 output	1
MM-4 or ML-4	64-0204 or 64-0201	4 input, 1 output	1
MM-6 or ML-6	64-0205 or 64-0202	6 input, 1 output	1
ML-8	64-0199	8 input, 1 output	1

#### **D. Comments**

- 1) Silicone vacuum grease (also called stopcock grease) is available from Warner Instruments (**Warner #111**).
- 2) Best temperature regulation is achieved by preheating the perfusion solution with an in-line heater (**SH-27B** or **SF-28**) in addition to warming the chamber.