



Xcellerex™ XDR cell culture bioreactor systems

The Xcellerex XDR bioreactor product line offers the benefits of single-use technology and stirred-tank design in a modular, turnkey, bioreactor platform (Fig 1). Designed for scalability and robustness, the XDR bioreactor systems provide the performance and flexibility needed from process development to large-scale biopharmaceutical manufacturing. XDR bioreactor systems can be operated in batch, fed-batch, and perfusion modes.

XDR bioreactor systems offer the following benefits:

- Separation of gas and electrical power for enhanced safety
- Scalable and predictable stirred-tank performance up to 2000 L
- Single-use technology eliminates costly and time-consuming cleaning and cleaning validation
- Advanced automation and modular system design to support a variety of installation scenarios
- Process and operational support from staff with extensive manufacturing experience

System overview

The full line of XDR bioreactor systems are designed and characterized to deliver scalable process equivalence from 4.5 L to 2000 L working volume, in both GMP and non-GMP environments. The system design is based on the same foundational principles as conventional stainless steel bioreactors. Consistent vessel geometries, tight relationship between consumables and equipment features, and a host of accessories combine for an easily scalable, single-use product line. Traditional scaling methodology, based on measures such as shear, tip speed, power per unit volume, $k_L a$, and specific process sensitivities, can be used during scale-up. Technology transfer using the XDR systems is straightforward, minimizing the need for costly and time-consuming process redesign. For enhanced utility across the bioreactor platform, the minimum working volume is as low as 20% of the maximum working volume.



Fig 1. Bioreactor system components: XDR vessel and X-Station mobile control console.

The bioreactor bag assembly (XDA) is disposed after culture termination and eliminates costly and time-consuming cleaning-in-place (CIP) and steam-in-place (SIP) operations. The XDA bag assembly is prepackaged with a low profile impeller, a variety of sparge components, filters, and tubing, for quick and hassle-free installation. The flexibility of single-use technology enables quick changeover between production runs, for efficient equipment utilization. Interconnection of bioreactor bag and equipment is key in achieving the excellent performance that XDR bioreactor systems deliver.

The modularity of the XDR product line stems from three main subsystem components: bioreactor vessel with frame, I/O cabinet, and X-Station mobile control console. The XDR product line is further enhanced by the dual-panel I/O cabinet design, which separates gas management from electrical power. Additionally, high and low voltage power are in separate subsections of the main I/O cabinet. The system components can be used together for a complete turnkey system with true plug-and-play performance. Alternatively, the components can be used separately and integrated into existing infrastructure, for enhanced flexibility. The jacketed vessel has a consistent design and delivers integrated heating and cooling for

efficient temperature control throughout all scales. The versatile I/O cabinet houses all critical process instrumentation such as probe transmitters and peristaltic pumps: up to four internal and two external pumps are configurable. The gas management cabinet can be configured or customized with up to six mass flow controllers. The X-Station mobile control console is the heart of the product line's turnkey capability. The power and versatility of the X-Station allow for up to four XDR bioreactor systems to be controlled from one single control unit. This truly modular design creates a process-ready system upon delivery and also supports integration into a user-preferred automation platform.

XDR system components

Well-mixed bioreactor vessel

Constructed of 304 grade stainless steel (304 SS), the jacketed vessel enables efficient heat transfer and, together with an external temperature control unit (TCU), offers highly accurate temperature control of the cell culture. The bioreactor vessel features load cells for weight measurement and locking casters with leveling feet. Other features include a bioreactor bag tubing manager for convenient positioning and routing of the bag tubing and a high-performance, bottom-mounted, magnetically coupled drive system. Because of the bottom drive, there are no shafts to install from the top of the bioreactor vessel, minimizing ceiling height requirements. To aid in coupling and decoupling the motor drive and the bag, each XDR includes a mechanical assist device.

The systems are equipped with inlet and exhaust filter holders and vessel sidewall viewing ports. A lower sidewall port opening makes room for a sampling port as well as probes for pH, dissolved oxygen (DO), and temperature. An optional perfusion-specific bag loading door is available to accommodate cell retention devices. The 1000 L and 2000 L systems feature integrated bag loading doors that, along with the semiautomatic bag hoist, simplifies bag installation. An efficient exhaust gas filter heater is also included to avoid condensate that could compromise exhaust filter performance.

The complete XDR bioreactor system product portfolio supports operating volumes from 4.5 L up to 2000 L. The smallest process development system, XDR-10, is discussed in detail in a separate data file (29092927).

Versatile I/O cabinet

Two 304 SS I/O cabinets functionally separate devices for gas management, as well as pumps and transmitters for pH and DO measurement. Standard XDR gas and liquid management configurations cover the majority of cell culture applications. Probes on the bioreactor system provide real-time data, monitored throughout the process run using Wonderware™ software. Profibus™ communication standard is used for device communication and communication to the X-Station. For custom installations, direct Profibus communication between the I/O cabinet and other automation systems (e.g., Rockwell, DeltaV™, Honeywell, Siemens) can be accomplished.

Liquid management

The I/O cabinet can be configured with up to four pumps including on-off and variable speed peristaltic pumps. The on-off pumps utilize a Watson-Marlow™ 114 pump head, while the variable speed pumps utilize Watson-Marlow 313 or 520 pump heads depending on configuration. The pumps have ranges to support liquid addition or removal. They can also be programmed for fed-batch and perfusion culturing and easily calibrated using Wonderware software.

Gas management

Up to six mass flow controllers offer multiple sparging regimes, CO₂ abatement at large-scale, and overlay gas addition. The XDR systems include a gas manifold to distribute the various gases to the available bag destinations: sparger or headspace. The dual-panel XDR design uses a separate gas management cabinet.

Measurements of DO and pH

DO and pH can be measured using conventional polarographic sensors and glass electrodes, respectively. These sensors can be autoclaved prior to use in a specially designed probe sheath. Aseptic insertion into the bioreactor bag is conveniently done using single-use connector technology. Optionally, single-use, weld-in DO (optical) and pH sensors are available; ready for use to minimize start-up time. The flexibility of the system allows the sensor technology to be mixed for use of conventional and single-use technologies simultaneously. All sensors are connected to the I/O cabinet transmitters. The dual-panel XDR includes options for Rosemount 56, Rosemount 1056, and Mettler-Toledo MT-800 transmitters.

Measurement of dissolved carbon dioxide

Conventional, reusable, insertion-type probe technology is used for monitoring of dissolved carbon dioxide. A dedicated transmitter is available optionally for integration into the I/O cabinet.

Plug-and-play X-Station mobile control console

X-Station is a stand-alone, mobile control console featuring intuitive process control, data historian, and industrial-quality automation hardware and software (Fig 2). The control system provides real-time data acquisition, enables accurate process control, and offers convenient, real-time trending. X-Station is capable of measuring and controlling up to four XDR bioreactor systems simultaneously.

Inside the 304 SS cover is housed a scalable programmable logic controller (PLC)/programmable automation controller (PAC) and a server-class computer running user interface and data historian software. X-Station comes with a 19 inch touchscreen, industrial, wash down-resistant mouse, a QWERTY keyboard, and a built-in uninterruptible power supply (UPS). Profibus and Ethernet communication standards are included for equipment and local area network connectivity.



Fig 2. The X-Station mobile control console.

XDA bioprocessing consumables

The XDA bioreactor bag is an essential part of the process performance achieved with XDR bioreactor systems. Constructed with a contact layer of USP class VI-compliant low-density polyethylene (LDPE) plastic, the bioreactor bags are robust to withstand process conditions. The XDA bioreactor bag incorporates a seal-less, bottom-mounted impeller/sparger assembly: XDR-50, center-mounted; XDR-200-2000, 15° offset. (Fig 3A). Installed in the bioreactor vessel, the impeller/sparger assembly couples with the magnetic drive head, creating a powerful and robust agitation system. Up to eight sparge elements are included in the impeller/sparge assembly (Fig 3B). Each sparge element can be configured with various porosities, drilled holes, or a combination of both to support both macro- and microsparging. Each of the standard sparge elements has been verified to provide out-of-the-box performance consistent with current cell culture practices.

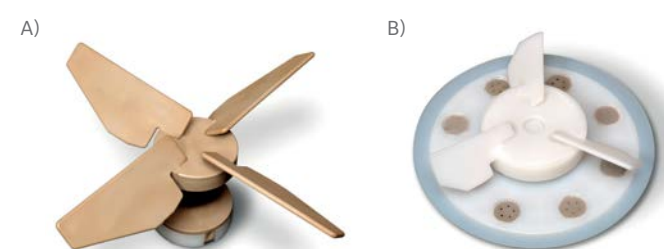


Fig 3. (A) Impeller for XDR-2000 with four pitched blades. (B) Impeller/sparger assembly for XDR-200 with three pitch blades and eight sparge elements.

The XDA bioreactor bags are available in Pro, Development, or Custom formats (Fig 4). Pro-type bags are available for all bioreactor systems and have verified sparge configurations, established based on customer feedback and our own biomanufacturing experience. Development bags are available for XDR-50 and XDR-200 bioreactor systems and differ from the Pro bags primarily in the configuration of the sparge elements. Development bags can be used in a broad array of process development activities where various micro- or macrosparging regimes are evaluated. Custom bioreactor bags can be modified with tubing type and length, connection type, filter element, or sparger configuration. Custom bags can also incorporate a CO₂-removal sparge wand to address processes sensitive to dissolved CO₂.

All bioreactor bags for cell culture include a magnetically coupled, M40e 40°, pitched-blade impeller with ceramic bearings. Ceramic bearings, originally developed for aggressive mixing applications and fermentation, provide excellent overall performance. The medical-grade ceramic bearings meet the relevant industry requirements for leachables, extractables, and particulates according to the bag validation guide (for more information, please contact your sales representative). Impeller configurations for microcarrier applications are optionally available.

Additional bag components include tubing with a combination of weldable sections and aseptic connectors for liquid addition/removal, a disposable pressure sensor, and filters for exhaust, sparge, and overlay/headspace gas. XDA bioreactor bags support both insertion-type reusable probes and single-use

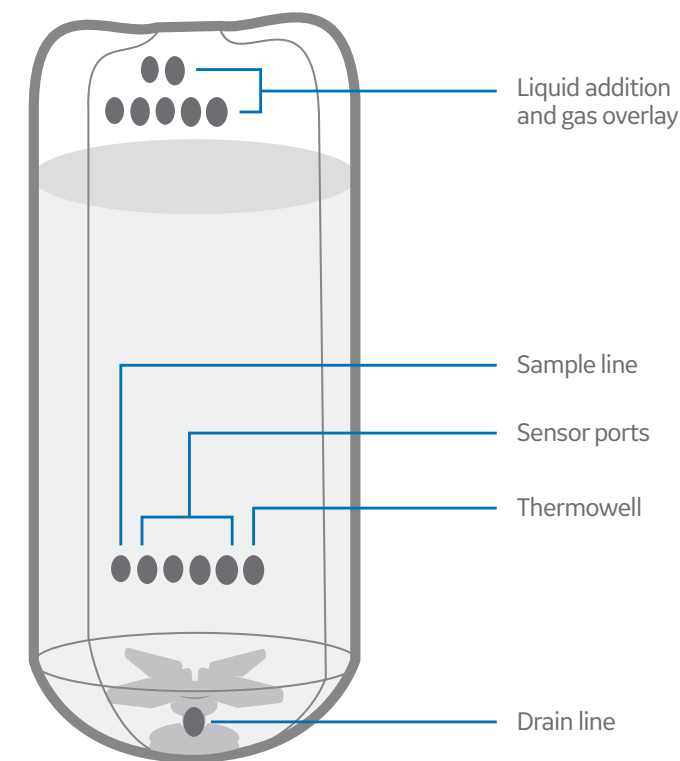


Fig 4. XDR-2000 Pro bag assembly.

probes. Probe configurations can include reusable probes only, single-use probes only, or mixed reusable and single-use probes. For details on probes, see section "Measurements of DO and pH".

To assist in efficient bioreactor operation, a number of supplementary XDA bag-related accessories are optionally available. Like the main bioreactor bags, these accessories are tightly coupled to the equipment design to be adaptable to varied process requirements and to support operational efficiency. XDA accessories include seal-and-store sample manifolds, foam traps, X-Connect tubing sets, and exhaust filter tubing sets.

Qualification support

The XDR bioreactor systems are designed for use in environments that require 21 CFR Part 11 and GAMP™ 5. The systems are delivered with an operating manual, system specification, drawings to support qualification, and major component documentation. Industry standard installation and operation qualification (IQ/OQ) packages are available as an option.

Applications

XDR cell culture bioreactor systems have successfully been used to cultivate a wide range of cell types and organisms including CHO cells, Vero cells, HEK293, and MDCK cells. In addition, a fermentor system is available for microbial applications including *E. coli*, *Pseudomonas spp.*, and yeast (see data file 29092929). XDR bioreactor systems can be operated in batch, fed-batch, and perfusion (or chemostat) modes. Bioreactor bag design can be process-dependent, requiring customization for proper use and performance.

Customization

The XDR bioreactor offers standard configurations capable of addressing a broad set of cell culture applications. The product platform offers a variety of customizable options, which broaden its application. Contact your local GE representative to match your process to the XDR configuration that is right for your application.

Vessel specifications

Standard cell culture specifications are listed in Table 1.

Table 1. Specifications of standard configuration XDR cell culture bioreactor systems

| | XDR-50* | XDR-200 | XDR-500 | XDR-1000 | XDR-2000 |
|---|---|-----------------------|-----------------------|-----------------------|-----------------------|
| Specifications | | | | | |
| Max. working volume (L) | 50 | 200 | 500 | 1000 | 2000 |
| Min. working volume (L) | 22 | 40 | 100 | 200 | 400 |
| Volume turn-down ratio | 2.2:1 | 5:1 | 5:1 | 5:1 | 5:1 |
| Aspect ratio (H/D) | 2.25:1 | 1.5:1 | 1.5:1 | 1.5:1 | 1.5:1 |
| Vessel | Jacketed 304 SS | | | | |
| Filter heat assembly | 1 | | | | |
| Additional filter heater assemblies (optional) | 1 | | | | |
| Bag hoist | Not applicable | Not applicable | Not applicable | Semi-automatic | Semi-automatic |
| Impeller, M40e pitched-blade type | 3 blades at 40° pitch | 3 blades at 40° pitch | 3 blades at 40° pitch | 3 blades at 40° pitch | 4 blades at 40° pitch |
| Custom bag assembly | 3 | 3 | 4 | 4 | 4 |
| Process instrumentation | | | | | |
| pH probes† | 1 (2 optional) | 2 | 2 | 2 | 2 |
| DO probes† | 1 (2 optional) | 2 | 2 | 2 | 2 |
| CO ₂ probes (optional) | 1 internal or 1 external | | | | |
| MFC§ (standard) | 4 | | | | |
| Additional MFC‡ (optional) | 2 | | | | |
| Internal pumps (standard) | 4 (from among 114, 313 or 520) | | | | |
| External pumps (optional)§ | 2 | | | | |
| Temperature control unit¶ (heating, kW/cooling, HP) | 3/1 | 9/1.5 | 9/1.5 | 9/1.5 | 9/1.5 |
| Load cells | 3 | 4 | 4 | 4 | 4 |
| X-Station control unit | | | | | |
| Interfaces | 19"/52.4 mm touchscreen, wash-down compatible keyboard and mouse; includes built-in UPS | | | | |
| Hardware | Rockwell™/Allen Bradley™ | | | | |
| Operator interface | Wonderware HMI†† | | | | |
| HMI†† Data Historian | Wonderware | | | | |
| Compliance | 21 CFR Part 11 compliant‡‡ | | | | |

* For specifications of XDR-50 MO fermentation system, please see data file 29092929.

† Single-use or reusable probes.

‡ Thermal mass flow controllers.

§ External pumps are Profibus devices and might be Watson-Marlow 520, 620, or 720 series depending on required flow rate.

¶ Optional standalone heating/cooling TCU listed. Other TCU configurations available, including units that use facility chilled water/glycol.

†† Human-machine interface.

‡‡ Customer will need to implement appropriate operating procedures to be fully 21 CFR Part 11 compliant. The XDR is built to support this two-part compliance.

Note: For specifications of XDR-10 bioreactor system, please see data file 29092927

Privacy and security

XDR systems are designed around a contemporary cyber-security threat model to protect against unintended access or malicious activity. Complementary to customer access and use control methods, XDR bioreactors employ unique user names and passwords along with application execution control software. Application control avoids the need for anti-virus software.

Consumable specifications

Table 2. Specifications of standard configuration for XDA bags for XDR cell culture bioreactor systems

Product description

Product code

XDR-50 DEV

Minimum volume: 22 L; nominal volume: 50 L; headspace volume: 13 L

IMP‡: M40e, 3 blades, 8.5 in diameter, Di/Dt*: 0.61, 40° pitch, center

Film: ASI™ PL-01026/01077

A, B, D, G, H: 1 in of 1/4" × 3/8" C-Flex® 374

E: 1 in of 3/8" × 5/8" C-Flex 374

A, G, H (liquid additions): 3 in of 1/4 in × 7/16 in C-Flex 374 reduced to 48 in 1/8 in × 1/4 in C-Flex 374, plugged, pinch clamp

B, D (liquid additions): 48 in of 1/4 in × 7/16 in C-Flex 374, plugged, pinch clamp

C (vent filter): CFVTV0.2-33A filter (Meissner), T with 6 in of 1/2 in × 3/4 in C-Flex 374 terminated with ReadyMate™ connector, pinch clamp

E (liquid addition): 60 in of 3/8 in × 9/16 in Platinum-cured Silicon to 18 in of 3/8 in × 5/8 in C-Flex 374 terminated with ReadyMate connector, pinch clamp

F (headspace gas): pressure sensor, A50V002P2NV filter (Pall), 3 in of 1/4 in × 7/16 in C-Flex 374 terminated with instant tube fitting, pinch clamp

I (RTD† thermowell): 1/4 in barb with dip tube for RTD† connection

J, K (probe ports): female Kleenpak™ port for probe connection

L (sample lines): 12 in of 1/8 in × 1/4 in C-Flex 374 terminated with female luer sampling port, pinch clamp (× 2)

M, O (liquid additions): 10 in of 3/4 in × 1 in C-Flex 374 terminated with ReadyMate connector

N (liquid addition): 18 in of 3/8 in × 5/8 in C-Flex 374 reduced to 18 in of 1/4 in × 7/16 in C-Flex 374, plugged, pinch clamp

Sparge 2: 2 µm sintered disk

Sparge 4, 6: 2 µm sintered disk with 5 × 0.5 mm drilled holes

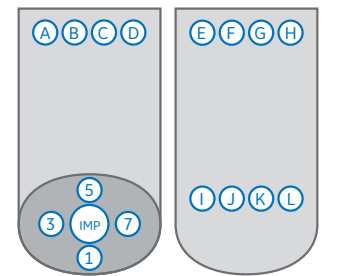
Sparge 5: 20 µm sintered disk

Sparge 8: 2 µm sintered disk with 5 × 1 mm drilled holes

Sparge 2 and 5: tubing from each port combined to A50V002P2NV filter (Pall) to 3 in of 1/4 in × 7/16 in C-Flex 374 terminated with instant tube fitting, pinch clamp

Sparge 4, 6 and 8: tubing from each port combined to A50V002P2NV filter (Pall) to 3 in of 1/4 in × 7/16 in C-Flex 374 terminated with instant tube fitting, pinch clamp

Sparge 1, 3 and 7 (drain): tubing from each port combined to 48 in of 3/8 in × 5/8 in C-Flex 374 terminated with ReadyMate connector, pinch clamp



XDR-50 PRO

Minimum volume: 22 L; nominal volume: 50 L; headspace volume: 13 L

IMP‡: M40e, 3 blades, 8.5 in diameter, Di/Dt*: 0.61, 40° pitch, center

Film: ASI PL-01026/01077

A, B, D, G, H: 1 in of 1/4 in × 3/8 in C-Flex 374

E: 1 in of 3/8 in × 5/8 in C-Flex 374

A, G, H (liquid additions): 3 in of 1/4 in × 7/16 in C-Flex 374 reduced to 48 in 1/8 in × 1/4 in C-Flex 374, plugged, pinch clamp

B, D (liquid additions): 48 in of 1/4 in × 7/16 in C-Flex 374, plugged, pinch clamp

C (vent filter): CFVTV0.2-33A filter (Meissner), T with 6 in of 1/2 in × 3/4 in C-Flex 374 terminated with ReadyMate connector, pinch clamp

E (liquid addition): 48 in of 3/8 in × 5/8 in C-Flex 374, plugged, pinch clamp

F (headspace gas): pressure sensor, A50V002P2NV filter (Pall), 3 in of 1/4 in × 7/16 in C-Flex 374 terminated with instant tube fitting, pinch clamp

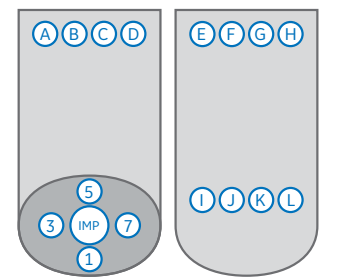
I (RTD† thermowell): 1/4 in barb with dip tube for RTD† connection

J, K (probe ports): female Kleenpak port for probe connection

L (sample lines): 12 in of 1/8 in × 1/4 in C-Flex 374 terminated with female luer sampling port, pinch clamp (× 2)

Sparge 5: 2 µm sintered disk, 48 in of 1/4 in × 7/16 in C-Flex 374 to A50V002P2NV filter (Pall) to 3 in of 1/4 in × 7/16 in C-Flex 374 terminated with instant tube fitting, pinch clamp

Sparge 1, 3 and 7 (drain): tubing from each port combined to 48 in of 3/8 in × 5/8 in C-Flex 374, plugged, pinch clamp



* Impeller diameter to bioreactor bag diameter

† Resistance temperature detectors

‡ IMP=Impeller

XDR-50 PRO FLEX

Minimum volume: 22 L; nominal volume: 50 L; headspace volume: 13 L

IMP†: M40e, 3 blades, 8.5 in diameter, Di/Dt*: 0.61, 40° pitch, center

Film: ASI PL-01026/01077

A, B, D, G, H: 1 in of 1/4 in × 3/8 in C-Flex 374

E: 1 in of 3/8 in × 5/8 in C-Flex 374

A, G, H (liquid additions): 3 in of 1/4 in × 7/16 in C-Flex 374 reduced to 48 in 1/8 in × 1/4 in C-Flex 374, plugged, pinch clamp

B, D (liquid additions): 48 in of 1/4 in × 7/16 in C-Flex 374 terminated with ReadyMate connector, pinch clamp

C (vent filter): CFVT0.2-33A1 filter (Meissner), T with 6 in of 1/2 in × 3/4 in C-Flex 374 terminated with ReadyMate connector, pinch clamp

E (liquid addition): 48 in of 3/8 in × 5/8 in C-Flex 374 terminated with ReadyMate connector, pinch clamp

F (headspace gas): pressure sensor, A50V002P2NV filter (Pall), 3 in of 1/4 in × 7/16 in C-Flex 374 terminated with instant tube fitting, pinch clamp

I (RTD[†] thermowell): 1/4 in barb with dip tube for RTD[†] connection

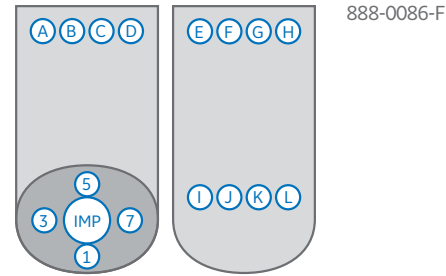
J, K (probe ports): female Kleenpak port for probe connection

L (sample lines): 12 in of 1/8 in × 1/4 in C-Flex 374 terminated with female luer sampling port, pinch clamp (× 2)

Sparge 5: 2 μm sintered disk, 48 in of 1/4 in × 7/16 in C-Flex 374 to A50V002P2NV filter (Pall) to 3 in of 1/4 in × 7/16 in C-Flex 374 terminated with instant tube fitting, pinch clamp

Sparge 6: 2 μm sintered disk with 5 × 1 mm drilled holes, 48 in of 1/4 in × 7/16 in C-Flex 374 to A50V002P2NV filter to (Pall) 3 in of 1/4 in × 7/16 in C-Flex 374 terminated with instant tube fitting, pinch clamp

Sparge 1, 3 and 7 (drain): tubing from each port combined to 48 in of 3/8 in × 5/8 in C-Flex 374 terminated with ReadyMate connector, pinch clamp



XDR-200 DEV

Minimum volume: 40 L; nominal volume: 200 L; headspace volume: 60 L

IMP†: M40e, 3 blades, 8.5 in diameter, Di/Dt*: 0.38, 40° pitch, 15° off center

Film: ASI PL-01026/01077

A, B (liquid additions): 3 in of 1/4 in × 7/16 in C-Flex 374 reduced to 120 in 1/8 in × 1/4 in C-Flex 374, plugged, pinch clamp

C, D, F (liquid additions): 18 in of 1/2 in × 3/4 in C-Flex 374 terminated with female Kleenpak connector, pinch clamp

E (headspace gas): pressure sensor, CFVT0.2-33A filter (Meissner), 3 in of 1/4 in × 7/16 in C-Flex 374 terminated with instant tube fitting

G (liquid addition): 120 in of 1/2 in × 3/4 in C-Flex 374, plugged, pinch clamp

H (sample lines): 12 in of 1/8 in × 1/4 in C-Flex 374 terminated with female luer sampling port, pinch clamp (× 2)

I, J, K, L (probe ports): female Kleenpak port for probe connection

M (RTD[†] thermowell): 1/4 in barb with dip tube for RTD[†] connection

N (drain): 36 in of 1/2 in × 3/4 in C-Flex 374 terminated with female Kleenpak connector, pinch clamp

O (vent filter): KA3V002PV1G filter (Pall), T with 6 in of 1/2 in × 3/4 in C-Flex 374 terminated with female Kleenpak, pinch clamp

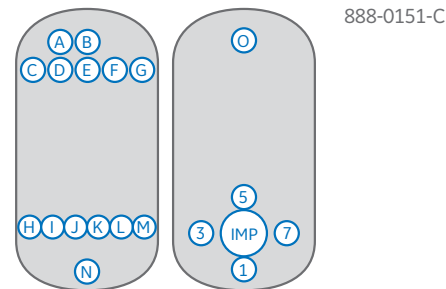
Sparge 1 and 5: 20 μm sintered disk

Sparge 2, 6: 2 μm sintered disk

Sparge 3 and 7: 2 μm sintered disk with 5 × 1 mm drilled holes

Sparge 4 and 8: 2 μm sintered disk with 5 × 0.5 mm drilled holes

Sparge 1 & 5, 2 & 6, 3 & 7, 4 & 8: tubing from each port for each pair combined to 84 in of 1/8 in × 1/4 in C-Flex 374 to CFVT0.2-33A filter (Meissner), 3 in of 1/4 in × 7/16 in C-Flex 374 terminated with instant tube fitting



* Impeller diameter to bioreactor bag diameter

† Resistance temperature detectors

‡ IMP=Impeller

XDR-200 PRO

Minimum volume: 40 L; nominal volume: 200 L; headspace volume: 60 L

IMP†: M40e, 3 blades, 8.5 in diameter, Di/Dt*: 0.38, 40° pitch, 15° off center

Film: ASI PL-01026/01077

A, B (liquid additions): 3 in of 1/4 in × 7/16 in C-Flex 374 reduced to 120 in 1/8 in × 1/4 in C-Flex 374, plugged, pinch clamp

C, D, F (liquid additions): 18 in of 1/2 in × 3/4 in C-Flex 374 terminated with female Kleenpak connector, pinch clamp

E (headspace gas): pressure sensor, CFVT0.2-33A filter (Meissner), 3 in of 1/4 in × 7/16 in C-Flex 374 terminated with instant tube fitting

G (liquid addition): 120 in of 1/2 in × 3/4 in C-Flex 374, plugged, pinch clamp

H (sample lines): 12 in of 1/8 in × 1/4 in C-Flex 374 terminated with female luer sampling port, pinch clamp (× 2)

I, J, K, L (probe ports): female Kleenpak port for probe connection

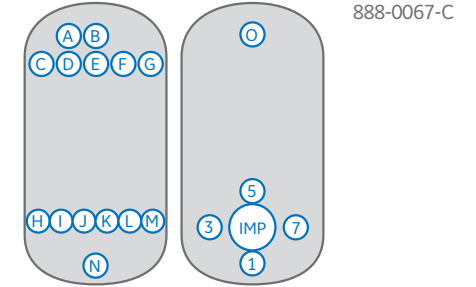
M (RTD[†] thermowell): 1/4 in barb with dip tube for RTD[†] connection

N (drain): 36 in of 1/2 in × 3/4 in C-Flex 374 terminated with female Kleenpak connector, pinch clamp

O (vent filter): KA3V002PV1G filter (Pall), T with 6 in of 1/2 in × 3/4 in C-Flex 374 terminated with female Kleenpak, pinch clamp

Sparge 1, 4 and 6: 2 μm sintered disk

Sparge 1, 4 and 6: tubing from each port combined to 96 in of 1/8 in × 1/4 in C-Flex 374 to CFVT0.2-33A filter (Meissner), 3 in of 1/4 in × 7/16 in C-Flex 374 terminated with instant tube fitting, pinch clamp



XDR-500 PRO

Minimum volume: 100 L; nominal volume: 500 L; headspace volume: 125 L

IMP†: M40e, 3 blades, 10.5 in diameter, Di/Dt*: 0.35, 40° pitch, 15° off center

Film: ASI PL-01026/01077

A, B (liquid additions): 3 in of 1/4 in × 7/16 in C-Flex 374 reduced to 120 in 1/8 in × 1/4 in C-Flex 374, plugged, pinch clamp

C, D, F (liquid additions): 18 in of 1/2 in × 3/4 in C-Flex 374 terminated with female Kleenpak connector, pinch clamp

E (headspace gas): pressure sensor, CFVT0.2-33A filter (Meissner), 3 in of 1/4 in × 7/16 in C-Flex 374 terminated with instant tube fitting

G (liquid addition): 120 in of 1/2 in × 3/4 in C-Flex 374, plugged, pinch clamp

H (sample lines): 12 in of 1/8 in × 1/4 in C-Flex 374 terminated with female luer sampling port, pinch clamp (× 2)

I, J, K, L (probe ports): female Kleenpak port for probe connection

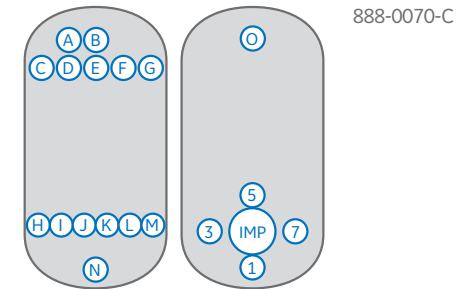
M (RTD[†] thermowell): 1/4 in barb with dip tube for RTD[†] connection

N (drain): 36 in of 1/2 in × 3/4 in C-Flex 374 terminated with female Kleenpak connector, pinch clamp

O (vent filter): KA3V002PV1G filter (Pall), T with 6 in of 1/2 in × 3/4 in C-Flex 374 terminated with female Kleenpak, pinch clamp

Sparge 1, 3, 5 and 7: 2 μm sintered disk

Sparge 1, 3, 5 and 7: tubing from each port combined to 96 in of 1/4 in × 7/16 in C-Flex 374 to CFVT0.2-33A filter (Meissner), 3 in of 1/4 in × 7/16 in C-Flex 374 terminated with instant tube fitting, pinch clamp



XDR-500 PRO FLEX

Minimum volume: 100 L; nominal volume: 500 L; headspace volume: 125 L

IMP†: M40e, 3 blades, 10.5 in diameter, Di/Dt*: 0.35, 40° pitch, 15° off center

Film: ASI PL-01026/01077

A, B (liquid additions): 3 in of 1/4 in × 7/16 in C-Flex 374 reduced to 120 in 1/8 in × 1/4 in C-Flex 374, plugged, pinch clamp

C, D, F (liquid additions): 18 in of 1/2 in × 3/4 in C-Flex 374 terminated with ReadyMate connector, pinch clamp

E (headspace gas): pressure sensor, CFVT0.2-33A1 filter (Meissner), 3 in of 1/4 in × 7/16 in C-Flex 374 terminated with instant tube fitting

G (liquid addition): 120 in of 1/2 in × 3/4 in C-Flex 374 terminated with ReadyMate connector, pinch clamp

H (sample lines): 12 in of 1/8 in × 1/4 in C-Flex 374 terminated with female luer sampling port, pinch clamp (× 2)

I, J, K, L (probe ports): female Kleenpak port for probe connection

M (RTD[†] thermowell): 1/4 in barb with dip tube for RTD[†] connection

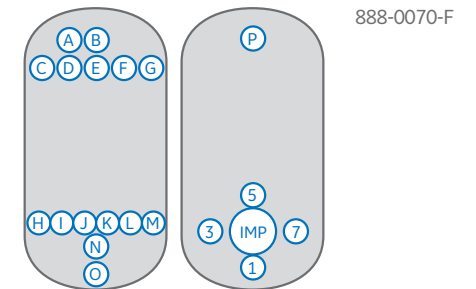
N (sparge line): 96 in of 1/4 in × 7/16 in C-Flex 374 to CFVT0.2-33A1 filter (Meissner), 3 in of 1/4 in × 7/16" C-Flex 374 terminated with instant tube fitting, pinch clamp with internal 2 mm drilled hole Sparge-T

O (drain): 36 in of 3/4 in × 1 in C-Flex 374 terminated with ReadyMate connector

P (vent filter): KA3V002PV1G filter (Pall), T with 6 in of 1/2 in × 3/4 in C-Flex 374 terminated with ReadyMate connector, pinch clamp

Sparge 1, 3, 5 and 7: 2 μm sintered disk

Sparge 1, 3, 5 and 7: tubing from each port combined to 96 in of 1/4 in × 7/16 in C-Flex 374 to CFVT0.2-33A1 filter (Meissner), 3 in of 1/4 in × 7/16 in C-Flex 374 terminated with instant tube fitting, pinch clamp



* Impeller diameter to bioreactor bag diameter

† Resistance temperature detectors

‡ IMP=Impeller

XDR-1000 PRO

Minimum volume: 200 L; nominal volume: 1000 L; headspace volume: 210 L

IMP†: M40e, 3 blades, 12.5 in diameter, Di/Dt*: 0.33, 40° pitch, 15° off center

Film: ASI PL-01026/01077

A, B (liquid additions): 3 in of 1/4 in × 7/16 in C-Flex 374 reduced to 120 in 1/8 in × 1/4 in C-Flex 374, plugged, pinch clamp

C, D, F (liquid additions): 18 in of 1/2 in × 3/4 in C-Flex 374 terminated with female Kleenpak connector, pinch clamp

E (headspace gas): pressure sensor, CFVTV0.2-33A filter (Meissner), 3 in of 1/4 in × 7/16 in C-Flex 374 terminated with instant tube fitting

G (liquid addition): 120 in of 1/2 in × 3/4 in C-Flex 374, plugged, pinch clamp

H (sample lines): 12 in of 1/8 in × 1/4 in C-Flex 374 terminated with female luer sampling port, pinch clamp (× 2)

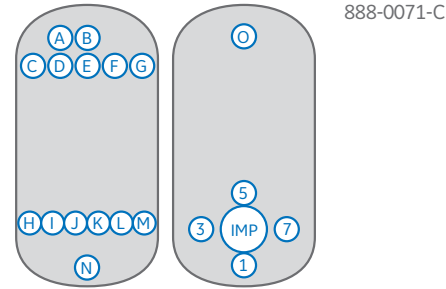
I, J, K, L (probe ports): female Kleenpak port for probe connection

M (RTD⁺ thermowell): 1/4 in barb with dip tube for RTD⁺ connection

N (drain): 36 in of 1/2 in × 3/4 in C-Flex 374 terminated with female Kleenpak connector, pinch clamp

O (vent filter): KA3V002PV1G filter (Pall), T with 6 in of 1/2 in × 3/4 in C-Flex 374 terminated with female Kleenpak, pinch clamp

Sparge 1 to 8: 2 µm sintered disk, all ports combined to 96 in of 1/4 in × 7/16 in C-Flex 374 to CFVTV0.2-33A filter (Meissner), 3 in of 1/4 in × 7/16 in C-Flex 374 terminated with instant tube fitting, pinch clamp



XDR-1000 PRO FLEX

Minimum volume: 200 L; nominal volume: 1000 L; headspace volume: 210 L

IMP†: M40e, 3 blades, 12.5 in diameter, Di/Dt*: 0.33, 40° pitch, 15° off center

Film: ASI PL-01026/01077

A, B (liquid additions): 3 in of 1/4 in × 7/16 in C-Flex 374 reduced to 120 in 1/8 in × 1/4 in C-Flex 374, plugged, pinch clamp

C, D, F (liquid additions): 18 in of 1/2 in × 3/4 in C-Flex 374 terminated with ReadyMate connector, pinch clamp

E (headspace gas): pressure sensor, CFVTV0.2-33A filter (Meissner), 3 in of 1/4 in × 7/16 in C-Flex 374 terminated with instant tube fitting

G (liquid addition): 120 in of 1/2 in × 3/4 in C-Flex 374, ReadyMate Connector, pinch clamp

H (sample lines): 12 in of 1/8 in × 1/4 in C-Flex 374 terminated with female luer sampling port, pinch clamp (× 2)

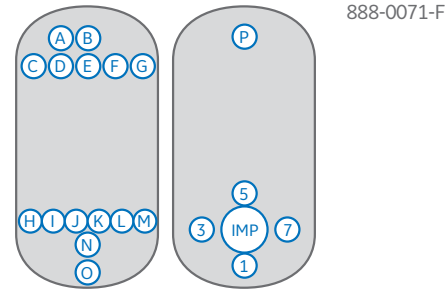
I, J, K, L (probe ports): female Kleenpak port for probe connection

M (RTD⁺ thermowell): 1/4 in barb with dip tube for RTD⁺ connection

N (Sparge-T): 2 mm drilled hole Sparge-T

O (vent filter): 48 in of 1 in × 1 3/8 in C-Flex 374 terminated with ReadyMate connector

Sparge 1 to 8: 2 µm sintered disk, all ports combined to 96 in of 1/4 in × 7/16 in C-Flex 374 to CFVTV0.2-33A filter (Meissner), 3 in of 1/4 in × 7/16 in C-Flex 374 terminated with instant tube fitting, pinch clamp



XDR-2000 PRO

Minimum volume: 400 L; nominal volume: 2000 L; headspace volume: 500 L

IMP†: M40e, 4 blades, 16.5 in diameter, Di/Dt*: 0.34, 40° pitch, 15° off center

Film: ASI PL-01026/01077

A, B (liquid additions): 3 in of 1/4 in × 7/16 in C-Flex 374 reduced to 120 in 1/8 in × 1/4 in C-Flex 374, plugged, pinch clamp

C, D, F (liquid additions): 18 in of 1/2 in × 3/4 in C-Flex 374 terminated with female Kleenpak connector, pinch clamp

E (headspace gas): pressure sensor, CFVTV0.2-33A filter (Meissner), 3 in of 1/4 in × 7/16 in C-Flex 374 terminated with instant tube fitting

G (liquid addition): 120 in of 1/2 in × 3/4 in C-Flex 374, plugged, pinch clamp

H (sample lines): 12 in of 1/8 in × 1/4 in C-Flex 374 terminated with female luer sampling port, pinch clamp (× 2)

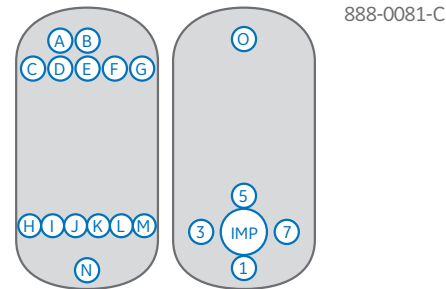
I, J, K, L (probe ports): female Kleenpak port for probe connection

M (RTD⁺ thermowell): 1/4 in barb with dip tube for RTD⁺ connection

N (drain): 36 in of 3/4 in × 1 in C-Flex 374 terminated with ReadyMate connector

O (vent filter): KA3V002PV1G filter (Pall), Y with 36 in of 3/4 in × 1 in C-Flex 374 terminated with ReadyMate connector

Sparge 1 to 8: 20 µm sintered disk, all ports combined to 120 in of 1/2 in × 3/4 in C-Flex 374 to KA2V002PV1G filter (Pall), pinch clamp, 1-1/2" TC at filter inlet



XDR-2000 PRO FLEX

Minimum volume: 400 L; nominal volume: 2000 L; headspace volume: 500 L

IMP†: M40e, 4 blades, 16.5 in diameter, Di/Dt*: 0.34, 40° pitch, 15° off center

Film: ASI PL-01026/01077

A, B (liquid additions): 3 in of 1/4 in × 7/16 in C-Flex 374 reduced to 120 in 1/8 in × 1/4 in C-Flex 374, plugged, pinch clamp

C, D, F (liquid additions): 18 in of 1/2 in × 3/4 in C-Flex 374 terminated with ReadyMate connector, pinch clamp

E (headspace gas): pressure sensor, CFVTV0.2-33A filter (Meissner), 3 in of 1/4 in × 7/16 in C-Flex 374 terminated with instant tube fitting

G (liquid addition): 120 in of 1/2 in × 3/4 in C-Flex 374, ReadyMate connector, pinch clamp

H (sample lines): 12 in of 1/8 in × 1/4 in C-Flex 374 terminated with female luer sampling port, pinch clamp (× 2)

I, J, K, L (probe ports): female Kleenpak port for probe connection

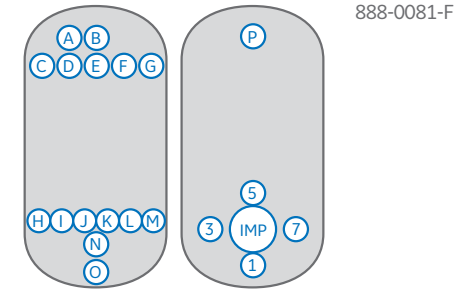
M (RTD⁺ thermowell): 1/4 in barb with dip tube for RTD⁺ connection

N (Sparge-T): 2 mm drilled hole Sparge-T

O (drain): 36 in of 1 in × 1 3/8 in C-Flex 374 terminated with ReadyMate connector

P (vent filter): KA3V002PV1G filter (Pall), Y with 36 in of 3/4 in × 1 in C-Flex 374 terminated with ReadyMate Connector

Sparge 1 to 8: 20 µm sintered disk, all ports combined to 120 in of 1/2 in × 3/4 in C-Flex 374 to KA2V002PV1G filter (Pall), pinch clamp, 1-1/2" TC at filter inlet



* Impeller diameter to bioreactor bag diameter

† Resistance temperature detectors

‡ IMP=Impeller

* Impeller diameter to bioreactor bag diameter

† Resistance temperature detectors

‡ IMP=Impeller



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