2-D Electrophoresis

Tools for Rapid, High-Resolution Protein Separations
Expression proteomics defines patterns of proteins expressed in different biological samples. Bio-Rad’s approach to expression proteomics focuses on three technologies: sample preparation, two-dimensional (2-D) electrophoresis, and imaging and analysis.

Resolution of Complex Mixtures in Two Dimensions

2-D electrophoresis is one of the most powerful protein separation techniques available. It has the ability to resolve complex mixtures of thousands of proteins simultaneously in a single gel. In the first dimension, proteins are separated by isoelectric point (pI), while in the second dimension, they are separated by molecular weight. Standardization of this technique has simplified the process and improved gel-to-gel reproducibility.

Depending on the experiment, requirements for resolution, throughput, and speed may vary. For example, when sample preparation conditions are being developed, speed is more important than resolution or throughput. Whereas resolution is more important for analyzing complicated proteomes, throughput is important when many samples must be run.

Bio-Rad addresses these varying requirements by offering choices for all components of the 2-D process, including IPG strips, gels, and electrophoresis systems. Mini systems allow speed during the initial phases of experimentation and screening, while large systems provide maximum loading capacity and area for separation when resolution is important.
2-D Workflow

First-Dimension Separation: Isoelectric Focusing

PROTEAN® IEF System

Second-Dimension Separation: SDS-PAGE

Mini Gels
Mini-PROTEAN® System

Midi Gels
Criterion™ System

Large Gels
PROTEAN II and PROTEAN Plus Dodeca™ Systems

Maximum Speed

Maximum Resolution

Visualization

Stains
Stainers
First-Dimension Separation

The PROTEAN IEF system ensures rapid, reproducible first-dimension isoelectric focusing (IEF), whether you’re screening an entire proteome or searching for a specific protein. You can tailor your strategy to your sample using convenient ReadyStrip IPG strips, available in a wide range of pH ranges and strip lengths for maximum flexibility.

**PROTEAN IEF Cell**
- Optimized for first-dimension IEF
- Provides simple, reproducible, and efficient separations
- Offers preset methods and real-time editing for maximum flexibility
- Can run up to 24 (7 cm) or 12 (11, 17, 18, or 24 cm) IPG strips simultaneously

**Cup Loading Tray**
- Expands the range of applications for first-dimension IEF using the PROTEAN IEF cell
- Optimizes resolution of proteins that have pIs at extreme pH ranges

**ReadyStrip IPG Strips**
- Easy-to-use strips that yield high-quality, reproducible separations
- Available in 7, 11, 17, 18, and 24 cm lengths, all with micro, narrow, and broad pH ranges

For accessories, see Related Products.
**Mini-ProTEAn System**

This compact system is designed for speed and includes the four-gel Mini-ProTEAn Tetra cell and the high-throughput Mini-ProTEAn 3 Dodeca cell (for separation of up to 12 gels). Setup is fast and simple, facilitating rapid sample optimization, method development, and targeted protein analysis. Choose from precast gels in a wide range of polyacrylamide percentages to optimize separation for your sample.

- Accommodates 7 cm IPG strips
- Accommodates both handcast and Ready Gel® precast gels
- Available complete with combs, plates, and casting accessories for 10-well, 0.75 mm, 1.0 mm, and 1.5 mm thick gels (IPG combs also available)
- Supports other casting modules with specific well type and thickness configurations
- Incorporates cooling units and stirbars to prevent overheating and maintain uniform buffer temperatures for reproducible runs
- 1-D configuration also available

For accessories, see Related Products.
Bio-Rad's Criterion midi gel system is an excellent choice when you need both speed and resolution. You can quickly check experimental results in a Criterion cell (for 1–2 gels) or answer complex biological questions with the high-throughput Criterion Dodeca cell (for up to 12 gels). Criterion precast gels provide increased resolution over a mini gel system but run fast enough to let you generate 2-D data from your sample in a single day; they’re available in a wide range of polyacrylamide percentages in both standard and extended shelf-life formulations.

**Criterion System**

- Accommodates 11 cm IPG strips
- Precast gels with 12-month shelf life and room temperature storage
- Cooling units and stirbars to prevent overheating and maintain uniform buffer temperatures for reproducible runs
- Locator slots to slide the gel cassettes into place without alignment hassles or bulky clamps
- Leak-free design — the patented upper buffer chamber is integrated into the gel cassette
- Cassette opener built into the cell for easy gel access in a single step
- Convenient buffer draining via the built-in quick-connect drain port
- 1-D configuration also available

For accessories, see Related Products.
For the highest-resolution separations, or to accommodate larger protein loads, choose from large format cells that are compatible with 17 cm IPG strips (ProTEAn ii Xl cell and multi-cell) or 24 cm IPG strips (ProTEAn Plus Dodeca cell). Whether your sample requires maximum flexibility or maximum throughput, these cells meet your needs for reproducible, high-resolution results. Precast Tris-HCl gels are available for the ProTEAn ii system.

<table>
<thead>
<tr>
<th></th>
<th>Precast Gel Options</th>
<th>Handcast Gel Options</th>
<th>IPG Strips</th>
<th>Maximum # of Gels Run</th>
</tr>
</thead>
<tbody>
<tr>
<td>ProTEAn ii</td>
<td>Yes</td>
<td>Yes</td>
<td>17 cm</td>
<td>2</td>
</tr>
<tr>
<td>XL cell</td>
<td>Yes</td>
<td>Yes</td>
<td>17 cm</td>
<td>6</td>
</tr>
<tr>
<td>XL multi-cell</td>
<td>Yes</td>
<td>Yes</td>
<td>17 cm</td>
<td>6</td>
</tr>
<tr>
<td>ProTEAn Plus</td>
<td>No</td>
<td>Yes</td>
<td>18 and 24 cm</td>
<td>12</td>
</tr>
</tbody>
</table>

* ProTEAn ii system can also be configured to accommodate 1-D applications.

**Large 2-D Gel Electrophoresis Systems**

**ProTEAn ii System and ProTEAn Plus Dodeca Cell**

For the highest-resolution separations, or to accommodate larger protein loads, choose from large format cells that are compatible with 17 cm IPG strips (ProTEAn ii XL cell and multi-cell) or 24 cm IPG strips (ProTEAn Plus Dodeca cell). Whether your sample requires maximum flexibility or maximum throughput, these cells meet your needs for reproducible, high-resolution results. Precast Tris-HCl gels are available for the ProTEAn ii system.

**ProTEAn ii System**

- High-resolution separation — 17 cm IPG strips and precast gels
- Application flexibility — ability to reconfigure between 1-D and 2-D options
- Gel capacity flexibility — run 2, 4, or 6 gels at one time depending on your needs; start with 2-gel capacity with flexibility to expand to 6 using the multi-cell option

**ProTEAn Plus Dodeca Cell**

- Largest format available for the best resolution — 24 cm IPG strips and gels
- Dedicated high-throughput system
- Enhanced reproducibility with simultaneous multi-gel runs
- Capacity to run up to 12 gels at a time

For accessories, see Related Products.
Proteins vary in their interactions with stains. A protein spot that can be visualized using one staining protocol may not be visible when a different stain is applied. Therefore, it is important to evaluate the efficacy of multiple stains with each new sample and select the stains that generate the best results.

The most popular gel stains are Coomassie Blue R-250 and Bio-Safe Coomassie G-250. These stains are less sensitive than other protein stains, but they interact uniformly with all proteins. Silver stains are more sensitive; however, they have a limited dynamic range and do not react with all proteins uniformly.

The more sensitive Flamingo fluorescent gel stain is ideal for nonspecific visualization and quantitation of proteins in SDS-PAGE gels. It uses an easy two-step protocol that can be completed in as little as 5 hours and does not require destaining. It is ideally suited for use with high-performance laser-based imaging systems, such as the Molecular Imager® PharosFX™ system. Moreover, the steps are not time-sensitive, and the dye will not overstain the gels.
Dodeca Stainers

The Dodeca stainers facilitate staining multiple gels at once to ensure high-quality, consistent results. These stainers accommodate up to 12 large format gels simultaneously. The Dodeca stainers feature a shaking mechanism integrated into the design, eliminating the need to purchase a separate shaker. The patent-pending shaking design allows gentle, consistent, and thorough staining. Dodeca stainers also include a shaking rack that allows all 12 gels to be easily managed as a single unit. The Dodeca stainers are compatible with Bio-Safe Coomassie stain, Coomassie Blue R-250 stain, SYPRO Ruby protein gel stain, Flamingo fluorescent gel stain, and the Dodeca silver stain kit.

Stainer Compatibility With Different Gel Sizes

<table>
<thead>
<tr>
<th>Gel Size (W x L)</th>
<th>Gel Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large Dodeca stainer</td>
<td>25 x 20.5 cm</td>
</tr>
<tr>
<td>Small Dodeca stainer</td>
<td>20 x 20.5 cm</td>
</tr>
<tr>
<td></td>
<td>18.5 x 20 cm</td>
</tr>
<tr>
<td></td>
<td>18.3 x 19.3 cm</td>
</tr>
<tr>
<td></td>
<td>13.3 x 8.7 cm</td>
</tr>
</tbody>
</table>

High-Throughput Stainers

Dodeca Stainers
The Dodeca stainers facilitate staining multiple gels at once to ensure high-quality, consistent results. These stainers accommodate up to 12 large format gels simultaneously. The Dodeca stainers feature a shaking mechanism integrated into the design, eliminating the need to purchase a separate shaker. The patent-pending shaking design allows gentle, consistent, and thorough staining. Dodeca stainers also include a shaking rack that allows all 12 gels to be easily managed as a single unit. The Dodeca stainers are compatible with Bio-Safe Coomassie stain, Coomassie Blue R-250 stain, SYPRO Ruby protein gel stain, Flamingo fluorescent gel stain, and the Dodeca silver stain kit.
Precast Gels

Availability of 2-D Gel Types for Precast Gel Systems Based on Application

<table>
<thead>
<tr>
<th>Gel Types</th>
<th>Ready Gel</th>
<th>Criterion</th>
<th>PROTEAN II</th>
<th>Application</th>
<th>Sample Buffer</th>
<th>Running Buffer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bis-Tris</td>
<td></td>
<td></td>
<td></td>
<td>SDS-PAGE for small proteins</td>
<td>XT</td>
<td>XT MOPS or XT MES</td>
</tr>
<tr>
<td>Tris-acetate</td>
<td></td>
<td></td>
<td></td>
<td>SDS-PAGE for large proteins</td>
<td>XT</td>
<td>XT Tricine</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Native PAGE</td>
<td>Native</td>
<td>Tris/glycine</td>
</tr>
<tr>
<td>Tris-HCl</td>
<td></td>
<td></td>
<td></td>
<td>SDS-PAGE</td>
<td>Laemmli</td>
<td>Tris/glycine/SDS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Native PAGE</td>
<td>Native</td>
<td>Tris/glycine</td>
</tr>
<tr>
<td>Tris-Tricine</td>
<td></td>
<td></td>
<td></td>
<td>SDS-PAGE for peptides, small proteins</td>
<td>Tricine</td>
<td>Tris/Tricine/SDS</td>
</tr>
</tbody>
</table>

Ready Gel Precast Gels
These gels can be run in less than an hour. They accommodate 7 cm IPG strips and are compatible with both the Mini-PROTEAN Tetra cell and the Mini-PROTEAN 3 Dodeca cell. In addition to a wide range of polyacrylamide gels with the traditional Tris-HCl buffer formulation for SDS-PAGE, Ready Gel precast gels are available in buffer formulations suitable for peptide analysis and other applications.

Criterion Precast Gels
Designed for the Criterion and Criterion Dodeca cells, Criterion gels are longer and wider than standard mini gels. They accommodate 11 cm IPG strips for SDS-PAGE, or up to 26 lanes of samples per gel for 1-D applications. Criterion gels are available in a wide range of polyacrylamide percentages and gradients with the traditional Tris-HCl formulation. For even more options for protein separation, extended shelf-life gels are available in Tris-acetate and Bis-Tris buffer formulations. Formulations are also available for other applications.

PROTEAN II Precast Gels
For the PROTEAN II cell and multi-cell, PROTEAN II XL Ready Gel Tris-HCl precast gels are available with an IPG well to accommodate 17 cm IPG strips. Slightly smaller gels are available for 1-D applications.

Mini Gels
18.3 x 19.3 cm

Midi Gels
13.3 x 8.7 cm

Large Gels
8.6 x 6.8 cm
for large, hydrophobic, or other proteins that are poorly resolved by traditional IEF. The Model 491 prep cell performs preparative-scale, high-resolution separation of proteins by continuous-elution gel electrophoresis.

Gradient Formers
Use Bio-Rad’s gradient formers to pour linear, concave, or convex exponential acrylamide gradients for optimum separation of proteins of interest.

AnyGel Stands
These stations for docking and preparing gels safely hold gel cassettes of all sizes. Ideal for hand casting, loading IPG strips, or transitioning from IEF to a Dodeca cell, these stands give you the third hand you need.

Gel Clip
The gel clip facilitates handling of large gels without tearing.
Support

Global Technical Support

Bio-Rad has over 30 years of experience in 2-D technology. Our worldwide technical support staff is highly trained and can advise you on how to obtain good results. They can help with troubleshooting or with advice on suitable tools for sample preparation or other expression proteomics technologies.

Application Support

Bio-Rad’s expression proteomics experts offer field support to customers worldwide. Each specialist has a solid understanding of the technology and research experience that will help you find solutions to your experimental needs.

Sales Support

Bio-Rad’s trained, knowledgeable customer support staff operates worldwide. They can help you choose the best system to fit your particular needs.

For more information, contact your local Bio-Rad sales representative or visit us on the Web at www.expressionproteomics.com

Purchase of Criterion XT Bis-Tris gels, XT MOPS running buffer, XT MES running buffer, XT MOPS buffer kit, and XT MES buffer kit is accompanied by a limited license under US patents 6,143,154; 6,096,182; 6,059,948; 5,578,180; 5,922,185; 6,162,338; and 6,785,651 and corresponding foreign patents. Coomassie is a trademark of BASF Aktiengesellschaft. SYPRO is a trademark of Invitrogen Corporation.