

Ready Gel[®] Precast Gels

Application Guide

Catalog Number
161-0993



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Section 1

General Information

1.1 Introduction

Ready Gel[®] precast gels greatly simplify polyacrylamide gel electrophoresis. They are specifically for use with the Mini-PROTEAN Systems (Mini-PROTEAN Tetra, Mini-PROTEAN-III and Mini-PROTEAN Dodeca Cells). Stringent production and quality control criteria, and the use of the highest quality reagents, ensure reproducible electrophoretic analysis with minimum effort. Every gel is checked during production for defects, and each lot of gels is further tested by electrophoresis to verify quality.

Ready Gel precast gels come ready to use with preformed sample wells and a stacking gel when necessary. Each Ready Gel Cassette is 8 x 10 cm (H x W) and 4.0 mm thick. Gel dimension is 6.8 x 8.6 cm (HxW) and 1.0 mm thick. Each gel is individually packaged in a leakproof pouch with an absorbent pad containing gel buffer and 0.02% Sodium Azide.

Ready Gel precast gels are available for use in Tris-glycine (Tris-HCl and zymogram gels), Tris-Tricine, TBE, TBE-urea, and IEF buffer systems. The Tris-HCl gels can be used for SDS-PAGE and non-SDS gel electrophoresis. The Tris-Tricine/peptide gels are optimized for peptide electrophoresis. The TBE gels are for use in nucleic acid electrophoresis and can be used for native protein electrophoresis. TBE-urea gels provide denaturing conditions for nucleic acids. Resolution of different size ranges of proteins or nucleic acids can be obtained by choosing the correct gel.

1.2 Mini-format gel System Specifications

| | |
|-----------------------------|---|
| Gel material | Polyacrylamide |
| Gel dimensions | 8.6 x 6.8 cm (W x L) |
| Gel thickness | 1.0 mm |
| Resolving gel height | 5.5 cm |
| Cassette dimensions | 10 x 8.0 cm (W x L) |
| Cassette material | Back (long): acrylic; front (short): glass |
| Comb material | Polycarbonate |
| Total running buffer volume | 700 ml for 2 gels, 1,000 ml for L. gels (Mini-PROTEAN Tetra Cell) |
| Storage conditions | Store flat at 4°C; DO NOT FREEZE |

1.3 Ready Gel Comb Configurations

| Comb | Load Volume |
|-------------|--|
| 9-well | 30 μ l |
| 10-well | 30 μ l |
| 10-well | 50 μ l |
| 12-well | 20 μ l |
| 15-well | 15 μ l |
| IPG | 7 cm ReadyStrip™ IPG strip |
| Prep | 450 μ l with one 15 μ l reference well |

Section 2

Setup and Basic Operation Using Mini-PROTEAN Tetra Cell

2.1 Setting Up and Running Ready Gel Precast Gels

1. Each Ready Gel should be used immediately after it is removed from the storage pouch.
2. Remove the comb and gently rinse the wells with deionized water or running buffer.
3. Use the key knife or a razor blade to cut the tape at the bottom of the gel along the black “cut here” line. It is helpful to cut all the way to the edge of the cassette where the pull tab begins.
4. Pull the tape tab along the cut line, up from the cassette and at an angle towards the comb end of the gel.

Required materials:

- Clean and dry Mini-PROTEAN® Tetra cell tank
- Electrophoresis module (Electrode Assembly Module only for 1 or 2 gels; for 3 or 4 gels also use the Companion Running Module)
- Running buffer (700 ml for 2 gels; 1000 ml for 4 gels)
- Ready Gel® precast gels or hand-cast gels
- PowerPac™ Basic power supply

1. Assembly

Note: When running 2 gels only, use the Electrode Assembly (the one with the banana plugs), Not the Companion Running Module (the one without the banana plugs). When running 4 gels, both the Electrode Assembly and the Companion Running Module must be used, for a total of 4 gels (2 gels per assembly).

- a. Set the clamping frame to the open position on a clean flat surface (see Figure 4a)
- b. Place the first gel sandwich or gel cassette (with the short plate facing inward) onto the gel supports; gel supports are molded into the bottom of the clamping frame assembly; there are two supports in each side of the assembly. Note that the gel will now rest at a 30° angle, tilting away from the center of the clamping frame. **Please use caution when placing the first gel, making sure that the clamping frame remains balanced and does not tip over.** Now, place the second gel on the other side of the clamping frame, again by resting the gel onto the supports. At this point there will be two gels resting at an angle, one on either side of the clamping frame, tilting away from the center of the frame (see Figure 4b).

Note: It is critical that gel cassettes are placed into the clamping frame with the short plate facing inward. Also, the clamping frame requires 2 gels to create a functioning assembly, If an odd number of gels (1 or 3) is being run, you must use the buffer dam (see Figure 4b).

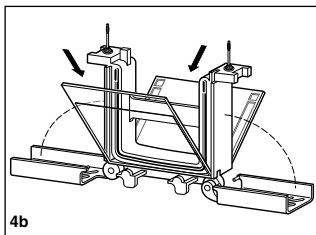
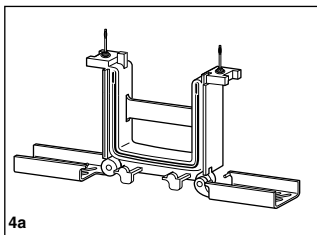
- c. Using one hand, gently pull both gels towards each other, making sure that they rest firmly and squarely against the green gaskets that are built into the clamping frame; make certain that the short plates sit just below the notch at the top of the green gasket.
- d. While gently squeezing the gel sandwiches or cassettes against the green gaskets with one hand (keeping constant pressure and both gels firmly held in place), slide the green arms of the clamping frame over the gels, locking them into place. Alternatively, you may choose to pick-up the entire assembly with both hands, making sure that the gels do not shift, and simultaneously sliding both arms of the clamping frame into place (see Figure 4c).

The arms of the clamping frame push the short plates of each gel cassette up against the notch in the green gasket, creating a leak-proof seal (check again to make certain that the short plates sit just below the notch at the top of the green gasket). At this point, the sample wells can be washed-out with running buffer, and sample can be loaded (Figure 4d).

Note: If running more than 2 gels, repeat steps 1a–d with the Companion Running Module.

Important Note: Do not attempt to lock the green arms of the clamping frame, without first ensuring that the gel cassettes are perfectly aligned and stabilized against the notches on the green gaskets of the module. To prevent the gels from shifting during the locking step, firmly and evenly grip them in place against the core of the module with one hand.

CAUTION: When running 1 or 2 gels only, DO NOT place the Companion Running Module in the tank. Doing so will cause excessive heat generation and prevent electrophoretic separation.



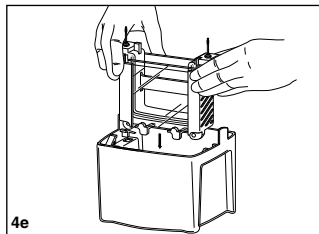
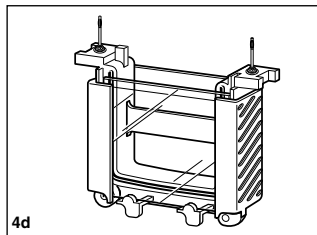
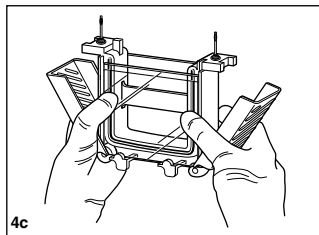


Fig. 4. Assembling the Mini-PROTEAN Tetra Cell Electrophoresis Module.

Section 3

SDS-PAGE

3.1 Introduction

Ready Gel Tris-HCl gels provide a versatile system for the separation of proteins by molecular weight (SDS-PAGE conditions) or charge to mass ratio (native conditions). (See section 4 for native PAGE applications and protocols.) This is possible because Ready Gel Tris-HCl gels are made without SDS, allowing the sample buffer and running buffer to determine the separation mechanism. Historically, SDS-PAGE systems contained SDS in both the gel and the running buffer. Reproducible SDS-PAGE separations are performed in gels lacking SDS provided the sample buffer and running buffers contain sufficient SDS to saturate the proteins during electrophoresis. The recommended concentration of SDS is 2% in sample buffer and 0.1% in running buffers.

SDS-PAGE uses discontinuous chloride and glycine ion fronts to form moving boundaries that stack and then separate SDS-coated polypeptides by molecular weight. Protein samples are prepared in a reducing denaturing sample buffer containing either 2-mercaptoethanol or dithiothreitol as the reducing reagent, and heat and SDS are used to denature the proteins. 2-Mercaptoethanol and dithiothreitol eliminate protein secondary structure by reducing disulfide bonds. SDS minimizes charge variability among proteins, giving them the same charge to mass ratio and forcing them into rod-like shapes. This effectively eliminates the effects of protein conformation and native charge density on the electrophoretic migration distance. Molecular weight determinations are obtained by plotting the logarithm of protein molecular mass vs. the relative mobility ($R_f = \text{distance migrated by protein} / \text{distance migrated by dye front}$).

3.2 Ready Gel Tris-HCl Gel Composition

| | |
|----------------|--------------------------|
| Gel buffer | 0.375 M Tris-HCl, pH 8.8 |
| Cross-linker | 2.6% C |
| Stacking gel | 4% T, 2.6% C |
| Storage buffer | 0.375 M Tris-HCl, pH 8.8 |
| Shelf life | 12 weeks |

3.3 Ready Gel Tris-HCl Gel Selection Guide

Tris-HCl gels are available in a wide selection of single percentages and gradients for the separation of proteins by SDS-PAGE.

| Tris-HCl Gels | Optimal Separation | Tris-HCl Gradient Gels | Optimal Separation |
|----------------------|---------------------------|-------------------------------|---------------------------|
| 5% | 100–250 kD | 4–15% | 20–250 kD |
| 7.5% | 40–200 kD | 4–20% | 10–200 kD |
| 10% | 30–150 kD | 8–16% | 20–120 kD |
| 12% | 20–120 kD | 10–20% | 10–100 kD |
| 15% | 10–100 kD | | |
| 18% | 10–50 kD | | |

3.4 SDS-PAGE Buffers

| | | | |
|-----------------------|---|---|--------------|
| Running Buffer | <u>1X Working Concentration</u> | <u>10x Stock</u> | |
| | 25 mM Tris | Tris base | 15.0 g |
| | 192 mM glycine | Glycine | 72.0 g |
| | 0.1% SDS | SDS | <u>5.0 g</u> |
| | | to 500 ml with deionized water | |
| | | Note: running buffer should be ~ pH 8.3. Do not adjust the pH. | |
| Sample Buffer | <u>2X Working Concentration</u> | <u>2X Stock</u> | |
| | 62.5 mM Tris-HCl, pH 6.8 | 0.5 M Tris-HCl, pH 6.8 | 1.0 ml |
| | 2% SDS | 10% (w/v) SDS | 1.6 ml |
| | 25% glycerol | Glycerol | 2.0 ml |
| | 0.01% Bromophenol Blue | 1.0% Bromophenol Blue | 0.08 ml |
| | 5% 2-mercaptoethanol or 350 mM DTT (added fresh) | 2-Mercaptoethanol | 0.4 ml |
| | Deionized water | <u>2.92 ml</u> 8.0 ml | |

3.5 Sample Preparation

Determine the appropriate protein concentration of your sample based on the detection method and load volume used. (See section 10.1 for approximate stain sensitivities.) Dilute 1 part sample with 1 part sample buffer (see section 3.4) and heat at 95°C for 5 min.

3.6 Running Conditions

| | | |
|-------------------------|-------------------|-----------|
| Power conditions | 200 V constant | |
| | Starting current: | 50 mA/gel |
| | Final current: | 30 mA/gel |
| Run time | 35 min | |

Section 4

Native PAGE

4.1 Introduction

Ready Gel Tris-HCl gels are made without SDS, allowing separation of protein in their native conformation. The nonreducing and nondenaturing environment of native PAGE allows the detection of biological activity and can improve antibody detection. Native PAGE can also be used to resolve multiple protein bands where molecular mass separation by SDS-PAGE would reveal only one.

Native PAGE uses the same discontinuous chloride and glycine ion fronts as SDS-PAGE to form moving boundaries that stack and then separate polypeptides by charge to mass ratio. Proteins are prepared in a nonreducing nondenaturing sample buffer, which maintains the proteins' secondary structure and native charge density. Native PAGE is not suitable for accurate molecular weight determination due to the variability of charge to mass ratio among different proteins.

4.2 Ready Gel Tris-HCl Gel Composition

| | |
|----------------|--|
| Gel buffer | 0.375 M Tris-HCl, pH 8.8 |
| Cross-linker | 2.6% C |
| Stacking gel | 4% T, 2.6% C |
| Storage buffer | 0.375 M Tris-HCl, pH 8.8, NaN ₃ |
| Shelf life | 12 weeks from the date of manufacture |

4.3 Ready Gel Tris-HCl Gel Selection

Native PAGE separates by charge to mass ratio, making individual protein migration protein dependent. Optimal Tris-HCl gel percentages will have to be determined experimentally.

4.4 Native PAGE Buffers

Running Buffer

Working Concentration

25 mM Tris
192 mM glycine

10x Stock

Tris base 15.0 g
Glycine 72.0 g
to 500 ml with deionized water 87.0 g

Note: running buffer should be
~ pH 8.3. Do not adjust the pH.

Sample Buffer

2X Working Concentration

62.5 mM Tris-HCl, pH 6.8
25% glycerol
1% Bromophenol Blue

2X Stock

0.5 M Tris-HCl, pH 6.8 1.0 ml
Glycerol 2.0 ml
1% Bromophenol Blue 1.0 ml
Deionized water 4.92 ml
8.0 ml

4.5 Sample Preparation

Determine the desired protein concentration and load volume of your sample based on the detection method used. (See section 10.1 for approximate stain sensitivities). Sample preparation for native PAGE applications requires special consideration. In the absence of SDS, the net charge of a polypeptide will be determined by the pH of the sample buffer. Only polypeptides with a net negative charge will migrate into a native PAGE Tris-HCl gel. Most polypeptides have an acidic or slightly basic pI (~3–8). These proteins can be separated using a standard protocol by diluting 1 part sample with 1 part native sample buffer (see section 4.4; DO NOT HEAT SAMPLES).

Strongly basic peptides (pI >9) will have a net positive charge in a native PAGE Tris-HCl gel. In order for polypeptides with a net positive charge to migrate into a native PAGE Tris-HCl gel, the polarity of the electrodes must be changed by reversing the color-coded jacks when connecting to the power supply.

4.6 Running Conditions

| | | |
|-------------------------|-------------------|-----------|
| Power conditions | 200 V constant | |
| | Starting current: | 50 mA/gel |
| | Final current: | 30 mA/gel |
| Run time | 35 min | |

Section 5

Peptide Analysis

5.1 Introduction

Ready Gel Tris-Tricine/peptide gels are optimized for separating peptides and proteins <10 kD. Superior resolution of peptides is achieved by moving the peptide-SDS complexes more slowly through the gel. This allows the faster moving SDS micelles, which normally interfere with peptide separations, to completely separate from the peptides, allowing distinct peptide bands to resolve.

5.2 Ready Gel Tris-Tricine/Peptide Gel Composition

| | |
|----------------|---|
| Gel buffer | 1.0 M Tris-HCl, pH 8.45 |
| Cross-linker | 2.6% C |
| Stacking gel | 4% T, 2.6% C |
| Storage buffer | 1.0 M Tris-HCl, pH 8.45, NaN ₃ |
| Shelf life | 12 weeks from the date of manufacture |

5.3 Ready Gel Tris-Tricine/Peptide Gel Selection Guide

Tris-Tricine/peptide gels are available in either a single percentage gel or a linear gradient gel.

| Peptide Gel | Optimal Separation |
|-------------|--------------------|
| 16.5% | 15–30 kD |
| 10–20% | 1–40 kD |

5.4 Tris-Tricine/Peptide Buffers

| | | | |
|-----------------------|------------------------------|------------------|--------------|
| Running buffer | <u>Working Concentration</u> | <u>10x Stock</u> | |
| | 100 mM Tris | Tris base | 60.55 g |
| | 100 mM Tricine | Tricine | 89.60 g |
| | 0.1% SDS | SDS | <u>5.0 g</u> |

to 500 ml with deionized water

Note: Tricine running buffer should be
~ pH 8.25. Do not adjust the pH.

| | | | |
|----------------------|---|---------------------------|--------------------------|
| Sample Buffer | <u>Working Concentration</u> | <u>2X Stock</u> | |
| | 200 mM Tris-HCl, pH 6.8 | 1.0 M Tris-HCl, pH 6.8 | 2.0 ml |
| | 2% SDS | 10% SDS | 2.0 ml |
| | 40% glycerol | Glycerol | 4.0 ml |
| | 0.04% Coomassie Blue G-250 | 0.5% Coomassie Blue G-250 | 0.8 ml |
| | 2% 2-mercaptoethanol or 350 mM DTT (Added fresh) | 2-Mercaptoethanol | 0.2 ml |
| | | Deionized water | <u>1.0 ml</u> 10.0 ml |

5.5 Sample Preparation

Determine the appropriate protein concentration of your sample based on the detection method and load volume used. (See section 10.2 for approximate stain sensitivities.) Dilute 1 part sample with 1 part sample buffer and heat at 95°C for 5 min.

5.6 Running Conditions

| | | |
|-------------------------|-------------------|--------------|
| Power Conditions | 100 V constant | |
| | Starting current: | 30–35 mA/gel |
| | Final current: | 15–20 mA/gel |

Run Time 100 min

Section 6

Isoelectric Focusing

6.1 Introduction

Ready Gel IEF gels are cast with Bio-Rad's Bio-Lyte® ampholytes, amphoteric molecules that set up a pH gradient across the gels. Proteins migrate in IEF gels to their neutral isoelectric point (pI), where the protein has zero net charge. Ready Gel IEF gels contain no denaturing agents, so all focusing is performed under native conditions.

6.2 Ready Gel IEF Gel Composition

| | |
|----------------|---------------------------------------|
| Gel buffer | 2% ampholyte, pH 3–10, 5–8 |
| Cross-linker | 3.0% C |
| Stacking gel | None |
| Storage buffer | Deionized water, NaN ₃ |
| Shelf life | 26 weeks from the date of manufacture |

6.3 Ready Gel IEF Gel Selection Guide

Ready Gel IEF gels are available in narrow and broad pH ranges.

| IEF gel | pH Range |
|---------|----------|
| 5–8 | 5–8 |
| 3–10 | 4–8.5 |

6.4 IEF Buffers

| | | | |
|-----------------------|--|---|--------------------|
| Running buffer | <u>1x Cathode Buffer</u> | <u>5x Cathode Buffer</u> | |
| | 20 mM lysine (free base) 20 mM arginine (free base) | Lysine (free base) Arginine (free base) to 1 L with deionized water | 14.50 g 17.42 g |
| | <u>1x Anode Buffer</u> | <u>10x Anode Buffer</u> | |
| | 7mM% phosphoric acid | Phosphoric acid to 1 L with deionized water | 4.2 ml |
| Sample Buffer | 50% glycerol | | |

6.5 Sample Preparation

Determine the appropriate protein concentration of your sample based on the detection method and load volume used. (See section 10.3 for approximate stain sensitivities.) Dilute 1 part sample with 1 part sample buffer.

6.6 Running Conditions

| | | |
|-------------------------|-------------------|-------------|
| Power conditions | Stepwise | |
| | 100 V constant | 60 min |
| | 250 V constant | 60 min |
| | 500 V constant | 30 min |
| | Starting current: | 5–15 mA/gel |
| | Final current: | 5–15 mA/gel |
| Run time | 150 min | |

Section 7

Protease Analysis by Zymogram PAGE

7.1 Introduction

Ready Gel zymogram gels are used to test for proteolytic activity when performing protein characterizations. Gels are cast with gelatin or casein, which act as substrates for proteases that are separated on the gel. Proteases are detected by renaturing the enzyme followed by a development period in which the protease breaks down the substrate. Zymogram gels are stained with Coomassie Blue R-250, which stains the substrate while leaving clear areas around active proteases.

7.2 Ready Gel Zymogram Gel Composition

| | |
|----------------|---|
| Gel buffer | 0.375 M Tris-HCl, pH 8.6 |
| Cross-linker | 2.6% C |
| Stacking gel | 4% T, 2.6% C |
| Storage buffer | 0.375 M Tris-HCl, pH 8.6, 0.2% NaN ₃ |
| Shelf life | 12 weeks from the date of manufacture |

7.3 Ready Gel Zymogram Gel Selection Guide

Ready Gel zymogram gels are available with either gelatin or casein as substrate and should be selected based on their substrate and separation range.

| Zymogram Gel | Optimal Separation |
|-------------------------------|---------------------------|
| 10% zymogram gel with gelatin | 30–150 kD |
| 12% zymogram gel with casein | 20–120 kD |

7.4 Zymogram Buffers

| | | | |
|-----------------------|------------------------------|--------------------------------|--------|
| Running buffer | <u>Working Concentration</u> | <u>10x Stock</u> | |
| | 25 mM Tris | Tris base | 15.0 g |
| | 192 mM glycine | Glycine | 72.0 g |
| | 0.1% SDS | SDS | 5.0 g |
| | | to 500 ml with deionized water | |
| | | Note: running buffer should be | |
| | | -pH 8.3. Do not adjust the pH. | |

| | | | |
|----------------------|------------------------------|------------------------|----------------|
| Sample Buffer | <u>Working Concentration</u> | <u>2X Stock</u> | |
| | 62.5 mM Tris-HCl, pH 6.8 | 0.5 M Tris-HCl, pH 6.8 | 1.25 ml |
| | 4% SDS | 10% SDS | 4.0 ml |
| | 25% glycerol | Glycerol | 2.5 ml |
| | 0.01% Bromophenol Blue | 1% Bromophenol Blue | 0.1 ml |
| | | Deionized water | <u>2.15 ml</u> |
| | | | 10 ml |

7.5 Sample Preparation

Determine the appropriate protein concentration of your sample based on the detection method and load volume used. (See section 10.4 for approximate stain sensitivities.) Dilute 1 part sample buffer with 1 part Zymogram sample buffer. Dry samples can be dissolved directly in sample buffer. Do not heat.

7.6 Running Conditions

| | | |
|-------------------------|-------------------|--------------|
| Power conditions | 100 V constant | |
| | Starting current: | 10–15 mA/gel |
| | Final current: | 6 mA/gel |
| Run time | 90 min | |

Section 8

Nondenaturing Nucleic Acid PAGE

8.1 Introduction

Ready Gel TBE gels are ideal for separating small dsDNA fragments, especially PCR products. The uniform nature of DNA molecules provides samples with near-uniform charge to mass ratio, allowing nondenaturing nucleic acid PAGE to separate dsDNA by mass using a continuous TBE buffer system.

8.2 Ready Gel TBE Gel Composition

| | |
|----------------|---|
| Gel buffer | 89 mM Tris, 89 mM boric acid, 2 mM EDTA, pH 8.3 |
| Cross-linker | 3.3% C |
| Stacking gel | 4% T, 3.3% C |
| Storage buffer | 89 mM Tris, 89 mM boric acid, 2 mM EDTA, NaN ₃ |
| Shelf life | 12 weeks from the date of manufacture |

8.3 Ready Gel TBE Gel Selection Guide

Ready Gel TBE gels are available in a selection of single percentages and gradients for the separation of dsDNA.

| TBE Gels | Optimal Separation | TBE Gradient Gels | Optimal Separation |
|-----------------|---------------------------|--------------------------|---------------------------|
| 5% | 200–2,000 bp | 4–20% | 10–2,000 bp |
| 10% | 50–1,500 bp | | |
| 15% | 20–1,000 bp | | |

8.4 Nondenaturing Nucleic Acid PAGE Buffers

| | | | |
|-----------------------|---------------------------------------|---|---------------|
| Running Buffer | <u>Working Concentration</u> | <u>10x Stock</u> | |
| | 50 mM Tris | Tris base | 0.06 g |
| | 89 mM boric acid | Boric acid | 27.5 g |
| | 5 mM EDTA | 0.5 M EDTA (pH 8.0) | <u>0.1 ml</u> |
| | | to 500 ml with deionized water | |
| | | Note: TBE running buffer should be ~ pH 8.3. Do not adjust the pH. | |
| Sample Buffer | <u>2X Working Concentration</u> | | |
| | 50 mM EDTA | Tris Base | 0.06 g |
| | 25% glycerol | 0.5 M EDTA | 0.1 ml |
| | 0.2% Bromophenol Blue | Glycerol | 2.5 ml |
| | 0.2% Xylene Cyanole FF | 1% Bromophenol Blue | 2.0 ml |
| | | 1% Xylene Cyanole FF | 2.0 ml |
| | Make up to 10 ml with deionized water | | |

8.5 Sample Preparation

Determine the desired DNA concentration of your sample based on the detection method used. (See section 10.5 for approximate stain sensitivities.) Dilute 1 part sample with 4 parts sample buffer (see section 8.4).

8.6 Running Conditions

| | | |
|-------------------------|-------------------|-----------|
| Power conditions | 100 V constant | |
| | Starting current: | 13 mA/gel |
| | Final current: | 11 mA/gel |
| Run time | 45–105 min | |

Section 9

Denaturing Nucleic Acid PAGE

9.1 Introduction

Ready Gel TBE-urea gels are ideal for separating small ssDNA and RNA fragments. Applications include oligonucleotide analysis, RNase protection assays, and northern blotting.

9.2 Ready Gel TBE-Urea Gel Composition

| | |
|----------------|---|
| Gel buffer | 89 mM Tris, 89 mM boric acid, 2 mM EDTA, 7 M urea, pH 8.3 |
| Cross-linker | 3.3% C |
| Stacking gel | 4% T, 3.3% C |
| Storage buffer | 89 mM Tris, 89 mM boric acid, 2 mM EDTA, pH 8.3, NaN ₃ |
| Shelf life | 8 weeks from the date of manufacture |

9.3 Ready Gel TBE-Urea Gel Selection Guide

Ready Gel TBE-urea gels are available in a range of single percentage gels.

| TBE-Urea | Optimal Separation |
|-----------------|---------------------------|
| 5% | 50–1,000 bases |
| 10% | 25–300 bases |
| 15% | 10–50 bases |

9.4 TBE-Urea Buffers

Running Buffer

Working Concentration

89 mM Tris
89 mM boric acid
2 mM EDTA

10x Stock

Tris base 54.0 g
Boric acid 27.5
0.5 M EDTA (pH 8.0) 20.0 ml
to 500 ml with deionized water

Sample Buffer

Working Concentration

89 mM Tris, 89 mM boric acid, 2 mM EDTA, pH 8.0
12% Ficoll
0.01% Bromophenol Blue
0.02% Xylene Cyanole FF
7 M urea

10x TBE 1.0 ml
Ficoll 1.2 g
Urea 4.2 g
1% Bromophenol blue 0.1 ml
1% Xylene Cyanole FF 0.2 ml
0.5 M EDTA 0.02 ml
Make up to 10 ml with deionized water

9.5 Sample Preparation

Determine the desired ssDNA or RNA concentration for your sample based on the detection method used. (See section 10.6 for appropriate stain sensitivities.) Dilute 1 part sample with 1 part TBE-urea sample buffer. Dry samples can be dissolved directly in sample buffer. Heat to 70–90°C 4 min before loading.

9.6 Running Conditions

Power conditions

200 V constant
Starting current: 15 mA/gel
Final current: 10 mA/gel

Run time

40–70 min

Section 10

Detection

10.1 SDS-PAGE and Native PAGE Detection

Total Protein Gel Stains

| Method | Sensitivity | Optimal Protein Load | Advantages | Disadvantages |
|--------------------------------|-------------|----------------------|---|---|
| Coomassie Blue R-250 | 36–47 ng | ~0.5 µg/band | Laboratory standard | Requires MeOH |
| Bio-Safe™ Coomassie stain | 8–28 ng | ~0.5 µg/band | Nonhazardous, uses no MeOH | More steps than Coomassie Blue R-250 |
| Copper stain | 6–12 ng | ~0.2 µg/band | Fast, reversible stain be photographed; SDS-PAGE only | Negative stain, must be photographed; |
| Zinc stain | 6–12 ng | ~0.2 µg/band | High-contrast, fast, reversible stain SDS-PAGE only | Negative stain, must be photographed; |
| Silver Stain™ Plus kit | 0.6–1.2 ng | ~0.01 µg/band | Simple, robust, mass spectrometry compatible | Will not stain glycoproteins |
| Silver stain | 0.6–1.2 ng | ~0.01 µg/band | Stains complex proteins, i.e., glycoproteins and lipoproteins | Not mass spectrometry compatible |
| SYPRO Orange protein stain | 4–8 ng | ~0.2 µg/band | Will not stain nucleic acids; mass spectrometry compatible | Optimization required for maximum sensitivity |
| SYPRO Ruby protein gel stain | 1–10 ng | ~0.2 µg/band | Broad dynamic range, simple robust protocol maximum sensitivity | Requires imaging instrument for |
| Flamingo Fluorescent gel stain | 0.25–0.5 ng | ~0.2 ng/band | Broad dynamic range mass spec compatible | Requires imaging instrument for maximum sensitivity |

Total Protein Blot Stains

| Method | Sensitivity | Optimal Protein Load | Advantages | Disadvantages |
|---------------------------------------|--------------|--|---|---|
| SYPRO Ruby protein blot stain | 2–8 ng | ~0.2 µg/band immunological procedures | Compatible with mass spectrometry, Edman-based sequencing, and standard maximum sensitivity | Multiple step protocol; Requires imaging instrument for |
| Colloidal gold stain | 1 ng | ~0.1 µg/band | Sensitive, one step | Not compatible with nylon membranes |
| Enhanced colloidal gold detection kit | 10–100 pg | ~0.1 µg/band | Increases sensitivity of colloidal gold stain | Multiple steps |
| AmidoBlack 10B | 100–1,000 ng | ~5 µg/band | Standard membrane stain, economical | Low sensitivity |

Immunoblot Detection

| Method | Sensitivity | Optimal Protein Load | Advantages | Disadvantages |
|---------------------------------------|-------------|----------------------|--|---|
| 4CN colorimetric (HRP) | 500 pg | ~0.25 µg/band | Fast detection | Results may fade |
| DAB colorimetric (HRP) | 500 pg | ~0.25 µg/band | Fast detection | Contains toxic chemicals |
| Opti-4CN colorimetric (HRP) | 100 pg | ~0.05 µg/band | Color does not fade | More expensive than 4CN |
| Amplified Opti-4CN colorimetric (HRP) | 10 pg | ~0.005 µg/band | High sensitivity, low background | Amplification requires additional steps |
| BCIP/NBT colorimetric (AP) | 100 pg | ~0.05 µg/band | Sensitive, multiple antigen | May detect endogenous enzyme activity |
| Amplified alkaline phosphatase | 10 pg | ~0.005 µg/band | High sensitivity | Amplification requires additional steps |
| Immun-Star™ chemiluminescent (AP) | 10 pg | ~0.005 µg/band | Long-lasting signal, short and multiple exposures possible | Requires visualization on film or instrumentation |
| Immun-Star™ chemiluminescent (hrp) | 1–3 pg | ~0.005 µg/band | Intensifies signal output, very sensitive | Requires visualization on film or instrumentation |
| Immun-Star WesternC (HRP) | 10 fg | ~0.005 µg/band | long-lasting signal short and multiple exposures possible | Requires visualization on film or instrumentation |

10.2 Peptide Gel Staining

Peptides and small proteins are prone to diffusion and loss during staining. The following protocol uses a fixation step to prevent sample loss and is suitable for detection of bands as low as 10–20 ng.

Fixative Solution

40% methanol
10% acetic acid

Coomassie Brilliant Blue G-250 Stain Solution

0.025% Coomassie Blue G-250
10% acetic acid

Destain Solution

10% acetic acid

Place gels in fixative solution and equilibrate for 30 min. Stain gels with Coomassie Brilliant Blue G-250 stain solution for 1 hr. Stain should only be used once. Reuse of stain could result in loss of sensitivity. Destain gels 3 times for 15 min or until the desired background is achieved. Some peptides may not be completely fixed and may diffuse out of the gels if fixing and staining times are greatly exceeded.

10.3 IEF Gel Staining

Samples on IEF gels can be detected using multiple methods. Use the following table as a guide to select an appropriate staining method.

| Method | Sensitivity | Optimal Protein Load | Advantages | Disadvantages |
|-----------------------|--------------------|-----------------------------|--|-----------------------|
| IEF stain | 40–50 ng | ~0.5 µg/band | Simple, no fixation required | Requires MeOH |
| Silver Stain Plus kit | 0.6–1.2 ng | ~0.01 µg/band | Simple, robust, mass spectrometry compatible | Requires TCA fixation |
| Silver stain | 0.6–1.2 ng | ~0.01 µg/band | Stains complex proteins, i.e. glycoproteins and lipoproteins | Requires TCA fixation |

10.4 Zymogram Gel Staining

Prior to staining zymogram gels, sample proteases must be first renatured and allowed to break down the substrate contained in the gel. The following protocol provides basic guidelines for detection. Optimal results should be determined empirically.

Renaturing Solution

2.5% Triton X-100

Development Solution

50 mM Tris

200 mM NaCl

5 mM CaCl₂ (anhydrous)

0.02% Brij-35

Adjust to pH 7.5

Staining Solution

40% methanol

10% acetic acid

0.5% Coomassie Blue R-250

Destaining Solution

40% methanol

10% acetic acid

Proteins must be renatured first by placing the gels in renaturing solution for 30 min at room temperature. Incubate gels in development solution at 37°C for a minimum of 4 hr. Highest sensitivity is typically achieved with overnight incubation. Optimal results should be determined empirically. Stain gels with Coomassie Brilliant Blue R-250 staining solution for at least 1 hr at room temperature. Destain until clear bands appear against the blue background, approximately

30–60 min.

10.5 TBE Gel Staining

Use the following table as a guide to select an appropriate staining method.

| Method | Sensitivity | Optimal Protein Load | Advantages | Disadvantages |
|------------------|-------------|----------------------|--------------------------------------|----------------|
| Ethidium bromide | 50 ng | ~0.10 µg/band | Classic fluorescent DNA stain | Carcinogenic |
| Silver stain | 1.0–2.0 ng | ~0.5 µg/band | More sensitive than ethidium bromide | Multiple steps |

10.6 TBE-Urea Gel Staining

Samples on denaturing nucleic acid gels can be detected using multiple methods. Use the following table as a guide to select an appropriate staining method.

| Method | Sensitivity | Optimal Protein Load | Advantages | Disadvantages |
|--------------------------|-------------|----------------------|--------------------------------------|--------------------|
| Ethidium bromide | 50 ng | ~0.10 µg/band | Classic fluorescent DNA stain | Carcinogenic |
| Radiant [®] Red | 10 ng | ~0.10 µg/band | Fast single-step protocol | RNA and ssDNA only |
| Silver stain | 1.0–2.0 ng | ~0.5 µg/band | More sensitive than ethidium bromide | Multiple steps |

Section 11

Stock and Staining Solutions

11.1 Stock Solutions

0.5 M Tris-HCl, pH 6.8

6.06 g Tris base

~60 ml deionized water

Adjust to pH 6.8 with HCl. Make to 100 ml with deionized water and store at 4°C.

10% SDS

Dissolve 1 g SDS in water with gentle stirring and bring to 10 ml with deionized water.

1% Bromophenol Blue

Dissolve 0.1 g of Bromophenol Blue in 10 ml deionized water with gentle stirring.

1% Xylene Cyanole FF

Dissolve 0.1 g of Xylene Cyanole FF in 10 ml deionized water with gentle stirring.

0.5 M EDTA

18.6 g of EDTA

~ 50 ml of deionized water

Adjust to pH 8.0 with 1 N NaOH. Make to 100 ml with deionized water and store at 4°C.

11.2 Protein Staining Solutions

Coomassie Blue R-250 Staining Solution (0.1%)

| | Final Concentration | |
|----------------------|---------------------|------|
| Methanol | 400 ml | 40% |
| Acetic acid | 100 ml | 10% |
| Coomassie Blue R-250 | 1.0 g | 0.1% |
| Deionized water | 500 ml | |

Dissolve Coomassie R-250 in methanol/acetic acid. Add deionized water to a final volume of 500 ml.

Coomassie Blue R-250 Destaining Solution

| | Final Concentration | |
|-----------------|---------------------|-----|
| Methanol | 400 ml | 40% |
| Acetic acid | 100 ml | 10% |
| Deionized water | 500 ml | |

Silver Staining

See Bio-Rad's silver stain (catalog #161-0443) or Silver Stain Plus kit (catalog #161-0449) instructions.

IEF Staining Solution

| | Final Concentration | |
|----------------------|---------------------|-------|
| Isopropyl alcohol | 270 ml | 27% |
| Acetic acid | 100 ml | 10% |
| Coomassie Blue R-250 | 0.4 g | 0.04% |
| Crocein Scarlet | 0.5 g | 0.05% |
| Deionized water | 630 ml | |

IEF Destaining Solution

| | Final Concentration | |
|-----------------|----------------------------|-----|
| Methanol | 400 ml | 40% |
| Acetic acid | 100 ml | 10% |
| Deionized water | 500 ml | |

11.3 Peptide Staining Solutions

Fixative Solution

| | Final Concentration | |
|-----------------|----------------------------|-----|
| Methanol | 400 ml | 40% |
| Acetic acid | 100 ml | 10% |
| Deionized water | 500 ml | |

Coomassie Blue G-250 Staining Solution (0.025%)

| | Final Concentration | |
|----------------------|----------------------------|--------|
| Acetic acid | 100 ml | 10% |
| Coomassie Blue G-250 | 0.25 g | 0.025% |
| Deionized water | 900 ml | |

Coomassie Blue G-250 Destaining Solution

| | Final Concentration | |
|-----------------|----------------------------|-----|
| Acetic acid | 100 ml | 10% |
| Deionized water | 900 ml | |

11.4 Zymogram Staining Solutions

Renaturation Buffer

| | Final Concentration | |
|--|---------------------|-------|
| Triton X-100 | 25 g | 2.5 % |
| Deionized water to 1 L with deionized water | 900 ml | |

Development Solution

| | Final Concentration | |
|-------------------------------|---------------------|--------|
| Tris base | 6.06 g | 50 mM |
| NaCl | 11.7 g | 200 mM |
| CaCl ₂ (anhydrous) | 0.56 g | 5 mM |
| 30% Brij-35 | 0.67 ml | 0.02% |

Dissolve in 900 ml deionized water, adjust to 7.5 with 6 N HCl, make to 1 L with deionized water.

Staining Solution

| | Final Concentration | |
|----------------------|---------------------|------|
| Methanol | 400 ml | 40% |
| Acetic acid | 100 ml | 10% |
| Coomassie Blue R-250 | 5 g | 0.5% |
| Deionized water | 500 ml | |

Dissolve Coomassie R-250 in Methnaol/acetic acid. Add deionized water to final volume of 500 ml.

11.5 Nucleic Acid Staining Solutions

Ethidium Bromide Staining

Use Bio-Rad's ethidium bromide tablets or ethidium bromide solutions (catalog #161-0430 or 161-0443) for nucleic acid staining solutions.

Silver Staining

See instructions for Bio-Rad's silver stain, catalog #161-0443, or Silver Stain Plus kit, catalog #161-0449.

Radiant[®] Red Staining

Use Radiant Red stain, catalog #170-3122, for RNA staining.

Section 12

Troubleshooting

Improper storage of Ready Gel precast gels can produce numerous artifacts. Gels should be stored flat at 4°C. Avoid freezing or prolonged storage above 4°C. If you suspect your gels have been stored improperly, DO NOT USE THEM.

| Problem | Possible Cause | Solution |
|---|---|--|
| Samples do not migrate into gel | Tape at the bottom of the cassette not removed | Remove tape |
| | Insufficient buffer in integral buffer chamber | Fill buffer chamber with 125 ml running buffer |
| | Insufficient lower electrode buffer | Fill both halves of the lower buffer tank with sufficient running buffer |
| Bands "smile" across gel, band pattern curves upward at both sides of the gel | Electrical disconnection | Check electrodes and connections |
| | Excess heating of gel | Check buffer composition |
| | | Completely fill both halves of the lower buffer tank with sufficient running buffer |
| Skewed or distorted bands, lateral band spreading | | Do not exceed recommended running conditions |
| | Excess salt in samples | Remove salts from sample by dialysis or desalting column prior to sample preparation |
| | Insufficient sample buffer or wrong formulation | Check buffer composition and dilution instructions |
| Problem | Possible Cause | Solution |
| Vertical streaking | Overloaded samples | Dilute sample |

Gels run too fast, provide poor resolution,
and gel temperature is too high

Artifact bands at ~60–70 kD

Sample precipitation

Running buffer is too concentrated

Possible skin keratin contamination

Selectively remove predominant protein in
the sample

Centrifuge samples to remove particulates
prior to sample loading

Check buffer composition

Clean all dishware and wear gloves
while handling and loading gel

Filter all solutions through nitrocellulose

Use 10% iodoacetamide to eliminate
keratin bands

Section 13

Ordering Information

13.1 Ready Gel Precast Gels

| Ready Gel Tris-HCl Gels | 10-Well 30 µl | 15-Well 15 µl | Prep Well 450 µl | 10-Well 50 µl | 12-Well 20 µl | 9-Well 30 µl | IPG Comb 7 cm IPG Strip |
|--------------------------------|--------------------------|--------------------------|-----------------------------|--------------------------|--------------------------|-------------------------|------------------------------------|
| 5% Tris-HCl | 161-1210 | 161-1211 | | 161-1213 | 161-1214 | | |
| 7.5% Tris-HCl | 161-1100 | 161-1118 | 161-1136 | 161-1154 | 161-1172 | | |
| 10% Tris-HCl | 161-1101 | 161-1119 | 161-1137 | 161-1155 | 161-1173 | 161-1191 | 161-1390 |
| 12% Tris-HCl | 161-1102 | 161-1120 | 161-1138 | 161-1156 | 161-1174 | | 161-1391 |
| 15% Tris-HCl | 161-1103 | 161-1121 | 161-1139 | 161-1157 | 161-1175 | | |
| 18% Tris-HCl | 161-1216 | 161-1217 | | 161-1219 | 161-1220 | | |
| 4–15% Tris-HCl | 161-1104 | 161-1122 | 161-1140 | 161-1158 | 161-1176 | 161-1194 | 161-1392 |
| 4–20% Tris-HCl | 161-1105 | 161-1123 | 161-1141 | 161-1159 | 161-1177 | | 161-1393 |
| 8–16% Tris-HCl | 161-1222 | 161-1223 | | 161-1225 | 161-1226 | | 161-1394 |
| 10–20% Tris-HCl | 161-1106 | 161-1124 | 161-1142 | 161-1160 | 161-1178 | | 161-1395 |

Ready Gel TBE Precast Gels

| | | | | | | | |
|------------|----------|----------|---|----------|----------|--|--|
| 5%, TBE | 161-1109 | 161-1127 | — | 161-1163 | 161-1181 | | |
| 10%, TBE | 161-1110 | 161-1128 | — | 161-1164 | 161-1182 | | |
| 15%, TBE | 161-1228 | 161-1229 | — | | 161-1232 | | |
| 4–20%, TBE | 161-1234 | 161-1235 | — | 161-1237 | | | |

Ready Gel Tris-Tricine/Peptide Precast Gels

| | | | | | | | |
|-----------------------------|----------|----------|----------|----------|----------|----------|--|
| 16.5% Tris-Tricine/Peptide | 161-1107 | 161-1125 | 161-1143 | 161-1161 | 161-1179 | 161-1197 | |
| 10–20% Tris-Tricine/Peptide | 161-1108 | 161-1126 | 161-1144 | 161-1162 | 161-1180 | 161-1198 | |

Ready Gel IEF Precast Gels

| | | | | |
|-------------|----------|----------|--|----------|
| IEF pH 3–10 | 161-1111 | 161-1129 | | 161-1165 |
| IEF pH 5–8 | 161-1112 | | | |

Ready Gel Zymogram Precast Gels

| | | | | | |
|------------------------|----------|----------|---|----------|----------|
| 10% Zymogram, gelatin | 161-1113 | 161-1131 | — | 161-1167 | 161-1185 |
| 12.5% Zymogram, casein | 161-1114 | | — | 161-1168 | |

Ready Gel TBE-Urea Precast Gels

| | | | | | |
|--------------|----------|----------|--|---|----------|
| 5% TBE-Urea | 161-1115 | 161-1133 | | — | |
| 10% TBE-Urea | 161-1116 | 161-1134 | | | |
| 15% TBE-Urea | 161-1117 | 161-1135 | | | 161-1189 |

13.2 Buffers

Premixed Running Buffers

| | |
|----------|--------------------------------------|
| 161-0732 | 10x Tris/Glycine/SDS, 1 L |
| 161-0772 | 10x Tris/Glycine/SDS, 5 L |
| 161-0734 | 10x Tris/Glycine, 1 L |
| 161-0771 | 10x Tris/Glycine, 5 L |
| 161-0744 | 10x Tris/Tricine/SDS, 1 L |
| 161-0761 | 10x IEF Anode Buffer, 250 ml |
| 161-0762 | 10x IEF Cathode Buffer, 250 ml |
| 161-0733 | 10x Tris/Boric Acid/EDTA, 1 L |
| 161-0770 | 10x Tris/Boric Acid/EDTA, 5 L |
| 161-0765 | Zymogram Renaturation Buffer, 125 ml |
| 161-0766 | Zymogram Development Buffer, 125 ml |

Individual Reagents

| | |
|----------|--------------------------|
| 161-0719 | Tris, 1 kg |
| 161-0716 | Tris, 500 g |
| 161-0717 | Glycine, 250 g |
| 161-0718 | Glycine, 1 kg |
| 161-0724 | Glycine, 2 kg |
| 161-0301 | SDS, 100 g |
| 161-0710 | 2-Mercaptoethanol, 25 ml |
| 161-0610 | Dithiothreitol, 1 g |
| 161-0611 | Dithiothreitol, 5 g |
| 161-0404 | Bromophenol Blue, 10 g |

Premixed Sample Buffers

| | |
|----------|---------------------------------------|
| 161-0737 | Laemmli Sample Buffer, 30 ml* |
| 161-0738 | Native Sample Buffer, 30 ml |
| 161-0739 | Tricine Sample Buffer, 30 ml |
| 161-0763 | IEF Sample Buffer, 30 ml |
| 161-0764 | Zymogram Sample Buffer, 30 ml |
| 161-0767 | Nucleic Acid Sample Buffer, 5x, 10 ml |
| 161-0768 | TBE-Urea Sample Buffer, 30 ml |

* Requires addition of 2-mercaptoethanol or DTT

13.3 Detection Reagents

Total Protein Gel Stains

| | |
|----------|--|
| 161-0436 | Coomassie Blue R-250 Stain Solution, 1 L |
| 161-0438 | Coomassie Blue R-250 Destain Solution, 1 L |
| 161-0400 | Coomassie Brilliant Blue R-250, 10 g |
| 161-0786 | Bio-Safe Coomassie Stain, 1 L |
| 161-0470 | Copper Stain and Destain Kit |
| 161-0440 | Zinc Stain and Destain Kit |
| 161-0449 | Silver Stain Plus Kit |
| 161-0443 | Bio-Rad Silver Stain Kit |
| 170-3120 | SYPRO Orange Protein Stain, 500 μ l |
| 170-3125 | SYPRO Ruby Protein Gel Stain, 1 L |
| 161-0490 | Flamingo Fluorescent Gel Stain (10x), 20 ml |
| 161-0491 | Flamingo Fluorescent Gel Stain (10x), 100 ml |
| 161-0492 | Flamingo Fluorescent Gel Stain (10x), 500 ml |

Immunoblot Detection

| | |
|----------|-------------------------------------|
| 170-6431 | HRP Conjugate Substrate Kit, 4CN |
| 170-6535 | HRP Color Development Reagent, DAB |
| 170-8238 | Amplified Opti-4CN Kit |
| 170-8235 | Opti-4CN Substrate Kit |
| 170-6432 | BCIP/NBT AP Conjugate Substrate Kit |
| 170-6412 | Amplified Alkaline Phosphatase Kit |
| 170-5012 | Immun-Star™ Substrate Pack |

Total Protein Blot Stains

| | |
|----------|--|
| 170-3127 | SYPRO Ruby Protein Blot Stain, 200 ml |
| 170-6527 | Colloidal Gold Total Protein Stain, 500 ml |
| 170-6517 | Enhanced Colloidal Gold Detection Kit |
| 161-0402 | Amido Black 10B, 25 g |

13.4 Blotting Membranes

| | |
|----------|--|
| 162-0232 | 0.2 µm Nitrocellulose/Filter Paper Sandwich, 8.5 x 13.5 cm, 20 pack |
| 162-0233 | 0.2 µm Nitrocellulose/Filter Paper Sandwich, 8.5 x 13.5 cm, 50 pack |
| 162-0234 | 0.45 µm Nitrocellulose/Filter Paper Sandwich, 8.5 x 13.5 cm, 20 pack |
| 162-0235 | 0.45 µm Nitrocellulose/Filter Paper Sandwich, 8.5 x 13.5 cm, 50 pack |
| 162-0236 | Sequi-Blot PVDF/Filter Paper Sandwich, 8.5 x 13.5 cm, 20 pack |
| 162-0237 | Sequi-Blot PVDF/Filter Paper Sandwich, 8.5 x 13.5 cm, 50 pack |

13.5 Protein and DNA Standards

| | |
|----------|---|
| 161-0363 | Precision Plus Protein™ Unstained Standards (10–250 kD), 1,500 µl, 150 applications |
| 161-0373 | Precision All Blue Prestained Standards (10–250 kD), 500 µl, 50 applications |
| 161-0324 | Kaleidoscope™ Prestained Standards, 500 µl, 50 applications |
| 161-0326 | Polypeptide SDS-PAGE Standards (1.4–26.6 kD), 200 µl, 400 applications |
| 161-0310 | IEF Standards, pI range 4.45–9.6, 250 µl, 500 applications |
| 161-0375 | Precision Plus Protein™ Kaleidoscope Standards 500 µl, 50 applications |
| 161-0370 | Precision Plus Protein™ WesternC Standards, 250 µl, 50 applications |
| 170-8351 | 20 bp EZ Load™ Molecular Ruler (20–1,000 bp), 50 µg, 100 applications |
| 170-8352 | 100 bp EZ Load Molecular Ruler (100–1,000 bp), 25 µg, 100 applications |
| 170-8353 | 100 bp PCR EZ Load Molecular Ruler (100–3,000 bp), 40 µg, 100 applications |
| 170-8200 | AmpliSize® Molecular Ruler (50–2,000 bp), 25 µg, 50 applications |
| 165-8004 | Mini-PROTEAN Tetra Cell for Ready Gel Precast gels |

13.6 Equipment

| | |
|----------|--|
| 165-3302 | Mini-PROTEAN 3 Electrophoresis Module |
| 170-3930 | Mini Trans-Blot® Electrophoresis Transfer Cell |

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Catalog Number 161-0993



1610993

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