Criterion XT™ Precast Gel Instruction Guide

Catalog Number
345-9898

BIO-RAD

For Technical Service Call Your Local Bio-Rad Office
or in the US, Call **1-800-4BIORAD** (1-800-424-6723)

Table of Contents

Section 1
General Information

1.1 Introduction

Criterion is the next generation of dedicated precast gel systems. The innovative, easy-to-use design produces superior resolution while allowing you to run more samples per gel. Compared to any other precast gel system, Criterion produces more results while providing significant cost and time savings. Some of the unique features and benefits provided are:

- 12 month shelf life for Bis-Tris gels
- 8 month shelf life for Tris-acetate gels
- Room temperature storage for Bis-Tris gels
- Easy sample preparation without extra anti-oxidant addition steps
- Patented integral buffer chamber that eliminates buffer leaks
- Up to 26 sample capacity per gel
- Flexibility to run one or two gels
- Multichannel pipet compatible gels
- Outlined and numbered wells that simplify sample loading
- J-foot that improves gel drying and blotting results

US Patents #5,073,246, #5,656,145, #6,093,301 and other patents issued and pending.

1.2 Criterion XT Precast Gels

Criterion XT precast gels are formulated at pH near neutrality to optimize gel matrix stability, significantly delaying acrylamide hydrolysis, which occurs in traditional Laemmli systems. Specially optimized buffers result in tight, consistently resolved bands throughout the life of the gel.

This versatile system allows the separation of small to large proteins using just two gel buffer systems: Criterion XT Bis-Tris precast gels for small to mid-sized proteins and Criterion XT Tris-acetate precast gels for large proteins.

The Criterion XT Bis-Tris gels are based on a Bis-Tris·HCl buffer system (pH 6.4) that uses discontinuous chloride and MES or MOPS ion fronts to form moving boundaries to stack and then separate denatured proteins by size. The chemistry of the XT Bis-Tris gels allows maximum stability and consistent results for a minimum of one year. Running the same XT Bis-Tris gels with the XT MES denaturing running buffer or the XT MOPS denaturing running buffer will produce different migration patterns. A combination of these two running buffers and our three XT Bis-Tris gels can produce up to six different migration patterns in the small and mid-size range.

The Criterion XT Tris-acetate gels are based on a Tris-acetate buffer system (pH 7.0). It uses discontinuous acetate and Tricine ion fronts to form moving boundaries to stack and then separate large denatured proteins by molecular weight. The Criterion XT Tris-acetate gels can also be used to separate proteins by their charge-to-mass ratio (under native-PAGE conditions). This is possible because the XT Tris-acetate gels are made without SDS, allowing the sample buffer and running buffer to dictate the separation mechanism. 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 multi-protein bands where molecular mass separation by SDS-PAGE would reveal only one and for the separation of intact protein

complexes. Separation by native PAGE with XT Tris-acetate gels uses discontinuous acetate and glycine ion fronts to form moving boundaries to stack and separate proteins by both size and charge.

Protein samples for the Criterion XT precast gel system are prepared in a reducing denaturing sample buffer. The sample buffer contains XT reducing agent, a pH neutralized and stabilized solution of TCEP as the reducing agent; heat and SDS are used to denature the proteins. In addition, the use of TCEP in combination with Bio-Rad's optimized running buffers maintains proteins in a fully reduced state during the electrophoresis run, eliminating the need for an anti-oxidant in the upper buffer chamber. Criterion XT Tris-acetate precast gels can also be used for native PAGE. Proteins are prepared in a nonreducing, nondenaturing sample buffer, which maintains the proteins' native structure and charge density.

1.3 Criterion System Specifications

Gel material	Polyacrylamide
Gel dimensions (W x L)	13.3 x 8.7 cm
Gel thickness	1.0 mm
Resolving gel height	6.5 cm
Cassette dimensions (W x L)	15.0 x 10.6 cm
Cassette material	Styrene copolymer
Comb material	Polycarbonate
Storage tray material	PET
Upper running buffer volume	60 ml
Lower running buffer volume	800 ml
Storage conditions	Bis-Tris gels: Store flat at ambient temperature; DO NOT FREEZE
	Tris-acetate gels: Store flat at 4°C; DO NOT FREEZE
Gel shelf life	12 months for Bis-Tris gels; 8 months for Tris-acetate gels

1.4 Criterion XT Comb Configurations

Comb	Load Volume	Comments
12+2 well	45 µl with two 15 µl reference wells	Multichannel pipet compatible
18-well	30 µl	
26-well	15 µl	Multichannel pipet compatible
Prep+2 well	800 µl with two 15 µl reference wells	
IPG	11 cm ReadyStrip™ IPG strip	
IPG+1 well	11 cm ReadyStrip IPG strip with one 15 µl reference well	

Section 2
Setup and Basic Operation

2.1 Setting Up and Running Criterion XT Gels

1. Each Criterion XT gel is packaged individually in a plastic storage tray. Remove the cover by gently pulling the corner tab up and diagonally across the package. Remove the gel from the package.

2. Remove the comb and gently rinse the wells with ddH_2O or running buffer.

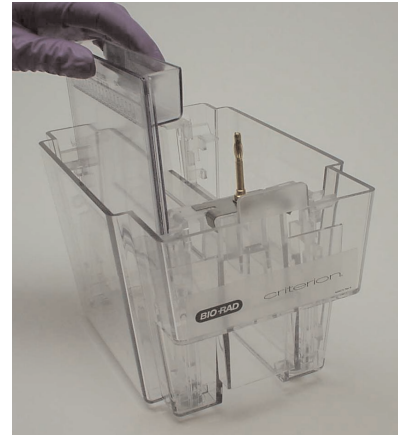
3. Remove the tape from the bottom of the cassette by pulling the tab across the gel.

4. Insert the Criterion XT gel into one of the slots in the Criterion cell tank. Ensure that each integral buffer chamber faces the center of the cell.

5. Fill each integral buffer chamber with 60 ml running buffer.

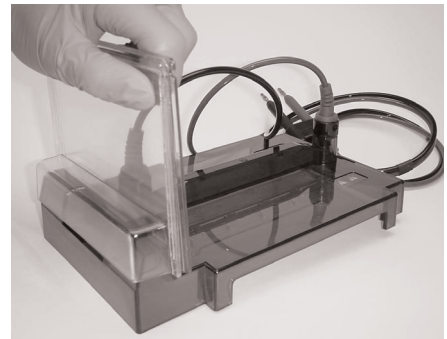
6. Load samples using a Hamilton syringe or a pipet with gel loading tips. A sample loading guide can be placed on the outer edge of the cassette to aid in aligning pipet tips with the wells. This is especially useful with multichannel pipets.

7. Fill each half of the lower buffer tank with 400 ml of running buffer to the marked fill line.

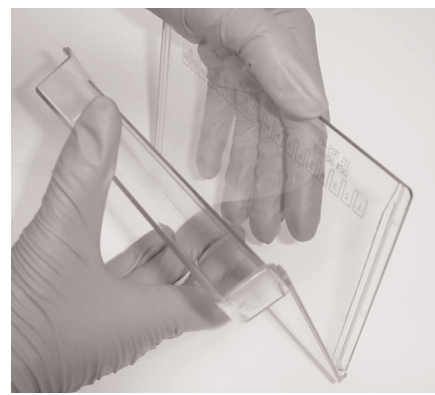


8. Place the lid on the tank, aligning the color-coded banana plugs and jacks. See section 3.6 for power conditions.

2.2 Opening Criterion XT Cassettes and Removing the Gels



1. After electrophoresis is complete, turn off the power supply and disconnect the electrical leads.
2. Remove the lid from the tank and remove the Criterion XT gel(s) from the cell. Pour off and discard the upper running buffer.
3. Invert the cassette and place the integral buffer chamber over the cassette-opening tool built into the Criterion cell lid.
4. Firmly press down on the cassette to crack the cassette welds on both sides of the cassette. The cassette will split open approximately 1/3 of the way.
5. Alternatively, the gel cassette can be opened by sliding the tapered back of the comb into the slits on either side of the cassette.
6. Pull the two halves of the cassette apart to completely expose the gel.
7. Remove the gel by either floating the gel into a fixing or staining solution or by carefully lifting the gel from the cassette.



Section 3
SDS-PAGE and Native PAGE

3.1 Criterion XT Gel Selection Guide

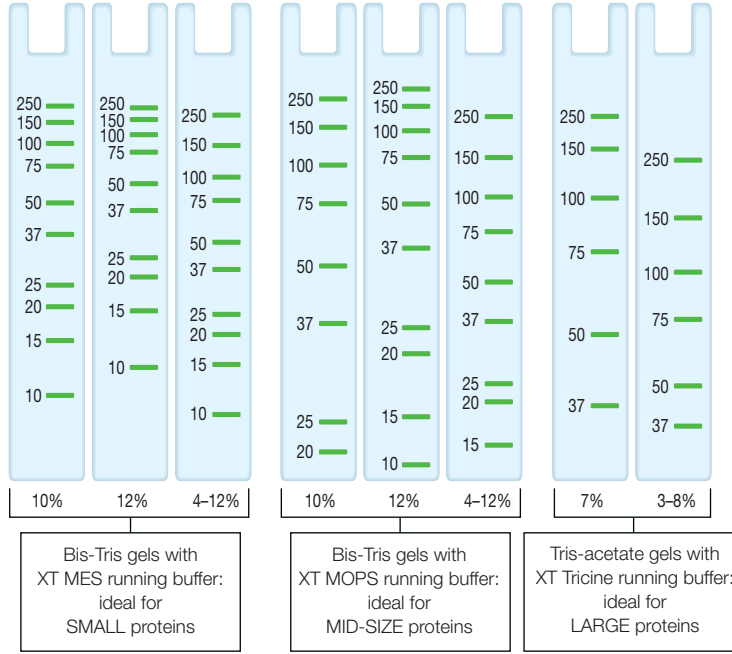
Criterion XT gels are available in a wide selection of single acrylamide percentages and gradients for the separation of proteins by SDS-PAGE or native PAGE.

Optimal Separation

Bis-Tris Gels	**With XT MES Running Buffer**	**With XT MOPS Running Buffer**
10%	2.5–200 kD	14–220 kD
12%	1–30 kD	6–66 kD
4–12%	2.5–200 kD	10–300 kD
Tris-Acetate Gels*	**With XT Tricine Running Buffer**	**With Tris/Glycine Running Buffer**
7%	36–200 kD	N/A
3–8%	40–400 kD	N/A

*Because Criterion XT Tris-acetate gels are made without SDS, they can be used to separate proteins by both SDS-PAGE and native PAGE.

Criterion XT Protein Migration Chart



3.2 Bis-Tris Gel Composition

Gel buffer	Bis-Tris·HCl, pH 6.4
Cross linker	5% C
Stacking gel	4% T, 5% C
Storage buffer	Bis-Tris·HCl, pH 6.4
Shelf life	12 months; individual expiration date is printed on each cassette; store flat at ambient temperature

3.3 Tris-Acetate Gel Composition

Gel buffer	Tris-acetate, pH 7.0
Cross linker	3.8% C
Stacking gel	4% T, 3.8% C
Storage buffer	Tris-acetate, pH 7.0
Shelf life	8 months; individual expiration date is printed on each cassette, store flat at 4°C

3.4 Criterion XT Buffers and Reagents

Bis-Tris running buffer for SDS-PAGE	20x XT MOPS (dilute to 1x) For separation of mid-size proteins Catalog #161-0788	or	XT MES (dilute to 1x) For separation of small proteins Catalog #161-0789
Tris-acetate running buffer for SDS-PAGE	20x XT Tricine (dilute to 1x) For separation of large proteins Catalog #161-0790		
Tris-acetate running buffer for Native-PAGE	10x Tris-Glycine (dilute to 1x) Catalog #161-0732		
XT sample buffer	Catalog #161-0791		
XT reducing agent	Catalog #161-0792		

3.5 Sample Preparation

Determine the appropriate protein concentration of your sample based on the detection method and load volume used. (See section 4.1 for approximate stain sensitivities.) XT sample buffer is a 4x concentrate and can be used with both dilute and concentrated samples. Refer to the sample preparation guide below:

Sample Preparation Guide

SDS-PAGE	**Native-PAGE**
25 µl XT sample buffer 5 µl XT reducing agent x µl sample	50 µl Native sample buffer x µl sample
Make up to 100 µl with ddH_20	Make up to 100 µl with ddH_2O
Heat sample at 95°C for 5 min.	Do not heat sample

3.6 Running Conditions

Gel type	**Bis-Tris (for SDS-PAGE)**	**Bis-Tris (for SDS-PAGE)**	**Tris-Acetate (for SDS-PAGE)**	**Tris-Acetate (for Native-PAGE)**
Running buffer	**XT MOPS**	**XT MES**	**XT Tricine**	**Tris/Glycine**
Power conditions	200 V constant	200 V constant	150 V constant	200 V constant
Run time	60 min	45 min	65 min	75 min
Starting current	165–175 mA/gel	185–200 mA/gel	170–180 mA/gel	70–80 mA/gel
Final current	60–70 mA/gel	90–110 mA/gel	85–95 mA/gel	25–35 mA/gel

Section 4
2-D Electrophoresis

4.1 Equilibration

Use existing equilibration protocols as described in the ReadyPrep 2-D Starter Kit (catalog #163-2105 or bulletin 411009) or existing protocols and buffers used for Tris-HCl gels.

4.2 Agarose Overlay

Make a solution of 0.6% low melt agarose and 0.002% Bromophenol blue. To make 10 ml of the agarose overlay, mix 9.5 ml of the above agarose with 0.5 ml of 20x XT Running Buffer. Use the XT Running Buffer that will be used to run the second dimension gel.

Section 5
Staining and Detection

5.1 SDS-PAGE and Native PAGE Detection

Total Protein Gel Stain 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 R-250
Zinc stain	6–12 ng	~0.2 µg/band	High-contrast, fast, reversible stain	Negative stain, must be photographed; SDS-PAGE only
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	Requires imaging instrument for maximum sensitivity

Total Protein Blot Stain Method	Sensitivity	Optimal Protein Load	Advantages	Disadvantages
SYPRO Ruby protein blot stain	2–8 ng	~0.2 µg/band	Compatible with mass spectrometry, Edman-based sequencing, and standard immunological procedures	Multiple-step protocol; Requires imaging instrument for maximum sensitivity
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
Amido Black	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 antigens	May detect endogenous enzyme activity
Amplified AP*	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

*(HRP) horseradish peroxidase; (AP) alkaline phosphatase

Section 6
Blotting

Criterion XT gels are blotted using the same buffers and protocols used to blot Tris-HCl and other polyacrylamide gels. Please refer to the Criterion blotter instruction manual (bulletin 4006190) for detailed instructions on how to blot gels. Tris/Glycine (Towbin) transfer buffer is recommended for western transfer of the Criterion XT pre-cast gels.

Section 7
Troubleshooting

Improper storage of Criterion XT gels can produce numerous artifacts. Criterion XT Bis-Tris gels should be stored flat at ambient temperature. Criterion XT Tris-acetate gels should be stored flat at 4°C. Avoid freezing. 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 integral buffer chamber with 60 ml running buffer
	Insufficient lower electrode buffer	Fill both halves of the lower buffer tank with 400 ml running buffer when running two gels
	Electrical disconnection	Check electrodes and connections
Bands “smile” across gel, band pattern curves upward at both sides of the gel	Excess heating of gel	Check buffer composition
		Completely fill both halves of the lower buffer tank with 400 ml running buffer when running two gels
		Do not exceed recommended running conditions
Skewed or distorted bands, lateral band spreading	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	Samples overloaded	Dilute sample
		Selectively remove predominant protein in the sample
	Sample precipitation	Centrifuge samples to remove particulates prior to sample loading
Gels run too fast, provide poor resolution, and gel temperature is too high	Running buffer is too concentrated	Check buffer composition
Artifact bands at ~60–70 kD	Possible skin keratin contamination	Wear gloves while cleaning all dishware and while handling and loading gel
		Filter all solutions through nitrocellulose
		Use 10% iodoacetamide to eliminate keratin bands

Section 8 Ordering Information

8.1 Criterion XT Gels

Criterion XT Bis-Tris Gels	12+2 Well	18-Well	26-Well	Prep Well	IPG+1 Well	IPG Well
10% Bis-Tris	345-0111	345-0112	345-0113	345-0114	345-0115	345-0116
12% Bis-Tris	345-0117	345-0118	345-0119	345-0120	345-0121	345-0122
4–12% Bis-Tris	345-0123	345-0124	345-0125	345-0126	345-0127	345-0128

Criterion XT Tris-Acetate Gels	12+2 Well	18-Well	26-Well	Prep Well	IPG+ 1 Well	IPG Well
3–8% Tris-Acetate	345-0129	345-0130	345-0131	345-0132	345-0133	345-0134
7% Tris-Acetate	345-0135	345-0136	345-0137	345-0138	345-0139	345-0140

8.2 Criterion XT Buffers and Kits

Catalog #	Description
161-0788	XT MOPS Running Buffer, 20x, 500 ml
161-0789	XT MES Running Buffer, 20x, 500 ml
161-0790	XT Tricine Running Buffer, 20x, 500 ml
161-0791	XT Sample buffer, 4x, 10 ml
161-0792	XT Reducing Agent, 20x, 1 ml
161-0793	XT MOPS Buffer Kit, includes 500 ml 20x XT MOPS running buffer, 10 ml 4x XT sample buffer, 1 ml 20x XT reducing agent
161-0796	XT MES Buffer Kit, includes 500 ml 20x XT MOPS running buffer, 10 ml 4x XT sample buffer, 1 ml 20 x XT reducing agent
161-0797	XT Tricine Buffer Kit, includes 500 ml 20x XT MOPS running buffer, 10 ml 4x XT sample buffer, 1 ml 20x XT reducing agent

8.3 Other Related Products

161-0738	Native Sample Buffer, 30 ml
161-0734	10x Tris/Glycine, 1 L
161-0404	Bromophenol Blue, 10 g
161-0311	Certified Low-Melt Agarose, 25 g
163-2107	ReadyPrep 2-D Starter Kit Equilibration Buffer I, with DTT
163-2108	ReadyPrep 2-D Starter Kit Equilibration Buffer II, with DTT

8.4 Criterion Gels

Criterion Tris-HCl Gels	12+2 Well 45 µl Samples	18-Well 30 µl Samples	26-Well 15 µl Samples	Prep+2 Well 800 µl Samples	IPG Well 11 cm IPG Strip	IPG+1 Well 11 cm IPG Strip
5% Tris-HCl	345-0001	345-0002	345-0003	345-0004	-	-
7.5% Tris-HCl	345-0005	345-0006	345-0007	345-0008	-	-
10% Tris-HCl	345-0009	345-0010	345-0011	345-0012	345-0013	345-0101
12.5% Tris-HCl	345-0014	345-0015	345-0016	345-0017	345-0018	345-0102
15% Tris-HCl	345-0019	345-0020	345-0021	345-0022	-	-
18% Tris-HCl	345-0023	345-0024	345-0025	345-0026	-	-
4–15% Tris-HCl	345-0027	345-0028	345-0029	345-0030	345-0031	345-0103
4–20% Tris-HCl	345-0032	345-0033	345-0034	345-0035	345-0036	345-0104
8–16% Tris-HCl	345-0037	345-0038	345-0039	345-0040	345-0041	345-0105
10.5–14% Tris-HCl	345-9949	345-9950	345-9951	345-9952	345-9953	345-0106
10-20% Tris-HCl	345-0042	345-0043	345-0044	345-0045	345-0046	345-0107

Criterion TBE Gels	12+2 Well 45 µl Samples	18-Well 30 µl Samples	26-Well 15 µl Samples	Prep+2 Well 800 µl Samples
5% TBE	345-0047	345-0048	345-0049	345-0050
10% TBE	345-0051	345-0052	345-0053	345-0054
15% TBE	345-0055	345-0056	345-0057	345-0058
4–20% TBE	345-0059	345-0060	345-0061	345-0062

Criterion Peptide Gels	12+2 Well 45 µl Samples	18-Well 30 µl Samples	26-Well 15 µl Samples	Prep+2 Well 800 µl Samples
16.5% Peptide	345-0063	345-0064	345-0065	345-0066
10–20% Peptide	345-0067	345-0068	345-0069	345-0070

Criterion IEF Gels	12+2 Well 45 µl Samples	18-Well 30 µl Samples	26-Well 15 µl Samples	Prep+2 Well 800 µl Samples
IEF pH 3–10	345-0071	345-0072	345-0073	345-0074
IEF pH 5–8	345-0075	345-0076	345-0077	345-0078

Criterion Zymogram Gels	12+2 Well 45 µl Samples	18-Well 30 µl Samples	26-Well 15 µl Samples	Prep+2 Well 800 µl Samples
10% Zymogram, gelatin	345-0079	345-0080	345-0081	-
12.5% Zymogram, casein	345-0082	345-0083	345-0084	-

Criterion TBE-Urea Gels	12+2 Well 45 µl Samples	18-Well 30 µl Samples	26-Well 15 µl Samples	Prep+2 Well 800 µl Samples
5% TBE-Urea	345-0085	345-0086	345-0087	-
10% TBE-Urea	345-0088	345-0089	345-0090	-
15% TBE-Urea	345-0091	345-0092	345-0093	-

8.5 Criterion Gel Accessories

345-9920	Criterion Staining/Blotting Trays, 12
345-9901	Criterion Empty Cassettes, 1.0 mm with 12+2 comb, 10
345-9902	Criterion Empty Cassettes, 1.0 mm with 18-well comb, 10
345-9903	Criterion Empty Cassettes, 1.0 mm with 26-well comb, 10
345-9904	Criterion Empty Cassettes, 1.0 mm with prep+2 comb, 10
345-9905	Criterion Empty Cassettes, 1.0 mm with IPG comb, 10
165-6006	Criterion Sample Loading Guide, 12+2 well, 1
165-6007	Criterion Sample Loading Guide, 18-well, 1
165-6008	Criterion Sample Loading Guide, 26-well, 1

8.6 Protein Standards

161-0362	Precision Plus Protein™ Unstained Standards (10–250 kD), 500 µl, 100 applications
161-0373	Precision Plus Protein All Blue Standards (10–250 kD), 500 µl, 100 applications
161-0317	SDS-PAGE Standards, broad range, 200 µl
161-0303	SDS-PAGE Standards, high range, 200 µl
161-0304	SDS-PAGE Standards, low range, 200 µl
161-0324	Kaleidoscope Prestained Standards, broad range, 500 µl
161-0325	Kaleidoscope Polypeptide Standards, 500 µl
161-0326	Polypeptide SDS-PAGE Standards (1.4–26.6 kD), 200 µl, 400 applications

8.7 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
161-0440	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 µl
170-3125	SYPRO Ruby Protein Gel Stain, 1 L
161-0434	IEF Gel Staining Solution, 1 L

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
170-5040	Immun-Star HRP Substrate, 500 ml

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

8.8 Blotting Membranes

162-0175	Immun-Blot PVDF Membrane, 10 x 15 cm, 10 sheets
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

8.9 Equipment

165-6001	Criterion Cell, includes tank, lid with power cables, three sample loading guides
170-4070	Criterion Blotter With Plate Electrodes
170-4071	Criterion Blotter With Wire Electrodes

Catalog Number
345-9898

Bio-Rad Laboratories, Inc.

Life Science Group

Web site *www.bio-rad.com* ***USA*** *(800) 4BIORAD* ***Australia*** *02 9914 2800*
Austria *(01) 877 89 01* ***Belgium*** *09-385 55 11* ***Brazil*** *55 21 507 6191*
Canada *(905) 712-2771* ***China*** *(86-21) 63052255*
Czech Republic *(420) 2-4141 0532* ***Denmark*** *45 44 52-1000*
Finland *358 (0)9 804 2200* ***France*** *01 47 95 69 65* ***Germany*** *089 318 84-177*
Hong Kong *852-2789-3300* ***India*** *(91-124) 6398112/113/114, 6450092/93*
Israel *03 951 4127* ***Italy*** *39 02 216091* ***Japan*** *03-5811-6270*
Korea *82-2-3473-4460* ***Latin America*** *305-894-5950*
Mexico *52 5 534 2552 to 54* ***The Netherlands*** *0318-540666*
New Zealand *64-9-4152280* ***Norway*** *47-23-38-41-30* ***Poland*** *(48) 22-8126 672*
Portugal *351-21-472-7700* ***Russia*** *7 095 721 1404* ***Singapore*** *65-2729877*
South Africa *00 27 11 4428508* ***Spain*** *34 91 590 5200*
Sweden *46 (0)8-55 51 27 00* ***Switzerland*** *061 717-9555* ***United Kingdom*** *0800-181134*

Sig 0402

4110130 Rev B