WideScreen™ Rat Kidney Toxicity Panel 1

Table of Contents

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About the Kit

WideScreen™ Rat Kidney Toxicity Panel 1 72164-3

Overview

Bead-based flow cytometric assays enable sensitive, precise quantitation of analytes within a sample. When directed toward proteins or peptides, such assays are essentially ELISAs on a bead. Samples are combined with fluorescently labeled microparticles (beads) covalently conjugated to a capture antibody. Analytes captured on the beads are identified with detection antibodies and a fluorescent label. Alternatively, competitive-type assays may be performed. A major advantage of bead-based assays over traditional protein quantitation methods (such as ELISA) is the capacity for multiplexing, as bead-based assays allow simultaneous quantitation of multiple analytes in a small sample volume.

WideScreen™ Rat Kidney Toxicity Panel 1 is a pre-mixed multiplex bead kit of antibody-based assays for simultaneous quantitation of five kidney damage biomarkers in rat urine and plasma. The Rat Kidney Toxicity Panel 1 contains two types of immunoassays: conventional and competitive. GST-α, KIM-1, TIMP-1, and VEGF are conventional (non-competitive) sandwich-based immunoassays. β2m (β-2-microglobulin) is a competitive assay in which biotinylated antigen in the blocking buffer is competed off the beads by analyte, resulting in a decrease in fluorescent signal.

Analyte	Full name
β2m	Beta-2-microglobulin
GST-α	Glutathione S-transferase alpha
KIM-1	Kidney injury molecule 1
TIMP-1	Tissue inhibitor of matrix metalloproteinase 1
VEGF	Vascular endothelial growth factor

An essential aspect of drug development is determining detrimental side effects, preferably prior to clinical trials. The WideScreen Rat Kidney Toxicity Panels measure key biomarkers found in urine that can indicate drug-induced damage to kidneys, known as renal toxicity or nephrotoxicity. Traditional tests of this nature test for biomarkers that are detectable days or weeks after kidney damage has occurred. In contrast, the WideScreen Rat Kidney Toxicity Panels provide researchers with a tool to detect biomarkers which may be upregulated and reveal damage within hours, allowing drugs to be efficiently and rigorously tested before human clinical trials begin.

- β2m is a small cell surface protein shed into the blood and normally reabsorbed through the proximal tubules of the kidney. High β2m levels result from lack of efficient reabsorption due to renal failure.
- GST-α contributes to detoxification of a wide range of compounds including carcinogens, therapeutic drugs, and products of oxidative stress.
- KIM-1 is a membrane protein expressed at elevated levels after injury of proximal tubule epithelial cells due to renal ischemia.
- TIMP-1 regulates extracellular matrix synthesis and degradation and, along with matrix metalloproteases, plays a role in tumor growth and metastasis.
- VEGF is a growth factor that induces endothelial cell proliferation, promotes cell migration, inhibits apoptosis, and induces permeabilization of blood vessels.

The WideScreen Rat Kidney Toxicity Panel 1 is a pre-mixed multiplex bead kit of quantitative antibody-based assays for simultaneous detection of five proteins found in rat urine and associated with kidney damage: β2m, GST-α, KIM-1, TIMP-1, and VEGF. The kit includes all the reagents and buffers needed to analyze the above proteins in rat urine samples using the Luminex® xMAP® System.

Note: WideScreen Rat Kidney Toxicity Panel 1 can also be used with rat plasma samples. Please refer to sample preparation section on p 5.

Components and Storage

The kit includes all the reagents and buffers needed to assay the above proteins in rat urine samples using the Luminex® xMAP® System. The kit contains sufficient components to assay one 96-well plate.

WideScreen™ Rat Kidney Toxicity Panel 1		**72164-3**
1.1 ml	Rat Kidney Toxicity Panel 1 Capture Beads PBS with BSA, Tween 20 and 0.025% ProClin® 300	Store all components at 4°C*
1 vial	Rat Kidney Toxicity Panel 1 Detection Antibodies Lyophilized, biotinylated detection antibody premix	
1 vial	Rat Kidney Toxicity Panel 1 Standards Mix Lyophilized recombinant protein standards for β2m, GST-α, KIM-1, TIMP-1, and VEGF	
1 vial	Rat Kidney Toxicity Panel 1 Control 1 Lyophilized, low levels of recombinant β2m, GST-α, KIM-1, TIMP-1, and VEGF	
1 vial	Rat Kidney Toxicity Panel 1 Control 2 Lyophilized, high levels of recombinant β2m, GST-α, KIM-1, TIMP-1, and VEGF	
60 ml	Assay Buffer Type 2 1X, proprietary mix of domestic animal proteins in PBS with 0.025% ProClin 300	
1 vial	Rat Kidney Toxicity Panel 1 Blocking Buffer Lyophilized, proprietary mix of domestic animal proteins and biotinylated β2m antigen (for competitive assay) to minimize non-specific interactions	
7.5 ml	Sample Dilution Buffer Type 3 1X, proprietary mix of domestic animal proteins in PBS with 0.025% ProClin 300	
1 vial	Standard Curve Diluent Type 3 Lyophilized, proprietary mix of domestic animal proteins	
150 µl	15X Streptavidin-Phycoerythrin PBS with 2 mM NaN_3	
1	96-well Filter Plate and Sealer	

*****Following reconstitution of lyophilized reagents, store any unused reagent at –70°C. See Reagent Preparation section (p 4).

Note: *WideScreen™ Rat Kidney Toxicity Panel 1 is not compatible with other bead kits and buffers sold by EMD or other vendors.*

Caution: *All materials derived from animal fluids or tissues should be considered biohazardous and handled accordingly. Refer to MSDS for additional information.*

Additional Materials Required But Not Supplied

- Luminex® xMAP® System (or equivalent)
- Vacuum manifold for filter plates (Pall 5017 or Millipore MSVMHTS00)
- 96-well plate platform shaker, such as IKA MTS4
- Polypropylene microcentrifuge tubes
- 15 ml polypropylene centrifuge tubes
- Vortex mixer
- Ultrasonic bath, such as Cole Parmer EW-08849 (optional)
- Multichannel pipet (optional)

Rat Kidney Toxicity Panel 1 Protocol

Considerations Before You Begin

- Guidelines when using filter plates and vacuum manifold:
  - Excessive vacuum will cause the filter plate membrane to perforate. Adjust the pressure using a non-filter (ELISA or tissue culture) plate, ensuring that vacuum does not exceed 5 in. (127 mm) Hg.
  - After adjusting the vacuum with a non-filter plate, place filter plate on the manifold. Use fingertips to apply pressure evenly across the plate. The liquid should drain in 2–5 sec.
  - To avoid drying out the beads, vacuum only long enough to drain all wells. Do not allow drained beads to sit for >5 min before rehydrating with buffer.
  - It is critical to remove excess buffer from the underside of the filter plate by tapping it on a paper towel several times before adding samples or reagents. This prevents samples from wicking out of the wells during incubation steps. For the same reason, avoid placing filter plate on an absorbent surface during incubations.
  - To avoid perforating the filter plate membrane, make certain that the probe height on the xMAP® system is adjusted correctly. Do not touch the membrane with pipet tips. For accurate pipetting, touch tips to the sides of the filter plate wells. Change tips as necessary to prevent cross-contamination.
- Capture Beads and Streptavidin-PE are light sensitive. To avoid photobleaching, keep beads and Streptavidin-PE in microcentrifuge tubes covered. Cover filter plates with aluminum foil during incubation steps.
- To prevent fluorescent dye loss, do not use organic solvents with capture beads. Beads are incompatible with DMSO concentrations >1%.
- Many of the washing and reagent dispensing steps may be done with an 8-channel or 12-channel pipet (manual or automatic). For accurate results, use calibrated single-channel pipets for manipulation of standards and test samples.
- Test samples should be stored at –70°C prior to use.

Reagent Preparation

1. Resuspend each of the following lyophilized reagents in deionized water, immediately prior to performing the assay:

Reagent	dH_2O Volume
Rat Kidney Toxicity Panel 1 Standards Mix	150 µl
Rat Kidney Toxicity Panel 1 Control 1	100 µl
Rat Kidney Toxicity Panel 1 Control 2	100 µl
Rat Kidney Toxicity Panel 1 Blocking Buffer	1.5 ml
Standard Curve Diluent Type 3	1.0 ml
Rat Kidney Toxicity Panel 1 Detection Antibodies	4.4 ml

2. Mix each vial by vortexing at medium speed for 15 sec. Incubate at room temperature for a minimum of 5 min (not to exceed 30 min) and repeat vortexing step. Rat Kidney Toxicity Panel 1 Detection Antibodies can remain at room temperature for up to 2 hours.

Note: Following reconstitution, store any unused reagents at –70°C. Unused reagents can be stored at –70°C for up to one month. Avoid multiple freeze-thaw cycles.

Test Sample Preparation

1. Thaw and dilute samples within 1 h of use. Remove any particulates by centrifugation or filtration. Avoid multiple freeze/thaw cycles.
2. Dilute urine samples 2-fold in Sample Dilution Buffer Type 3. For preparing duplicate samples (recommended), mix 40 µl sample + 40 µl Sample Dilution Buffer Type 3. Mix well and store on ice.
3. Under some experimental conditions, higher urine sample dilutions (such as 1:10) may be required to ensure readings within the ranges of the assay standards. Optimal dilutions need to be determined empirically. Perform all sample dilutions in Sample Dilution Buffer Type 3.

Notes: *WideScreen™ Rat Kidney Toxicity Panel 1 can also be used with rat plasma samples. The optimal dilution for plasma samples must be determined empirically. However, as a starting point, we recommend a 5-fold dilution in Sample Dilution Buffer Type 3.*

For examples of dilutions used for plasma and urine samples, see the Representative Data section of the Certificate of Analysis.

Standard Dilution Series Preparation

This preparation provides sufficient volume to run duplicate standard dilution curves. Label 8 polypropylene tubes S8 through S1. Alternatively, prepare standard dilutions in a 96-well plate. Pipet Standard Curve Diluent Type 3 into labeled tubes as described below. Transfer the reconstituted Rat Kidney Toxicity Panel 1 Standards Mix to the S8-labeled tube. Prepare 3-fold serial dilutions of S8 following the table below. Ensure that each new standard is mixed well by vortexing before proceeding to the next dilution. Change tips between each dilution.

Standard	Volume of Standard Curve Diluent Type 3	Volume of Standards Mix
S8	0 µl	150 µl from vial
S7	80 µl	40 µl of S8
S6	80 µl	40 µl of S7
S5	80 µl	40 µl of S6
S4	80 µl	40 µl of S5
S3	80 µl	40 µl of S4
S2	80 µl	40 µl of S3
S1	80 µl	40 µl of S2

Note: *Standard concentrations are lot-specific. Refer to Certificate of Analysis of appropriate lot for specific standard concentrations.*

Immunoassay Protocol

1. Seal any unused wells of the 96-well filter plate with plate sealer (included) or lab tape for future use.
2. Pre-wet 96-well filter plate wells with 50 µl Assay Buffer Type 2 and incubate for a minimum of 5 min. Immediately prior to Step 3, remove liquid from filter plate by vacuum filtration. Do not exceed 5 in. Hg or 127 mm Hg vacuum; liquid should drain in 2–5 sec. Tap filter plate on a paper towel to remove any buffer remaining on the underside.

Note: *It is critical to remove excess buffer from the underside of the filter plate before adding samples or reagents. Otherwise, samples may wick out of the wells during incubation steps. For the same reason, avoid placing filter plate on an absorbent surface during incubations. If a well does not drain, use the non-tip end of a 200 µl pipet tip to flick the center of the plastic support on the underside of the well, then reapply vacuum.*

3. Add 10 µl of Rat Kidney Toxicity Panel 1 Blocking Buffer to each filter plate well that will be used. Be careful to add a consistent volume to each well, as the biotinylated antigen in the Blocking Buffer is used to quantify proteins for competitive assays.
4. Add 30 µl of each standard, sample or control to appropriate well of the 96-well filter plate.

Note: Rat Kidney Toxicity Panel 1 Control 1 and Control 2 do not need to be diluted.

5. Vortex the plate by gently gliding the plate over the vortex mixer.

Note: Gradually increase the vortex speed from low to medium. Hold the plate with a loose grip. Mix thoroughly for 10 sec. Avoid splashing. Alternatively, mix using a plate shaker for 10 sec on high speed (1200 rpm).

6. Sonicate 10 sec (optional) and vortex the tube of Rat Kidney Toxicity Panel 1 Capture Beads for 10 sec. Add 10 µl to each well.
7. Vortex or shake the plate 10 sec as described above in Step 5.
8. Cover plate with aluminum foil to protect from light and incubate 1 hr at room temperature on a plate shaker (750 rpm).
9. Remove liquid from filter plate by vacuum filtration (5 in. Hg or 127 mm Hg maximum).
10. Wash beads by adding 100 µl Assay Buffer Type 2 to each well and applying vacuum to remove buffer. Repeat wash step for total of two washes in Assay Buffer Type 2. After the second wash and vacuum, tap the filter plate on paper towels to remove any buffer remaining on the underside.

Note: Do not resuspend beads in Assay Buffer Type 2 after second wash.

11. Add 40 µl Rat Kidney Toxicity Panel 1 Detection Antibodies to each well. Vortex or shake the plate as described in Step 5.
12. Cover plate with aluminum foil to protect from light and incubate 1 h at room temperature on a plate shaker (750 rpm)

Note: Do not wash beads after Detection Antibody incubation.

13. Microcentrifuge 15X Streptavidin-PE briefly (5 sec) to ensure all material is in the bottom of the tube. If using all 96 wells, dilute 15X Streptavidin-PE to 1X by adding 144 µl concentrated Streptavidin-PE to 2016 µl Assay Buffer Type 2.

Note: Do not dilute the whole vial of Streptavidin-PE if the entire kit will not be used. Dilute only what is needed based on the number of wells. Allow 10% extra for pipetting error. If there is an insufficient volume of 15X Streptavidin-PE for your final experiment, making a slightly more dilute working stock will not adversely affect results.

14. Add 20 µl 1X Streptavidin-PE to each well.
15. Cover plate with aluminum foil to protect from light and incubate 30 min at room temperature on a plate shaker (750 rpm).
16. Remove liquid from filter plate by vacuum filtration.
17. Wash beads by adding 100 µl Assay Buffer Type 2 to each well and applying vacuum to remove buffer. Repeat wash step for total of two washes in Assay Buffer Type 2. After second wash and vacuum, tap filter plate on paper towels to remove any buffer remaining on the underside.
18. Add 100 µl Assay Buffer Type 2 to each well.
19. Cover plate to protect from light. Incubate 3–5 min at room temperature on a plate shaker (750 rpm).
20. Analyze using a Luminex® instrument.

Collecting Data and Data Analysis

Data Acquisition

For detailed instructions on the operation of Luminex® systems, refer to the user guide for your specific instrument and software. General recommendations are given below.

1. Using your Luminex system software, prepare a protocol for the assay you will run. Enter information for each bead target, and for the standards, samples, and controls.

Note: Standard concentrations are lot-specific. Refer to Certificate of Analysis of appropriate lot for specific standard concentrations.

2. Select the following bead regions:

Analyte	Bead Region	Analyte	Bead Region
β2m	22	TIMP-1	36
GST-α	33	VEGF	08
KIM-1	20		

3. Acquire data using the system settings shown below:

Software	Sample Size	Events per Bead Region	Timeout	Doublet Discriminator	CAL2 Gain Setting
Luminex® IS™ or equivalent	50 µl	50–100*	60 sec	7500–15500	default
Bio-Plex® Manager™	default (50 µl)	50–100*	60 sec	default (4335–10000)	RP1 low

*If the time spent acquiring samples needs to be reduced, collect as few as 50 events per bead region.

Generation of Standard Curves and Quantitation of Experimental Samples

- Protein standards are supplied in the Rat Kidney Toxicity Panel 1 kit, allowing for accurate quantitation using a titrated standard curve. Representative standard curves and assay performance information can be found in the Certificate of Analysis for the specific lot.
- Refer to the Certificate of Analysis for expected control ranges.
- The eight data points obtained with the concentration standards are plotted using Median Fluorescent Intensity (MFI) as the signal readout (Y-axis), against concentration of standard dilutions (X-axis).
- For competitive assay (β2m), biotinylated antigen in the Rat Kidney Toxicity Panel 1 Blocking Buffer is competed off the beads by analyte, resulting in a decrease in fluorescent signal (high analyte concentration yields lower signal). As a result, the shape of the standard curve is reversed compared to traditional assays (GST-α, KIM-1, TIMP-1, and VEGF).
- Five-parameter logistic (5PL) curve fitting is recommended for modeling data obtained from bead-based immunoassays. Most ranges of standard concentrations are too wide for accurate linear regression analysis. Four-parameter logistic (4PL) equations will often give a good fit, but are not ideal because they assume the standard curve is symmetrical.
- If the signal from an unknown sample exceeds the highest point of the standard curve, the concentration of the unknown should *not* be calculated by extrapolation, because the non-linear shape of the standard curve cannot be accurately modeled past the last measured point. In this case, dilute the samples and test again.
- When concentrations of unknowns have been determined by reading off of the standard curve, remember to multiply this value by the dilution factor to obtain the concentration of the target in the original sample.

Troubleshooting

Problem	Probable Cause	Solution
Leaking wells in filter plate	Wicking due to adherent drops	Tap filter plate several times on paper towel before adding samples or reagents. Do not place filter plate on an absorbent surface during incubations. If wells leaked during data acquisition, it is possible to reacquire these wells. Blot underside of wells and add 100 µl/well Assay Buffer Type 2.
	Perforation of filter plate membranes	Adjust the vacuum setting to <5 in. (127 mm) Hg. Do not touch membranes with pipet tips.
Filter plate wells not draining under vacuum	Vacuum is too low	Adjust vacuum setting to 3–5 in. (76–127 mm) Hg. Clean rubber seals. Apply fingertip pressure to filter plate to ensure formation of a good seal. Use the plate sealer to cover wells not in use.
	Clogged membranes	Clarify samples by centrifugation or filtration. If samples are viscous, dilute further before assaying. Use the non-tip end of a 200 µl pipette to flick the center support on the underside of the well, then reapply vacuum.
Low bead counts during data acquisition	No beads in the wells	See "Leaking wells in filter plate" solutions above. Verify that beads were added at the correct concentration, and that correct bead regions and wells were selected during acquisition setup.
	xMAP® fluidics system is clogged	Clear system of clogs or air using maintenance steps described in the instrument user manual (sanitize, alcohol flush, probe sonication, etc.). Make sure that the probe height is set correctly. Make sure that beads are in suspension by incubating plate for 3–5 min on plate shaker (750 rpm) immediately before analysis. Microbial growth in buffers can cause beads to stick to the filter plate membrane. Do not use contaminated reagents.
	Timeout limit is set too low	50–100 events per bead region should be acquired within the 60 sec timeout limit. If necessary, the timeout limit can be set higher, e.g. 75 sec.
Beads are not falling into the gates properly	Beads were not resuspended in Assay Buffer Type 2 before analysis	The setting of the Doublet Discriminator (DD) gate is buffer-specific. This gate can be adjusted, but Assay Buffer Type 2 is the recommended buffer for running samples. Other buffers may cause bead aggregation.
	DD gate setting not optimal	Use the DD gate setting recommended in the Data Acquisition Section. If necessary, raw data results can be reanalyzed with different DD gate settings; see software user manual.
	Beads were exposed to organic solvents	Do not use organic solvents in the immunoassay, as they will damage beads irreversibly.
	Beads are falling outside the bead region gates due to photobleaching	Do not use expired beads. Do not expose the beads to ambient light for >10 min. Avoid intense light.
	Fluidics system is not running properly	Confirm that the waste container is not full, the sheath fluid is not empty, and the SD fluidics module is turned on. Check system calibration using approved calibration beads. Verify correct system pressure. Confirm that the system is free of air or particulate buildup. Follow maintenance steps in the instrument user manual.
Insufficient volume of an immunoassay reagent	Solutions were not prepared or used as described in protocol	Briefly spin tubes to collect reagents that might be trapped in the tube cap. Confirm correct buffer dilutions and use. If additional Assay Buffer Type 2 is needed, PBS can be used for the final bead resuspension step. If additional 96-well filter plates are required, we recommend Millipore Cat. No. MSBVN1210. If there is insufficient volume of 15X Streptavidin-PE for your final experiment, making a slightly more dilute working stock (e.g., 20-fold instead of 15-fold) will not adversely affect results.
Sample measurements not within the standard curve	Dilution of sample is too low or too high	If values are higher than the standard curve, dilute samples further in Sample Dilution Buffer Type 3 and repeat assay.
	Target concentration is below detection	Verify that curve fitting at the lower end of the standard curve is accurate. Not all urine or plasma samples contain detectable levels of all analytes.

Appendix A: Flowchart for Rat Kidney Toxicity Panel 1 Immunoassay