

## User Guide

# MILLIPLEX<sup>®</sup> Mouse High Sensitivity T Cell Magnetic Bead Panel

## 96-Well Plate Assay

**MHSTCMAG-70K**  
**MHSTCMAG-70KPMX**  
**MHSTCMAG-70KPXBK**

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## Introduction

Cytokines are immunomodulatory polypeptides that play key roles in both adaptive and innate immune responses. A generic term, "cytokines" includes myokines (produced by myocytes), lymphokines (produced by activated Th cells), interleukins (acting as mediators between T cells), and chemokines (responsible for T cell migration). As one of the regulatory mechanisms of the immune system, cytokines act at the recognition, activation, or effector phases of an immune response, modulating the development and functional activities of the subtypes of T cells, B cells and myeloid cells. Consequently, research involving cytokines plays a significant role in achieving a deeper understanding of the immune system and its multi-faceted response to most antigens, especially those responses that make up the inflammatory process.

Low levels of inflammation are involved in many clinical and sub-clinical disease states, such as autoimmune disease, cardiovascular disease, diabetes, neurological disorders and cancer. Measuring picogram levels of cytokines, therefore, is critical for understanding the pathogenesis of these diseases.

The MILLIPLEX® Mouse High Sensitivity T Cell Magnetic Bead Panel enables you to focus on the therapeutic potential of cytokines, as well as the modulation of even low levels of cytokine expression. It is the most versatile system available for the study of low-level expression in cytokine research. MILLIPLEX® products offer you the ability to select an 18-plex or choose any combination of 18 analytes to design a custom kit that better meets your needs. In addition, data obtained from the Mouse High Sensitivity T Cell Panel will correlate with data for the respective cytokines in the Mouse Cytokine/Chemokine Panel I, furthering your ability to measure specific cytokine response in both normal and disease states.

Coupled with the Luminex® xMAP® platform in a magnetic bead format, you receive the advantage of ideal speed and sensitivity, allowing quantitative multiplex detection of dozens of analytes simultaneously, dramatically improving productivity. While magnetic beads can make the process of automation and high throughput screening easier with features such as walk-away washing, advantages even outside automation include:

- Lower and more consistent CVs
- Improved performance with samples having high nonspecific binding
- More flexible plate / plate washer option

The MILLIPLEX® Mouse High Sensitivity T Cell Magnetic Bead Panel is to be used for the simultaneous quantification of any or all of the following 18 mouse cytokines: GM-CSF, IFN $\gamma$ , IL-1 $\alpha$ , IL-1 $\beta$ , IL-2, IL-4, IL-5, IL-6, IL-7, IL-10, IL-12 (p70), IL-13, IL-17A, KC, LIX, MCP-1, MIP-2 and TNF $\alpha$  in mouse plasma, serum, and cell/tissue culture supernatant samples. This panel provides biomedical researchers quality tools for the study of low-level inflammatory disease.

**For research use only. Not for use in diagnostic procedures.  
Please read entire protocol before use.**

## Principle

MILLIPLEX® products are based on the Luminex® xMAP® technology — one of the fastest growing and most respected multiplex technologies offering applications throughout the life-sciences and capable of performing a variety of bioassays including immunoassays on the surface of fluorescent-coded magnetic bead (MagPlex®-C and non-magnetic bead (MicroPlex®) microspheres.

- Luminex® products use proprietary techniques to internally color-code microspheres with multiple fluorescent dyes. Through precise concentrations of these dyes, distinctly colored bead sets of 500-5.6 µm non-magnetic or 80-6.45 µm magnetic polystyrene microspheres can be created, each of which is coated with a specific capture antibody.
- After an analyte from a test sample is captured by the bead, a biotinylated detection antibody is introduced.
- The reaction mixture is then incubated with Streptavidin-PE conjugate, the reporter molecule, to complete the reaction on the surface of each microsphere.
- The following Luminex® instruments can be used to acquire and analyze data using two detection methods:
  - The Luminex® analyzers, Luminex® 200™, FLEXMAP 3D® and xMAP® INTELLIFLEX, are flow cytometry-based instruments that integrate key xMAP® detection components, such as lasers, optics, advanced fluidics and high-speed digital signal processors.
  - The Luminex® analyzer (MAGPIX®), a CCD-based instrument that integrates key xMAP® capture and detection components with the speed and efficiency of magnetic beads.
- Each individual microsphere is identified and the result of its bioassay is quantified based on fluorescent reporter signals. We combine the streamlined data acquisition power of Luminex® xPONENT® acquisition software with sophisticated analysis capabilities of the new MILLIPLEX® Analyst 5.1, integrating data acquisition and analysis seamlessly with all Luminex® instruments.
- xMAP® INTELLIFLEX runs on INTELLIFLEX software for instrument control, run setup and generating high quality data with flexible output options. Data can be exported in xPONENT® style CSV files for compatibility with many existing analytical applications, or in the new, customizable INTELLIFLEX file format. The INTELLIFLEX file format is intended for flexibility and simplicity, allowing the user to freely select which data points to include and to reduce the time to analysis.

The capability of adding multiple conjugated beads to each sample results in the ability to obtain multiple results from each sample. Open-architecture xMAP® technology enables multiplexing of many types of bioassays reducing time, labor and costs over traditional methods.

## Storage Conditions Upon Receipt

- Recommended storage for kit components is 2–8 °C.
- Once the standards and controls have been reconstituted, immediately transfer contents into polypropylene vials. **DO NOT STORE RECONSTITUTED STANDARDS OR CONTROLS IN GLASS VIALS.** For long-term storage, freeze reconstituted standards and controls at  $\leq -20$  °C. Avoid multiple (> 2) freeze/thaw cycles.
- **DO NOT FREEZE** Antibody-Immobilized Beads, Detection Antibody, and Streptavidin-Phycoerythrin.

## Reagents Supplied

Store all reagents at 2–8 °C

Reagents	Volume	Quantity	Cat. No.
Mouse High Sensitivity T Cell Standard	Lyophilized	1 vial	MHSTC-8070
Mouse High Sensitivity T Cell Quality Control 1 and 2	Lyophilized	2 vials	MHSTC-6070
Serum Matrix*	Lyophilized	1 vial	MXMSM-11
Set of one 96-Well Plate with 2 sealers	—	1 set	—
Assay Buffer	30 mL	1 bottle	L-AB
10X Wash Buffer**	60 mL	1 bottle	L-WB
Mouse High Sensitivity T Cell Detection Antibodies	3.2 mL	1 bottle	MHSTC-1070
Streptavidin-Phycoerythrin	3.2 mL	1 bottle	MC-SAPE10
Mixing Bottle (not provided with premixed panel)	—	1 bottle	—

\* Contains 0.08% Sodium azide

\*\* Contains 0.05% Proclin

## Mouse High Sensitivity T Cell Antibody-Immobilized Premixed Magnetic Beads

	Volume	Quantity	Cat. No.
Premixed 18-plex Beads	3.5 mL	1 bottle	MHSTCPMX18-MAG

Included Mouse High Sensitivity T Cell Antibody-Immobilized Magnetic Beads are dependent on customizable selection of analytes within the panel.

## Mouse High Sensitivity T Cell Antibody-Immobilized Magnetic Beads

Bead/Analyte Name	Luminex® Magnetic Bead Region	Customizable 18 Analytes (50X concentration, 90µL) Available	Cat. No.	18-Plex Magnetic Premixed Beads
	Anti-Mouse GM-CSF Bead	15	✓	MGMCSF-MAG
Anti-Mouse IFN $\gamma$ Bead	19	✓	MIFNG-MAG	✓
Anti-Mouse IL-1 $\alpha$ Bead	21	✓	MIL1A-MAG	✓
Anti-Mouse IL-1 $\beta$ Bead	25	✓	MIL1B-MAG	✓
Anti-Mouse IL-2 Bead	26	✓	MIL2-MAG	✓
Anti-Mouse IL-4 Bead	28	✓	MIL4-MAG	✓
Anti-Mouse IL-5 Bead	30	✓	MIL5-MAG	✓
Anti-Mouse IL-6 Bead	34	✓	MCYIL6-MAG	✓
Anti-Mouse IL-7 Bead	36	✓	MIL7-MAG	✓
Anti-Mouse IL-10 Bead	43	✓	MIL10-MAG	✓
Anti-Mouse IL-12 (p70) Bead	47	✓	MIL12P70-MAG	✓
Anti-Mouse IL-13 Bead	52	✓	MIL13-MAG	✓
Anti-Mouse LIX Bead	53	✓	MLIX-MAG	✓
Anti-Mouse IL-17A Bead	56	✓	MIL17-MAG	✓
Anti-Mouse KC Bead	61	✓	MKC-MAG	✓
Anti-Mouse MCP-1 Bead	62	✓	MCYMCP1-MAG	✓
Anti-Mouse MIP-2 Bead	73	✓	MMIP2-MAG	✓
Anti-Mouse TNF $\alpha$ Bead	77	✓	MCYTNFA-MAG	✓

## Materials Required (not included)

MAGPIX® Drive Fluid PLUS (Cat. No. 40-50030), xMAP® Sheath Fluid PLUS (Cat. No. 40-50021), or xMAP® Sheath Concentrate PLUS (Cat. No. 40-50023)

### Instrumentation/Materials








- Adjustable pipettes with tips capable of delivering 25 µL to 1000 µL
- Multichannel pipettes capable of delivering 5 µL to 50 µL, or 25 µL to 200 µL
- Reagent reservoirs
- Polypropylene microfuge tubes
- Rubber bands
- Aluminum foil
- Absorbent pads
- Laboratory vortex mixer
- Sonicator (Branson Ultrasonic Cleaner Model B200 or equivalent)
- Titer plate shaker (VWR® Microplate Shaker Cat. No. 12620-926 or equivalent)
- Luminex® 200™, HTS, FLEXMAP 3D®, MAGPIX® instrument with xPONENT® software, or xMAP® INTELLIFLEX instrument with INTELLIFLEX software by Luminex® Corporation
- Automatic plate washer for magnetic beads (BioTek® 405 LS and 405 TS, Cat. No. 40-094, 40-095, 40-096, 40-097 or equivalent) or Handheld Magnetic Separation Block (Cat. No. 40-285 or equivalent).

**Note:** If a plate washer or handheld magnetic separation block for magnetic beads is not available, one can use a microtiter filter plate (Cat. No. MX-PLATE) to run the assay using a vacuum filtration unit (Vacuum Manifold, Cat. No. MSVMHTS00 or equivalent with Vacuum Pump, Cat. No. WP6111560 or equivalent).

## Safety Precautions

- All blood components and biological materials should be handled as potentially hazardous. Follow universal precautions as established by the Centers for Disease Control and Prevention and by the Occupational Safety and Health Administration when handling and disposing of infectious agents.
- Sodium azide or Proclin has been added to some reagents as a preservative. Although the concentrations are low, Sodium azide and Proclin may react with lead and copper plumbing to form highly explosive metal azides. Dispose of unused contents and waste in accordance with international, federal, state, and local regulations.

## Symbol Definitions

Ingredient	Cat. No.	Label	
Mouse High Sensitivity T Cell Standard	MHSTC-8070	 	<p><b>Danger.</b> Harmful if swallowed. Causes serious eye damage. Harmful to aquatic life with long lasting effects. Avoid release to the environment. Wear eye protection. <b>IF IN EYES:</b> Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical advice/attention.</p>
Mouse High Sensitivity T Cell Quality Control 1 and 2	MHSTC-6070	 	<p><b>Danger.</b> Harmful if swallowed. Causes serious eye damage. Harmful to aquatic life with long lasting effects. Avoid release to the environment. Wear eye protection. <b>IF IN EYES:</b> Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical advice/attention.</p>
Serum Matrix	MXMSM-11		Harmful to aquatic life with long lasting effects. Avoid release to the environment.
10X Wash Buffer	L-WB		<p><b>Warning.</b> May cause an allergic skin reaction. Wear protective gloves. <b>IF ON SKIN:</b> Wash with plenty of soap and water.</p>
Mouse High Sensitivity T Cell Detection Antibodies	MHSTC-1070		<p><b>Warning.</b> Causes serious eye irritation. <b>IF IN EYES:</b> Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.</p>
Streptavidin-Phycoerythrin	L-SAPE3		<p><b>Warning.</b> Causes serious eye irritation. <b>IF IN EYES:</b> Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.</p>

## Technical Guidelines

To obtain reliable and reproducible results, the operator should carefully read this entire manual and fully understand all aspects of each assay step before running the assay. The following notes should be reviewed and understood before the assay is set up.

- FOR RESEARCH USE ONLY. NOT FOR USE IN DIAGNOSTIC PROCEDURES.
- Do not use beyond the expiration date on the label.
- Do not mix or substitute reagents with those from other lots or sources.
- The Antibody-Immobilized Beads are light sensitive and must be protected from light at all times. Cover the assay plate containing beads with opaque plate lid or aluminum foil during all incubation steps.
- It is important to allow all reagents to warm to room temperature (20-25 °C) before use in the assay.
- Incomplete washing can adversely affect the assay outcome. All washing must be performed with the Wash Buffer provided.
- After hydration, all standards and controls must be transferred to polypropylene tubes.
- The standards prepared by serial dilution must be used within 1 hour of preparation. Discard any unused standards except the standard stock which may be stored at  $\leq -20$  °C for 1 month and at  $\leq -80$  °C for greater than one month.
- If samples fall outside the dynamic range of the assay, further dilute the samples with the appropriate diluent and repeat the assay.
- Any unused mixed Antibody-Immobilized Beads may be stored in the Mixing Bottle at 2-8 °C for up to one month.
- During the preparation of the standard curve, make certain to mix the higher concentration well before making the next dilution. Use a new tip with each dilution.
- The plate should be read immediately after the assay is finished. If, however, the plate cannot be read immediately, seal the plate, cover with aluminum foil or an opaque lid, and store the plate at 2-8 °C for up to 24 hours. Prior to reading, agitate the plate on the plate shaker at room temperature for 10 minutes. Delay in reading a plate may result in decreased sensitivity for some cytokines and chemokines.
- The titer plate shaker should be set at a speed to provide maximum orbital mixing without splashing of liquid outside the wells. For the recommended plate shaker, this would be a setting of 5-7 which is approximately 500-800 rpm.
- Ensure that the needle probe is clean. This may be achieved by sonication and/or alcohol flushes.



- When reading the assay on the Luminex® 200™ instrument, adjust probe height according to the protocols recommended by Luminex® to the kit solid plate or to the recommended filter plates using 3 alignment discs. When reading the assay on MAGPIX® instrument, adjust probe height according to the protocols recommended by Luminex® to the kit solid plate or to the recommended filter plates using 2 alignment discs. When reading the assay on the FLEXMAP 3D® instrument, adjust probe height according to the protocols recommended by Luminex® to the kit solid plate using 1 alignment disc.
- For the FLEXMAP 3D® instrument, when using the solid plate in the kit, the final resuspension should be with 150 µL Sheath Fluid PLUS in each well and 75 µL should be aspirated.
- For xMAP® INTELLIFLEX, adjust probe height based on the type of plate you are using, place an alignment disk or an alignment sphere in the well according to the protocol recommended by Luminex®.
- For cell culture supernatants or tissue extraction, use the culture or extraction medium as the matrix solution in background, standard curve and control wells. If samples are diluted in assay buffer, use the assay buffer as matrix.
- For serum/plasma samples that require dilution, use the MXMSM-11 provided and prepared as described in the kit for a two-fold dilution (for example, 50 µL of sample and 50 µL of MXMSM-11).
- For cell/tissue homogenate, the final cell or tissue homogenate should be prepared in a buffer that has a neutral pH, contains minimal detergents or strong denaturing detergents, and has an ionic strength close to physiological concentration. Avoid debris, lipids, and cell/tissue aggregates. Centrifuge samples before use.
- Vortex all reagents well before adding to plate.

## Sample Collection and Storage

### Preparation of Serum Samples

- Allow the blood to clot for at least 30 minutes before centrifugation for 10 minutes at 1000 x g. Remove serum and assay immediately or aliquot and store samples at  $\leq -20$  °C.
- Avoid multiple (> 2) freeze/thaw cycles.
- When using frozen samples, it is recommended to thaw the samples completely and mix well by vortexing.
- Serum samples should be centrifuged at a high speed (for example, 20,000 x g for 5 minutes) to separate lipids. Take care when pipetting samples to insert the pipette tip below the lipid layer formed on the surface and above any particulates on the bottom. This is recommended to avoid low bead counts. Neat Serum samples are used. If further dilution is required, we recommend diluting samples no more than one to two in MXMSM-11 (for example, 50 µL sample and 50 µL MXMSM-11).

## Preparation of Plasma Samples

- Plasma collection using EDTA as an anti-coagulant is recommended. Centrifuge for 10 minutes at 1000 x g within 30 minutes of blood collection. Remove plasma and assay immediately or aliquot and store samples at  $\leq -20$  °C.
- Avoid multiple (> 2) freeze/thaw cycles.
- When using frozen samples, it is recommended to thaw the samples completely and mix well by vortexing.
- Plasma samples should be centrifuged at a high speed (for example, 20,000 x g for 5 minutes) to separate lipids. Take care when pipetting samples to insert the pipette tip below the lipid layer formed on the surface and above any particulates on the bottom. This is recommended to avoid low bead counts. Neat Plasma samples are used. If further dilution is required, we recommend diluting samples no more than one to two in MXMSM-11 (for example, 50  $\mu$ L sample and 50  $\mu$ L MXMSM-11).

## Preparation of Tissue Culture Supernatant

- Centrifuge the sample to remove debris and assay immediately or aliquot and store samples at  $\leq -20$  °C.
- Avoid multiple (> 2) freeze/thaw cycles.
- Tissue culture supernatant may require a dilution with an appropriate control medium prior to assay. Tissue/cell extracts should be done in neutral buffers containing reagents and conditions that do not interfere with assay performance. Excess concentrations of detergent, salt, denaturants, high or low pH, etc. will negatively affect the assay. Organic solvents should be avoided. The tissue/cell extract samples should be free of particles such as cells or tissue debris.

### NOTE:

- A maximum of 25  $\mu$ L per well of neat or one to two diluted serum or plasma can be used. Tissue culture or other media may also be used.
- All samples must be stored in polypropylene tubes. **DO NOT STORE SAMPLES IN GLASS.**
- Avoid debris, lipids and cells when using samples with gross hemolysis or lipemia.
- Care must be taken when using heparin as an anticoagulant since an excess of heparin will provide falsely high values. Use no more than 10 IU heparin per mL of blood collected.

## Preparation of Reagents for Immunoassay

### Preparation of Antibody-Immobilized Beads

- If premixed beads are used, sonicate the premixed bead bottle 30 seconds and then vortex for 1 minute before use.
- For individual vials of beads, sonicate each antibody-bead vial for 30 seconds; vortex for 1 minute. Add 60  $\mu\text{L}$  from each antibody bead vial to the Mixing Bottle and bring final volume to 3 mL with Assay Buffer. Vortex the mixed beads well. Unused portion may be stored at 2-8  $^{\circ}\text{C}$  for up to one month.  
**(Note:** Due to the composition of magnetic beads, you may notice a slight color in the bead solution. This does not affect the performance of the beads or the kit.)

Example: When using 10 cytokine antibody-immobilized beads, add 60  $\mu\text{L}$  from each of the 10 bead vials to the Mixing Bottle. Then add 2.4 mL Assay Buffer.

### Preparation of Quality Controls

Before use, reconstitute Quality Control 1 and Quality Control 2 with 250  $\mu\text{L}$  MXMSM-11. Invert the vial several times to mix and vortex. Allow the vial to sit for 5-10 minutes and then transfer the controls to appropriately labeled polypropylene microfuge tubes. Unused portion may be stored at  $\leq -20$   $^{\circ}\text{C}$  for up to one month.

For culture samples, substitute the appropriate sample media for the MXMSM-11 used for serum and plasma samples above.

### Preparation of Wash Buffer

Bring the 10X Wash Buffer to room temperature and mix to bring all salts into solution. Dilute 60 mL of 10X Wash Buffer with 540 mL deionized water. Store unused portion at 2-8  $^{\circ}\text{C}$  for up to one month.

### Preparation of Serum Matrix

#### **This step is required for serum or plasma samples only.**

Add 2.0 mL Assay Buffer to the bottle containing lyophilized Serum Matrix. Mix well. Allow at least 10 minutes for complete reconstitution. Leftover reconstituted Serum Matrix should be stored at  $\leq -20$   $^{\circ}\text{C}$  for up to one month.

### Preparation of Mouse High Sensitivity T Cell Standard

1. Prior to use, reconstitute the Mouse High Sensitivity T Cell Standard with 250  $\mu\text{L}$  MXMSM-11 to give a Standard 7. Invert the vial several times to mix. Vortex the vial for 10 seconds. Allow the vial to sit for 5-10 minutes and then transfer the standard to an appropriately labeled polypropylene microfuge tube. This will be used as the Standard 7; the unused portion may be stored at  $\leq -20$   $^{\circ}\text{C}$  for up to one month.  
For other samples (tissue culture, cell culture etc.) substitute the appropriate media for the MXMSM-11 used for serum and plasma samples above.

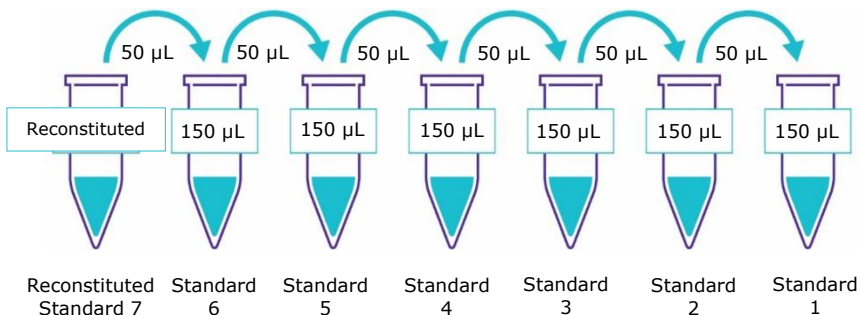
## 2. Preparation of Working Standards

Label six polypropylene microfuge tubes Standard 1, Standard 2, Standard 3, Standard 4, Standard 5 and Standard 6. Add 150  $\mu\text{L}$  of MXMSM-11 to each of the six tubes. Prepare serial dilutions by adding 50  $\mu\text{L}$  of the Standard 7 reconstituted standard to the Standard 6 tube, mix well and transfer 50  $\mu\text{L}$  of the Standard 6 to the Standard 5 tube, mix well and transfer 50  $\mu\text{L}$  of the Standard 5 to the Standard 4 tube, mix well and transfer 50  $\mu\text{L}$  of the Standard 4 to the Standard 3 tube, mix well and transfer 50  $\mu\text{L}$  of the Standard 3 to the Standard 2 tube, mix well and transfer 50  $\mu\text{L}$  of the Standard 2 to the Standard 1 tube and mix well. The 0  $\text{pg/mL}$  standard (Background) will be **MXMSM-11**.

Standard No.	Add MXMSM-11 ( $\mu\text{L}$ )	Add Standard (volume)
Standard 7	250	0

Standard No.	Add MXMSM-11( $\mu\text{L}$ )	Add Standard (volume)
Standard 6	150	50 $\mu\text{L}$ of Standard 7
Standard 5	150	50 $\mu\text{L}$ of Standard 6
Standard 4	150	50 $\mu\text{L}$ of Standard 5
Standard 3	150	50 $\mu\text{L}$ of Standard 4
Standard 2	150	50 $\mu\text{L}$ of Standard 3
Standard 1	150	50 $\mu\text{L}$ of Standard 2

### Preparation of Standards



<b>Standard</b>	<b>IL-4 (pg/mL)</b>	<b>IFN<math>\gamma</math>, IL-7 IL-17A, TNF<math>\alpha</math> (pg/mL)</b>	<b>IL-2, IL-5 IL-6 (pg/mL)</b>
Standard 1	0.098	0.488	0.977
Standard 2	0.39	1.95	3.91
Standard 3	1.56	7.81	15.6
Standard 4	6.25	31.3	62.5
Standard 5	25	125	250
Standard 6	100	500	1000
Standard 7	400	2000	4000

<b>Standard</b>	<b>KC (pg/mL)</b>	<b>IL-10 (pg/mL)</b>	<b>IL-12p70 (pg/mL)</b>	<b>LIX (pg/mL)</b>
Standard 1	0.732	1.34	2.93	3.17
Standard 2	2.93	5.37	11.7	12.7
Standard 3	11.7	21.5	46.9	50.8
Standard 4	46.9	85.9	187.5	203
Standard 5	188	343.8	750	813
Standard 6	750	1375	3000	3250
Standard 7	3000	5500	12000	13000

<b>Standard</b>	<b>IL-13 (pg/mL)</b>	<b>IL-1<math>\alpha</math>, IL-1<math>\beta</math> MCP-1 (pg/mL)</b>	<b>GM-CSF (pg/mL)</b>	<b>MIP-2 (pg/mL)</b>
Standard 1	3.42	3.91	6.1	7.32
Standard 2	13.7	15.6	24.4	29.3
Standard 3	54.7	62.5	97.7	117
Standard 4	218.8	250	391	469
Standard 5	875	1000	1563	1875
Standard 6	3500	4000	6250	7500
Standard 7	14000	16000	25000	30000

## Immunoassay Procedure

- Prior to beginning this assay, it is imperative to read this protocol completely and to thoroughly understand the Technical Guidelines.
  - Allow all reagents to warm to room temperature (20-25 °C) before use in the assay.
  - Diagram the placement of Standards [0 (Background), Standards 1 through 7], Controls 1 and 2, and Samples on Well Map Worksheet in a vertical configuration.  
(**Note:** Most instruments will only read the 96-well plate vertically by default.) It is recommended to run the assay in duplicate.
  - If using a filter plate, set the filter plate on a plate holder at all times during reagent dispensing and incubation steps so that the bottom of the plate does not touch any surface.
1. Add 200  $\mu\text{L}$  of Wash Buffer into each well of the plate. Seal and mix on a plate shaker for 10 minutes at room temperature (20-25 °C).
  2. Decant Wash Buffer and remove the residual amount from all wells by inverting the plate and tapping it smartly onto absorbent towels several times.
  3. Add 50  $\mu\text{L}$  of each Standard or Control into the appropriate wells. The **Serum Matrix** should be used for 0 pg/mL standard (Background). When assaying tissue culture or other supernatant, use proper control culture medium as the matrix solution.
  4. Add 25  $\mu\text{L}$  of Assay Buffer to the sample wells.
  5. Add 25  $\mu\text{L}$  of sample into the sample wells.
  6. Vortex Mixing Bottle and add 25  $\mu\text{L}$  of the Mixed or Premixed Beads to each well. (**Note:** During addition of Beads, shake bead bottle intermittently to avoid settling.)
  7. Seal the plate with a plate sealer. Wrap the plate with foil and incubate with agitation on a plate shaker overnight (16-18 hrs) at 2-8 °C.

Add 200  $\mu\text{L}$  Wash Buffer per well



Shake 10 min, RT  
Decant

- Add 50  $\mu\text{L}$  Standard or Control to appropriate wells
- Add 50  $\mu\text{L}$  appropriate matrix to background wells
- Add 25  $\mu\text{L}$  Assay Buffer to sample wells
- Add 25  $\mu\text{L}$  neat samples to sample wells
- Add 25  $\mu\text{L}$  Beads to each well



Incubate overnight at 2-8 °C

8. Gently remove well contents and wash plate 3 times following instructions listed in the Plate Washing section.
9. Add 25  $\mu$ L of Detection Antibodies into each well.  
(**Note:** Allow the Detection Antibodies to warm to room temperature prior to addition.)
10. Seal, cover with foil and incubate with agitation on a plate shaker for 1 hour at room temperature (20-25  $^{\circ}$ C). **DO NOT ASPIRATE AFTER INCUBATION.**
11. Add 25  $\mu$ L Streptavidin-Phycoerythrin to each well containing the 25  $\mu$ L of Detection Antibodies.
12. Seal, cover with foil and incubate with agitation on a plate shaker for 30 minutes at room temperature (20-25  $^{\circ}$ C).
13. Gently remove well contents and wash plate 3 times following instructions listed in the Plate Washing section.
14. Add 150  $\mu$ L of Sheath Fluid PLUS (or Drive Fluid PLUS if using MAGPIX<sup>®</sup>) to all wells. Resuspend the beads on a plate shaker for 5 minutes.
15. Run plate on Luminex<sup>®</sup> 200™, HTS, FLEXMAP 3D<sup>®</sup>, MAGPIX<sup>®</sup> instrument with xPONENT<sup>®</sup> software or xMAP<sup>®</sup> INTELLIFLEX instrument with INTELLIFLEX software.
16. Save and analyze the Median Fluorescent Intensity (MFI) data using a 5-parameter logistic or spline curve-fitting method for calculating analyte concentrations in samples and Controls.  
(**Note:** Because of the built-in two-fold sample dilution, for all neat samples, multiply the calculated concentrations by two. For two-fold diluted samples, multiply the calculated concentrations by four. Calculated Quality Control concentrations do not require multiplication by a dilution factor.)



Remove well contents and wash 3X with 200  $\mu$ L Wash Buffer



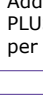
Add 25  $\mu$ L Detection Antibodies per well



Incubate 1 hour at RT  
Do Not Aspirate



Add 25  $\mu$ L Streptavidin-Phycoerythrin per well



Incubate for 30 minutes at RT



Remove well contents and wash 3X with 200  $\mu$ L Wash Buffer



Add 150  $\mu$ L Sheath Fluid PLUS or Drive Fluid PLUS per well



Read on Luminex<sup>®</sup> (100  $\mu$ L, 50 beads per bead set)

## Plate Washing

### Solid Plate

If using a solid plate, use either a handheld magnet or magnetic plate washer.

- Handheld magnet (Cat. No. 40-285)  
Rest plate on magnet for 60 seconds to allow complete settling of magnetic beads. Remove well contents by gently decanting the plate in an appropriate waste receptacle and gently tapping on absorbent pads to remove residual liquid. Wash plate with 200  $\mu\text{L}$  of Wash Buffer by removing plate from magnet, adding Wash Buffer, shaking for 30 seconds, reattaching to magnet, letting beads settle for 60 seconds and removing well contents as previously described after each wash. Repeat wash steps as recommended in Assay Procedure.
- Magnetic plate washer (Cat. No. 40-094, 40-095, 40-096 and 40-097)  
Please refer to specific automatic plate washer manual for appropriate equipment settings. Please note that after the final aspiration, there will be approximately 25  $\mu\text{L}$  of residual wash buffer in each well. This is expected when using the BioTek<sup>®</sup> plate washer and this volume does not need to be aspirated from the plate.

If using an automatic plate washer other than BioTek<sup>®</sup> 405 LS or 405 TS, please refer to the manufacturer's recommendations for programming instructions.

### Filter Plate (Cat. No. MX-PLATE)

If using a filter plate, use a vacuum filtration manifold to remove well contents. Wash plate with 200  $\mu\text{L}$ /well of Wash Buffer, removing Wash Buffer by vacuum filtration after each wash. Repeat wash steps as recommended in the Assay Procedure.

## Equipment Settings

Luminex<sup>®</sup> 200™, HTS, FLEXMAP 3D<sup>®</sup>, MAGPIX<sup>®</sup> with xPONENT<sup>®</sup> software and xMAP<sup>®</sup> INTELLIFLEX with INTELLIFLEX software:

These specifications are for the above listed instruments and software. Luminex<sup>®</sup> instruments with other software (for example, MasterPlex<sup>®</sup>, StarStation, LiquiChip, Bio-Plex<sup>®</sup> Manager™, LABScan™100) would need to follow instrument instructions for gate settings and additional specifications from the vendors for reading Luminex<sup>®</sup> magnetic beads.

For magnetic bead assays, each instrument must be calibrated and performance verified with the indicated calibration and verification kits.



<b>Instrument</b>	<b>Calibration Kit</b>	<b>Verification Kit</b>
Luminex® 200™ and HTS	xPONENT® 3.1 compatible Calibration Kit (Cat. No. LX2R-CAL-K25)	Performance Verification Kit (Cat. No. LX2R-PVER-K25)
FLEXMAP 3D®	FLEXMAP 3D® Calibrator Kit (Cat. No. F3D-CAL-K25)	FLEXMAP 3D® Performance Verification Kit (Cat. No. F3D-PVER-K25)
xMAP® INTELLIFLEX	xMAP® INTELLIFLEX Calibration Kit (Cat. No. IFX-CAL-K20)	xMAP® INTELLIFLEX Performance Verification Kit (Cat. No. IFX-PVER-K20)
MAGPIX®	MAGPIX® Calibration Kit (Cat. No. MPX-CAL-K25)	MAGPIX® Performance Verification Kit (Cat. No. MPX-PVER-K25)

**NOTE:** When setting up a Protocol using the xPONENT® software, you must select MagPlex® as the Bead Type in the Acquisition settings.

**NOTE:** These assays cannot be run on any instruments using Luminex® IS 2.3 or Luminex® 1.7 software.

The Luminex® probe height must be adjusted to the plate provided in the kit. Please use Cat. No. MAG-PLATE, if additional plates are required for this purpose.

Events	50, per bead
Sample Size	100 $\mu$ L
Gate Settings	8,000 to 15,000
Reporter Gain	Default (low PMT)
Time Out	60 seconds
Bead Set	Customizable 18-Plex Beads
	<hr/>
	GM-CSF 15
	IFN $\gamma$ 19
	IL-1 $\alpha$ 21
	IL-1 $\beta$ 25
	IL-2 26
	IL-4 28
	IL-5 30
	IL-6 34
	IL-7 36
	IL-10 43
	IL-12 (p70) 47
	IL-13 52
	LIX 53
	IL-17A 56
	KC 61
	MCP-1 62
	MIP-2 73
	TNF $\alpha$ 77

## Quality Controls

The ranges for each analyte in Quality Control 1 and 2 are provided on the card insert or can be located at our website [SiamaAldrich.com](http://SiamaAldrich.com) using the catalogue number as the keyword.

## Assay Characteristics

### Cross-Reactivity

There was no or negligible cross-reactivity between the antibodies for an analyte and any of the other analytes in this panel, except MIP-2 cross-reacts with LIX beads ~ 25%.

### Assay Sensitivities (minimum detectable concentrations, pg/mL)

Minimum Detectable Concentration (MinDC) is calculated using MILLIPLEX® Analyst 5.1. It measures the true limits of detection for an assay by mathematically determining what the empirical MinDC would be if an infinite number of standard concentrations were run for the assay under the same conditions.

Cytokine	Overnight Protocol (n = 9 Assays)	
	MinDC (pg/mL)	MinDC+2SD (pg/mL)
GM-CSF	5.33	7.27
IFN $\gamma$	0.15	0.26
IL-1 $\alpha$	1.54	3.12
IL-1 $\beta$	2.58	4.68
IL-2	0.80	1.34
IL-4	0.06	0.12
IL-5	0.53	1.00
IL-6	0.54	1.26
IL-7	0.98	2.48
IL-10	0.53	1.10
IL-12 (p70)	1.29	2.82
IL-13	3.76	6.16
LIX	2.70	6.26
IL-17A	0.18	0.38
KC	0.45	0.91
MCP-1	3.00	6.20
MIP-2	9.06	11.14
TNF $\alpha$	0.41	0.76

## Precision

Intra-assay precision is generated from the mean of the %CV's from 8 reportable results across two different concentrations of cytokines in a single assay. Inter-assay precision is generated from the mean of the %CV's across two different concentrations of cytokines across 8 different assays.

Cytokine	Overnight Protocol	
	Intra-assay %CV	Inter-assay %CV
GM-CSF	< 10%	< 10%
IFN $\gamma$	< 10%	< 10%
IL-1 $\alpha$	< 10%	< 10%
IL-1 $\beta$	< 10%	< 10%
IL-2	< 10%	< 10%
IL-4	< 10%	< 10%
IL-5	< 10%	< 10%
IL-6	< 10%	< 10%
IL-7	< 10%	< 10%
IL-10	< 10%	< 10%
IL-12 (p70)	< 10%	< 10%
IL-13	< 10%	< 10%
LIX	< 10%	< 10%
IL-17A	< 10%	< 10%
KC	< 10%	< 10%
MCP-1	< 10%	< 10%
MIP-2	< 10%	< 10%
TNF $\alpha$	< 10%	< 10%

## Accuracy

Spike Recovery: The data represent mean percent recovery of spiked standards ranging from low, medium, and high concentration in serum matrix (n=3).

<b>Cytokine</b>	<b>Overnight Protocol % Recovery in Serum Matrix</b>
GM-CSF	102
IFN $\gamma$	97
IL-1 $\alpha$	94
IL-1 $\beta$	101
IL-2	89
IL-4	90
IL-5	85
IL-6	85
IL-7	95
IL-10	95
IL-12 (p70)	91
IL-13	102
LIX	95
IL-17A	91
KC	82
MCP-1	94
MIP-2	99
TNF $\alpha$	93

## Troubleshooting

<b>Problem</b>	<b>Probable Cause</b>	<b>Solution</b>
Insufficient bead count	Plate washer aspirate height set too low	Adjust aspiration height according to manufacturers' instructions.
	Bead mix prepared inappropriately	Sonicate bead vials and vortex just prior to adding to bead mix bottle according to protocol. Agitate bead mix intermittently in reservoir while pipetting this into the plate.
	Samples cause interference due to particulate matter or viscosity	See above. Also sample probe may need to be cleaned with alcohol flushes, back flushes and washes; or if needed, probe should be removed and sonicated.
	Probe height not adjusted correctly	When reading the assay on the Luminex® 200™ instrument, adjust probe height according to the protocols recommended by Luminex® to the kit solid plate using 3 alignment discs. When reading the assay on the MAGPIX® instrument, adjust probe height to the kit solid plate or to the recommended filter plates using 2 alignment discs. When reading the assay on the FLEXMAP 3D® instrument, adjust probe height to the kit solid plate using 1 alignment disc. For the FLEXMAP 3D® instrument, when using the solid plate in the kit, the final resuspension should be with 150 µL Sheath Fluid PLUS in each well and 75 µL should be aspirated. When reading the assay on the xMAP® INTELLIFLEX instrument, adjust probe height based on the type of plate you are using, place an alignment disk or an alignment sphere in the well according to the protocol recommended by Luminex®.
Background is too high	Background wells were contaminated	Avoid cross-well contamination by using sealer appropriately and pipetting with multichannel pipettes without touching reagent in plate.
	Matrix used has endogenous analyte or interference	Check matrix ingredients for cross reacting components (for example, interleukin modified tissue culture medium).
	Insufficient washes	Increase number of washes.

<b>Problem</b>	<b>Probable Cause</b>	<b>Solution</b>
Beads not in region or gate	Luminex® instrument not calibrated correctly or recently	Calibrate Luminex® instrument based on manufacturer's instructions, at least once a week or if temperature has changed by > 3 °C.
	Gate settings not adjusted correctly	Some Luminex® instruments (for example, Bio-Plex®) require different gate settings than those described in the kit protocol. Use instrument default settings.
	Wrong bead regions in protocol template	Check kit protocol for correct bead regions or analyte selection.
	Incorrect sample type used	Samples containing organic solvents or if highly viscous should be diluted or dialyzed as required.
	Instrument not washed or primed	Prime the Luminex® instrument 4 times to rid it of air bubbles, wash 4 times with sheath fluid or water if there is any remnant alcohol or sanitizing liquid.
Signal for whole plate is same as background	Incorrect or no Detection Antibody was added	Add appropriate Detection Antibody and continue.
	Streptavidin-Phycoerythrin was not added	Add Streptavidin-Phycoerythrin according to protocol. If Detection Antibody has already been removed, sensitivity may be low.
Low signal for standard curve	Detection Antibody may have been removed prior to adding Streptavidin-Phycoerythrin	May need to repeat assay if desired sensitivity not achieved.
	Incubations done at inappropriate temperatures, timings or agitation	Assay conditions need to be checked.
Signals too high, standard curves are saturated	Calibration target value set too high	With some Luminex® instruments (for example, Bio-Plex®) default target setting for RP1 calibrator is set at high PMT. Use low target value for calibration and reanalyze plate.
	Plate incubation was too long with standard curve and samples	Use shorter incubation time.

<b>Problem</b>	<b>Probable Cause</b>	<b>Solution</b>
Sample readings are out of range	Samples contain no or below detectable levels of analyte	If below detectable levels, it may be possible to use higher sample volume. Check with technical support for appropriate protocol modifications.
	Samples contain analyte concentrations higher than highest standard point.	Samples may require dilution and reanalysis for just that particular analyte.
	Standard curve was saturated at higher end of curve	See above.
High variation in samples and/or standards	Multichannel pipette may not be calibrated	Calibrate pipettes.
	Plate washing was not uniform	Confirm all reagents are removed completely in all wash steps.
	Samples may have high particulate matter or other interfering substances	See above.
	Plate agitation was insufficient	Plate should be agitated during all incubation steps using an orbital plate shaker at a speed where beads are in constant motion without causing splashing.
	Cross-well contamination	Check when reusing plate sealer that no reagent has touched sealer. Care should be taken when using same pipette tips that are used for reagent additions and that pipette tip does not touch reagent in plate.



## FOR FILTER PLATES ONLY

<b>Problem</b>	<b>Probable Cause</b>	<b>Solution</b>
Filter plate will not vacuum	Vacuum pressure is insufficient	Increase vacuum pressure such that 0.2 mL buffer can be suctioned in 3-5 seconds.
	Samples have insoluble particles	Centrifuge samples just prior to assay setup and use supernatant.
	High lipid concentration	After centrifugation, remove lipid layer and use supernatant.
Plate leaked	Vacuum pressure too high	Adjust vacuum pressure such that 0.2 mL buffer can be suctioned in 3-5 seconds. May need to transfer contents to a new (blocked) plate and continue.
	Plate set directly on table or absorbent towels during incubations or reagent additions	Set plate on plate holder or raised edge so bottom of filter is not touching any surface.
	Insufficient blotting of filter plate bottom causing wicking	Blot the bottom of the filter plate well with absorbent towels after each wash step.
	Pipette touching plate filter during additions	Pipette to the side of plate.
	Probe height not adjusted correctly	Adjust probe to 3 alignment discs in well H6.
	Sample too viscous	May need to dilute sample.

## Product Ordering

<b>Replacement Reagents</b>	<b>Cat. No.</b>
Mouse High Sensitivity T Cell Standard	MHSTC-8070
Mouse High Sensitivity T Cell Quality Controls	MHSTC-6070
Serum Matrix	MXMSM-11
Mouse High Sensitivity T Cell Detection Antibodies	MHSTC-1070
Streptavidin-Phycoerythrin	MC-SAPE10
Assay Buffer	L-AB
Set of two 96-Well plates with sealers	MAG-PLATE
10X Wash Buffer	L-WB
Mouse High Sensitivity T Cell 18 Plex Premixed Magnetic Bead Kit – BULK PACKAGED	MHSTCMAG-70KPXBK

### Antibody-Immobilized Magnetic Beads

<b>Cytokine</b>	<b>Bead No.</b>	<b>Cat No.</b>
GM-CSF	15	MGMCSF-MAG
IFN $\gamma$	19	MIFNG-MAG
IL-1 $\alpha$	21	MIL1A-MAG
IL-1 $\beta$	25	MIL1B-MAG
IL-2	26	MIL2-MAG
IL-4	28	MIL4-MAG
IL-5	30	MIL5-MAG
IL-6	34	MCYIL6-MAG
IL-7	36	MIL7-MAG
IL-10	43	MIL10-MAG
IL-12 (p70)	47	MIL12P70-MAG
IL-13	52	MIL13-MAG
LIX	53	MLIX-MAG
IL-17A	56	MIL17-MAG
KC	61	MKC-MAG
MCP-1	62	MCYMCP1-MAG
MIP-2	73	MMIP2-MAG
TNF $\alpha$	77	MCYTNFA-MAG
Premixed 18-plex Beads	-	MHSTCPMX18-MAG

## Well Map

	1	2	3	4	5	6	7	8	9	10	11	12
A	0 pg/mL Standard (Background)	Standard 4	QC-1 Control	Etc.								
B	0 pg/mL Standard (Background)	Standard 4	QC-1 Control									
C	Standard 1	Standard 5	QC-2 Control									
D	Standard 1	Standard 5	QC-2 Control									
E	Standard 2	Standard 6	Sample 1									
F	Standard 2	Standard 6	Sample 1									
G	Standard 3	Standard 7	Sample 2									
H	Standard 3	Standard 7	Sample 2									

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## Contact Information

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