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Enabling Legendary Discovery™

# LEGENDplex™

## Multi-Analyte Flow Assay Kit

**Cat. No. 740999**

**Human Acute Phase Panel 1 (8-plex) with Filter Plate**

**Cat. No. 741000**

**Human Acute Phase Panel 1 (8-plex) with V-Bottom Plate**

**Please read the entire manual before running the assay.**

BioLegend.com

***It is highly recommended that this manual be read in its entirety before using this product. Do not use this kit beyond the expiration date.***

*For Research Purposes Only. Not for use in diagnostic or therapeutic procedures. Purchase does not include or carry the right to resell or transfer this product either as a stand-alone product or as a component of another product. Any use of this product other than the permitted use without the express written authorization of BioLegend is strictly prohibited.*

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# Chapter 1: KIT DESCRIPTION

## Introduction

The acute phase response is a complex systemic reaction triggered by the onset of various critical conditions including trauma, infection, tissue damage, inflammation, stress, or neoplasia. The most important change of this response is the highly increased production of a large family of proteins from the liver, collectively known as acute phase proteins. Considered as a part of innate immunity, acute phase proteins are responsible for many systemic effects such as anti-protease activities, leukocytosis, complement cascade, increased cortisol, and many others. Measuring and monitoring acute phase proteins provide research value in understanding the mechanisms, therapeutics, and prognosis of many diseases.

The LEGENDplex™ Human Acute Phase Panel 1 (8-plex) contains fluorescence-encoded beads suitable for use on common flow cytometers. It allows for the simultaneous quantification of 8 key acute phase molecules including α2-microglobulin, α1-Acid Glycoprotein (α1-AGP), Haptoglobin, α1-antitrypsin, Ceruloplasmin, Fibrinogen, Prothrombin, and Serum Amyloid P Component (SAP). This assay panel provides higher detection sensitivity and broader dynamic range than traditional ELISA methods. The panel has been validated for use on cell culture supernatant, serum, and plasma samples.

The Human Acute Phase Panel 1 is designed to allow flexible customization within the panel. Please visit **www.biolegend.com/legendplex** for more information on panel design and how to mix and match within the panel.

This assay is for research use only

## Principle of the Assay

BioLegend's LEGENDplex™ assays are bead-based immunoassays that use the same basic principle as sandwich immunoassays.

Beads are differentiated by size and internal fluorescence intensities. The surface of each bead set is first conjugated with specific antibodies, and then used as capture beads for that particular analyte. When a selected panel of capture beads are mixed and incubated with a sample containing target analytes, each analyte will bind to its specific capture beads. After washing, a biotinylated detection antibody cocktail is added, and each detection antibody in the cocktail will bind to its specific analyte bound on the capture beads, thus forming capture bead-analyte-detection antibody sandwiches. Streptavidin-phycoerythrin (SA-PE) is subsequently added, which will bind to the biotinylated detection antibodies, providing fluorescent signal intensities in proportion to the amount of bound analytes.

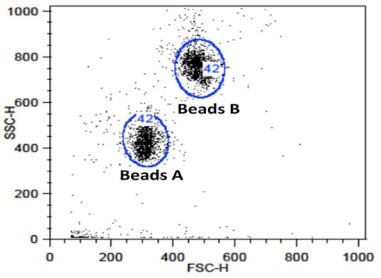
Since the beads are differentiated by size and internal fluorescence intensity on a flow cytometer, analyte-specific populations can be segregated and PE fluorescent signal quantified. The concentration of a particular analyte is determined using a standard curve generated in the same assay.

## Beads Usage

The Human Acute Phase Panel 1 uses two sets of beads. Each set has a unique size that can be identified based on their forward scatter (FSC) and side scatter (SSC) profiles (Beads A and Beads B, Figure 1). Each bead set can be further resolved based on their internal fluorescence intensities. The internal dye can be detected using either the FL3, FL4, or APC channels, depending on the type of flow cytometer used. The smaller A Beads consists of 6 bead populations and the larger B Beads consists of 7 bead populations (Figure 2-3). Four Populations of each set of beads are used for this panel (indicated as Beads ID in Table 1).

Using a total of 8 bead populations distinguished by size and internal fluorescent dye, the Human Acute Phase Panel 1 allows simultaneous detection of 8 proteins in a single sample. Each analyte is associated with a particular bead set as indicated (Figures 2-3 and Table 1).

**Figure 1. Beads Differentiated by Size**




Beads A = smaller beads

Beads B = larger beads

**Figure 2. Beads A Classification by FL4**

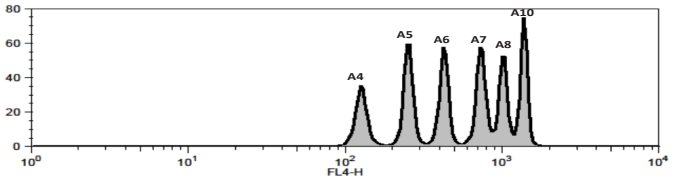
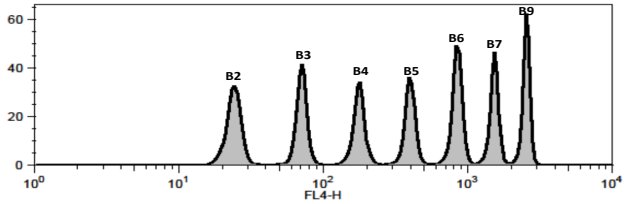


**Figure 3. Beads B Classification by FL4**




For Beads usage in the full panel, please refer to Table 1 below.

**Table 1. Panel Targets and Bead ID***

| Target | Bead ID | Top Standard Concentrations |
|---|---|---|
| α2-macroglobulin | **A4** | The top standard concentration of each target may vary and may subject to change from lot to lot. Please refer to the lot-specific Certificate of Analysis for this information. |
| α1-AGP | **A5** | |
| Haptoglobin | **A7** | |
| α1-antitrypsin | **A10** | |
| Ceruloplasmin | **B3** | |
| Fibrinogen | **B4** | |
| Prothrombin | **B5** | |
| SAP | **B7** | |

*Bead ID is used to associate a bead population to a particular analyte in the LEGENDplex™ Data Analysis Software. The association of analyte and bead ID will be defined during the gating step of the data analysis.

**When entering analyte and bead ID infomation during the gating step, always enter in the sequential order of the bead ID (e.g, A4, A5...B3, B4...).** Please refer to the LEGENDplex™ Data Analysis Software User Guide and Online Help for details (**www.biolegend.com/legendplex**).

## Storage Information

Recommended storage for all original kit components is between 2°C and 8°C. DO NOT FREEZE Pre-mixed Beads, Detection Antibodies or SA-PE.

- Once the standards have been sufficiently reconstituted, immediately transfer contents into polypropylene vials. DO NOT STORE RECONSTITUTED STANDARDS IN GLASS VIALS.
- Upon reconstitution, leftover top standard should be stored at ≤-70°C for use within one month. Avoid multiple (>2) freeze-thaw cycles. Discard any leftover diluted standards.

## Materials Supplied

The LEGENDplex™ kit contains reagents for 100 tests, listed in the table below. When assayed in duplicate, this is enough for an 8-point standard curve and 40 samples.

| Kit Components | Quantity | Volume | Part # |
|---|---|---|---|
| Setup Beads 1: FITC Beads | 1 vial | 1 mL | 77840 |
| Setup Beads 2: PE Beads | 1 vial | 1 mL | 77842 |
| Setup Beads 3: Raw Beads | 1 vial | 2 mL | 77844 |
| Human Acute Phase Panel 1 Premixed Beads | 1 bottle | 3.5 mL | 750000667 |
| Human Acute Phase Panel 1 Detection Antibodies | 1 bottle | 3.5 mL | 750000668 |
| Human Acute Phase Panel 1 Standard | 1 vial | Lyophilized | 750000666 |
| Lyophilized Standard Reconstitution Buffer | 1 vial | 1 mL | 75241 |
| LEGENDplex™ SA-PE | 1 bottle | 3.5 mL | 77743 |
| LEGENDplex™ Assay Buffer | 3 bottles | 75 mL | 77562 |
| LEGENDplex™ Wash Buffer, 20X | 1 bottle | 25 mL | 77564 |
| Filter Plate* or V-bottom Plate** | 1 plate | -- | 76187* or 76883** |
| Plate Sealers | 4 sheets | -- | 78101 |
| Data Analysis Software Dongle | 1 | -- | 21217 |
| Human Acute Phase Panel 1 Manual | 1 | -- | 750000669 |

* For kit with filter plate. ** For kit with V-bottom plate. Only one plate is provided for each kit.

## Materials to be Provided by the End-User

- A flow cytometer equipped with two lasers (e.g., a 488 nm blue laser or 532 nm green laser and a 633-635 nm red laser) capable of distinguishing 575 nm and 660 nm or a flow cytometer equipped with one laser (e.g., 488 nm blue laser) capable of distinguishing 575 nm and 670 nm.

**Partial list of compatible flow cytometers:**

| Flow Cytometer | Reporter Channel | Reporter Emission | Classification Channel | Channel Emission | Compensation needed? |
|---|---|---|---|---|---|
| BD FACSCalibur™ | FL2 | 575 nm | FL4 | 660 nm | No* |
| BD Accuri™ C6 | FL2 | 585 nm | FL4 | 675 nm | No* |
| BD FACSCanto™, BD FACSCanto™ II | PE | 575 nm | APC | 660 nm | No* |
| BD™ LSR, LSR II BD LSRFortessa™ | PE | 575 nm | APC | 660 nm | No* |
| Gallios™ | PE | 575 nm | APC | 660 nm | No* |
| CytoFLEX | PE | 585 nm | APC | 660 nm | No* |
| NovoCyte | PE | 572 nm | APC | 660 nm | No* |
| Attune™ NxT | PE | 574 nm | APC | 670 nm | No* |

***Compensation is not required for the specified flow cytometers when set up properly.**

For setting up various flow cytometers, please visit: **www.biolegend.com/legendplex** and click on the **Instrument Setup** tab.

- Multichannel pipettes capable of dispensing 5 µL to 200 µL
- Reagent reservoirs for multichannel pipette
- Polypropylene microfuge tubes (1.5 mL)
- Micro FACS tubes, 1.1 mL (if the flow cytometer does not contain an autosampler)
- Laboratory vortex mixer
- Sonicator bath (e.g., Branson Ultrasonic Cleaner model #B200, or equivalent)
- Aluminum foil
- Absorbent pads or paper towels
- Plate shaker (e.g., Lab-Line Instruments model #4625, or equivalent)
- Tabletop centrifuges (e.g., Eppendorf centrifuge 5415 C, or equivalent)

**If the assay is performed in a filter plate:**

- A vacuum filtration unit (Millipore MultiScreen ® HTS Vacuum Manifold, cat # MSVMHTS00 or equivalent). Instructions on how to use the vacuum manifold can be found at the supplier's website.
- A vacuum source (mini vacuum pump or line vacuum, e.g., Millipore Vacuum Pump, catalog # WP6111560, or equivalent)
- If needed, additional Filter plates can be ordered from BioLegend (Cat# 740377 or 740378).

**If the assay is performed in a V-bottom plate:**

- Centrifuge with a swinging bucket adaptor for microtiter plates (e.g., Beckman Coulter Allegra™ 6R Centrifuge with MICROPLUS CARRIER adaptor for GH3.8 and JS4.3 Rotors) .
- If needed, additional V-bottom plates can be ordered from BioLegend (Cat# 740379).

## Precautions

- All blood components and biological materials should be handled as potentially hazardous. Follow universal precautions as established by the Center for Disease Control and Prevention and by the Occupational Safety and Health Administration when handling and disposing of infectious agents.
- Sodium azide has been added to some reagents as a preservative. Although the concentrations are low, sodium azide may react with lead and copper plumbing to form highly explosive metal azides. On disposal, flush with a large volume of water to prevent azide build-up.
- Do not mix or substitute reagents from different kits or lots. Reagents from different manufacturers should not be used with this kit.
- Do not use this kit beyond its expiration date.
- SA-PE and beads are light-sensitive. Minimize light exposure.

# Chapter 2: ASSAY PREPARATION

## Sample Collection and Handling

**Preparation of Serum Samples:**

- Allow the blood to clot for at least 30 minutes and centrifuge for 20 minutes at 1,000 x *g*.
- Remove serum and assay immediately or aliquot and store samples at

≤-20°C. Avoid multiple (>2) freeze/thaw cycles.

- When using frozen samples, it is recommended that samples be thawed completely, mixed and centrifuged to remove particulates prior to use.

**Preparation of Plasma Samples:**

- Plasma collection should be collected using an anti-coagulant (e.g., EDTA, Heparin, Citrate). Centrifuge for 20 minutes at 1,000 x *g* within 30 minutes of blood collection.
- Remove plasma and assay immediately, or aliquot and store samples at ≤-20°C. Avoid multiple (>2) freeze/thaw cycles.
- When using frozen samples, it is recommended that samples be thawed completely, mixed well and centrifuged to remove particulates.

**Preparation of Cell Culture Supernatant:**

- Centrifuge the sample to remove debris and assay immediately. If not possible, aliquot and store samples at ≤-20°C. Avoid multiple (>2) freeze/thaw cycles.

## Reagent Preparation

**Preparation of Antibody-Immobilized Beads**

Sonicate pre-mixed Beads bottle for 1 minute in a sonicator bath and then vortex for 30 seconds prior to use. If no sonicator bath is available, increase the vortexing time to 1 minute to completely resuspend the beads.

**Preparation of Wash Buffer**

- Bring the 20X Wash Buffer to room temperature and mix to bring all salts into solution.
- Dilute 25 mL of 20X Wash Buffer with 475 mL deionized water. Store unused portions between 2°C and 8°C for up to one month.

## Standard Preparation

1. Prior to use, reconstitute the lyophilized Human Acute Phase Panel 1 Standard with 250 µL Lyophilized Standard Reconstitution Buffer

2. Mix and allow the vial to sit at room temperature for 15 minutes, and then transfer the standard to an appropriately labeled polypropylene microcentrifuge tube. This will be used as the top standard C7.

**Note: The top standard concentrations of analytes in this panel were set**

**at various concentrations, but may be subject to change from lot to lot (see lot-specific Certificate of Analysis provided in the kit box for details).**

3. Label 6 polypropylene microcentrifuge tubes as C6, C5, C4, C3, C2 and C1, respectively.

4. Add 75 µL of Assay Buffer to each of the six tubes. Prepare 1:4 dilution of the top standard by transferring 25 µL of the top standard C7 to the C6 tube and mix well. This will be the C6 standard.

5. In the same manner, perform serial 1:4 dilutions to obtain C5, C4, C3, C2 and C1 standards (**see the table below using the top standard at 10,000 pg/mL as an example**). Assay Buffer will be used as the 0 pg/mL standard (C0).

| Tube/Standard ID | Serial Dilution | Assay Buffer to add (µL) | Standard to add | Final Conc. (pg/mL) |
|---|---|---|---|---|
| C7 | -- | -- | -- | 10,000 |
| C6 | 1:4 | 75 | 25 µL of C7 | 2,500 |
| C5 | 1:16 | 75 | 25 µL of C6 | 625 |
| C4 | 1:64 | 75 | 25 µL of C5 | 156.25 |
| C3 | 1:256 | 75 | 25 µL of C4 | 39.01 |
| C2 | 1:1024 | 75 | 25 µL of C3 | 9.77 |
| C1 | 1:4096 | 75 | 25 µL of C2 | 2.44 |
| C0 | -- | 75 | -- | 0 |

## Sample Dilution

- Serum or plasma samples must be diluted 20,000-fold with Assay Buffer as described in the tabel below.

| Sample | 1st Diluton (1:200) | 2nd Dilution (1 : 100) | Final Dilution Fold |
|---|---|---|---|
| Serum, plasma | 2 µL + 398 µL Assay Buffer | 2 µL 1st Dilution + 198 µL Assay Buffer | 20,000 |

- **Adding serum or plasma samples without dilution will result in low assay accuracy and possibly, clogging of the filter plate.**

- For cell culture supernatant samples, the levels of analyte can vary greatly from sample to sample. To test cell culture supernatant samples, a preliminary experiment may be required to determine the appropriate dilution

factor. If further dilution is desired, dilution should be done with corresponding fresh cell culture medium or Assay Buffer as a diluent to ensure accurate measurement.

# Chapter 3: ASSAY PROCEDURE

The LEGENDplex™ assay can be performed in a filter plate, or in a V-bottom plate.

## Performing the Assay Using a Filter Plate

- Allow all reagents to warm to room temperature (20-25°C) before use.
- Set the filter plate on an inverted plate cover at all times during assay setup and incubation steps, so that the bottom of the plate does not touch any surface. Touching a surface may cause leakage.
- Keep the plate upright during the entire assay procedure, including the washing steps, to avoid losing beads.
- The plate should be placed in the dark or wrapped with aluminum foil for all incubation steps.
- **Standards and samples should be run in duplicate and arranged on the plate in a vertical configuration convenient for data acquisition and analysis (as shown in attached PLATE MAP, page 29). Be sure to load standards in the first two columns. If an automation device is used for reading, the orientation and reading sequence should be carefully planned.**

1. Pre-wet the plate by adding 100 µL of LEGENDplex™ 1X Wash Buffer to each well and let it sit for 1 minute at room temperature. To remove the excess volume, place the plate on the vacuum manifold and apply vacuum. Do not exceed 10" Hg of vacuum. Vacuum until wells are drained (5-10 seconds). Blot excess Wash Buffer from the bottom of the plate by pressing the plate on a stack of clean paper towels. Place the plate on top of the inverted plate cover.

2. Load the plate as shown in the table below (in the order from left to right) **For measuring cell culture supernatant samples:**

| | Cell Culture Medium or Assay Buffer | Standard | Sample* |
|---|---|---|---|
| Standard Wells | 25 µL | 25 µL | -- |
| Sample wells | 25 µL | -- | 25 µL |

**For measuring serum or plasma samples:**

| | Assay Buffer | Standard | Sample* |
|---|---|---|---|
| Standard Wells | 25 µL | 25 µL | --- |
| Sample wells | 25 µL | --- | 25 µL |

*See **Sample Dilution on page 10**

3. Vortex mixed beads bottle for 30 seconds. Add 25 µL of mixed beads to each well. The volume should be 75 µL in each well after beads addition. (Note: During addition of the beads, shake mixed beads bottle intermittently to avoid bead settling).

4. Seal the plate with a plate sealer. **To avoid plate leaking, do not apply positive pressure to the sealer when sealing the plate**. Wrap the entire plate, including the inverted plate cover, with aluminum foil. Place the plate on a plate shaker, secure it with a rubber band and shake at approximate 500 rpm for 2 hours at room temperature.

**5.** **Do not invert the plate**! Place the plate on the vacuum manifold and apply vacuum as before in Step 1. Add 200 µL of 1X Wash Buffer to each well. Remove Wash Buffer by vacuum filtration. Blot excess Wash Buffer from the bottom of the plate with an absorbent pad or paper towels. Repeat this washing step once more.

6. Add 25 µL of Detection Antibodies to each well.

7. Seal the plate with a fresh plate sealer. Wrap the entire plate, including the inverted plate cover, with aluminum foil. Place the plate on a plate shaker and shake at approximately 500 rpm for 1 hour at room temperature.

**8.** **Do not vacuum!** Add 25 µL of SA-PE to each well directly.

9. Seal the plate with a fresh plate sealer. Wrap the entire plate, including the inverted plate cover, with aluminum foil. Place the plate on a plate shaker and shake at approximate 500 rpm for 30 minutes at room temperature.

10. Repeat step 5 above.

11. Add 150 µL of 1X Wash Buffer to each well. Resuspend the beads on a plate shaker for 1 minute.

12. Read samples on a flow cytometer, preferably within the same day of the assay (Note: Prolonged sample storage can lead to reduced signal).

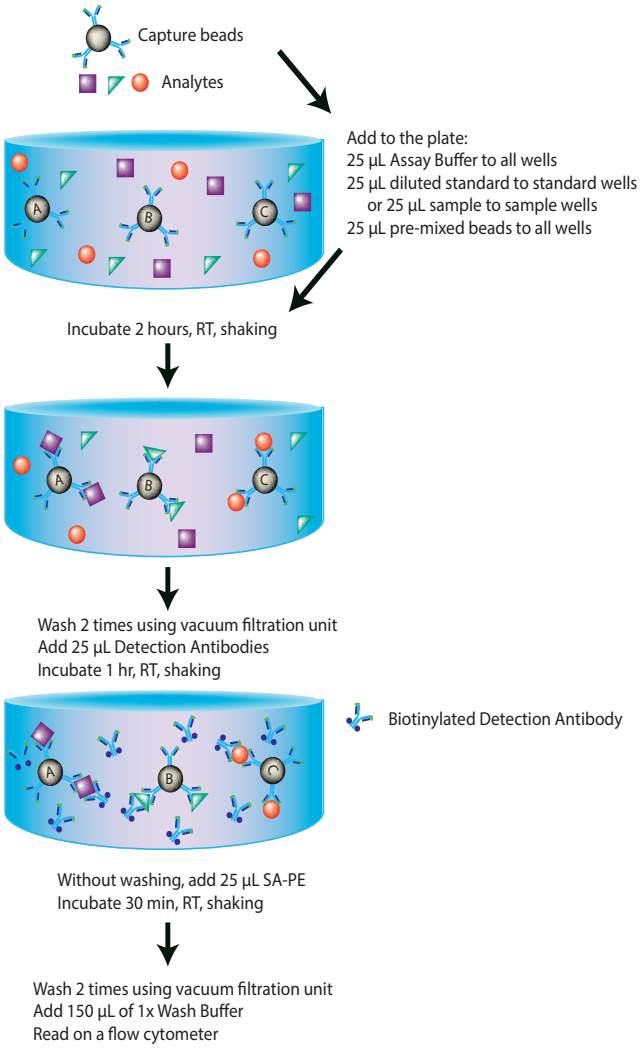
    If the flow cytometer is equipped with an autosampler, read the plate directly using the autosampler. **Please be sure to program the autosampler to resuspend beads in the well immediately before taking samples. The**

**probe height may need to be adjusted when using an autosampler**.

If an autosampler is not available, the samples can be transferred from the filter plate to micro FACS (or FACS) tubes and read manually.

**Assay Procedure Summary for Filter Plate**

Add 100 µL 1X Wash Buffer to filter plate wells
Vacuum to remove excess buffer



## Performing the Assay Using a V-bottom Plate

- Allow all reagents to warm to room temperature (20-25°C) before use.
- Keep the plate upright during the entire assay procedure, including the washing steps, to avoid losing beads.
- The plate should be placed in the dark or wrapped with aluminum foil for all incubation steps.
- Standards and samples should be run in duplicate and arranged on the plate in a vertical configuration convenient for data acquisition and analysis (as shown in attached PLATE MAP, page 29). Be sure to load standards in the first two columns. If an automation device is used for reading, the orientation and reading sequence should be carefully planned.

1. load the plate as shown in the table below (in the order from left to right)
**For measuring cell culture supernatant samples:**

| | Cell Culture Medium or Assay Buffer | Standard | Sample* |
|---|---|---|---|
| Standard Wells | 25 µL | 25 µL | -- |
| Sample wells | 25 µL | -- | 25 µL |

**For measuring serum or plasma samples**:

| | Assay Buffer | Standard | Sample* |
|---|---|---|---|
| Standard Wells | 25 µL | 25 µL | --- |
| Sample wells | 25 µL | --- | 25 µL |

*See **Sample Dilution on page 10**

2. Vortex mixed beads for 30 seconds. Add 25 µL of mixed beads to each well. The total volume should be 75 µL in each well after beads addition. (Note: During beads addition, shake mixed beads bottle intermittently to avoid bead settling).

3. Seal the plate with a plate sealer. Cover the entire plate with aluminum foil to protect the plate from light. Shake at 800 rpm on a plate shaker for 2 hours at room temperature **(Depending on the shaker, the speed may need to be adjusted. The optimal speed is one that is high enough to keep beads in suspension during incubation, but not too high that it may cause sample to spill from the wells)**.

4. Centrifuge the plate at 1050 rpm (~250 g) for 5 minutes, using a swinging bucket rotor (G.H 3.8) with microplate adaptor (Please refer to **Materials to be Provided by the End-User, page 7).** Do not use excessive centrifugation speed as it may make it harder to resuspend beads in later steps. **Make sure the timer of the centrifuge works properly and standby to make sure the centrifuge reaches preset speed.**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5. Immediately after centrifugation, dump the supernatant into a biohazard waste container by quickly inverting and flicking the plate **in one continuous and forceful motion**. The beads pellet may or may not be visible after dumping the supernatant. Loss of beads should not be a concern as the beads will stay in the tip of the well nicely. Blot the plate on a stack of clean paper towel and drain the remaining liquid from the well as much as possible. Be careful not to disturb the bead pellet.

   Alternatively, removal of the supernatant may be completed using a multichannel pipette set at 75 µL. Try to remove as much liquid as possible without removing any beads. Be sure to change pipette tips between each row or column.

6. Wash the plate by dispensing 200 µL of 1X Wash Buffer into each well and incubate for one minute. Repeat step 4 and 5 above. A second wash is optional, but may help reduce background.

7. Add 25 µL of Detection Antibodies to each well.

8. Seal the plate with a new plate sealer. Cover the entire plate with aluminum foil to protect the plate from light. Shake at 800 rpm on a plate shaker for 1 hour at room temperature.

9. **Do not wash the plate!** Add 25 µL of SA-PE to each well directly.

10. Seal the plate with a new plate sealer. Wrap the entire plate with aluminum foil and shake the plate on a plate shaker at approximate 800 rpm for 30 minutes at room temperature.

11. Repeat step 4, and 5.

12. (This washing step is optional but helps to reduce the background.) Wash the plate by dispensing 200 µL of 1X Wash Buffer into each well and incubate for one minute. Repeat step 4 and 5 above.

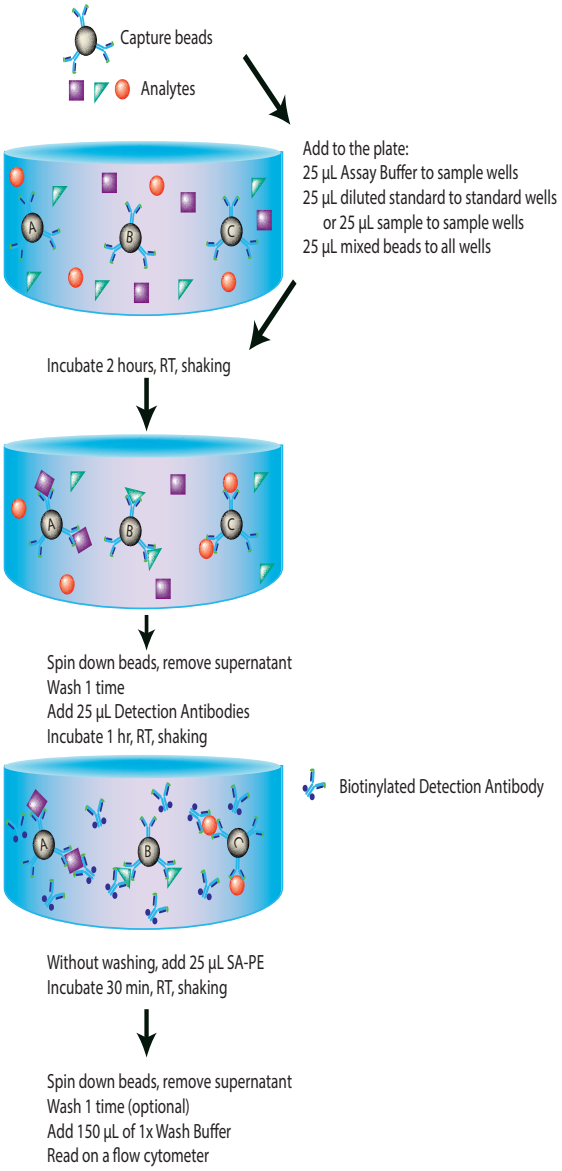
13. Add 150 µL of 1X Wash Buffer to each well. Resuspend the beads by pipetting.

14. Read samples on a flow cytometer, preferably within the same day of the assay (Note: Prolonged sample storage can lead to reduced signal).

    If the flow cytometer is equipped with an autosampler, the samples can be read directly. **Please be sure to program the autosampler to resuspend beads in the well immediately before taking samples. The probe height may need to be adjusted when using an autosampler**.

    If an autosampler is not available, the samples can be transferred from the plate to micro FACS (or FACS) tubes and read manually.

**Assay Procedure Summary for V-bottom Plate**



# Chapter 4: FLOW CYTOMETER SETUP

In order to generate reliable data, the flow cytometer must be set up properly before data acquisition.

The setup instructions have been removed from this manual and uploaded onto our website to save paper.

To access the setup instructions, please visit: **www.biolegend.com/legendplex** and click on the **Instrument Setup** tab.

# Chapter 5: DATA ACQUISITION AND ANALYSIS

## Data Acquisition

1. Before reading samples, make sure that the flow cytometer is set up properly.

2. Create a new template or open an existing template (for details on how to create a cytometer-specific template, please refer to the Flow Cytometer Setup Guide).

3. Vortex each sample for 5 seconds before analysis.

4. Set the flow rate to low. Set the number of beads to be acquired to about 300 per analyte (e.g., acquire 2,400 beads for a 8-plex assay or 3,000 beads for a 13-plex assay). Do not set to acquire total events as samples may contain large amounts of debris. Instead, create a large gate to include both Beads A and Beads B (gate A+B) and set to acquire the number of events in gate A + B. This will exlude majority of the debris.

   Note: Do not acquire too few or too many beads. Too few beads acquired may result in high CVs and too many beads acquired may result in slow data analysis later.

5. Read samples.

   When reading samples, set the flow cytometer to setup mode first and wait until bead population is stabilized before recording or switching to acquisition mode.

   To simplify data analysis using the LEGENDplex™ Data Analysis Software, read samples in the same order as shown on the PLATE MAP attached at the end of the manual. For an in-plate assay, read column by column (A1, B1, C1...A2, B2, C2...).

When naming data files, try to use simple names with a consecutive numbering for easy data analysis (e.g. for standards, C0.001, C0.002, C1.003, C1.004, C2.005, C2.006, C3.007, C3.008, ... C7.015, C7.016; for samples, S1.017, S1.018, S2.019, S2.020, S3.021, S3.022…)

Store all FCS files in the same folder for each assay. If running multiple assays, create a separate folder for each assay.

6. Proceed to data analysis using LEGENDplex™ Data Analysis Software when data acquisition is completed.

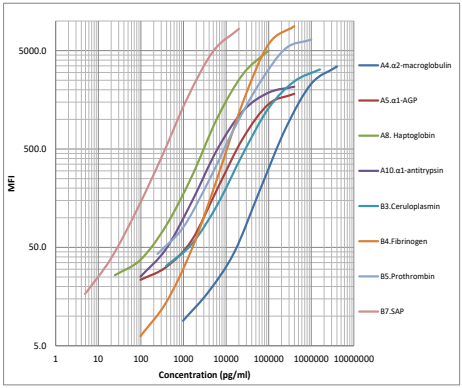
## Data Analysis

- The FCS file generated on a flow cytometer should be analyzed using BioLegend's LEGENDplex™ Data Analysis Software. The LEGENDplex™ Data Analysis Software can be downloaded for free here: **www.biolegend.com/legendplex.**
- For PC users, install the software on a PC running Windows 7 or Windows 8 and use it in conjunction with the Data Analysis Software Dongle included in this kit. The dongle has a license key stored in it and is needed to run the software. To use the dongle, simply plug it in the USB port of the computer on which the data analysis software is installed, prior to launching the software.
- For Mac users, install on a Mac OS X version 10.7 (Lion) or later and you will be promoted to request a software license key after the software installation.
- Follow the LEGENDplex™ Data Analysis Software User Guide and Online Help to use the software (**www.bioLegend.com/legendplex; or press F1 for online help at any step of the data analysis**).

# Chapter 6: ASSAY CHARACTERIZATION

## Representative Standard Curve

This standard curve was generated using the LEGENDplex™ Human Acute Phase Panel 1 for demonstration purposes only. A standard curve must be run with each assay.




## Assay Sensitivity

The assay sensitivity or minimum detectable concentration (MDC) is the theoretical limit of detection calculated using the LEGENDplex™ Data Analysis Software by applying a 5-parameter curve fitting algorithm.

| Analyte | MDC (pg/mL) (n=12) | |
|---|---|---|
| | Mean | STDEV |
| α2-macroglobulin | 232.7 | 89.9 |
| α1-AGP | 31.2 | 12.4 |
| Haptoglobin | 6.1 | 2.7 |
| α1-antitrypsin | 26.1 | 15.4 |
| Ceruloplasmin | 107.6 | 47.2 |
| Fibrinogen | 27.7 | 15.6 |
| Prothrombin | 105.4 | 34.0 |
| SAP | 1.4 | 0.5 |

## Cross-Reactivity

Target human proteins were tested individually at the indicated concentrations below using the LEGENDplex™ Human Human Acute Phase Panel 1, with negligible cross-reactivity observed for non-intended targets.

| Analyte | Conc. (ng/mL) |
|---|---|
| α2-macroglobulin | 40,000 |
| α1-AGP | 4,000 |
| Haptoglobin | 1,000 |
| α1-antitrypsin | 4,000 |
| Ceruloplasmin | 16,000 |
| Fibrinogen | 4,000 |
| Prothrombin | 10,000 |
| SAP | 200 |

The following recombinant proteins were tested individually at at least 50 ng/mL. No or negligible cross-reactivity was found.

| Human | | | |
|---|---|---|---|
| PAI-1 | SP-D | Adiponectin | MCP-1 |
| Ferritin | BPI | Adipsin | IL-1β |
| CRP | LBP | NGAL | IL-6 |
| Properdin | CD14 | MMP-2 | IL-8 |
| tPA | Procalcitonin | OPN | IL-10 |
| SAA | MIF | MPO | IL-12 (p70) |
| α1-antichymotrypsin | CD141 | IGFBP-4 | IL-17A |
| β2-microglobulin | α1-microglobulin | ICAM-1 | IL-18 |
| Myoglobin | suPAR | VCAM-1 | IL-23 |
| Antithrombin | Leptin | MMP-9 | IL-33 |
| Plasminogen | Proinsulin | Cystatin C | TNF-α |
| Factor XIII | RBP4 | Myoglobin | IFNγ |
| PTX3 | Resistin | MRP8/14 | IFNα2 |

## Accuracy (Spike Recovery)

For spike recovery in cell culture medium (n=2), RPMI or DMEM with 10% FBS were spiked with target recombinant proteins at three different levels within the assay range. The spiked samples were then assayed, and the measured concentrations were compared with the expected values.

| Analyte | % of Spike Recovery |
|---|---|
| α2-macroglobulin | 102% |
| α1-AGP | 95% |
| Haptoglobin | 96% |
| α1-antitrypsin | 94% |
| Ceruloplasmin | 92% |
| Fibrinogen | 97% |
| Prothrombin | 95% |
| SAP | 94% |

## Linearity of Dilution

Serum (n=10) and plasma (n=28) samples were initially diluted 20,000-fold with Assay Buffer, then serially diluted 2, 4, 8 fold still with Assay Buffer and assayed.

Cell culture samples (n=2) were spiked with target proteins with known concentrations in the assay range, then serially diluted 2, 4, 8 fold with Assay Buffer and assayed.

The measured concentrations of serially diluted samples were then compared with the concentration of the lowest dilution based on serial dilution factor used.

| Analyte | % Linearity | | |
|---|---|---|---|
| | Serum | Plasma | Cell Culture |
| α2-macroglobulin | 102% | 101% | 86% |
| α1-AGP | 97% | 102% | 111% |
| Haptoglobin | 92% | 96% | 101% |
| α1-antitrypsin | 104% | 108% | 107% |
| Ceruloplasmin | 112% | 93% | 128% |
| Fibrinogen | NA* | 92% | 90% |
| Prothrombin | NA* | 82% | 92% |
| SAP | 109% | 105% | 101% |

***Serum is not claimed as a sample type for Fibrinogen and Prothrombin**

## Intra-Assay Precision

Two samples with different concentrations of each target protein were analyzed in one assay with 16 replicates per sample. The intra-assay precision is shown below.

| Analyte | Sample | Mean (pg/mL) | STDEV | %CV |
|---|---|---|---|---|
| α2-macroglobulin | Sample 1 | 8,744.5 | 370.8 | 4% |
| | Sample 2 | 35,240.5 | 1,235.5 | 4% |
| α1-AGP | Sample 1 | 870.4 | 53.1 | 6% |
| | Sample 2 | 3,636.5 | 129.8 | 4% |
| Haptoglobin | Sample 1 | 252.0 | 8.5 | 3% |
| | Sample 2 | 946.1 | 29.2 | 3% |
| α1-antitrypsin | Sample 1 | 945.2 | 48.5 | 5% |
| | Sample 2 | 3,668.5 | 137.8 | 4% |
| Ceruloplasmin | Sample 1 | 3,598.6 | 169.9 | 5% |
| | Sample 2 | 13,861.8 | 637.2 | 5% |
| Fibrinogen | Sample 1 | 1,168.4 | 50.7 | 4% |
| | Sample 2 | 4,474.9 | 188.4 | 4% |
| Prothrombin | Sample 1 | 2,509.0 | 144.5 | 6% |
| | Sample 2 | 10,141.4 | 497.5 | 5% |
| SAP | Sample 1 | 58.7 | 4.2 | 7% |
| | Sample 2 | 224.8 | 14.3 | 6% |

## Inter-Assay Precision

Two samples with different concentrations of each target protein were analyzed in ten independent assays with four replicates per sample. The inter-assay precision is shown below.

| Analyte | Sample | Mean (pg/mL) | STDEV | %CV |
|---|---|---|---|---|
| α2-macroglobulin | Sample 1 | 12,363.9 | 2,196.6 | 18% |
| | Sample 2 | 46,666.9 | 8,082.5 | 17% |
| α1-AGP | Sample 1 | 1,190.7 | 221.4 | 19% |
| | Sample 2 | 4,676.7 | 666.0 | 14% |

| | | | | |
|---|---|---|---|---|
| Haptoglobin | Sample 1 | 318.9 | 50.8 | 16% |
| | Sample 2 | 1,119.4 | 166.7 | 15% |
| α1-antitrypsin | Sample 1 | 1,284.2 | 218.3 | 17% |
| | Sample 2 | 4,671.0 | 722.9 | 15% |
| Ceruloplasmin | Sample 1 | 4,816.7 | 982.5 | 20% |
| | Sample 2 | 17,926.3 | 3,221.1 | 18% |
| Fibrinogen | Sample 1 | 1,525.9 | 298.5 | 20% |
| | Sample 2 | 5,420.4 | 1,074.9 | 20% |
| Prothrombin | Sample 1 | 3,783.0 | 855.6 | 23% |
| | Sample 2 | 13,069.8 | 2,469.0 | 19% |
| SAP | Sample 1 | 85.7 | 23.7 | 28% |
| | Sample 2 | 291.5 | 63.8 | 22% |

## Biological Samples

The values in this section are provided for reference only. The assays provided in this kit are intended for research use only.

**Serum and plasma (samples are paired)**

Normal human serum samples (n=20) were tested for endogenous levels of the proteins. The concentrations are shown below.

| Analyte | Range (µg/mL) | % Detectable | Mean (µg/mL) |
|---|---|---|---|
| α2-macroglobulin | 1029.6-7730.9. | 100% | 2466.7 |
| α1-AGP | 384.3-2489.0 | 100% | 925.9 |
| Haptoglobin | 77.3-3061.1 | 100% | 1200.5 |
| α1-antitrypsin | 577.5-4823.8 | 100% | 1386.8 |
| Ceruloplasmin | 209.0-848.9 | 100% | 416.9 |
| SAP | 6.8-40.2 | 100% | 20.3 |

**Serum is not claimed as a sample type for Fibrinogen and Prothrombin**

Normal human plasma (Heparin, Citrate, and EDTA) samples (n=60) were tested for endogenous levels of the proteins. The concentrations are shown below.

| Analyte | Range (µg/mL) | % Detectable | Mean (µg/mL) |
|---|---|---|---|
| α2-macroglobulin | 615.9-4761.8 | 100% | 2100.4 |
| α1-AGP | 168.6-2129.4 | 100% | 726.5 |
| Haptoglobin | 48.7-3644.1 | 100% | 1175.5 |
| α1-antitrypsin | 300.7-3022.8 | 100% | 1088.5 |
| Ceruloplasmin | 75.6-1388.1 | 100% | 417.7 |
| Fibrinogen | 176.4-7101.6 | 100% | 2431.3 |
| Prothrombin | 20.6-256.3 | 100% | 120.7 |
| SAP | 2.8-47.2 | 100% | 16.6 |

**Cell Culture Supernatant**

Human HepG2 cells ($1x10^6$ cells/mL) were cultured under LPS (1 µg/mL), IL-6 (10ng/mL), IL-1β (10 ng/mL), and TNF-α (25 ng/mL) stimulations with unstimulated cells as a control. Cell Culture supernatants were collected 24 hour after stimulation and assayed. The results (all ng/mL) are summarized below.

| Analyte | Control | LPS | IL-6 | IL-1β | TNF-α |
|---|---|---|---|---|---|
| α2-macroglobulin | 170.0 | 199.9 | 266.6 | 523.3 | 264.2 |
| α1-AGP | 552.3 | 465.6 | 620.8 | 973.4 | 637.8 |
| Haptoglobin | 259.5 | 224.7 | 1,286.0 | 827.9 | 403.2 |
| α1-antitrypsin | 1,298.0 | 1,165.0 | 1,286.0 | 1,346.0 | 1,241.0 |
| Ceruloplasmin | 194.6 | 167.0 | 248.1 | 437.1 | 273.8 |
| Fibrinogen | 330.8 | 259.5 | 1,055.0 | 820.5 | 271.4 |
| Prothrombin | 465.6 | 371.8 | 449.1 | 1,165.0 | 518.6 |
| SAP | 7.3 | 6.9 | 7.5 | 7.8 | 7.2 |

## TROUBLESHOOTING

| Problem | Possible Cause | Solution |
|---|---|---|
| Bead population shifting upward or downward during acquisition | The strong PE signal from high concentration samples or standards may spill over to classification Channel (e.g., FL3/FL4/APC) and mess up the bead separation. | Optimize instrument settings using Kit Setup Beads, and make appropriate compensation between channels. |
| Filter plate will not vacuum or some wells clogged | Vacuum pressure is insufficient or vacuum manifold does not seal properly. | Increase vacuum pressure such that 0.2 mL buffer can be suctioned in 3-5 seconds. Clean the vacuum manifold and make sure no debris on the manifold. Press down the plate on the manifold to make a good seal. |
| | Samples have insoluble particles or sample is too viscous (e.g., serum and plasma samples) | Centrifuge samples just prior to assay setup and use supernatant. If high lipid content is present, remove lipid layer after centrifugation. Sample may need dilution if too viscous.<br><br>If some wells are still clogged during washing, try the following:<br><br>1). Add buffer to all the wells, pipette up and down the clogged wells and vacuum again.<br><br>2). Use a piece of clean wipe, wipe the under side of the clogged wells and vacuum again.<br><br>3). Take a thin needle (e.g., insulin needle), while holding the plate upward, poke the little hole under each of the clogged wells and vacuum again. Do not poke too hard or too deep as it may damage the filter and cause leaking. |
| | Filter plate was used without pre-wet. | Pre-wet plate with wash buffer before running the assay. |

| | | |
|---|---|---|
| Insufficient bead count or slow reading | Beads inappropriately prepared | Sonicate bead vials and vortex just prior to addition. Agitate mixed beads intermittently in reservoir while pipetting this into the plate. |
| | Samples cause beads aggregation due to particulate matter or viscosity. | Centrifuge samples just prior to assay setup and use supernatant. If high lipid content is present, remove lipid layer after centrifugation. Sample may need dilution if too viscous. |
| | Beads were lost during washing for in-tube assay | Make sure beads are spun down by visually check the pellet (beads are in light blue or blue color). Be very careful when removing supernatant during washing. |
| | Probe might be partially clogged. | Sample probe may need to be cleaned, or if needed, probe should be removed and sonicated. |
| Plate leaked | Vacuum pressure set too high | Adjust vacuum pressure such that 0.2 mL buffer can be suctioned in 3-5 seconds. Do not exceed 10” Hg of vacuum. |
| | 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. |
| | Liquid present on the under side of the plate after vacuum | After washing, press down plate firmly on a stack of clean paper towels to dry the underside of the plate. |
| | Pipette touching and damaged plate filter during additions. | Pipette to the side of wells. |
| High Background | Background wells were contaminated | Avoid cross-well contamination by changing tips between pipetting when performing the assay using a multichannel pipette. |
| | Insufficient washes | The background may be due to non-specific binding of SA-PE. Increase number of washes. |
| Debris (FSC/SSC) during sample acquisition | Debris or platelet may exist in sample solution. | Centrifuge samples before analyzing samples. Remove platelet as much as possible. |

| | | |
|---|---|---|
| Variation between duplicate samples | Beads aggregation | Sonicate and vortex the Beads prior to use. |
| | Multichannel pipette may not be calibrated or inconsistent pipetting | Calibrate Pipette. Ensure good pipetting practice. Prime pipette before use may help. |
| | Plate washing was not uniform | Make sure all reagents are vacuumed out completely in all wash steps. |
| | Samples may contain particulate matters. | Centrifuge samples just prior to assay setup and use supernatant. If high lipid content is present, remove lipid layer after centrifugation. Sample may need dilution if too viscous. |
| Low or poor standard curve signal | The standard was incorrectly reconstituted, stored or diluted | Follow the protocol to reconstitute, store and dilute standard. Double check your calculation. |
| | Wrong or short incubation time | Ensure the time of all incubations was appropriate. |
| Signals too high, standard curves saturated | PMT value for FL2/PE set too high | Make sure the PMT setting for the reporter channel is appropriate |
| | Plate incubation time was too long | Use shorter incubation time. |
| Sample readings are out of range | Samples contain no or below detectable levels of analyte | Make sure the experiment to generate the samples worked. Use proper positive controls. |
| | Samples concentrations higher than highest standard point. | Dilute samples and analyze again. |
| | Standard curve was saturated at higher end of curve. | Make sure the PMT setting for the reporter channel is appropriate. Use shorter incubation time if incubation time was too long |
| Missed beads populations during reading, or distribution is unequal | Sample may cause some beads to aggregate. | Centrifuge samples just prior to assay setup and use supernatant. If high lipid content is present, remove lipid layer after centrifugation. Sample may need dilution if too viscous. |
| | Beads populations are not mixed properly | Make sure all bead populations are mixed. and in similar numbers. |

## Notes



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# PLATE MAP (for in-plate assay)

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **A** | **C0** | **C4** | Sample1 | Sample5 | Sample 9 | Sample 13 | Sample 17 | Sample 21 | Sample 25 | Sample 29 | Sample 33 | Sample 37 |
| **B** | **C0** | **C4** | Sample1 | Sample5 | Sample 9 | Sample 13 | Sample 17 | Sample 21 | Sample 25 | Sample 29 | Sample 33 | Sample 37 |
| **C** | **C1** | **C5** | Sample2 | Sample6 | Sample 10 | Sample 14 | Sample 18 | Sample 22 | Sample 26 | Sample 30 | Sample 34 | Sample 38 |
| **D** | **C1** | **C5** | Sample2 | Sample6 | Sample 10 | Sample 14 | Sample 18 | Sample 22 | Sample 26 | Sample 30 | Sample 34 | Sample 38 |
| **E** | **C2** | **C6** | Sample3 | Sample7 | Sample 11 | Sample 15 | Sample 19 | Sample 23 | Sample 27 | Sample 31 | Sample 35 | Sample 39 |
| **F** | **C2** | **C6** | Sample3 | Sample7 | Sample 11 | Sample 15 | Sample 19 | Sample 23 | Sample 27 | Sample 31 | Sample 35 | Sample 39 |
| **G** | **C3** | **C7** | Sample4 | Sample8 | Sample 12 | Sample 16 | Sample 20 | Sample 24 | Sample 28 | Sample 32 | Sample 36 | Sample 40 |
| **H** | **C3** | **C7** | Sample4 | Sample8 | Sample 12 | Sample 16 | Sample 20 | Sample 24 | Sample 28 | Sample 32 | Sample 36 | Sample 40 |

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