LIFECODES®

Immucor GTI Diagnostics, Inc.
20925 Crossroads Circle
Waukesha, WI 53186 USA
Tel: (855) 466-8267
WWW.IMMUCOR.COM

Product Documentation and Translations available at: www.immucor.com

PRODUCT INSERT

LIFECODES®HLA-SSO TYPING KITS

For In Vitro Diagnostic Use IVD

Rx ONLY

TABLE OF CONTENTS

DEFINITION OF SYMBOLS (Product Labels and Supplemental Documents)

Batch Code	LOT	Catalog Number	REF	Temperature limitations		Upper limit of temperature	
Use By Date		Keep away from light		Sufficient for N Tests	Σ	Do Not Freeze	
Caution – See instructions for Use		Consult Instructions for use		Manufacturer		Authorized Representative in the European Community	EC REP
Danger		Prescription Use Only	Rx ONLY	*In vitro* diagnostic medical device	IVD	Unique Device Identification	UDI

KITS/REAGENTS BY CATALOG NUMBER

LCT-A LIFECODES HLA-A SSO Typing Kit, Catalog No. 628911

LM-A LIFECODES HLA-A Typing Kit for use with Luminex®

Product No. 628410-50

	Reagent	Product Number	Fill volume	Storage	
MX-A	LIFECODES HLA-A Master Mix	628405	870 µL	2 to 8°C	Σ 50 Sufficient for 50 samples
BM-A	LIFECODES HLA-A Probe Mix ‡	628453	810 µL	2 to 8°C Protect From Light	CE 0197
DS	Dilution Solution	628155	9.9 mL	18 to 30°C	
TAQ	LIFECODES Taq Polymerase	628075	25 µL	-10°C to -30°C	CE

LCT-AE LIFECODES HLA-A eRES SSO Typing Kit, Catalog No. 628913

LC-AE LIFECODES HLA-A eRES Typing Kit for use with Luminex

Product No. 628459-50

	Reagent	Product Number	Fill volume	Storage	
MX-A	LIFECODES HLA-A Master Mix	628405	870 µL	2 to 8°C	Σ 50 Sufficient for 50 samples
BM-A	LIFECODES HLA-A Probe Mix ‡	628453	810 µL	2 to 8°C Protect From Light	CE 0197
BM-AeRES	LIFECODES HLA-A eRES Probe Mix‡	628455	810 µL	2 to 8°C Protect From Light	
DS	Dilution Solution	628515	19.7 mL	18 to 30°C	
TAQ	LIFECODES Taq Polymerase	628075	25 µL	-10°C to -30°C	CE

LCT-B LIFECODES HLA-B SSO Typing Kit, Catalog No. 628915

LM-B LIFECODES HLA-B Typing Kit for use with Luminex

Product No. 628510-50

	Reagent	Product Number	Fill volume	Storage	
MX-B	LIFECODES HLA-B Master Mix	628556	870 µL	2 to 8°C	Σ 50 Sufficient for 50 samples
BM-B	LIFECODES HLA-B Probe Mix ‡	628553	810 µL	2 to 8°C Protect From Light	CE 0197
DS	Dilution Solution	628155	9.9 mL	18 to 30°C	
TAQ	LIFECODES Taq Polymerase	628075	25 µL	-10°C to -30°C	CE

LCT-BE LIFECODES HLA-B eRES SSO Typing kit, Catalog No. 628917

LC-BE LIFECODES HLA-B eRES Typing Kit for use with Luminex

Product No. 628559-50

	Reagent	Product Number	Fill volume	Storage	
MX-B	LIFECODES HLA-B Master Mix	628556	870 µL	2 to 8°C	Σ 50 Sufficient for 50 samples
BM-B	LIFECODES HLA -B Probe Mix ‡	628553	810 µL	2 to 8°C Protect From Light	CE 0197
BM-BeRES	LIFECODES HLA-B eRES Probe Mix‡	628554	810 µL	2 to 8°C Protect From Light	
DS	Dilution Solution	628515	19.7 mL	18 to 30°C	
TAQ	LIFECODES Taq Polymerase	628075	25 µL	-10°C to -30°C	CE

‡Probe Mixes are light sensitive: keep exposure to light at a minimum.
CAUTION: Do not use components past their expiration dates.
CAUTION: Deviations from recommended protocol and required materials including LIFECODES Taq Polymerase, have not been validated.

LCT-CE LIFECODES HLA-C eRES SSO Typing Kit, Catalog No. 628921

LC-CE LIFECODES HLA-C eRES Typing Kit for use with Luminex — Product No. 628850-50

Reagent		Product Number	Fill volume	Storage	
MX-C	LIFECODES HLA-C Master Mix	628803	870 µL	2 to 8°C	Σ 50 Sufficient for 50 samples
BM-CeRES	LIFECODES HLA-C eRES Probe Mix ‡	628804	810 µL	2 to 8°C Protect From Light	
DS	Dilution Solution	628515	19.7 mL	18 to 30°C	CE 0197
TAQ	LIFECODES Taq Polymerase	628075	25 µL	-10°C to -30°C	CE

LCT-DR1 LIFECODES HLA-DRB1 SSO Typing Kit, Catalog No. 628923

LM-DR1 LIFECODES HLA-DRB1 Typing Kit for use with Luminex — Product No. 628751-50

Reagent		Product Number	Fill volume	Storage	
MX-DR1	LIFECODES HLA-DRB1 Master Mix	628753	870 µL	2 to 8°C	Σ 50 Sufficient for 50 samples
BM-DR1	LIFECODES HLA-DRB1 Probe Mix ‡	628752	810 µL	2 to 8°C Protect From Light	
DS	Dilution Solution	628155	9.9 mL	18 to 30°C	CE 0197
TAQ	LIFECODES Taq Polymerase	628075	25 µL	-10°C to -30°C	CE

LCT-DR1E LIFECODES HLA-DRB1 eRES SSO Typing Kit, Catalog No. 628925

LC-DR1E LIFECODES HLA-DRB1 eRES Typing Kit for use with Luminex — Product No. 628759-50

Reagent		Product Number	Fill volume	Storage	
MX-DR1	LIFECODES HLA-DRB1 Master Mix	628753	870 µL	2 to 8°C	Σ 50 Sufficient for 50 samples
BM-DR1	LIFECODES HLA-DRB1 Probe Mix ‡	628752	810 µL	2 to 8°C Protect From Light	
BM-DR1eRES	LIFECODES HLA-DRB1 eRES Probe Mix ‡	628755	810 µL	2 to 8°C Protect From Light	CE 0197
DS	Dilution Solution	628515	19.7 mL	18 to 30°C	
TAQ	LIFECODES Taq Polymerase	628075	25 µL	-10°C to -30°C	CE

LCT-DRB3,4,5 LIFECODES HLA-DRB 3,4,5 SSO Typing Kit, Catalog No. 628927

LC-DRB3,4,5 LIFECODES HLA-DRB 3,4,5 Typing Kit for use with Luminex — Product No. 629200-50

Reagent		Product Number	Fill volume	Storage	
MX-DRB3,4,5	LIFECODES HLA-DRB 3,4,5 Master Mix	629201	870 µL	2 to 8°C	Σ 50 Sufficient for 50 samples
BM-DRB3,4,5	LIFECODES HLA-DRB 3,4,5 Probe Mix ‡	629202	810 µL	2 to 8°C Protect From Light	
DS	Dilution Solution	628515	19.7 mL	18 to 30°C	CE 0197
TAQ	LIFECODES Taq Polymerase	628075	25 µL	-10°C to -30°C	CE

‡Probe Mixes are light sensitive; keep exposure to light at a minimum.
CAUTION: Do not use components past their expiration dates.
CAUTION: Deviations from recommended protocol and required materials including LIFECODES Taq Polymerase have not been validated.

LCT-DQAB LIFECODES HLA-DQA1/B1 SSO Typing Kit, Catalog No. 628930

LC-DQAB LIFECODES HLA-DQA1/B1 Typing Kit for use with Luminex — Product No. 200210-50

	Reagent	Product Number	Fill volume	Storage	
MX-DQAB	LIFECODES HLA DQA1/B1 Master Mix	200200	870 µL	2 to 8°C	Σ 50 Sufficient for 50 samples CE
BM-DQAB	LIFECODES HLA DQA1/B1 Probe Mix ‡	200201	810 µL	2 to 8°C Protect From Light	
DS	Dilution Solution	628515	19.7 mL	18 to 30°C	CE
TAQ	LIFECODES Taq Polymerase	628075	25 µL	-10°C to -30°C	CE

LCT-DPAB LIFECODES HLA-DPA1/B1 SSO Typing Kit, Catalog No. 628936

LC-DPAB LIFECODES HLA-DPA1/B1 Typing Kit for use with Luminex — Product No. 200110-50

Reagent		Product Number	Fill volume	Storage	
MX-DPAB	LIFECODES HLA DPA1/B1Master Mix	200100	870 µL	2 to 8°C	Σ 50 Sufficient for 50 samples CE
BM-DPAB	LIFECODES HLA DPA1/B1 Probe Mix ‡	200101	810 µL	2 to 8°C Protect From Light	
DS	Dilution Solution	628515	19.7 mL	18 to 30°C	CE
TAQ	LIFECODES Taq Polymerase	628075	25 µL	-10°C to -30°C	CE

‡Probe Mixes are light sensitive: keep exposure to light at a minimum.
CAUTION: Do not use components past their expiration dates.
CAUTION: Deviations from recommended protocol and required materials including LIFECODES Taq Polymerase have not been validated.

INTENDED USE

DNA Typing of Class I and Class II HLA alleles, to aid in transfusion and transplantation donor and recipient matching.

SUMMARY AND EXPLANATION

DNA-based HLA typing using PCR amplified DNA is a common laboratory procedure. PCR amplification of DNA is used as the means to enrich for a selected DNA region. For HLA typing, a subsequent assay is utilized to determine the properties of the amplified DNA. Several types of assays, such as SSP (1), direct SSOP (2), RFLP (3) and reverse SSOP dot blot technologies (4), have been used in HLA typing. Like SSOP and reverse dot blot methods, LIFECODES HLA-SSO Typing kits utilize sequence-specific oligonucleotides (SSOs) to identify which HLA alleles are present in a PCR amplified sample. It is the set of SSOs employed, not the methodologies that determines the ability to distinguish among the various alleles present in the PCR amplification. Whereas reverse dot blot and SSOP methods employ enzyme labels and colorimetric substrates that require subsequent development, the LIFECODES assay is a homogenous multiplex system. That is, all SSOs are analyzed simultaneously and the entire assay is carried out in a single reaction vessel with the addition of a single reagent.

PRINCIPLES OF THE PROCEDURE

The LIFECODES HLA-SSO Typing procedure is based on the hybridization of biotin-labeled single stranded PCR product to SSO probes. Amplification of DNA using PCR typically employs equimolar amounts of both forward and reverse primer to generate a double-stranded DNA product. However, if the amount of one primer is in excess relative to the other, the reaction will generate some single-stranded DNA product in addition to double-stranded product. During the initial cycles of the LIFECODES amplification step, double-stranded DNA is generated. Once the limiting primer is exhausted, the remaining primer uses the double-stranded product as a template for generation of single-stranded DNA. This method generates both double stranded and single stranded products that upon denaturation, will both participate in the hybridization reaction.

Each of the different probes may be homologous to a sequence within the amplified DNA that is unique to an allele or group of alleles. In other words, these probes are designed so that each probe preferentially hybridizes to a complementary region that may or may not be present in the amplified DNA. In addition, the amplified DNA is also hybridized to one or more Consensus probes homologous to sequences present in all the alleles of a locus. SSO Typing can be affected by the type of biological material, method of purification, amount and integrity of genomic DNA. Therefore, the signal obtained for the Consensus probe(s) can serve as an indicator of the success of the amplification and hybridization procedures. After hybridization, R-Phycoerythrin Conjugated Streptavidin (SA-PE) is added, which binds to any captured DNA. The signal obtained with the Consensus probe can be used to normalize the signal of the allele specific probes and correct for variations in the amount of amplified product in the hybridization reaction. The analysis of the results generated from the SSO typing can be used to determine the presence or absence of particular DNA sequences in amplified DNA and to identify the possible alleles in the sample.

For the LIFECODES HLA-SSO Typing procedure, probes are attached to Luminex Microspheres designed for use with the Luminex 100, Luminex 200 or Luminex FLEXMAP 3D® Instrument. Up to 100 different populations of Luminex Microspheres can be mixed together and analyzed by the Luminex 100, Luminex 200 or Luminex FLEXMAP 3D Instrument because each population of microspheres can be distinguished by its

unique fluorescence signature or color. For HLA-A eRES, HLA-B eRES and HLA-DRB1 eRES, a second bead mix is provided so the total number of probes can exceed 100. A different SSO probe can be attached to each color microsphere. Therefore, a mixture of several probes can be distinguished from each other by virtue of their association with particular color microspheres. The Luminex 100, Luminex 200 or Luminex FLEXMAP 3D Instrument is also able to quantify the relative amounts of labeled PCR product hybridizing to each Luminex Microsphere. Therefore, the relative signal obtained with the SSO probes in the LIFECODES assay, as with other SSOP methods, can be used to assign the probes as having positive or negative reactivity with the amplified DNA sample (see Results section). This in turn provides the information needed to determine the HLA phenotype of the sample.

REAGENTS

A. Identification

See tables in Reagents by Catalog Number section for a complete listing of products and catalog numbers.

B. Warnings or Cautions

1. For In Vitro Diagnostic Use.
2. Separate pipettes should be designated for Pre-PCR manipulations as well as for Post-PCR manipulations.
3. Biohazard: All biological and blood samples should be treated as potentially infectious. **Use Universal Precautions when handling.**
4. The Probe mixes contain a hazardous compound. Avoid contact with skin and eyes and dispose of all materials after use according to local regulations. See Material Safety Data Sheets for additional information.
5. Results from these kits are not to be used as the sole basis upon which a clinical decision affecting the patient is made.

C. Storage Instructions

1. Refer to kit component packaging label for proper storage temperatures.
2. Probe mixes and R-Phycoerythrin Conjugated Streptavidin are light sensitive, **KEEP FROM LIGHT; DO NOT FREEZE.**
3. Do not use components past their expiration date.

D. Purification or Treatment Required for Use

See "Specimen Collection and Preparation."

E. Instability Indications

1. If salts have precipitated out of solution during shipping or storage, resolubilize completely prior to use by vortexing at room temperature (18 to 30°C).
2. Do not use R-Phycoerythrin Conjugated Streptavidin that has been frozen during shipment or storage.
3. Kits are stable a minimum of 6 months after opening when stored according to recommendations.

INSTRUMENT REQUIREMENTS

1. Luminex 100 or 200 Instrument and XY Platform (Product Number 888300, 888302) or Luminex FLEXMAP 3D (Product Number 888303).
2. The following Thermal Cyclers have been validated: 96-Well GeneAmp® PCR System 9700 set to MAX mode (Base Cat No. N8050200, Gold Block Cat No. 4314878), Veriti™ 96-Well Thermal Cycler set to 9700 MAX mode (Cat. No. 4375786). Refer to **Table 2** for maximum ramp speeds. Caution: Other thermal cyclers and ramp speeds have not been validated.

SPECIMEN COLLECTION AND PREPARATION

a. Human DNA can be purified from Whole blood, Buffy coats and Buccal swabs using a validated method that meets the criteria below. The following kits were used in studies performed to isolate purified genomic DNA:

DNA Isolation Kit	Sample types
QIAamp DNA Mini Kit (Qiagen)	Whole blood, Buffy coat (ACD, EDTA) and Buccal swabs
Gentra Puregene Blood Kit (Qiagen)	Whole blood, Buffy coat (ACD, EDTA)
Maxwell 16 DNA Purification Kit (Promega)	Whole blood, Buffy coat (ACD, EDTA)
ReliaPrep gDNA Tissue Miniprep System (Promega)	Buccal swabs
Gentra Puregene Buccal Cell Kit (Qiagen)	Buccal swabs

b. DNA extracted from blood preserved in EDTA and ACD (Acid Citrate Dextrose) have been tested and shown to yield expected performance in this assay. DNA extracted from blood preserved in heparin cannot be used in this assay. Other preservatives have not been tested.

c. The isolated DNA should be in 10 mM TRIS, pH 8.0-9.0, or in nuclease free water. If a chelating agent such as EDTA is present the final concentration of the chelating agent should not exceed 0.5 mM.

d. The presence of alcohol, detergents or salts may adversely affect DNA amplification.

e. Final DNA concentration should be 10 to 200 ng/µL.

f. Absorbance measurements of the DNA sample at 260 and 280 nm should give a ratio of 1.65 to 2.0.

g. DNA can be used immediately after isolation or stored at –20°C for up to 1 year. Repeated freeze/thawing should be avoided since this can result in DNA degradation.

PROCEDURE

Caution: Deviations from recommended protocol and required materials have not been validated

A. Materials Provided (See tables in Kits/Reagents by Catalog Number section for specific information)

- Appropriate Master Mix (MX)
- Appropriate Probe Mix (BM)
- Dilution Solution (DS)
- Threshold Table(s), Probe Hit Chart(s)
- LIFECODES Taq Polymerase (LIFECODES Cat. No 628075)

B. Materials, *Required*, but Not Provided

The following materials were used in the validation of the kit:

- Luminex Sheath Fluid (LIFECODES Cat. No. 628005) or Luminex Sheath Fluid Plus (LIFECODES Cat. No. 628010)
- Nuclease-free water (LIFECODES Cat. No. 757003; 20 mL)
- PCR tubes and caps - Corning® Thermowell Tube Strips (Costar® Cat. No. 6542, LIFECODES Cat. No. 888640) or Axygen 8-Strip PCR Tubes (Axygen Cat. No. PCR0208CPC) or Applied Biosystems MicroAmp 8-Tube Strip and MicroAmp 8-Cap Strip (ABI Cat. No. N8010580 and N8010535) or Corning® Thermowell PCR 96 well plates (Cat. No. CLS6551) or Thermoscientific AB Gene® Superplate 96-well PCR plate (Cat. No. AB-2100)
- Costar® plate (Costar® Cat. No. 6509, LIFECODES Cat. No. 888630)
- Thermowell Clear Polyethylene Tape (Costar® No. 6524 (LIFECODES Cat. No. 888635)
- R-Phycoerythrin Conjugated Streptavidin (SA-PE), 1mg/mL (LIFECODES Cat No. 628511)
- Luminex Calibration Kits (Luminex 100/200 Calibration Kit, Luminex 100/200 Performance Verification Kit, LIFECODES Cat. Nos. 628018 and 628019 respectively) or FLEXMAP 3D Calibration Kits (Luminex FLEXMAP 3D Calibration Kit, Luminex FLEXMAP 3D Performance Verification Kit, LIFECODES Cat No. 888307 and 888308 respectively)

C. Additional Materials to be provided by the user

- Vortex Mixer
- Silicone compression Mat, Axygen Scientific, No. CM-FLAT, or equivalent
- Bath Sonicator
- Microcentrifuge Barrier filter tips
- Pipettors, Multichannel pipettors and tips (1-20 µL, 20-200 µL,1000 µL)
- Spreadsheet analysis software
- Heat Block
- 70% Isopropanol or 20% Bleach
- Retainer tray – Applied Biosystems No. 403081 (for use with the 9700 thermal cycler only)

DIRECTIONS FOR USE

NOTES:

- Probe mixes and SA-PE are light sensitive: **keep away from light and do not freeze.**
- Warm beads at 55° to 60°C for at least 5 -10 minutes to thoroughly solubilize components in probe mixture.
- Sonicate briefly (~15 sec), then vortex probe mix for about 15 seconds to thoroughly suspend the beads.
- Take extreme caution in the aliquoting process, using calibrated pipettes. Failure to do so may result in reagent loss and sample failure.
- All temperatures must be precisely maintained. Fluctuations as little as +/- 0.5°C can affect results.
- At the hybridization stage, samples should not remain in the diluted state at 56°C for more than 5 minutes (see Results section).
- It is recommended to assay the amplified samples as soon as possible. If the samples cannot be run on the Luminex 100, Luminex 200 or Luminex FLEXMAP 3D Instrument the same day, ***the amplified product can be stored up to 3 days at 2-8°C prior to use. For longer storage, store at –20°C up to one week until ready to assay. The amplified product can only be frozen and thawed once. Repeated freezing and thawing will result in degradation of amplified samples and will yield poor results if assayed.***

A. Purify genomic DNA, using method of choice; final concentration should be 10 to 200 ng/µL. Adjust, if necessary, with nuclease free water. Keep all samples at similar concentrations.

B. DNA amplification (PCR)

1. Allow the Master Mix to warm to room temperature (18 to 30°C).
2. Gently vortex for approximately 10 seconds. This will ensure the salts are in solution. Spin briefly (5 – 10 seconds) in microcentrifuge to bring contents to the bottom of the tube.
3. Using **Table 1** below, prepare the components for amplification for n+1 reactions using the indicated amount of each component per reaction (except for DNA). Bring to a final volume of 20 µL per reaction with nuclease free water. Gently vortex.
4. Pipette the appropriate amount of Genomic DNA **(40 to 120 ng)** into the PCR tubes.
5. Aliquot the amplification mix into the PCR tubes containing the genomic DNA. (The total volume of amplification mix and genomic DNA should equal 20 µL for each sample reaction.)
6. Cap tubes tightly to prevent evaporation during PCR.
7. Place samples in the thermal cycler and run program, **see Table 2 and 3.**

Table 1. Reaction Components for Amplification

Component	Amount per PCR sample reaction
LIFECODES Master Mix	6 µL
Genomic DNA 10-200ng/µL	Total of ~80 ng
LIFECODES Taq Polymerase	0.2 µL (1 U)
Nuclease-free water	To 20 µL final volume

Table 2. Thermal Cycler Conditions for Amplification

Thermal Cycler	Mode (Ramp speed)
GeneAmp® PCR System 9700	MAX mode (3.9°C/sec)
Veriti™ 96-Well Thermal Cycler	9700 MAX mode (3.9°C/sec)

Table 3. Thermal Cycler Conditions for Amplification

Step	Temperature and Incubation Time	No. of Cycles
1	95°C for 3 min	1
2	95°C for 15 sec	12
	60°C for 30 sec	
	72°C for 30 sec	
3	95°C for 10 sec	28
	63°C for 30 sec	
	72°C for 30 sec	
4	72°C for 2 min	1
5	4°C forever	1

Note: To be sure of sample amplification, refer to Product Gel Electrophoresis (Appendix A).

C. Hybridization

- **Be sure hybridization buffer components of the LIFECODES probe mix are solubilized and that the beads are thoroughly suspended.**
- **Turn on the Luminex 100 or 200 Instrument and XY Platform or Luminex FLEXMAP 3D to allow for 30 minute warm-up.**

1. Warm probe mix in a 55° to 60°C heat block for at least 5 -10 minutes to thoroughly solubilize components in probe mixture.
2. Sonicate briefly (~15 sec), then vortex probe mix for about 15 seconds to thoroughly suspend the beads.
3. Combine 15 µL of the **appropriate** probe mix with 5 µL of locus specific PCR product into each well of a thermal cycler 96 well plate (Costar No. 6509). **Note The A eRES, B eRES and DRB1 eRES Kits require two wells per sample, one for eRES probe mix and one for the standard probe mix. The eRES probe mix and the standard probe mix do not have to be performed in the same run. Both probe mixes are required to obtain eRES results for these kits. The C eRES Kits contain only one standard probe mix.** When aliquoting probe mix to more than 10 wells, gently vortex probe mix after each set of ten. Seal plate with polyethylene tape (Costar No. 6524).
4. Place silicone compression mat on top of plate prior to hybridization.
5. Hybridize samples under the following incubation conditions:

Table 4. Thermal Cycler Conditions For Hybridization

97°C for 2 minutes
47°C for 10 minutes
56°C for 8 minutes
56°C HOLD

- **Ensure that the detection laser on the Luminex 100, Luminex 200 or Luminex FLEXMAP 3D Instrument is turned on for at least 30 minutes before the hybridization ends.**

6. While the samples are hybridizing, prepare a 200:1 Dilution Solution/SA-PE mixture. Combine 170 µL Dilution Solution (DS) and 0.85 µL 1mg/mL SA-PE per sample. *It is recommended to make enough Dilution Solution Mixture for n+1 samples to account for pipetting loss.* ***(See Table 5).***
7. *Keep Dilution Solution/ SA-PE mixture in the dark, at room temperature; SA-PE is light sensitive!* The Dilution Solution may be warmed at 45°C for 5 minutes and vortexed upon arrival to ensure all components are in solution. Dilution solution must be at room temperature (18 to 30°C) before making the mixture. **Prepare prior to use and discard any remaining portion.**

Table 5. Dilution Solution Preparation Volumes

# of Samples	Dilution Solution (DS)	SA-PE
1	170 µL	0.85 µL
5	850 µL	4.25 µL
10	1700 µL	8.5 µL
20	3400 µL	17 µL
50	8500 µL	42.5 µL

Note: DO NOT CANCEL HYBRIDIZATION PROGRAM BEFORE REMOVING THE TRAY FROM THE THERMAL CYCLER!

8. At the 56°C hold, while the tray is on the thermal cycler, dilute each sample with 170 µL of the prepared Dilution Solution/ SA-PE mixture. **It is critical to dilute all samples within 5 minutes (following the 8 minute 56°C HOLD step).**
9. Remove the sample tray from the thermal cycler and place in the Luminex 100, Luminex 200 or Luminex FLEXMAP 3D Instrument.

D. Analyze sample using the Luminex 100, Luminex 200 or Luminex FLEXMAP 3D Instrument*

For best results, assay the samples immediately using the Luminex 100, Luminex 200 or Luminex FLEXMAP 3D Instrument. Samples can be read up to 30 minutes after being diluted. If not read immediately, protect samples from light.

1. Turn on the Luminex 100, Luminex 200 or Luminex FLEXMAP 3D Instrument between 30 minutes and 4 hours before assaying the samples.
2. Prior to analyzing the samples on the Luminex 100, Luminex 200 or Luminex FLEXMAP 3D Instrument, set up a Batch Run by which the samples will be analyzed.
   a) Select ***Create a New Batch*** from the File menu.
      - For example, if analyzing for HLA-DRB1, add Batch for **HLA-DRB1**.
      - The Batch Template is provided and is named, in this case, HLA-DRB1.
      - Please note that the template versions are lot number specific and correspond to the kit lot numbers.
      - Follow the stepwise instructions that appear on the screen for creating batches.
      - **When naming the batch, do not include commas in the name because information after a comma will be lost upon exportation of the data.**
      - For further instructions on creating batches and multibatches, refer to the Luminex User's Manual.
   b) Click the eject icon to eject the plate holder. Place the 96 well thermal cycler plate containing the samples in the XYP heater block present on the plate holder.
   c) Click the Retract icon. The samples are now ready to be analyzed. A prime step should be performed before starting the run.
   d) After the samples have been run through the instrument, a sanitization step with 70% Isopropanol or 20% household bleach should be performed followed by two wash steps. The instrument can be turned off at this point if it is not going to be used for the remainder of the day.
3. After a batch is complete, the data is exported as a comma separated values (csv) file. These files are named 'OUTPUT.CSV' and saved in a folder with the Batch Name. This data is then available for making typing assignments as described below.

*Refer to Luminex User's Manual for instrument operation, including daily startup, calibration, maintenance, and shutdown procedures.

RESULTS

MATCH IT!™ DNA Software (▲ v1.3 with current applicable patches available at Immucor Customer Center) is intended as an aid in analysis of LIFECODES SSO Typing Kits.

Sample typing can be done as follows:
The generated CSV files can be opened and the data processed with common spreadsheet programs such as Microsoft Excel, Lotus 123, Corel Quattro Pro, or similar software. Analysis is comprised of the following steps:

1) Verify the minimum number of events for each SSO in each sample is met. This information is found in the ***DataType: Count*** section of the CSV file.
2) Determine that the values for the Consensus probes for each sample are above their minimum Median Fluorescent Intensity or MFI. The minimum thresholds are lot specific and can be found in the Threshold Table.

Caution:

- *To obtain reliable results, there must be sufficient data gathered by the Luminex 100, Luminex 200 or Luminex FLEXMAP 3D Instrument.*
- *Collect at least 40 events for HLA-DQA1/B1 (Part No. 628930) and HLA-DPA1/B1 (Part No. 628936). Collect at least 60 events for rest of the kits listed in Section "KITS/REAGENTS BY CATALOG NUMBER" or the minimum events specified in lot specific documents.*

3) Subtract the *Background Control* value for each probe from the sample values producing the background corrected data set. Background Control values are found in the Threshold Table and are lot specific. Background values are average MFI values for each bead to compensate for background noise due to bead variation.
4) For each sample, divide the background-corrected data for each probe by the background-corrected value for the corresponding consensus probe producing the normalized data set.

$$\frac{\text{MFI (Probe)} - \text{MFI (Control blank for probe)}}{\text{MFI (Consensus)} - \text{MFI (Control blank for consensus)}}$$

5) For each probe, record the normalized value on the Threshold Table Worksheet.
6) Once all values have been assigned, the probe hit pattern (i.e., the combination of all positive and negative assignments for a given sample) can be compared with the Probe Hit Table(s) provided.

Caution:

- *There is a separate threshold table for each locus and each probe mix.*
- ***These threshold tables are Lot-specific; be certain that the Lot No. on the threshold tables matches the Lot No. in the typing kit.***
- *If a normalized value for a particular probe falls above the maximum threshold for a negative assignment and below the minimum value for a positive assignment, the sample should be considered as indeterminate for this probe. The sample should be typed, first assuming the value to be negative and then again assuming the value to be positive.*
- ***See EXPECTED VALUES** section for further information on threshold values.*

QUALITY CONTROL

It is recommended that one negative and positive control be run with each test, such as a water blank and a previously typed sample respectively. Consensus SSO probes, listed on the Threshold Table, hybridize to their respective locus specific alleles. Values obtained with

the Consensus SSOs from positive controls should exceed the threshold value for the SSO as set forth in the Threshold Table Worksheet. Values obtained with the Consensus SSOs from water blanks should be below the threshold value for the SSO as set forth in the Threshold Table Worksheet.

The LIFECODES Probe Mix(es) contain one or more consensus SSO probes identified in the typing kit worksheets. These consensus probes hybridize to all alleles and act as internal controls to verify amplification and to confirm that hybridizations occurred. If the minimum value is not obtained for these SSOs, the sample may not produce the correct typing and the sample test should be repeated.

The assay should be run as recommended in the package insert as well as performed with any other quality control procedures that are in accordance with local, state, federal and/or accreditation agencies requirements.

LIMITATIONS OF THE PROCEDURE

The PCR conditions and assay conditions described require precisely controlled conditions. Deviations from these parameters may lead to product failure.

All instruments must be calibrated according to manufacturer's recommendations and operated within manufacture's prescribed parameters.

1) Beads must be pre-warmed and well suspended prior to use. This ensures that the hybridization buffer components are in solution.
2) 47°C and 56°C incubations require a high degree of accuracy (+/- 0.5°C). A thermal cycler should be employed. Temperature should be verified, within wells of the 96 well thermal cycler plate, using a thermocouple (e.g., Bio-Rad, Model VPT-0300 or equivalent). The temperature within wells and among wells should not vary more than +/- 0.5°C.
3) Time at 56°C is critical and should not exceed a total of 13 minutes. This includes the 8-minute incubation plus no more than 5 minutes to dilute all the samples with Dilution Solution/ SA-PE mixture.
4) Once diluted, the samples are stable at room temperature (18 to 30°C) for up to 2 hours (protect from light). Since a full 96-well plate can take up to 1.5 hrs to run through the Luminex 100, Luminex 200 or Luminex FLEXMAP 3D Instrument, the analysis should be started no more than 30 minutes after dilution to ensure that the last sample is analyzed within the 2-hour limit.
5) Do not mix components from other kits and lots.
6) SSO has limitations regarding resolution of ambiguities because the oligonucleotide probes used in SSO can only interrogate sample DNA at one region, whereas SSP can interrogate sample DNA at two regions and sequencing can interrogate entire exonic sequences. This is a basic limitation of the SSO method, which is well understood by the HLA professional.

Due to the complex nature of HLA typing, qualified personnel should review data interpretation and typing assignments.

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE		SOLUTION
Low Bead Count	Probe Mix not well suspended		Pre-warm, sonicate and vortex probe mix and repeat assay.
	Instrument not functioning properly	Out of Calibration	Calibrate Instrument. *(Refer to Luminex User's manual.)*
		Sample flow path blocked	Remove and sonicate needle. Perform backflush. Call Immucor GTI Diagnostics, Inc. if problem persists. (855) 466-8267
CON Threshold Failure	Sample failed to amplify or amplified poorly*	Low DNA	Check DNA concentration and purity.
		Salts in Master Mix are out of solution	Heat Master Mix at 37°C for 5 minutes, vortex gently and spin down briefly.
		Poor Taq Polymerase	Use validated LIFECODES Taq Polymerase Cat. No. 628075.
	Amplification conditions not within specific parameters		Run Thermal profile on Thermal cycler to verify parameters are within specified parameters.
	Low Median Fluorescent Intensity Value (MFI)		Warm dilution solution at 45°C for 5 minutes before use and vortex. Store at room temperature.
			Replace R-Phycoerythrin Conjugated Streptavidin.
Multiple SSO failures or sample fails to yield a HLA typing result	Allele specific amplification	Amplification conditions not within specific parameters	Run Thermal profile on Thermal cycler to verify parameters are within specified parameters.
	DNA sample contaminated		Re-isolate DNA from Blood sample.
	DNA partially degraded		
	Evaporation during hybridization step		If not using an entire plate, leave one row empty on each side of samples to be assayed to allow plate to be sealed tightly.

*** PCR amplification can be verified by gel electrophoresis (See Appendix A).**

EXPECTED VALUES

Values typically can be resolved as positive and negative. In some rare instances, the values may be indeterminate. An "indeterminate value" represents a range in which neither positive nor negative values have been observed. If a sample contains indeterminate values for a particular SSO probe, the sample should be typed with the probe as a negative and again with the probe as a positive. Three cases can arise:

1. One of the choices (i.e. Positive or Negative) provides a match.
2. Both choices provide matches.
   - Sample can be re-assayed, or the alleles obtained from both typings can be reported.
3. Neither choice produces a match.
   - In this instance, there are likely to be other probes that were incorrectly assigned. This sample needs to be re-assayed and possibly re-amplified.

- If more than two probes are indeterminate, the sample should be re-assayed.
- If a probe hit pattern does not produce an HLA type, the sample should be re-amplified and re-assayed. It may also be necessary to re-isolate DNA from the sample and re-amplify and re-assay.
- As noted in the ***Limitations of the Procedure*** section, it is critical to precisely follow the protocol. Any deviations can lead to sample typing failure.

SPECIFIC PERFORMANCE CHARACTERISTICS

When LIFECODES HLA SSO Typing Kits are used according to the procedure described in the product insert, the Class I and Class II HLA type of DNA samples can be determined.

ACCURACY

The HLA A kit (Catalog No. 628911) shows 98.46% agreement for HLA A Alleles (95.24% lower boundary using one-sided exact method at 95% confidence interval) when comparing HLA typing results at 2 fields in 130 well characterized samples.

The HLA A eRes kit (Catalog No. 628913) shows 98.46% agreement for HLA A Alleles (95.24% lower boundary using one-sided exact method at 95% confidence interval) when comparing HLA typing results at 2 fields in 130 well characterized samples.

The HLA B kit (Catalog No. 628915) shows 99.23% agreement for HLA B Alleles (96.40% lower boundary using one-sided exact method at 95% confidence interval) when comparing HLA typing results at 2 fields in 130 well characterized samples.

The HLA B eRes kit (Catalog No. 628917) shows 99.23% agreement for HLA B Alleles (96.40% lower boundary using one-sided exact method at 95% confidence interval) when comparing HLA typing results at 2 fields in 130 well characterized samples.

The HLA C eRes kit (Catalog No. 628921) shows 99.23% agreement for HLA C Alleles (96.40% lower boundary using one-sided exact method at 95% confidence interval) when comparing HLA typing results at 2 fields in 130 well characterized samples.

The HLA DRB1 kit (Catalog No. 628923) shows 98.46% agreement for HLA DRB1 Alleles (95.24% lower boundary using one-sided exact method at 95% confidence interval) when comparing HLA typing results at 2 fields in 130 well characterized samples.

The HLA DRB1 eRes kit (Catalog No. 628925) shows 98.46% agreement for HLA DRB1 Alleles (95.24% lower boundary using one-sided exact method at 95% confidence interval) when comparing HLA typing results at 2 fields in 130 well characterized samples.

The HLA DRB 3, 4, 5 kit (Catalog No. 628927) shows 100% agreement for HLA DRB 3, 4, 5 Alleles (97.72% lower boundary using one-sided exact method at 95% confidence interval) when comparing HLA typing results at 2 fields in 130 well characterized samples.

The HLA-DQA1/B1 kit (Catalog No. 628930) shows 99.2% agreement for DQA Alleles (96.2% lower boundary using one-sided exact method at 95% confidence interval) and 98.4% agreement for DQB Alleles (95.2% lower boundary using one-sided exact method at 95% confidence interval) when comparing HLA Typing results at 2 fields in 123 and 128 well characterized samples, respectively.

The HLA-DPA1/B1 kit (Catalog No. 628936) shows 100% agreement for DPA Alleles (97.8% lower boundary using one-sided exact method at 95% confidence interval) and 98.5% agreement for DPB Alleles (95.4% lower boundary using one-sided exact method at 95% confidence interval) when comparing HLA typing results at 2 fields in 133 and 135 well characterized samples, respectively.

PRECISION STUDIES

Reproducibility

Three operators using three lots of HLA-B and HLA-DRB1 tested 16 samples in duplicate. Percent concordance by operator and by lot ranged from 98.9% to 100% and percent failure ranged from 0% to 1.04%.

For HLA-DQA1B1 and HLA-DPA1/B1, operators performed testing on five non-consecutive days. All testing showed 100% concordance with 0% failures.

Repeatability

One operator performed testing on five non-consecutive days using one lot of the HLA-B and HLA-DRB1 kits. For HLA-B 100% concordance was obtained on each day. The % failures ranged from 0% to 1.6%. For HLA-DRB1 concordance ranged from 96.8% to 100%. The % failures ranged from 0% to 4.6%.

Three laboratories participated in the Repeatability study each testing twelve samples on HLA-DQA1/B1 and HLA-DPA1/B1. 100% concordance was observed on each day with each product. The % failures ranged from 0% to 3.1% for HLA-DPA1, 0% to 2.7% for HLA-DPB1, 0% to 0.7% for HLA-DQA1 and 0.3% to 1% for HLA-DQB1.

DETECTION LIMIT

Limit of Detection studies were performed with ten well-characterized samples across all products. Samples were tested in duplicate across six quantities of input DNA ranging from below the lower recommendation of 40 ng to above the upper recommendation of 120 ng. 95% or greater concordance was observed for all products at all concentrations.

HLA Typing by SSO (Sequence Specific Oligonucleotide) methods is accomplished using sequence-specific oligonucleotide probes. Each SSO Oligonucleotide is challenged with known positive and negative reacting alleles to establish and ensure expected reactivity.

INTERFERENCE

In laboratory testing, the following substances demonstrated some inhibition when evaluated with LIFECODES HLA-DQA1/B1 and LIFECODES HLA-DPA1/B1 SSO Typing Kits. The highest concentration of interfering substances without inhibition is Sodium Dodecyl Sulfate (0.005% (w/v)), Ethanol (500 mM), Phenol (0.125% (v/v)), Sucrose (0.1 M), EDTA (500µM), ACD, (0.1% (v/v)), Cholesterol (3 µg/mL), Bilirubin (16.4 µM), Hemoglobin (0.0156 mg/mL) and Hemolyzed Blood (0.1 % (v/v)).

REFERENCES

1. Olerup, O., & Zetterquist, H. (1992). HLA-DR typing by PCR amplification with sequence-specific primers (PCR-SSP) in 2 hours: an alternative to serological DR typing in clinical practice including donor-recipient matching in cadaveric transplantation. *Tissue antigens* **39**(5), 225–235.
2. Saiki, R., Bugawan, T., Horn, G. *et al.* (1986). Analysis of enzymatically amplified β-globin and HLA-DQα DNA with allele-specific oligonucleotide probes. *Nature* **324**, 163–166.
3. Maeda M, Murayama N, Ishii H, et al. (1989). A simple and rapid method for HLA-DQA1 genotyping by digestion of PCR-amplified DNA with allele specific restriction endonucleases. *Tissue Antigens* **34**(5):290-298.
4. Bugawan, T. L., Begovich, A. B., and Erlich, H. A. (1990) Rapid HLA-DPB typing using enzymatically amplified DNA and nonradioactive sequence-specific oligonucleotide probes. *Immunogenetics* **32**: 231–241.

LIMITED LICENSES

Taq Polymerase is manufactured for Immucor GTI Diagnostics by Promega Corp. It is licensed to Promega under U.S. Patent Nos. 5,338,671 and 5,587,287 and their corresponding foreign patents. The purchase of this product includes a limited, non-transferable license under U.S. patent 5,981,180 or its foreign counterparts, owned by Luminex Corporation, to perform multiplex analysis of clinical specimens for HLA typing.

AUTHORIZED REPRESENTATIVE

Authorized Representative: Immucor Medizinische Diagnostik GmbH, Robert-Bosch-Strasse 32, 63303 Dreieich, Germany
Phone: +49 (0) 6103 80560, Fax: +49 (0) 6103 8056199

Technical Support Contact Information:
US: Lifecodestechsupport@immucor.com
International: Tech.support.intl.transplant@immucor.com

CE

This document last revised and issued: 2021-11-22

TRADEMARKS USED

AB Gene®	AB Gene House
Costar®	Corning Incorporated
Microseal™	Bio-Rad Laboratories, Inc.
IDNA™ Agarose	Lonza Group, Ltd.
GelStar™	Lonza Group, Ltd.
Luminex®	Luminex Corporation
FLEXMAP 3D®	Luminex Corporation
Gene Amp®	Roche Molecular System
Veriti™	Applied Biosystem
LIFECODES®	Immucor Inc.

APPENDIX A

Gel Electrophoresis

The PCR reactions performed in the LIFECODES HLA-SSO Typing Kits are designed to produce both double and single stranded products, which are the predominant products that hybridize to the SSOs. For quality assurance or to trouble shoot an experiment it might be necessary to perform gel electrophoresis to examine the PCR reaction for the presence of amplified DNA.

Materials Required (as listed or equivalent)

- Electrophoresis Grade Agarose (Lonza Group, Ltd. IDNA® Agarose No. 50170)
- Electrophoresis apparatus/power supply
- 1X Gel Buffer (40xTAE, Promega No. V4281)
- GelStar® Nucleic Acid Gel Stain (Lonza Group, Ltd. No. 50535)
- UV Transilluminator (ChromatoVUE, UVP Inc. Model TM36)
- Photographic imaging system

The relative migration of the single stranded product is dependent upon the gel concentration and buffer system employed. Approximate migrations for each amplification are listed below for samples run in a 2% Agarose gel in 1X TAE buffer.

Electrophoresis Conditions

Note: Not applicable for HLA-DQA1/B1 (Part No. 628930), HLA-DRB 3,4,5 (Part No. 628927) and HLA-DPA1/B1 (Part No. 628936) as Individual bands cannot be distingulshed in combination multiplex.

1. Remove GelStar® Nucleic Acid Stain (Lonza Group, Ltd. No. 50535) from freezer to thaw. Keep in dark.
2. The gel used for this procedure must be 2%, i.e. for a 200 ml gel bed use 4 grams of agarose to 200 mL 1X TAE (Dilute from 40X TAE). Add 10µL GelStar® Nucleic Acid Stain to the molten agarose. When pouring the gel be sure to leave ample room for DNA to run a significant distance (1 to 2 inches). **USE CAUTION: GelStar® is a potential Carcinogen.**
   NOTE: It is possible to run gels with 20µL of 10mg/mL Ethidium Bromide in place of GelStar® Nucleic Acid Stain. Product band intensity will be less in gels containing Ethidium Bromide than in gels containing GelStar®. **USE CAUTION: Ethidium Bromide is a known Carcinogen.**
3. Keep gel in dark and allow to solidify.
4. Load a mixture of 2.5 µL of each PCR product and 2.5 µL 2X loading buffer with visible dye per sample, per amplification. Let gel run in the dark at approximately 160 volts for 45 minutes or until sample runs far enough to see separate bands for single and double stranded product (bromophenol blue band or other visible marker migrates 1 to 2 inches from wells).
5. Photograph using UV Transilluminator accompanied by a GelStar® Yellow Photographic Filter (Lonza Group, Ltd. No. 50536). **CAUTION: Wear protective equipment when handling GelStar® Nucleic Acid Stain or Ethidium Bromide and when photographing gel using UV Transilluminator.**
6. Gel analysis:

	HLA-A	HLA-B	HLA-C	HLA-DRB1
Double Strand(s) (bp)	~420	~370, ~340	~476, ~447	~280
Single Strand(s) (bp)	~240	~200	~250, ~200	~180

Gel Interpretation