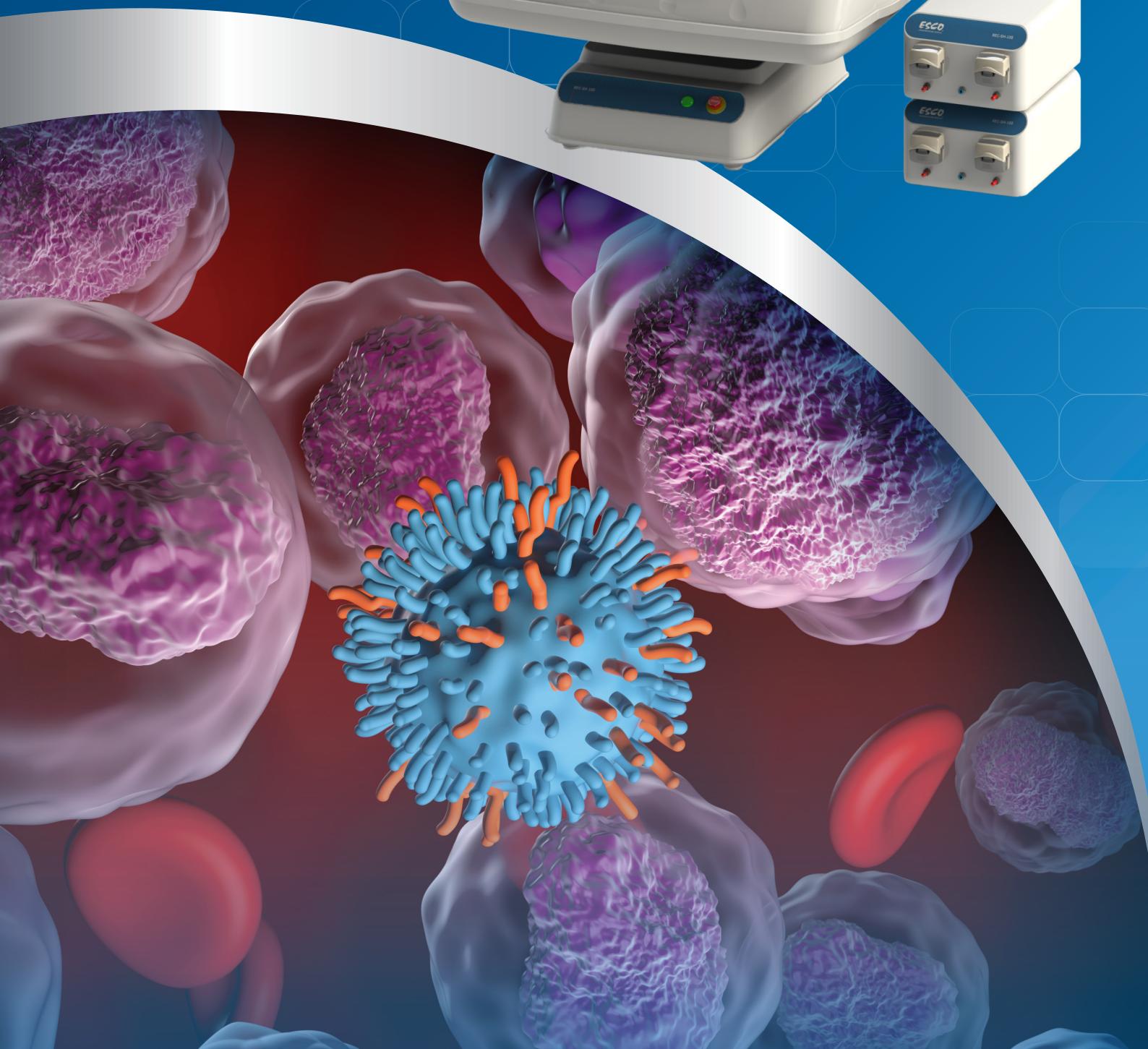


TideWave™

**The Rhythm of Reliable and
Flexible Cell Culture**



TideWave™

The TideWave™ is a GMP-compliant, single-use cell expansion platform designed and manufactured to meet the rigorous demands of biopharmaceutical manufacturing and research. It offers a seamless, linear scale-up from our research-grade CelXrocker™ system, accelerating process development while enabling efficient transition to clinical commercial manufacturing.

Designed for versatility, it supports both adherent using macroporous carriers and suspension cultures in both non permeable and permeable bags—ideal for autologous cell therapies, genetically modified cell products, as well as gene therapy products.



Why Choose the TideWave™ Bioreactor System?

1. Key Versatile Culture Modes

Supports traditional suspension wave bioreactor operation and Esco's innovative TideWave™ mode, enhancing performance and flexibility. Suitable for batch, fed-batch, and perfusion cultures, enabling multi-purpose use in one platform.

2. Efficient Tide-Based Technology

Inspired by tidal motion, the system gently moves the medium across fixed carriers within the bag, creating an environment of low shear stress, high aeration, and effective nutrient exchange—ideal for adherent cell growth and productivity.

3. Linear Scalable Product Portfolio

Available in 10L, 20L, 50L, and 200L volumes.

4. Advanced Contamination Control

Single-use technology ensures sterility, reduces contamination risk, and allows fast, flexible product changeover with no cross-contamination.

5. Superior Culture Performance

Achieves rapid mixing, oxygen transfer without bubble aeration, and enhanced cell viability and density, resulting in improved yield—while eliminating the need for antifoam agents.

6. Intelligent Control System

Features precise PID control, swing/rock angle regulation, pH/DO stabilization, and gas flow algorithms. The system includes cascading functions, an intuitive interface, complete audit trails, and easy learning curve.

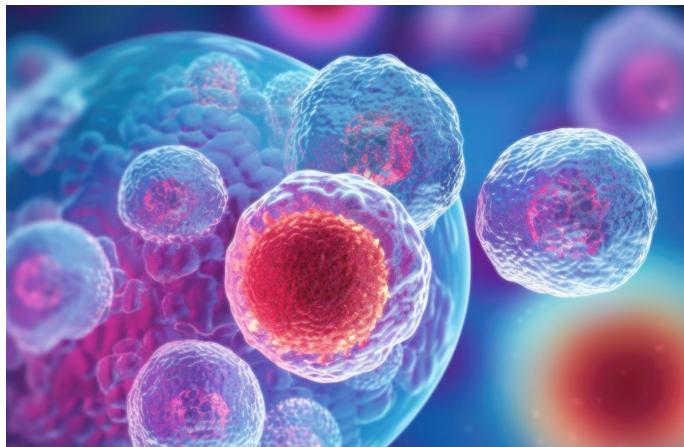
7. Integrated Safety Monitoring

Equipped with sensors for pressure, leak detection, and multi-parameter alarms to ensure operational safety and efficiency. CE-certified for regulatory compliance.

8. Comprehensive Support Services

Includes full documentation for FAT, IQ, and OQ, along with professional maintenance and cell culture technical support to ensure long-term success.

Application Areas



1. Traditional Wave Bioreactor Mode

a. Biopharmaceuticals – Vaccines & Antibodies

Supports the research, development, and production of vaccines and monoclonal antibodies. Applications include:

- Seed expansion for suspension (e.g., CHO, Sf-9) and adherent cells (e.g., Vero) on microcarriers or paper carriers
 - Viral seed preparation for both suspension and adherent cultures
 - Fed-batch and perfusion culture, and recombinant protein expression



b. Cell & Gene Therapy

Enables suspension and adherent culture of immune cells such as CAR-T and CAR-NK, along with development and production of viral vectors for gene therapy applications.

c. Stem Cells & Cultivated Meat

Optimized for the culture of mesenchymal stromal cells (MSCs), muscle stem cells, and other adherent or suspension-grown cell types for regenerative medicine and cell-based meat production

d. Growth Factors, Viral Vectors & Exosomes

Supports upstream processes for the production of growth factors, viral vectors, and extracellular vesicles/exosomes, including scale-up and process optimization.

e. Plant Biotechnology & Natural Medicines

Facilitates plant cell culture for plant breeding, and the development and extraction of traditional herbal and natural medicines.



2. TideMotion Bioreactor Mode

TideMotion is a patented technology which enable the culture medium flows through a packed-bed of carriers, giving cells nutrients during immersion and oxygen during exposure.

This creates very low shear stress, allowing adherent cells to grow to high densities for vaccine, viral vector, and cell therapy production.

a. Adherent Cell Culture

Cultivation of mammalian and insect cells, including derivatives, using macrocarriers (e.g. BioNOC II®, BioMESH®) and/or disk-type carrier.

b. System Transition & Scale-Up

Seamless upgrade from open systems (e.g., 2D flasks, roller bottles) to closed, scalable 3D bioreactors—enhancing efficiency, sterility, and production yield.

c. Biologics Manufacturing

End-to-end support for the research, development, and production of biologics, including recombinant proteins and monoclonal antibodies.

d. Vaccine Production

Supports upstream processes for the production of growth factors, viral vectors, and extracellular vesicles/exosomes, including scale-up and process optimization.

Scalable solutions for the research, development, and manufacturing of viral and protein-based vaccines.

e. Stem Cells & Cultivated Meat

Optimized for the culture of mesenchymal stromal cells (MSCs), muscle stem cells, and other adherent cell types for regenerative medicine and cell-based meat production.

f. Enables adherent culture such as MSC, along with development and production of viral vectors for gene therapy applications.

Key Components

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This all-in-one system integrates:

- A **rocking platform** with adjustable speed, angle, and dwell time for optimal mixing and gas transfer.
- A **single-use culture bag** for sterile, closed-system processing
- A complete **automation suite**, including PLC control, temperature regulation, peristaltic pumps, DO/pH monitoring, pressure and leak sensors, and gas flow control (via MFC and check valves)

Key components include trays, thermal insulation covers, control cabinets, and a comprehensive electrical and gas distribution system. The platform supports precise control of critical culture parameters—such as rocking motion, gas flow, temperature, pH, and DO—to enable consistent and scalable, cell culture.



TideWave Platform

Electrically driven base that moves the cell culture bag side to side at a programmable frequency and angle. This movement promotes homogenized mixing which promotes oxygen transfer while minimizing shear stress.

Light Indicator

Green, yellow, and red light for equipment status



Thermal Insulation Cover

Designed to minimize heat loss and maintain stable temperature conditions throughout the cell culture process.

Cell Culture Bag

A sterile, single-use bag that holds the culture medium and cells.

Tray

Serves as the support structure for the culture bag during operation, ensuring stable and uniform TideWave motion. Available in three (3) tray models, it accommodates a range of working volumes.

Peristaltic Pumps

Enables accurate, sterile, and gentle fluid handling during cell culture processes. Designed to transfer media, buffers, feed solutions, and harvest fluids without exposing them to contamination.

Technical Parameters

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Equipment Model	TideWave		
Tray Specification	10 L	20 L	50 L
Cell Bag Specification	2 L; 5 L; 10 L	20 L	50 L
Working Volume	0.4-1 L; 1-2.5 L; 2-5 L	4-10 L	5-15L
Control System	14-inch color control screen, Ethernet interface, USB interface		
Temperature Control	Heated by a heating blanket, with PID automatic control. The precision is $\pm 0.3^{\circ}\text{C}$, and the control range is 25-40°C.		
Swing	Speed: 2-40RPM ± 1 rpm Tide: The holding time is set independently for three sections: the previous high position, the horizontal position, and the subsequent high position. The stagnation setting time and accuracy: 0 - 9999 minutes and 59 seconds ± 15 seconds. The swinging direction is in the front - back and high - low mode.		
Swing Angle	5-12° $\pm 0.1^{\circ}$		
Aeration	Air/O ₂ /CO ₂ and other mass flow meters		
Exhaust Gas Control	Exhaust gas condensation device equipped with a filter heating function		
pH	Disposable optical electrode, with a range of 5.5 - 8.5 ± 0.02 ; can be connected to the gas and peristaltic pump, and has automatic PID control.		
DO	Disposable optical electrode, with a range of 0.0~100.0%; can be connected to the gas and has automatic PID control.		
Pump	Two (2) sets of peristaltic pumps, which can be customized for feeding, harvesting, acid supplementing, and alkali supplementing; two (2) sets of peristaltic pumps are used for perfusion.		
Weighing Module	0-35kg ± 0.1 kg		
Monitoring	Pressure monitoring, ranging from -1000 mbar to 1000mbar. The gas intake will stop when the set pressure is exceeded. Liquid leakage sensor, with liquid leakage alarm and protection functions.		
Power	AC220V $\pm 10\%$, single phase, 50/60Hz		

Equipment Model	TideWave	
Tray Specification	200 L	
Cell Bag Specification	200 L	
Working Volume	40-100 L	
Control System	14-inch color control screen, Ethernet interface, USB interface	
Temperature Control	Heated by a heating blanket, with PID automatic control. The precision is $\pm 0.3^{\circ}\text{C}$, and the control range is 25-40°C.	
Swing	Speed: 1-25 rpm Tide: The holding time is set independently for three sections: the previous high position, the horizontal position, and the subsequent high position. The stagnation setting time and accuracy: 0 - 9999 minutes and 59 seconds ± 15 seconds. The swinging direction is in the front - back and high - low mode.	
Swing Angle	1-10°	
Aeration	Air/O ₂ /CO ₂ and other mass flow meters	
Exhaust Gas Control	Exhaust gas condensation device equipped with a filter heating function	
pH	Disposable optical electrode, with a range of 5.5 - 8.5 ± 0.02 ; it can be connected to the gas and peristaltic pump, and has automatic PID control.	
DO	Disposable optical electrode, with a range of 0.0~100.0%; can be connected to the gas and has automatic PID control.	
Pump	Two (2) sets of peristaltic pumps, which can be customized for feeding, harvesting, acid supplementing, and alkali supplementing; two (2) sets of peristaltic pumps are used for perfusion.	
Weighing Module	0-200kg ± 0.5 kg	
Monitoring	Pressure monitoring, ranging from -1000kPa to 1000kPa. The gas intake will stop when the set pressure is exceeded. Liquid leakage sensor, with liquid leakage alarm and protection functions.	
Power	AC220V $\pm 10\%$, single phase, 50/60Hz	

Scale-Up Strategy

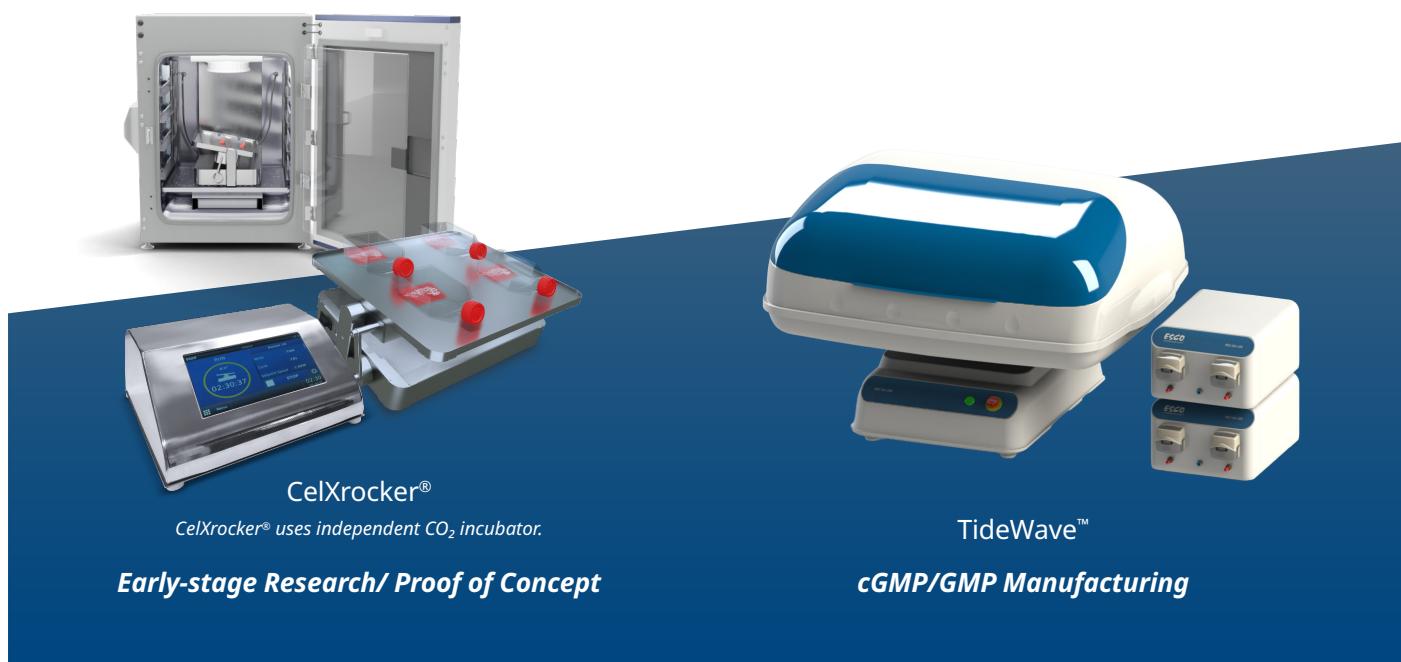
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Esco Healthcare enables efficient process development and scale-out for suspension and semi-adherent cell applications, supporting the full journey from research to regulated manufacturing.

The **CelXrocker®** platform provides a user-friendly, small-scale solution for early-stage research, proof of concept, and protocol optimization in a non-GMP setting. Once processes are established, they can be seamlessly scaled to the **TideWave™ Bioreactor**, a large-scale, GMP-compliant platform designed for clinical and commercial manufacturing.

For teams seeking a capital-efficient path to production, **Esco Aster** offers cGMP-compliant **CRDMO services** powered by the TideWave™ system—enabling technology transfer and scalable manufacturing of clinical materials from RUO labs to GLP studies and full cGMP production.

Together, CelXrocker® and TideWave™ provide a flexible and scalable solution for innovators developing vaccines, cell therapies, biologics, and other adherent and/or suspension-based applications.

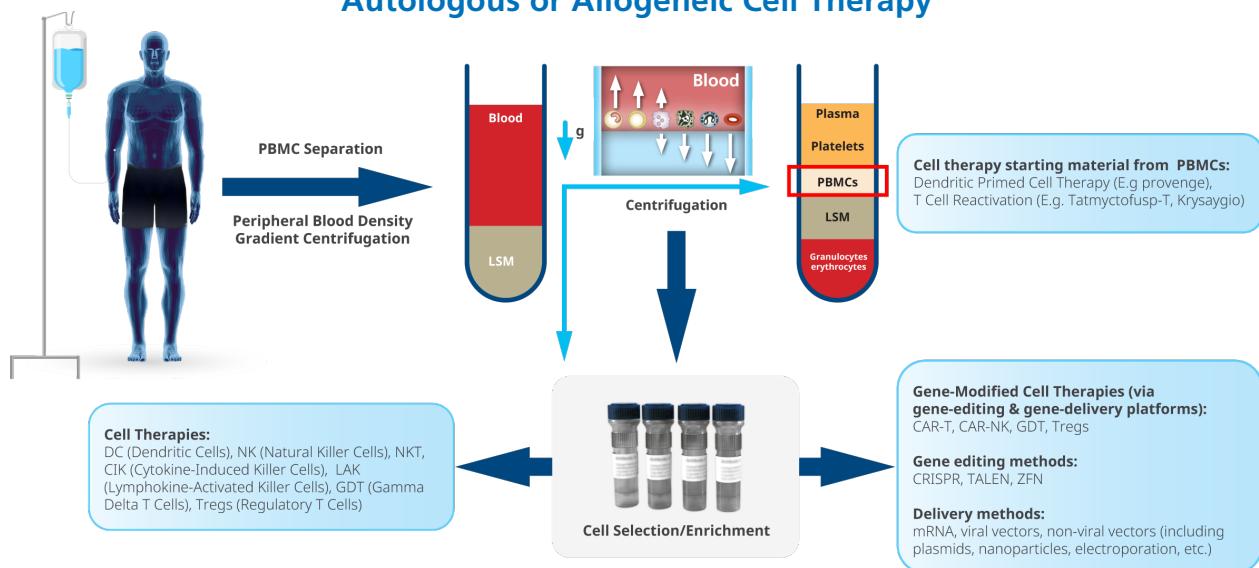


Ordering Information

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Item Code	Equipment
TW-010	TideWave-10L
TW-020	TideWave-20L
TW-050	TideWave-50L
TW-200	TideWave-200L
Item Code	Single-use bags
TWB002	2L TideWave Bag
TWB005	5L TideWave Bag
TWB010	10L TideWave Bag
TWB020	20L TideWave Bag
TWB050	50L TideWave Bag
TWB200	200L TideWave Bag

Autologous or Allogeneic Cell Therapy



Cell Centrifuge, Separation, and Washing Cup Closed System Applications: Immune Cell Therapy Products

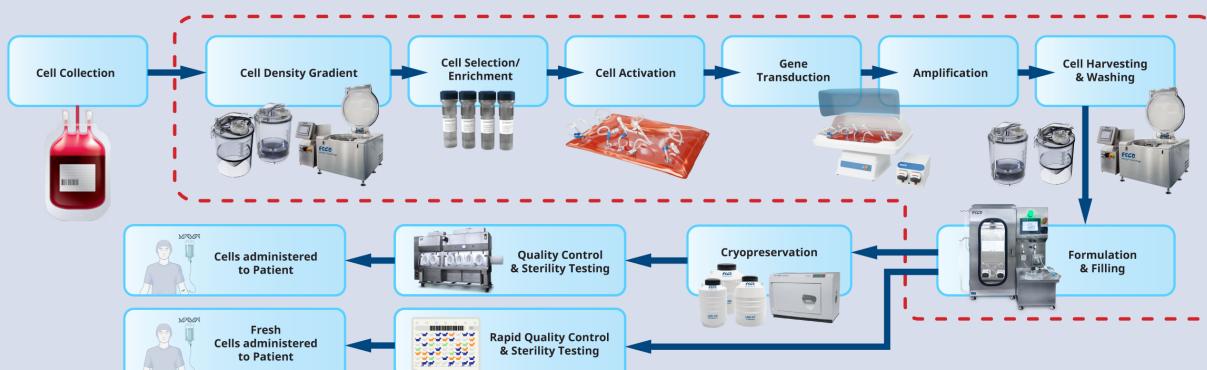
Cell Therapy Workflow (Without Genetic Modification)



The **Infinity™ Centrifuge** is designed for versatility—it may function as a standalone centrifugation solution or be integrated within the **Infinity™ Workstation (CPWS)** or **Cell Processing Isolator (CPI)**. This modularity enables users to match their facility layout, biosafety needs, and process requirements while maintaining a compliant and efficient cell therapy workflow.



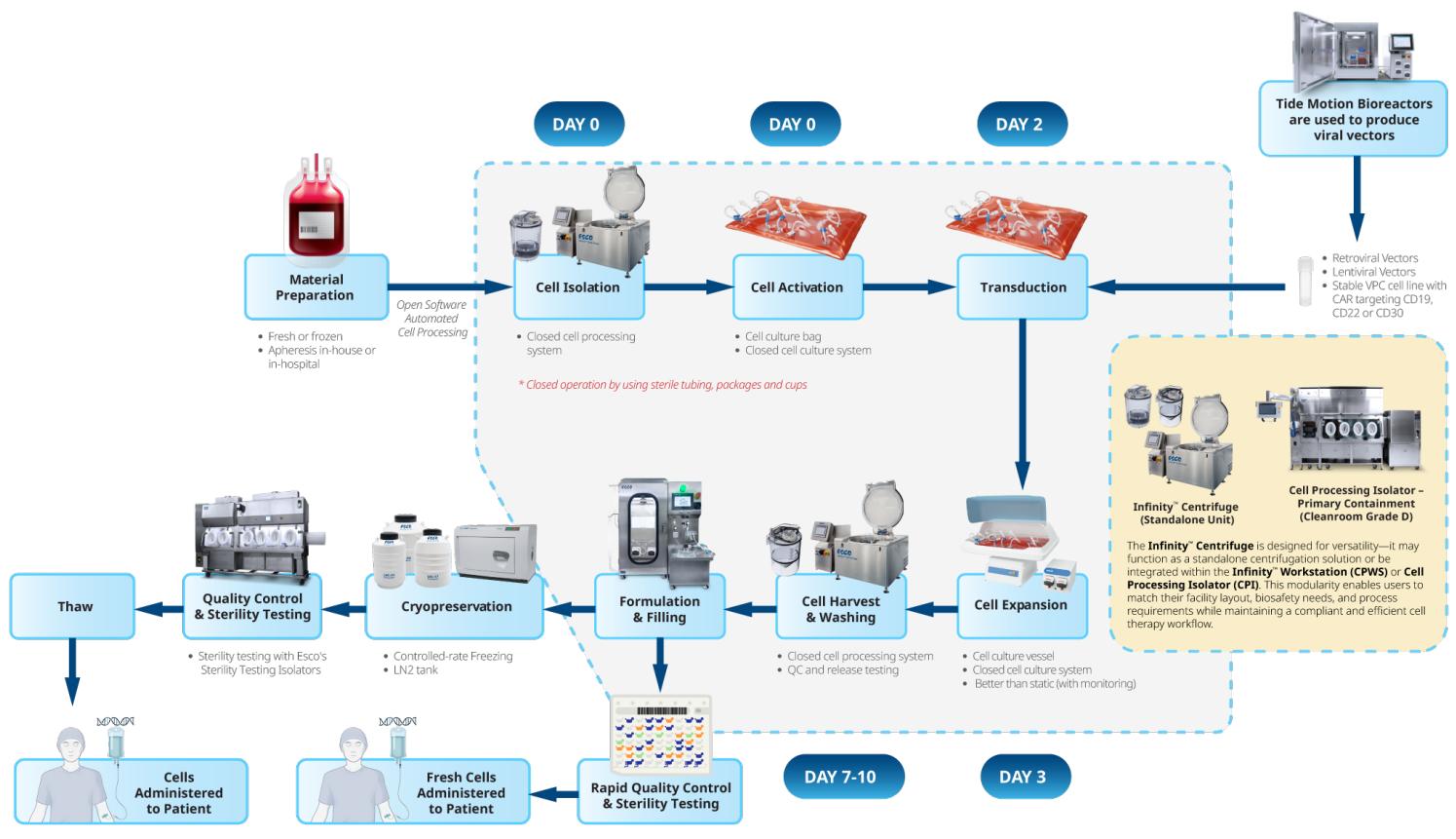
Genetically-modified Cell Therapy Workflow



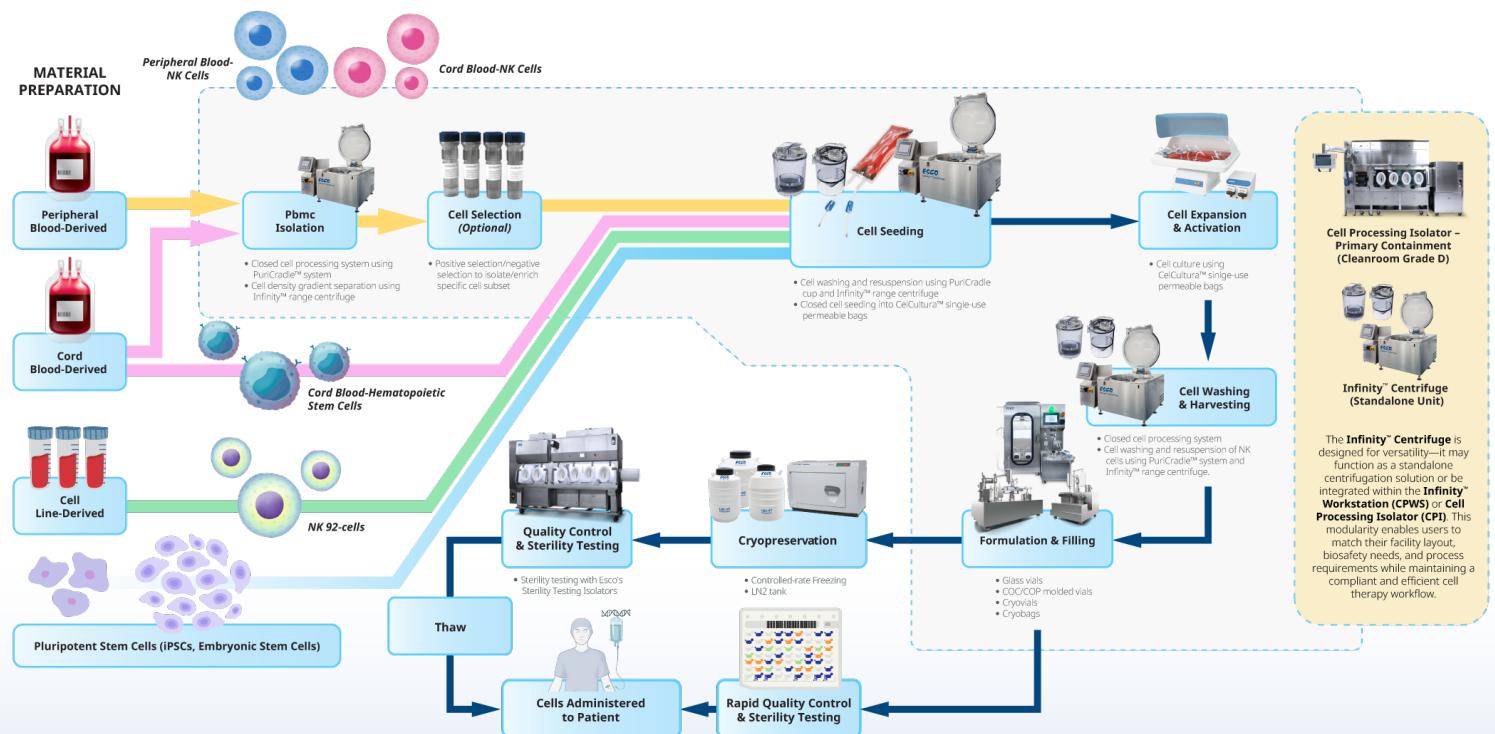
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Esco Aster's cGMP CAR-X Cell Therapy Manufacturing Process



Esco Aster's NK Cell Therapy Workflow



ESCO LIFESCIENCES GROUP NETWORK
42 Locations in 24 Countries All Over the World



Air Shower
 Aseptic Containment Isolator (ACTI)
 Ceiling Laminar Airflow Units
 Cleanroom Transfer Hatch
 Containment Barrier Isolator (CBI)
 Downflow Booth (DFB)
 Dynamic Floor Laminar Hatch
 Dynamic Pass Box
 Evidence Drying Cabinet
 Garment Storage Cabinet
 General Processing Platform Isolator (GPPI)
 Laminar Flow Horizontal Trolley
 Laminar Flow Straddle Units, Single and Double
 Laminar Flow Vertical Trolley
 Pass Box
 Soft Wall Cleanroom
 Sputum Booth
 Ventilated Balance Enclosure (VBE)
 Weighing and Dispensing Containment Isolator (WDCI)

Since 1978, Esco has emerged as a leader in the development of controlled environment, laboratory and pharmaceutical equipment solutions. Products sold in more than 100 countries include biological safety cabinets, fume hoods, ductless fume hoods, laminar flow clean benches, animal containment workstations, cytotoxic cabinets, hospital pharmacy isolators, and PCR cabinets and instrumentation. With the most extensive product line in the industry, Esco has passed more tests, in more languages, for more certifications, throughout more countries than any biosafety cabinet manufacturer in the world. Esco remains dedicated to delivering innovative solutions for the clinical, life science, research and industrial laboratory community.

ESCO
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