



scale-X™ carbo bioreactor system

Intensified fixed-bed technology for cost-effective & scalable viral production

scale-X™ [carbo]

Bench-scale automated cell culture system for expression and concentration of viral drug substance, suited for rapid process development and cost-effective clinical production. The scale-X™ carbo system features a modular, scalable, fixed-bed bioreactor designed for enhanced upstream processing of viral products.

Cost-effectiveness

Low-footprint integrated system delivering high cell densities & viral titers

- ▶ Optimized capital investment & production costs

Reliability

Homogeneous cell distribution throughout the fixed-bed

- ▶ Provides consistency within & among batches
- ▶ Automated process control

Scalability

Predictable cell & product behavior

- ▶ Reduced risk in process transfer
- ▶ Simplified process development
- ▶ Seamless scale-up



Applications

- ▶ Viral vaccines
- ▶ Viral vectors
- ▶ Oncolytic viruses

Scales

- ▶ 10 m² and 30 m² of available growth surface
- ▶ Suited from R&D to clinical production

AUTOMATED PROCESS CONTROL

Controller

Advanced process control functionalities for protocol execution & standard parameter monitoring

Benchtop system

Ease of use in laminar flow or biosafety cabinet, docking slots for single-use components



Sensors

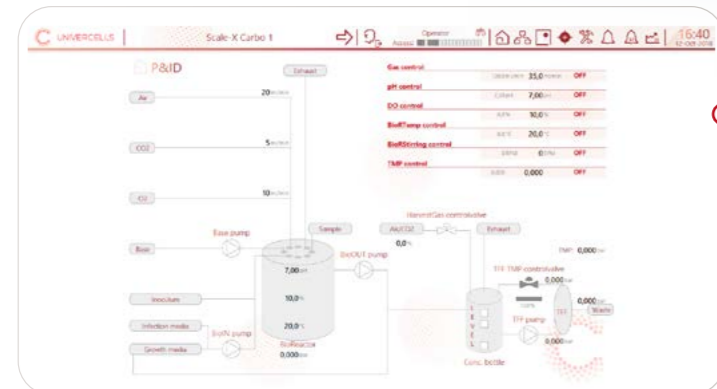
pH, Dissolved Oxygen, temperature, pressure and fluid levels

Sampling

Fixed-bed and media sampling for cells and metabolite profiling

Quick access screen

Key parameters display & manual pump control



Operations supervision

Mobile workstation & Wonderware® system platform

- ▶ Process protocol upload
- ▶ Data recording & reporting
- ▶ Operates one or two controllers in parallel

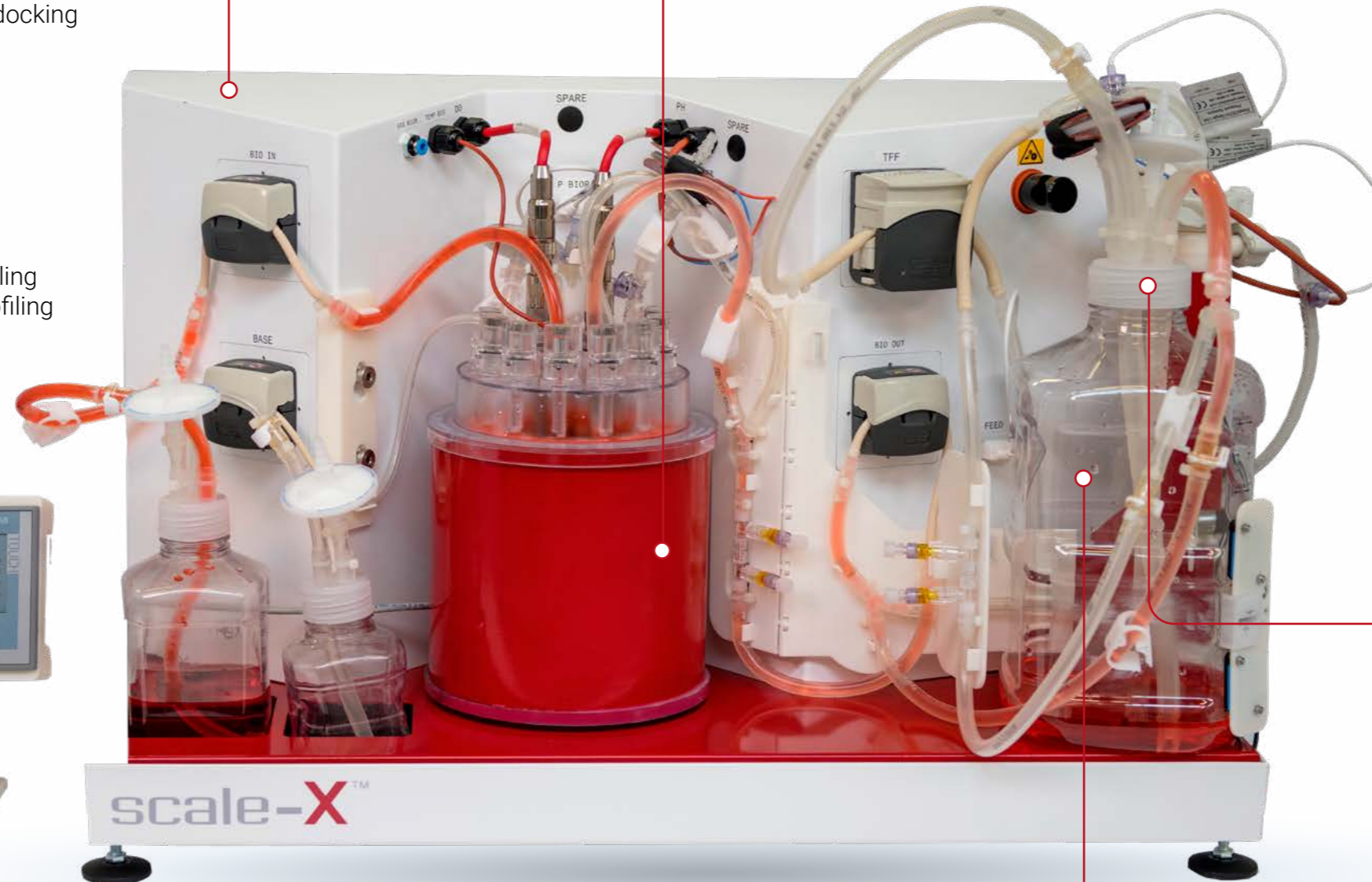
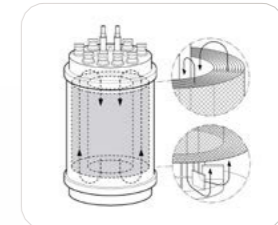
High-density fixed-bed bioreactor

Single-use bioreactor with novel structured design for reliable & scalable production

Growth surface

Treated micro-fabric with alternate spacer netting, assembled as spiral-wound structure

- ▶ Rapid & homogeneous cell entrapment
- ▶ Homogeneous media flow & nutrients availability



Scalability by design

- ▶ Constant linear velocity of fluids and even distribution through the fixed-bed ensure a smooth scale-up
- ▶ Bubble-free aeration mechanism provides high gas mass transfer coefficient while minimizing stresses

In-line concentration

Delivering continuously concentrated harvest for simplified purification

Hollow fiber tangential flow filtration

- ▶ Plug-and-play, 1300 cm² cartridge & pre-assembled manifolds
- ▶ Automated process control



Manifolds & bottles

Complete set of consumables for media circulation, automated adjustment and sampling

- ▶ Tubing manifolds pre-assembled on bioreactor for easy set-up

scale-X™ [carbo]

DELIVERING INTENSIFIED PRODUCTION



The scale-X carbo bioreactor offers a significant increase of the surface/volume ratio compared to conventional technologies:

- ▶ 10 m² growth surface in 1.8 L working volume
- ▶ 30 m² growth surface in 4.2 L working volume



scale-X carbo Stirred-tank bioreactor Roller bottle Cell Factory™ 40 HYPERStack® 36

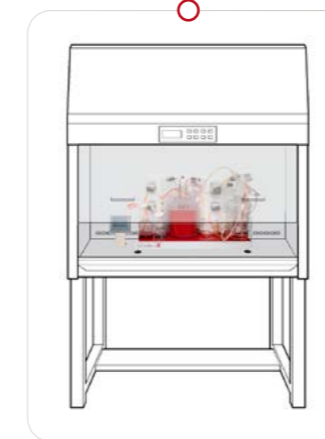
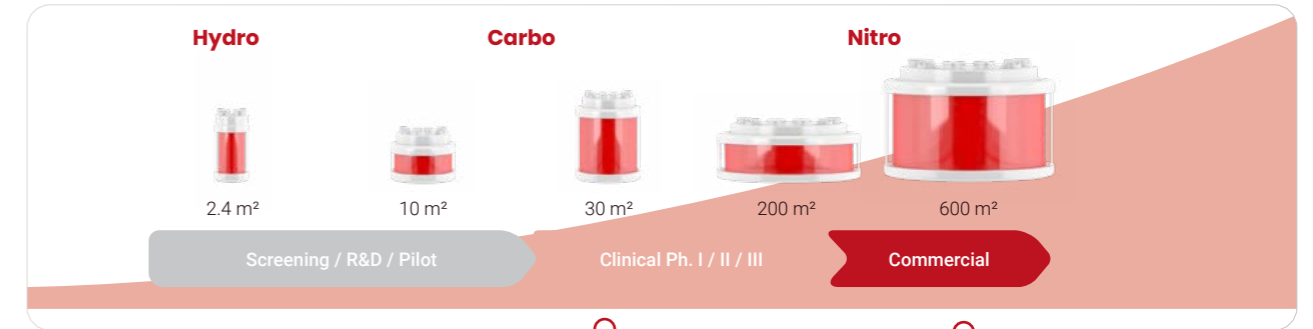
Consumables					
Growth surface/unit	30 m ²	4,400 cm ² /g	850 cm ² /RB	25,280 cm ² /CF40	18,000 cm ² /HS36
# units	1 bioreactor	68 g microcarriers	350 RB	12 CF40	16 HS36
Hardware					
Required equipment (W x D x H)	Controller 0.8 x 0.3 x 0.5 m	50 L Bioreactor 0.6 x 0.9 x 2.0 m Control tower 0.8 x 0.9 x 1.7 m	Incubator (for 55 RB) 1.0 x 0.9 x 2.2 m	Incubator (for 16 CF40) 1.9 x 1.2 x 1.7 m	Incubator (for 8 HS36) 1.4 x 1.2 x 1.8 m
# units	1 controller	1 bioreactor	7 incubators	1 incubator	2 incubators
Total footprint	0.24 m²	1.26 m²	6.3 m²	2.28 m²	3.36 m²

Consumables (# units)	scale-X carbo ³⁰		
	RB	1	350
HS36	16	16	
CF40	12	12	
STR	1	1	
Equipment footprint (m ²)	scale-X carbo ³⁰		
	RB	0.25	6.3
	HS36	3.36	3.36
	CF40	2.28	2.28
STR	1.26	1.26	

- Cost-efficient & reliable operations**
- ▶ Reduced consumables, media & utilities consumption
 - ▶ Simplified manual operations
- Optimized capital investment**
- ▶ Simplified equipment & infrastructure

A BROAD RANGE OF SOLUTIONS FROM DISCOVERY TO COMMERCIAL STAGE

The scale-X family is designed to ensure seamless scalability from early process development to commercial manufacturing. The fixed-bed structure provides a high surface area available for cell culture in a very low footprint, while delivering similar fluid conditions at all scales, thus ensuring predictable cell & product behavior.



scale-X carbo is the perfect tool for R&D activities and clinical material production

Benefiting from a low footprint, the scale-X carbo system can be used in a laminar flow or biosafety cabinet, providing production capacity for R&D to clinical applications.

- ▶ 800 x 300 x 500 mm for a total 0.24 m² footprint

Chaining scale-X nitro to downstream

in the NevoLine™ biomanufacturing platform, delivering concentrated bulk product for clinical and commercial manufacturing.



- ▶ Process intensification and chaining enable containment in 10 m² isolators or biosafety cabinets, for rapid deployment of low-CAPEX facilities

Control unit

Controller	Description	PLC-based Siemens® TIA S7-1200 control system with a local HMI control
	Automation design	Developed and tested according to Gamp5 standard
	Dimensions (W x D x H)	800 x 300 x 500 mm
	Net weight (empty)	30 kg
	Net weight (including largest consumable liquid filled)	40 kg
	Material	Painted stainless steel
	Heating	Heating docking station Bioreactor heating range: room temperature to 37°C
	Agitation	Magnetic agitation plate (0-1500 RPM)
	Pumps & flow rate range	<ul style="list-style-type: none"> • Bioreactor IN: Watson-Marlow™ 114; 0-141 mL/min • Bioreactor OUT: Watson-Marlow 114; 0-141 mL/min • Base, Watson-Marlow 114; 0-42 mL/min • TFF: Watson-Marlow 313; 0-900 mL/min
	Probes & sensors	Dissolved oxygen
pH		1 x Hamilton EasyFerm® plus HB Arc probe (autoclavable) 120 mm (carbo 10 m²); 225 mm (carbo 30 m²)
Temperature		1 x PT-100 Temperature probe (0-50°C)
Quick access screen (HMI)	Description	4" color touch screen HMI (Human Machine Interface) for parameters visualization & sampling command
	Communication	Ethernet port RJ45 connected to the controller
Power, data & gas management box	Location	Outside of BSC/LAF, within a 2-meter distance
	Materials of construction	Painted steel
	Dimensions (W x D x H)	300 x 160 x 600 mm
	Weight	15 kg
	Gas	Gas Process air, CO ₂ and O ₂ (up to 200 mL/min)
Utility requirements	Electrical supply	110 to 230 V
	Power consumption	650 W
Mobile workstation (SCADA)	Description	Mobile workstation with Wonderware SCADA software interface; PLC-based control system Siemens S7 Tia Portal
	Automation design	Developed and tested according to Gamp5 standard
	Network compatibility	Network connection available for Company network
	Data export	SQL-based structure, CSV format data export

Single-use components

Fixed-bed bioreactor		carbo 10	carbo 30
Vessel	Available growth surface (m²)	10	30
	Dimensions (D x H)	209 x 166 mm	209 x 341 mm
	Vessel total volume (L)	1.8	4.2
	Vessel working volume (L)	1.6	3.3
	Materials	Disposable single-use casing	
	Sterilization	Autoclavable	
Agitation	Impeller	Magnetically-driven impeller	
	Recommended agitation speed	250 rpm	450 rpm
Ports	Liquid and gas connections	<ul style="list-style-type: none"> • 1 x Liquid IN (1/4") • 1 x Alkali (1/8") • 1 x Liquid OUT (1/4") • 1 x Gas IN (1/4") • 1 x Gas OUT with pressure sensor (1/4") 	
	Monitoring	<ul style="list-style-type: none"> • 1 x port for pH probe • 1 x port for DO probe • 1 x port for temperature probe 	
Monitoring	Fixed-bed sampling	8 x single-use fixed-bed samples, non-aseptic sampling method	
	Liquid sampling	Via syringe on media OUT line	
Manifolds	Tubing manifolds pre-fitted with vessel	Allowing liquid inlet & outlet, base addition, gas vents	

Concentration via Tangential Flow Filtration – Optional

Cartridge	Description	1300 cm² Hollow Fiber Tangential Flow Filtration cartridge
	Materials	Cartridge: modified polyethersulfone; Cartridge housing: polysulfone
Manifolds	Description	Tubing, connectors and single-use pressure sensors for automated process control, 5L bottle
	Materials	Manifolds: C-Flex® tubing; Connectors: PC, PVDF and polysulfone; Bottle: PET

Manifolds & bottles

Bottles	1* Bottle kit (readily sterilized)	<ul style="list-style-type: none"> • 1 x Inoculation bottle (1 L) • 1 x Harvest bottle (5 L) • 1 x Alkali bottle (500 mL)
	1* Set of bottle caps pre-fitted with the required tubing, connectors and filters	<ul style="list-style-type: none"> • 1 x Inoculation bottle cap manifold • 1 x Harvest bottle cap manifold • 1 x Alkali bottle cap manifold
Manifolds	Base manifold	1/8" C-Flex, CPC connector
	Media IN manifold	1/4" C-Flex, sterile connector
	Media OUT manifold	1/4" C-Flex, sterile connector with filter vents (0.22 µm) 1 x foam trap bottle 2 x in-line liquid sampling ports with closed system transfer device
	Bioreactor vents	1/4" C-Flex, PendoTECH™ pressure sensor, 0.22 µm filters
Cell counting kit	Lysis solutions	500 mL of lysis solution, solution A 500 mL of lysis solution, solution B