







Liquid Injection System (LIS)

Automated Feeding of Liquids in Shake Flasks

LIS is the first easy-to-use technology allowing for automated feeding of liquids in shake flask cultures.

LIS Technology



LIS consists of three components that can be easily set up: the LIS Drive, the LIS Cartridge and optionally the LIS Software.

LIS – Components and Set-Up



The LIS cartridge is a sterile single use container that has the shape of a shake flask lid.

Under a sterile hood, fill the LIS cartridge with up to 25ml of the liquid that you want to feed to your culture.

Program the LIS Drive



The LIS Drive is a miniature pump that controls the feeding of the liquid from the LIS cartridge into the flask.

Define your feeding profile and program the LIS drive accordingly. You can either program the Drive directly or use the LIS software to control LIS wirelessly.

Install LIS on Your Flask



LIS is the first technology for the automated feeding of liquids into shake flasks.

Mount the LIS drive onto the LIS cartridge and install it on the shake flask. LIS will now automatically run your feeding profile.

LIS is easy to set-up: fill the cartridge with liquid, mount the LIS drive on the cartridge, program your LIS drive and start feeding. LIS – Set-Up



Various predefined feeding profiles allow users to quickly create individual feeding strategies for their shake flask cultures.

LIS Feeding Profiles



Additional feeding profiles are available in the LIS Software.

LIS is compatible with various substances such as sugars, alcohols as well as acids or bases.

LIS – Compatible Substances

	Compatibility of substance with LIS					
Substance	Unlimited	Under most	Can not	Not		
Substance		circumstances	be used	tested		
Sugar Solutions (e.g. up to 50% Glc)	х					
Viscous Solutions (e.g. up to 75% Glycerol)	х					
Aqueos Solutions (e.g. IPTG, Media, Acids, Bases, Buffer)	X					
Alcohols (e.g. 50% Ethanol, 75% Methanol)		×*				
Antifoam		×**				
Organic Solvents				×		
Phages				х		
Suspensions				×		
Solid Materials			x			

* Based on the alcohol, concentration and temperature, evaporation may influence the accuracy ** Accuracy can vary for different types of antifoams

LIS is compatible with all common laboratory shakers and shaking conditions.

LIS – Compatible Maximal Shaking Conditions

Shaking	Flasks fixed	Set-Up	Shake Flask Size (Total Volume)					
diameter	on tray with		100ml	250ml	500ml	1000ml	2000ml	
25mm	Clamps	Shake Flask only	250	300	250	250	250	
		Shake Flask + "New" CGQ Sensor	250	300	300	300	250	
		Shake Flask + "Old" CGQ Sensor		300	300	300	250	
	Sticky Stuff	Without CGQ Sensor	200	200	200	250	250	
50mm	Clamps	Shake Flask only	250	250	225	225	200	
		Shake Flask + "New" CGQ Sensor	200	250	250	225	200	
		Shake Flask + "Old" CGQ Sensor		250	225	225	200	
	Sticky Stuff	Without CGQ Sensor	200	200	200	250	250	

Tests were performed with a flask filling volume of 10 % and 20 ml filling volume of the LIS cartridge. All data is shown in rounds per minute (rpm).

LIS is the first easy-to-use technology allowing for fed-batch experiments in shake flask cultures.

Exemplary Use Case LIS (1/2): Fed-Batch



S. cerevisiae cultures were grown on YPD medium in 250 ml shake flasks with a filling volume of 10 % at 30 °C and 250 rpm. Additional carbon source was fed to three cultures using the LIS technology. Either glucose or glycerol was fed into the cultures over a time period of 48 or 60 h by using a constant feeding profile. Biomass of the cultures was monitored online by the CGQ technology (aquila biolabs). Optical density (OD) was measured offline at the end of the cultivation.

LIS can be used to control pH drifts of *Escherichia coli* shake flask cultures by automatically feeding buffer to the culture.

Exemplary Use Case LIS (2/2): pH Regulation



E. coli cultures were grown on LB medium + 2 % glucose in 250 ml shake flasks with a filling volume of 10 % at 37°C and 250 rpm. Additional buffer was fed to one culture using the LIS technology. 2 ml of 5,5 mM K_2 HPO₄ were fed into the culture over a time period of 10 h by using a constant feeding profile. Biomass of the cultures was monitored online by the CGQ technology (aquila biolabs). Optical density (OD) and pH were measured offline at the end of the cultivation.