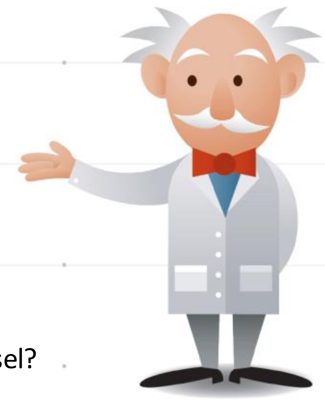
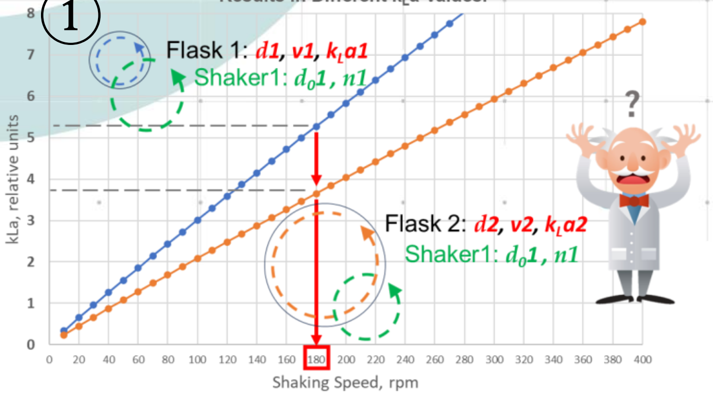
EquipNote by Kuhner shaker

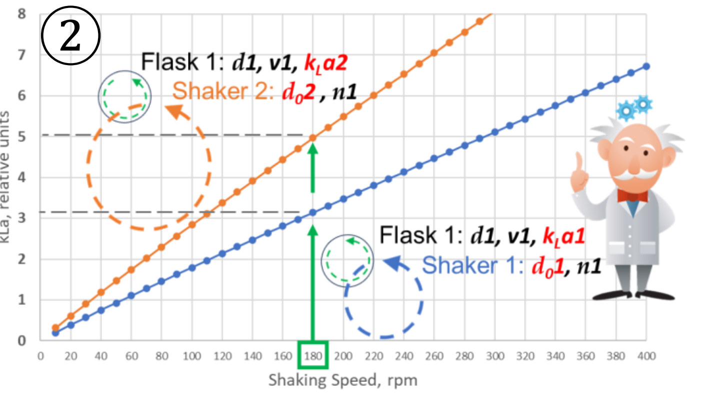
Changing Your Shaker Orbit Diameters.



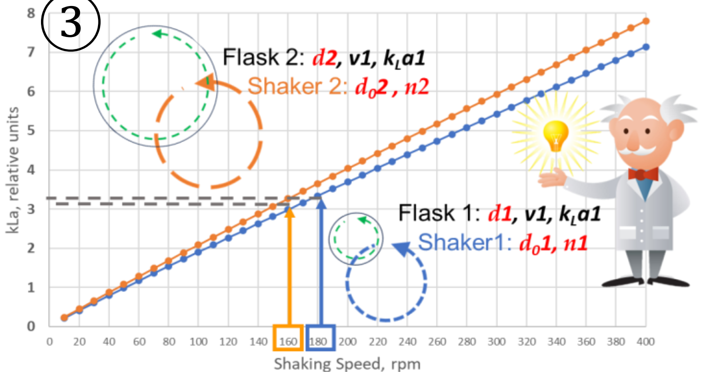
Altered Flask Diameter with Constant Shaker Conditions Results in Different k_La Values.



Conserved Flask Size at Different Orbit Diameters but Same Speed Results in Different k_La.



Change Shaker Diameter and Speed to Match k_La for Different Flask Sizes.



Why do we need to change orbit diameters?

Have you ever had a culture succeed at one scale - but fail at some new scale, shaker or vessel?

Successful scale-up begins with knowing what is happening inside your cultivation vessel - including how your orbit diameter and shaking speed (***n***) impact that environment. Kuhner shakers allow Scientists to adjust their orbit diameter (d_0) to create near-identical process conditions over very large differences in scale.

The basis of successful scale-up is keeping the cell environment (process conditions) near equivalent as vessels and volumes change. Promoting scalability by matching levels of shear (surface velocity (***v***)), gas transfer (**k_La**), mixing times and mixing forces is easy if you know where to start.

Start by defining the current process conditions for your most successful scale. Use our online calculator (https://kuhner.com/en/otr-calculator/index.php) or review our applications notes on oxygen transfer rates, k_La, and shaking speed selection (see below references). You will probably be fixed for the culture volume you are after and maybe also your vessel type or size. With the information above in hand – you simply need to adjust your shaker orbit diameter (d_0) *(see reverse)* and speed to provide equivalent process conditions to your most successful scale!

The following Scenarios highlight a typical problem addressed by changing orbit diameter (d_0) and speed (*n*):

Scenario ① A change in vessel size (diameter (***d***)) (Flask1 (*d1*)→ Flask2(*d2*)) on the same shaker means different volumes, surface velocities (***v***) and mixing forces. Flask 2 has a higher (***v***) than Flask 1 (*v2*>*v1*), but the larger volume added to flask 2 means k_La2 **<** k_La1. The process conditions are not the same and experimental results differ.

Scenario ② At fixed vessel diameter (Flask 1, *d1*) and fixed rpm (*n1*), increasing orbit diameter (d_01 → d_02) results in equal liquid *velocities (v1)*, but higher mixing forces and greater liquid surface area. The resulting higher k_La (k_La2**>**k_La1) again means different process conditions and this could again produce different experimental results.

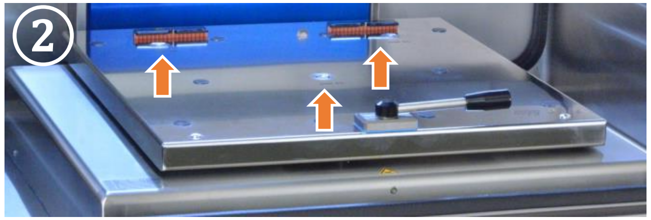
Scenario ③ When changing vessel sizes *(d1 →d2)*, adjust shaker diameter ***and*** shaker speed to target matched k_La and surface velocity (*v*). By changing diameter (d_0) and speed (*n*) as flask size increases (Flask1(*d1*) vs Flask2(*d2*)) – we achieve balanced k_La for both vessels while providing equivalent total forces and velocities (*v1*) in the systems.

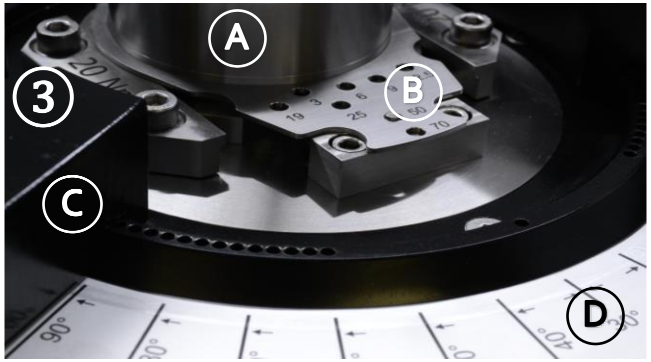
The mechanical changing of the orbit diameter is described on the reverse page.

See Kuhner AppNotes and references therein at **https://kuhner.com/en/science-room/**, including:
"Maximum Oxygen Transfer Capacity", Keebler, Laidlaw, Anderlei.
"How to calculate the minimum shaking frequency for microtiter plates", Keebler, Laidlaw, Anderlei.
"Volumetric Mass Transfer Coefficient (k_LA)", Keebler, Schulte, Laidlaw, Anderlei.

Kuhner shaker

Changing Your Shaker Orbit Diameter.





4

Standard counterweights					
2	2	2	2	2	2
9	**12.5**	**19**	**25**	**50**	**70**
87.5	87.5	85	85	77.5	72.5
87.5	87.5	85	82.5	77.5	70
87.5	85	85	82.5	75	70
87.5	85	85	82.5	75	67.5

Changing the shaking diameter on your Kuhner Shaker is easy!

Robust, flexible and future-proof: Our newest generation Kuhner drive attests to our 75 years of shaker construction experience.

While every Kuhner Shaker includes an adjustable orbit diameter - every new Z-generation motor drive allows end-user diameter adjustment to any of ***eight*** included, standard, options: 3mm, 6mm, 9mm, 12.5mm, 19mm, 25mm, 50mm and 70mm – no special order or factory request needs to have been made. To change the orbit diameter no training or engineer visit is necessary, the construction is friendly to lab personnel so you may make changes at any time. A single metric tool and about 10 minutes is all that is needed

We begin by confirming the existing diameter setpoint using the motor-reference key ① aligned with the corner of the shaker table. Read the corner point of your shaker table to the diameter label. Next ② three machine screws (orange arrows) are removed allowing one to remove the shaker table, thereby exposing the drive ③. Don't worry about removing these screws – they are high quality and easy to remove and replace! Next, we adjust eccentric bearing set **(A)** using the diameter selection key **(B)** and finally we re-position the counterweights **(C)**.

To adjust the bearing set – loosen the high quality screws and shift the eccentric bearing along the guide, allowing placement of the desired keyhole **(B)** into position on the peg. The 'keyhole and peg' design guarantees you are set to exactly the diameter you are intending. After positioning, the screws are tightened and counterweights re-positioned corresponding to balance against the load you are shaking (all possible counterweight settings may be found in a reference table in your manual). Consult the counterweight table (snippet shown in panel ④) before selecting and tightening the screws back up and you're done!

When you are done – it an easy secondary confirmation of the current set diameter is by using the same reference guide sticker shown in panel ①.

Following the steps above will assure your new diameter is set and your Kuhner Shaker will perform smoothly with zero vibration during rigorous shaking. For more information, your user manual guides you step by step through the process.