

What are Lower and Upper RLU limits?

Lower and Upper RLU limits are set values used to easily evaluate and categorize ATP test results in real time.

- **Lower Limit:** The maximum allowable RLU for a result to pass the ATP test for cleanliness. A surface that reads at or below the lower limit is categorized as a Pass result and considered acceptable. Passing results are indicated with a check mark (✓) on the screen
- **Upper Limit:** A surface that reads above the upper limit is categorized as a Fail result and considered not adequately cleaned. Fail results are indicated with an (X) on the screen.
- **Caution Area:** A surface that reads above the lower limit and at or below the upper limit is categorized as a Caution result. Caution results tell the user there could be something on the surface, but not enough to cause a Fail result. Caution areas can also show a surface is trending towards unclean and may require additional attention during the next cleaning. Caution results are indicated with an exclamation point (!) on the screen. Some facilities elect to eliminate the Caution range. To do this, the lower and upper limits are set to the same RLU value. With this setting, a surface that reads at or below the limit is categorized as a Pass result (✓) and a surface that reads above the limit is categorized as a Fail result (X).

Hygiena luminometers come pre-programmed with a lower limit of 10 RLU and an upper limit of 30 RLU. The Pass, Caution, and Fail ranges are as follows:

RLUs	0-10	11-30	31+
	Pass (✓)	Caution (!)	Fail (X)

To eliminate the Caution area, set 10 RLU as the lower *and* upper limit. The Pass and Fail ranges are as follows:

RLUs	0-10	11+
	Pass (✓)	Fail (X)

Why are the default limits 10 and 30?

Hygiena recommends that Pass and Fail limits be determined by the facility and documented as to how they were determined. The default limits of 10 (Pass) and 30 (Fail) RLU on the luminometer are based on years of food & beverage processing experience and third party studies. (See data below). Hygiena recommends users validate these recommendations and adjust them to meet the needs of each facility's unique needs.

The following guidelines are typical of those found in the food and beverage industry and are based on stainless steel surfaces. Other surfaces may be more difficult to clean and consequently may require higher Pass/Fail limits to be set if complete bio-burden removal is not necessary. (Refer to the following page for details on establishing custom RLU limits.)

The data below is extracted from *Performance Evaluation of Various ATP Detecting Units*, a report prepared by the world's largest third party reference laboratory¹. The report provides the mean result for two products tested at various dilutions dried on stainless steel surfaces as well as serial dilution detection levels of other food stuff. The process and results for both methods are described below.

Detection of ATP from Food Soiled Stainless Steel Surfaces

Process:

To replicate the scenario of detecting residue on an unclean surface in a food and beverage processing facility, food suspensions were created and 10 replicates of 500 µl were added to a stainless steel 4 x 4 inch square and allowed to dry. An UltraSnap test device was used to collect a sample and the device was activated. The RLU output was measured with SystemSURE Plus. The RLU limit in the right column is Hygiena's recommendations based on the data from the report.

Results:

SystemSURE Plus with UltraSnap Tests Dry soiled stainless steel surfaces				
Product	Dilution	Results Mean (RLU)	Range	Limit (RLU)
Raw Ground Beef	1:10	2945	2540-3644	Fail: 2000
	1:1000	147	116-205	Pass: 100
2% Milk	1:1	173	145-195	Fail: 100
	1:1000	8	2-16	Pass: 2

Detection of ATP from Food: Serial Dilutions Pipetted onto Swabs

Process:

Liquid food samples (orange juice and milk) were diluted using sterile water in various dilutions. Solid food samples (ground beef and salad greens) were first stomached using 10 g of sample in 90 ml sterile water and then diluted using sterile water in various dilutions. All test samples were shaken by hand for homogenization. Ten replicates of each food suspension were then analyzed using an UltraSnap ATP detection device by pipetting 10 µL of food suspension dilution directly onto the swab bud, activating the device, and measuring with the SystemSURE Plus luminometer to read RLU result. The RLU limit in the right column is Hygiena's recommendations based on the data from the report.

Results:

SystemSURE Plus with UltraSnap Tests Serial dilutions pipetted onto swabs				
Product	Dilution	Results Mean (RLU)	Range (RLU)	Limit (RLU)
Bagged Mixed Salad Greens	1:10	164	129-195	Fail: 100
	1:100	36	31-43	Fail: 30
	1:1000	13	10-15	Pass: 10
	1:10000	2	1-2	Pass: 2

¹ Kupski, Brian, et al. "Performance Evaluation of Various ATP Detecting Units." *Silliker, Inc., Food Science Center Report RPN: 13922*, (2010).

SystemSURE Plus with UltraSnap Tests Serial dilutions pipetted onto swabs (continued)				
Product	Dilution	Results Mean (RLU)	Range (RLU)	Limit (RLU)
2% Milk	1:1	301	217-366	Fail: 200
	1:10	72	59-84	Fail: 50
	1:100	13	11-15	Fail: 10
	1:1000	3	3-4	Pass: 5
	1:10000	2	2-2	Pass: 2
Pasteurized Orange Juice, No Pulp	1:1	5617	5331-6220	Fail: 5000
	1:10	3958	3563-4448	Fail: 3000
	1:100	437	294-541	Fail: 250
	1:1000	56	39-70	Pass: 30
Raw Ground Beef	1:10000	5	2-8	Pass: 2
	1:10	609	453-788	Fail: 400
	1:100	70	54-86	Fail: 50
	1:1000	1	0-8	Pass: 10
	1:10000	0	0-1	Pass: 2

Note: ATP tests are not organism tests, thus RLU values cannot be directly correlated to CFU values, nor can ATP tests be a replacement for microbiological tests. UltraSnap tests detect any organic material that contains ATP, which may include microorganisms. Refer to the full copy of the study for details on methodology and limit of detection for microorganisms.

For a full copy of *Performance Evaluation of Various ATP Detecting Units By Silliker, Inc.*, please contact Hygiena.

If you have any questions about the information provided, please contact your Hygiena representative or Hygiena's customer service department at:

Phone: 888-HYGIENA (494-4362)
E-mail: info@hygiena.com

Can I use the same RLU limits for every location?

In some cases, the same RLU limits may be set for several locations. Optimal RLU limits will depend on a variety of factors such as surface variation and risk level. See examples below.

- Surface Variations:
 - Surfaces which are easy to clean, such as stainless steel or other flat, non-porous surfaces may have stricter, lower limits. Surfaces which are hard to clean, such as porous, grooved, creviced or irregular surfaces like conveyor belts, may have higher limits.
- Risk Level:
 - Environment: An environment with more stringent cleaning requirements, like a clean room, may have stricter, lower limits compared to a food processing environment with less stringent volatility.
 - Contact Risk: Surfaces which come into direct contact with products require stricter RLU limits than non-contact areas, especially when dealing with higher risk products like meat, dairy, and/or produce.

Determining Custom RLU limits

The method for determining and validating custom lower and upper RLU limits is outlined below. In some cases, test results from different control points within a facility consistently fall in a similar range. In this case, RLU limits may be set to the same value for all control points in the facility. Likewise, test results from similar surfaces may consistently fall in a similar range. In this case, the RLU limits may be set to the same values for control points with the same surface type. Hygiena's SureTrend data tracking software allows users to take note of the surface type of each test location.

1. **Identify** control points in the facility. These are often outlined in the SSOP/HACCP programs.
 - a. Control points can be programmed into the luminometer before testing so that results are saved with the control point location name, date, and time of test.
2. **Clean** surfaces to the desired level of cleanliness.
 - a. This may include a total production line breakdown.
 - b. Future cleanings will be held to this level of clean as a standard.
3. **Perform** an ATP test at each control point, taking 5-10 replicate tests. Use one of two methods.
 - a. Perform tests over several days.
 - b. Or for control points with sufficient surface area, perform multiple tests from different spots at that test location. (e.g. Conveyor belt, tank, tabletop, etc.)
4. **Calculate** the lower and upper RLU limits
 - a. **Lower RLU limit:** Calculate the average RLU for each location based on the 5-10 test results. The average result will be the lower RLU limit.
 - b. **Upper RLU limit:** There are two options for determining the upper limit.
 - i. Multiply the lower limit by 3
 - ii. Or determine the standard deviation from the test results, multiply the standard deviation by 3, and add this to the lower limit.

CONTINUOUS IMPROVEMENT: Monitoring and assessment of trends is crucial to finding trouble zones, correcting improper cleaning procedures and decreasing risk. Continuous improvement provides brand protection, avoids recalls and shows due diligence to auditors. If high frequencies of Caution and Fail results are obtained with ATP monitoring, SSOP should be reviewed for ways to improve cleanliness. If low frequencies of Caution or Fail results are obtained, RLU limits could be reviewed and potentially lowered to maintain high standards and generate useful management data.

RLU Limit Worksheet

(Tip: photocopy or print duplicates of this page if you wish to record data manually. Save these documents for your records.)

NOTE: To calculate the average of your test results, add all test results together and divide by the number of tests. The standard deviation is a calculation of the variability of your results, or the amount that results differ from the average. The standard deviation is best calculated using a spreadsheet application, like Microsoft Excel, to minimize calculation errors. If you would like an excel document formatted to allow for result entry and automatic average and standard deviation calculations, please contact your Hygiena representative or the customer service department at 888-HYGIENA (494-4362) or info@hygiena.com

Location		<i>Example</i>				
Surface Type		<i>Stainless</i>				
Replicates	1	5				
	2	9				
	3	9				
	4	6				
	5	4				
	6	13				
	7	7				
	8	9				
	9	8				
	10	9				
Average		7.9				
St Dev (optional)		2.6				
Lower Threshold		8				
Upper Threshold		24 or 16				

Location						
Surface Type						
Replicates	1					
	2					
	3					
	4					
	5					
	6					
	7					
	8					
	9					
	10					
Average						
St Dev (optional)						
Lower Threshold						
Upper Threshold						