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Report Type	Evaluation and Certification
Report Date	30 January 2020
Issuing Laboratory	GLI Europe B.V.
Evaluating Laboratory	GLI Europe B.V.
Recipient	ClusterTech International Inc Ruđera Boškovića 13 78250, Laktaši Bosnia and Herzegovina
Tested against Requirements	GLI-11 - Gaming Devices in Casinos v3.0
Jurisdiction	Non-Jurisdictional
Manufacturer	ClusterTech International Inc Ruđera Boškovića 13 78250, Laktaši Bosnia and Herzegovina
Submitter	ClusterTech International Inc Ruđera Boškovića 13 78250, Laktaši Bosnia and Herzegovina
Product Name	**Classic SA**
Description of the Product Tested	**Classic SA** **game collector1.exe** As requested per submitter's letter received 7 January 2020.
Evaluation Period	8 January 2020 / 23 January 2020
Internal Reference	RN-123-CLT-20-01
Result	Pass (See Comments and Conditions on the following pages)
Internal methods used reference	Random Number Generator (RNG) Analysis WI-MA-006, PC-TC-001

Technical Evaluation authorized by:

Martin Britton
Managing Director

RANDOMNESS REPORT FOR THE CLASSIC SA DEVICE

The intent of this report is to indicate that **Gaming Laboratories International**, **LLC** (GLI) has completed its evaluation of the Classic SA physical randomness device, APX 517.1-10, provided by ClusterTech International Inc.

SECTION I — SCOPE OF TESTING

ClusterTech International Inc submitted the required materials to GLI in order to conduct a randomness analysis on the Classic SA device. The scope of this analysis was limited to device identification and data analysis. The device was tested for its ability to randomly produce outcomes for the Single-zero roulette game.
The Classic SA physical randomness device was evaluated against the RNG-specific requirements of the following technical standard:

- GLI-11 – Gaming Devices in Casinos v3.0

Please note, only one device was used for this evaluation. GLI does not test each device manufactured by ClusterTech International Inc and therefore does not attest to the randomness of each device on an individual basis. However, it is expected that each device is manufactured according to the same design and tolerances, and should have similar randomness qualities as the device tested.

SECTION II — DEVICE IDENTIFICATION

Product ID: Classic SA
Model: Classic SA APX
Serial number: APX 517.1-10

The Classic SA software listed below are the programs that control the functionality of the Roulette and manage the draws.

File	Type	Signature
game collector1.exe	Kobe4	PC3C
	MD5	5EC18F2B2EAF52AAF7805C3D5D008983
	SHA-1	FEC480389B5B2FED8EFD6F9BF3EC2BA1BDF7BCE1

Table 1. Digital Signatures

SECTION III — DATA ANALYSIS

The Classic SA device automatically detects the ball and records the extracted number.
The game configuration and parameters for the data obtained and tested are listed in Table 2. GLI performed a data format check on the data set listed in order to confirm that the game parameters were correctly represented in the data analyzed. A complete listing of the individual tests applied to each data set can be found in Appendix A.

Data Set	Range	Positions	Draws
Roulette	0-36	1	14,097

Table 2. Game Parameters

For a summary of the final outcome tests applied to each data set, see *Appendix A*. For a description of the overall test methodology and a description of each test used, see *Appendix B*.
Overall, the device passed the battery of tests for each configuration at the 95%, 98%, and 99% confidence levels. GLI makes no statement about the randomness qualities of the device if the recommended calibration and maintenance schedule is not followed.

SECTION IV — SUMMARY

Overall Evaluation of the Random Number Generator

GLI's conclusion based upon the tests applied to the Classic SA data is that this physical randomness device has exhibited random behavior and is suitable for the applications as described herein. If a game utilizes a different range or a different number of selections from the included ranges, the device should be resubmitted to test that set of parameters.

APPENDIX A: Statistical Test Summary

Data Set	Range	Positions	Draws	Test Name					
				Runs	Serial Corr.	Duplicates	Overlaps	Tot. Dist.	Mechanical Roulette Test
Roulette	0-36	1	14,097	X	X	X	X	X	X

Table A 1. Tests Applied

APPENDIX B: Test Descriptions

B.1 **Definitions.** The following terms apply to the below test descriptions. Randomness Device or Random Number Generator (RNG) output may be collected multiple numbers at a time. Each set of numbers is called a draw. Each individual number has a particular order within the *draw*. This is referred to as the number *position*.

B.2 **Distribution Comparisons.** Many of the tests compare an observed numerical distribution with an expected distribution. Unless otherwise specified, this is done by means of a statistical chi-square goodness-of-fit test. The value chi-square is computed in the standard way. If k is a possible value, o_k is the observed count of that value, and e_k is the expected count:

$$\chi^2 = \sum_k \frac{(o_k - e_k)^2}{e_k}$$

In the case where expected counts are too small for accurate use of the above formula, values are 'binned' together to ensure an appropriate minimum expected count. The resultant value for chi-square is compared against the distribution for the appropriate number of degrees of freedom. Unusually high (distribution mismatch) or unusually low (insufficient randomness) chi-square values can be causes for data failure.

B.3 **Meta-testing**. Evaluation of groups of p-values may include a meta-test for extremity of high or low p-values, a meta-test for frequency of high or low p-values, and a meta-test for uniformity of p-values, as appropriate.

B.4 **Confidence Level**. The statistical tests conducted by GLI are done at a particular *confidence level*. Common confidence levels used include 95%, 98%, and 99%, depending on jurisdictional requirements, and intended use of the RNG. High confidence level testing has low risk of mistakenly failing a good RNG, but higher risk of passing a bad RNG. Lower confidence level testing has increased power of detecting bad RNGs, while also increasing the risk of false failures of good RNGs. Specifically, the confidence level represents the probability that an ideal source of randomness would pass the testing. If an RNG passes statistical tests at a given confidence level, passage at all *higher* confidence levels is implied.

B.5 **Tests**. Some tests are only applicable to certain types of data. Some tests may be applied only to a portion of the data. Some tests may require that the data be parsed, binned, or otherwise transformed, as necessitated by data format.

APPENDIX B: Test Descriptions

Duplicates:
The Duplicates Test counts the number of times a draw is exactly duplicated in the data. In the case that a particular draw is repeated more than twice, every possible way to generate a duplicate is counted. This is compared against the theoretical distribution to verify that the number of duplicate draws falls within expected bounds. For example, consider the dataset consisting of the following draws of two numbers each.

$$a)\ 1, 3$$
$$b)\ 4, 1$$
$$c)\ 1, 3$$
$$d)\ 1, 3$$
$$e)\ 4, 1$$
$$f)\ 3, 1$$

The duplicate pairs are (*a*,*c*), (*a, d*), (*c, d*), and (*b, e*), for a total of 4 duplicates. *(f)* is not counted as a duplicate since the draw must match in order as well as values.

Mechanical Roulette Suite:
The Mechanical Roulette Suite consists of several tests which are intended to be able to detect biases that may be present in a physical roulette wheel. These biases may result from imbalanced wheels or from manufacturing irregularities that cause a particular position to be more or less likely than expected. Included in this suite are tests on overall distribution, draw-to-draw independence, and directional drift over time.

Overlaps:
The Overlaps Test compares consecutive draws for overlapping values. The number of overlapping values is recorded for each pair of draws. This observed distribution of overlaps is then compared against the expected distribution. For example, if the following draws are observed consecutively,

$$a)\ 1, 4, 5, 6$$
$$b)\ 4, 1, 7, 6$$

the number of overlaps would be 3, representing the values 1, 4, and 6.

Runs:
The Wald-Wolfowitz Runs Test is applied to each position within the draw. A center is established, typically the data median, and the number of 'runs' above and below the center are tallied. Values exactly equal to the center are discarded. This is compared to the expected distribution, which depends on the number of values above and below the center. For example, if the numbers drawn at a particular position were

$$2, 3, 1, 5, 4, 7, 3, 2, 3, 2, 3, 2, 6, 7, 3, 5$$

and the established center were the data median of 3, the data would be parsed for runs above 3 and runs below 3.

$$\underbrace{2, 3, 1}, \overbrace{5, 4, 7, 3}, \underbrace{2, 3, 2, 3, 2}, \overbrace{6, 7, 3, 5}$$

This would be counted as 4 runs.

APPENDIX B: Test Descriptions

Serial Correlation:
The Serial Correlation Test measures statistical correlation between consecutive draws of the same position. For each position, the sample Pearson correlation coefficient is calculated. If *X* represents the first number, and *Y* the number that follows, then the coefficient is

$$r = \frac{cov(X, Y)}{s_X s_Y}$$

where *s* denotes the sample standard deviation. The coefficients are used to generate a *p*-value for each position.

Total Distribution:
The Total Distribution Test is a simple tally of all observed values throughout the data. This is compared with the expected distribution. Typically, the expected distribution is a uniform distribution. In the case of unequal weighting of values, an appropriate discrete distribution is used.