

Richcraft

K.A.R. 111-23-26 · eInstant Cert Pack v1

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Authority: Multi.Bingo iLottery RGS · Operator: Kobow

Signing key: Ed25519 · ID d651f1b9f793f40d

Math validation (bit-exact)

| | |
|--|------------------|
| Pool size | 2,000,000 shares |
| Winners | 501,751 |
| Losers | 1,498,249 |
| Overall odds | 1 in 3.99 |
| Σ multipliers | 1,760,028 |
| RTP @ unit denom | 88.0014% |
| Paytable tiers | 65 |
| Top prize (max denom) | \$150,000 |
| Bonus engine | candles_survivor |
| Jackpot levels | none |

1. Game specification (K.A.R. 111-23-26)

Richcraft is an instant lottery game governed by Kansas Administrative Regulation K.A.R. 111-23-26. The game is operated as a finite-pool ticket-vending model with 2,000,000 shares per pool. The bit-exact payable below has been validated against the regulator-published spec, with empirical winner counts, sum-of-multipliers, and overall odds matching the regulation to integer precision.

Denominations (Kansas-strict): \$1, \$2, \$5, \$10, \$20, \$30

Prize formula (K.A.R. j): $\text{prize_cents} = \text{multiplier} \times \text{denom_cents} \times \text{tickets_purchased}$

Bonus engine: `candles_survivor` (deterministic from `pool_seed + position`; replay endpoint available)

2. Paytable (bit-exact K.A.R.)

| Multiplier | Count in pool | Odds (1 in) |
|---------------------|---------------|--------------|
| x5000 | 2 | 1,000,000.00 |
| x1000 | 2 | 1,000,000.00 |
| x250 | 20 | 100,000.00 |
| x200 | 1 | 2,000,000.00 |
| x100 | 53 | 37,735.85 |
| x90 | 5 | 400,000.00 |
| x85 | 19 | 105,263.16 |
| x80 | 243 | 8,230.45 |
| x75 | 9 | 222,222.22 |
| x70 | 31 | 64,516.13 |
| x65 | 49 | 40,816.33 |
| x60 | 60 | 33,333.33 |
| x55 | 71 | 28,169.01 |
| x50 | 384 | 5,208.33 |
| x49 | 10 | 200,000.00 |
| x48 | 42 | 47,619.05 |
| x47 | 6 | 333,333.33 |
| x46 | 50 | 40,000.00 |
| x45 | 130 | 15,384.62 |
| x44 | 69 | 28,985.51 |
| x43 | 50 | 40,000.00 |
| x42 | 72 | 27,777.78 |
| x41 | 97 | 20,618.56 |
| x40 | 266 | 7,518.80 |
| x39 | 115 | 17,391.30 |
| x38 | 40 | 50,000.00 |
| x37 | 199 | 10,050.25 |
| x36 | 216 | 9,259.26 |
| x35 | 357 | 5,602.24 |
| x34 | 167 | 11,976.05 |
| ... (35 more tiers) | | |
| x0 (non-winning) | 1,498,249 | — |

3. Pool architecture

Each pool consists of exactly **2,000,000 shares** arranged in a deterministic shuffle. Pool generation flow:

1. **RNG seed** obtained from the certified RGS service `multibingo-rng:9443` (RNG_STRICT=true, no local fallback) per K.A.R. RNG requirements.
2. **Server seed** hashed with SHA-256 → `shuffle_seed_hash` (pre-commit, published before any ticket sells).
3. Paytable counts (table in section 2) are written into the position array, then shuffled with **mulberry32 PRNG** seeded from the SHA-256 of the `server_seed`. The Fisher-Yates shuffle is deterministic — any auditor with the seed can reproduce the same pool order.
4. The pool's **audit_hash** (Ed25519-signed envelope of `game_code`, `variant_id`, `jurisdiction`, `pool_size`, `paytable_hash`, `deterministic_seed_hash`, `prev_audit_hash`) chains into the audit history.
5. Ticket positions are consumed sequentially as players buy; each ticket's outcome is the multiplier at its position in the shuffled array.

4. Audit chain

Per K.A.R. (h) compliance, every day at end-of-day the system seals a **daily Merkle root** over all tickets sold + all pools opened that day. Leaves are computed as:

```
ticket_leaf =  
sha256(id|pool_id|position|outcome_multiplier|prize_cents|validation_hash)  
pool_leaf = sha256('POOL'|id|game_code|variant_id|jurisdiction|shuffle_seed_hash|deterministic_seed_hash|audit_hash)
```

The root is signed with the operator's Ed25519 private key (key ID `d651f1b9f793f40d`) and persisted in an immutable PostgreSQL row (WORM-enforced via BEFORE UPDATE/DELETE trigger). The audit blob with all leaves is also written to disk and (in production) replicated to S3 with Object Lock and 3.5-year retention. Each day's row stores `prev_root_sha256` forming a hash chain back to genesis.

5. Verifier surface (public REST, CORS *, no auth)

| Endpoint | Purpose |
|---|---|
| GET /api/ilottery/verify/:ticket_id | Replay outcome from pool_seed + position; returns match boolean |
| POST /api/ilottery/vector/replay | Recompute outcome from payable + seed (no DB lookup; for cert) |
| GET /api/ilottery/reveal/:pool_id | Pool seed reveal (closed pools or sandbox) |
| GET /api/ilottery/merkle/days | List recent daily Merkle anchors |
| GET /api/ilottery/merkle/day/:date | Get specific anchor (root + Ed25519 sig + audit blob path) |
| GET /api/ilottery/merkle/proof/:ticket_id | Merkle inclusion proof (sibling-hash path + verifies bool) |
| GET /api/ilottery/audit/public-key | Ed25519 public key (PEM + JWK) for offline verification |
| POST /api/ilottery/audit/verify-signature | Server-side verify {message, signature_hex} |
| GET /api/ilottery/audit/summary | System-wide stats (games/tickets/jackpot/anchors) |

6. Test vectors v1

URL: https://kobowlotto.com/mathforge/ilottery/gdd/richcraft/vectors_v1.json

Contents: 6 tiers x ~100 vectors each (TOP / MID_HIGH / MID_MID / MID_LOW / X1 / LOSER). Per-vector fields: {id, tier, pool_seed_hex, position, expected_multiplier, expected_prize_cents{per denom}}

Verification protocol: POST /api/ilottery/vector/replay with {game_code, pool_seed_hex, position} returns expected_multiplier. Auditors can independently compute the same outcome by running mulberry32(sha256(seed)) Fisher-Yates over the payable.

7. Operator Ed25519 public key

Algorithm: Ed25519 · **Key ID:** d651f1b9f793f40d

```
-----BEGIN PUBLIC KEY-----
MCowBQYDK2VwAyEAU2k0zXnm09QHduKLSEQYUAFeACAEOTUceEuiRGLSiXs=
-----END PUBLIC KEY-----
```

8. Per-jurisdiction matrix

| Jurisdiction | max_tickets | cells | denoms (¢) | cap (\$) | cost_formula |
|---------------|-------------|-------|-------------------------------------|-----------|-----------------|
| BR-charity | 1 | 16 | 50, 100, 200, 500, 1000, 2000, 3000 | \$150,000 | tickets * denom |
| GLI-SANDBOX | 1 | 16 | 100, 200, 500, 1000, 2000, 3000 | \$150,000 | tickets * denom |
| US-MN-charity | 1 | 16 | 25, 50, 100, 200, 500, 1000 | \$50,000 | tickets * denom |
| US-WV | 1 | 16 | 100, 200, 500, 1000, 2000, 3000 | \$150,000 | tickets * denom |

9. Document attestation

This cert pack reflects the system state at issuance time. Live values (jackpot amounts, ticket counts, Merkle roots) can be queried in real time via the verifier endpoints above. The Ed25519 signature on the document SHA-256 attests document integrity; the operator's public key (section 7) is the same key used to sign all daily Merkle anchors and pool audit hashes.