

# Breakpoint Billiards Rating System (BBRS)

The rating system is an **Elo-derived system** with several enhancements designed to provide fair and accurate player ratings.

## Core Formula

### 1. Initial Rating

All players start at **500** (displayed as Breakpoint Level **5.0**)

### 2. Expected Win Probability (Elo Formula)

```
Expected = 1 / (1 + 10^((OpponentRating - PlayerRating) / 400))
```

#### 2a. Handicap Adjustment

If the match is played with a **handicap** (where the race targets differ, e.g., 7-5), the system assumes the handicap perfectly levels the playing field:

- **Expected Win Probability** is forced to **50% (0.5)**.
- This ensures higher-rated players are not penalized for playing against a handicap.

### 3. K-Factor (Based on Experience Level)

The K-Factor determines how much a player's rating can change. Less experienced players have higher volatility:

Racks Played	K-Factor	Category
Under 100	28	Provisional
100-300	20	Established
Over 300	14	Stable

### 4. Base Rating Change

```
BaseDelta = K × (ActualOutcome - ExpectedWinProb)
```

Where `ActualOutcome` is **1** for a win, **0** for a loss

### 5. Opponent Strength Scaling

Players earn more for beating stronger opponents and less for beating weaker ones:

```
Scale = 1 + (RatingDifference / 1000)
```

- Clamped between **0.85** (beating weaker) and **1.15** (beating stronger)

### 6. Match Modifier (Margin of Victory)

Compares actual rack differential vs expected:

```
Modifier = 1 + ((ActualRackDiff - ExpectedRackDiff) / 20)
```

- Bonus/penalty of up to **±10%** based on performance vs expectations

## 7. Event Weighting

Event Type	Weight
League	1.0x
Playoffs	1.05x
Tournament	1.08x

## Final Calculation

```
RatingChange = BaseDelta × OpponentScaling × MatchModifier × EventWeight
```

## Display Conversion

The raw rating is converted to a "Breakpoint Level" for display:

```
BreakpointLevel = floor(rating / 10) / 10
```

A rating of **523** displays as **5.2**

## Rating Categories

Rating	Breakpoint	Category
0-344	0.0 - 3.4	Beginner
345-436	3.5 - 4.3	Intermediate
437-499	4.4 - 4.9	Intermediate+
500-561	5.0 - 5.6	Good League Player
562-624	5.7 - 6.2	Advanced
625-686	6.3 - 6.8	Advanced+
687-749	6.9 - 7.4	Top Regional
750-875	7.5 - 8.7	Semi-Pro
876+	8.8+	World Class

## Example 1: Even Race (Standard Elo)

**Context:** Match played with **NO Handicap** (e.g. Tournament play). **Expectation:** Player A (Rating 790) is heavily favored (81.7%) vs Player B (530).

### Outcome A: Close Win (7-6)

Player A barely squeaks by.

- **Rack Diff:** +1 (Small margin) -> **+2.5% Bonus**
- **Player A:** **+3 pts** (Small gain, expected win + poor margin)
- **Player B:** **-4 pts** (Small loss)

### Outcome B: Big Win (7-0)

Player A dominates as expected.

- **Rack Diff:** +7 (Large margin) -> **+10% Bonus (Max)**
- **Player A:** **+5 pts** (Maximum possible for this match up)
- **Player B:** **-6 pts**

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## Example 2: Handicapped Race (New System)

**Context:** League match, Race 7-4. **Expectation:** 50% Win Probability (Coin Flip).

### Outcome A: Close Win (7-3)

Player A wins on the hill (P2 had 3, needed 4).

- **Player A:** **+9.4 pts** (Wins coin flip + Margin Bonus)
- **Player B:** **-12.7 pts**

### Outcome B: "Winning Big" (7-0)

Player A shuts out Player B.

- **Player A:** **+9.4 pts** (Still capped at max bonus)
- **Player B:** **-12.7 pts** *Note: In handicapped matches, the favorite winning often hits the max margin bonus automatically.*

### Outcome C: "Losing Big" (P2 Wins 4-0)

Player B dominates Player A.

- **Player B:** **+14.0 pts** (Wins coin flip + Max Bonus)
- **Player A:** **-11.0 pts** (Loses coin flip + Max Penalty)

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## Summary Table

Scenario	Race	Winner	Player A (7.9)	Player B (5.3)
Even Race	7-7	A Wins	<b>+3 pts</b> (Expected)	<b>-4 pts</b>
Handicap	7-4	A Wins	<b>+9.5 pts</b> (Beat Handicap)	<b>-12.7 pts</b>
Handicap	7-4	B Wins	<b>-9.5 pts</b> (Lost Coin Flip)	<b>+12.7 pts</b>

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## Key Takeaways

1. **Handicaps Matter:** If you give spots, the system treats the match as 50/50.
2. **Beating the Handicap pays:** High-rated players now earn full points for winning handicapped matches (instead of getting 1-2 points).

**3. Splitting Sets is Safe:** If two players split sets in handicapped play, their ratings will largely remain unchanged.

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*Breakpoint Billiards Rating System v1.1*