Master Lock

Combination Recovery

Technical Reference

40-Position Dial Locks · betaprojects.com

Overview

A standard Master Lock padlock has a 40-position dial (0–39) and a three-number combination, yielding a theoretical search space of **40^3 = 64,000** possible combinations. This tool reduces that space to approximately **64 valid candidates** by exploiting two mechanical properties of the lock's internal cam and disc system to find the last number of the combination in under a minute.

Step 1—Determining the Last Number

The last number is the only digit directly encoded in the lock's primary cam (the rear disc). It can be recovered without disassembly by applying shackle tension while rotating the dial.

Procedure 1 (older locks, before 1996)

1. Hold the lock with the shackle up. Apply firm upward pressure on the shackle.
2. While maintaining tension, rotate the dial clockwise one full revolution.
3. The dial will catch or bind at approximately 12 positions around the face.
4. 11 of those positions will fall on half-numbers (e.g. 2.5, 7.5). Discard them.
5. The single position that lands on a whole number is the last number.

Procedure 2 (newer locks)

1. Hold the lock with the shackle up. Apply firm upward pressure on the shackle.
2. While maintaining tension, rotate the dial clockwise one full revolution.
3. The dial will catch or bind at approximately 12 positions around the face.
4. Only one of those that catch will bracket a whole number (ex., 38 will be bracketed by 37 and 39).
5. The lower bracket is out last number (37 in this example).

Why It Works

Under shackle tension, the primary cam is pressed against the bolt. Only positions aligned with actual cam notches allow rotation and only the true last-number notch is machined at a **whole-number position**. All other catch points are artifacts of the cam edge geometry and land between dial markings.

Disambiguation

Occasionally two candidates appear to land on whole numbers. Apply modular filtering: all catch points after discarding half-integers should share the same ones digit, except one outlier. That outlier is the last number.

> **Example:** `Candidates: 32, 22, 19, 12, 2` → ones digits: 2, 2, **9**, 2, 2 → **19 is the last number**

Step 2—Deriving Candidate Combinations

Once the last number (c3) is known, all valid candidates are computed using modular arithmetic and five mechanical exclusion rules.

First Number (c1) Candidates

The first number shares the same remainder mod 4 as the last number: $c1 \equiv c3 \pmod 4, \quad c1 \in [0,39]$

This yields 10 candidates spaced 4 apart across the dial.

Second Number (c2) Candidates

The second number is offset by 2 from the last number's remainder: $c2 \equiv (c3 + 2) \pmod 4, \quad c2 \in [0,39]$

This also yields 10 candidates. The +2 offset ensures c1 and c2 never share the same residue class.

Exclusion Rules

Not all c1/c2 pairs are mechanically valid. These five conditions remove combinations that are physically impossible to set on the lock:

Condition	Meaning
c1 − c2 == 2	c1 is 2 above c2—too close
c1 − c2 == 6	c1 is 6 above c2—within tolerance band
c2 − c1 == 38	Wraparound equivalent of c1 − c2 == 2
c2 − c1 == 34	Wraparound equivalent of c1 − c2 == 6
|c3−c2| % 36 == 2	c2 is within 2 of c3 on the dial

Net result: From a theoretical 10×10 = 100 pairings, the exclusion rules eliminate 36, leaving approximately **64 valid combinations**.That's a 99.9% reduction from the original 64,000.

The Algorithm

JavaScript implementation—outer loop sorted by first number for easier sequential dialing:

```
for (var c1 = c3 % 4; c1 < 40; c1 += 4)
  for (var c2 = (c3 + 2) % 4; c2 < 40; c2 += 4)
    if (!(c1-c2==2 || c1-c2==6 || c2-c1==38 ||
          c2-c1==34 || Math.abs(c3-c2)%36==2))
      combos.push([c1, c2, c3]);
```

Step 3—Dialing Each Combination

Each attempt must begin from a fully cleared state. Follow this sequence precisely:

Step	Action	Direction	Detail
1	Reset	Clockwise	3 full rotations—clears all discs
2	1st Number (c1)	Clockwise	Continue from reset, stop on c1
3	2nd Number (c2)	Counter-clockwise	Pass c2 once, stop on it the 2nd time
4	3rd Number (c3)	Clockwise	Go directly to c3, pull shackle

Complexity Summary

Stage	Search Space	Reduction
Unrestricted (40^3)	64,000	—
After last number identified	1,600	97.5%
After mod-4 filtering (c1, c2)	~100	93.75% further
After exclusion rules applied	~64	36% further
Total reduction from 64,000	**~64**	**99.9%**

Notes & Limitations

- Applies to standard 40-position Master Lock padlocks (Series 1–5 and most common models).
- Worn or damaged locks may produce ambiguous catch points in Step 1. Try both candidates.
- Some locks accept ±1 tolerance on each digit; others require exact alignment.
- This tool is intended for personal lock recovery only. Do not use on locks you do not own.