V-Cube 7

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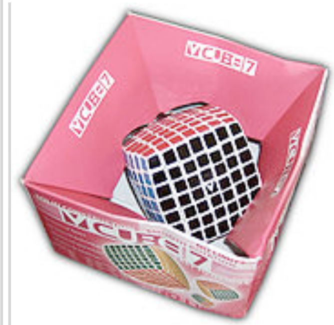
V-Cube 7 in original packaging.

The **V-Cube 7** is the 7×7×7 version of Rubik's Cube. It was invented by Panagiotis Verdes and is produced by his company, Verdes Innovations SA. Like the 3×3×3 and 5×5×5, the V-Cube 7 has fixed center facets.

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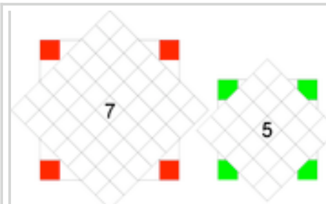
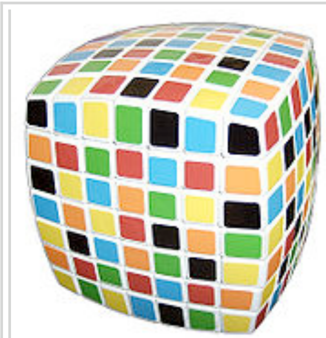
Mechanics

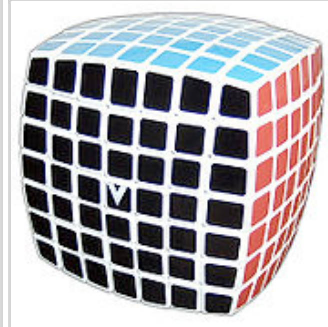


Issue with corners in a large cube

The puzzle consists of 218 unique miniature cubes ("cubies") on the surface. Six of these (the central tiles of the six faces) are attached directly to the internal "spider" frame and are fixed in position relative to one another. The same mechanism is used on the V-Cube 6, except that on the latter the central rows are completely hidden.[1] The 24 center pieces surrounding the centermost fixed piece of each face are merely single square façades hooked into the hidden internal mechanism. This is the largest change to the 3×3×3 cube, because the center pieces can move in relation to each other, unlike the fixed centers on the original.


The V-Cube 7 in a scrambled state.

There are 60 edge pieces which show two colored sides each, and eight corner pieces which show three colors. Each piece (or quintet of edge pieces) shows a unique color combination, but not all combinations are present (for example, there is no edge piece with both black and yellow sides, since black and yellow are on opposite sides of the solved Cube). The location of these cubes relative to one another can be altered by twisting the outer layers of the Cube 90°, 180° or 270°, but the location of the colored sides relative to one another in the completed state of the puzzle cannot be altered: it is fixed by the relative positions of the center squares and the distribution of color combinations on edge and corner pieces, as well as the fixed center pieces.



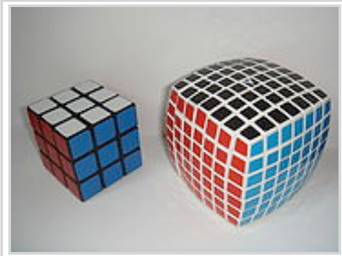
The V-Cube 7 in solved state.

Currently, the V-Cube 7 is produced with white plastic as a base, with red opposite orange, blue opposite green, and yellow opposite black. The fixed black center piece is branded with the letter **V**. Verdes also recently began selling a version with black plastic and a white face, with the other colors remaining the same.

Unlike the flat-sided V-Cube 6 produced by the same company, the V-Cube 7 is noticeably rounded. This departure from a true cube shape is necessary, since a 7×7×7 would be impossible to construct with uniform pieces. Note from the image at right that if a 7×7×7 were to be regularly constructed, the (red colored) corner pieces would lose contact with the body of the cube when a side was rotated 45 degrees.

Permutations

There are 8 corner cubelets, 60 edge cubelets and 150 center cubelets (6 fixed, 144 movable).


A size comparison between an original size 3×3×3 cube, and a 7×7×7 v-cube 7

Any permutation of the corner cubelets is possible, including odd permutations. Seven of the corner cubelets can be independently rotated, and the eighth cubelet's orientation depends on the other seven, giving $8! \times 3^7$ combinations.

There are 144 movable center cubelets, consisting of six sets of 24 pieces each. Center pieces from one set cannot be exchanged with those from another set. Each set can be arranged in 24! different ways. Assuming that the four center cubelets of each color in each set are indistinguishable, the number of permutations of each set is reduced to $24!/(4!^6)$ arrangements, all of which are possible, independently of the corner cubelets. The reducing factor comes from the fact that there are 4! ways to arrange the four pieces of a given color. This is raised to the sixth power because there are six colors. The total number of permutations of all six types of movable centers is this figure raised to the sixth power, $24!^6/(4!^{36})$.

There are 60 edge pieces, consisting of 12 central, 24 intermediate, and 24 outer edge cubelets. The central edges can be flipped but the rest cannot (because the internal shape of the pieces is asymmetrical), nor can an edge from one set exchange places with one from another set. The five edge cubelets in each matching quintet are distinguishable, since the colors on a non-central cubelet are reversed relative to the other. There are 12!/2 ways to arrange the central edges, since an odd permutation of the corners implies an odd permutation of these pieces as well. There are 2^{11} ways that they can be flipped, since the orientation of the twelfth edge depends on the preceding 11. Any permutation of the intermediate and outer edge cubelets is possible, including odd permutations, giving 24! arrangements for each set or $24!^2$ total, regardless of the orientation of the other cubelets.

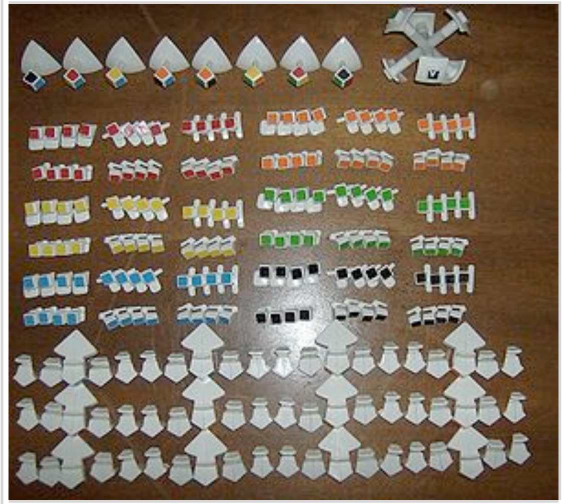
This gives a total number of permutations of

$$\frac{8! \times 3^7 \times 12! \times 2^{10} \times 24!^8}{4!^{36}} \approx 1.95 \times 10^{160}$$

The entire number is 19 500 551 183 731 307 835 329 126 754 019 748 794 904 992 692 043 434 567 152 132 912 323 232 706 135 469 180 065 278 712 755 853 360 682 328 551 719 137 311 299 993 600 000 000 000 000 000 000 000 000 000 000 000 (roughly 19,501 sexvigintillion or 19.5 sexvigintilliard on the long scale or 19.5 duoquinquagintillion on the short scale).

However, the fixed black center piece is marked with a **V**, which can be oriented four different ways. This increases the number of patterns by a factor of four to 7.80×10^{160}, although any orientation of this piece could be regarded as correct.

Solution



Disassembled.

One strategy involves grouping similar edge pieces into solid strips, and centers into one-colored blocks. This allows the cube to be quickly solved with the same methods one would use for a 3×3×3 cube. Because the centers, middle edges and corners can be treated as equivalent to a 3×3×3 cube, the parity errors sometimes seen on the 4×4×4 and 6×6×6 cannot occur on the 7×7×7 unless the cube has been tampered with.

Another strategy is to solve the edges of the cube first. The corners can be placed just as they are in any previous order of cube puzzle, and the centers are manipulated with an algorithm similar to the one used in the 4×4×4 cube.

Records

As of August 2008, this event has not been included in official competition, so no verifiable records exist for it. The earliest point the event may possibly become official is 2009 when new regulations may come into effect. Unofficially, Michal Halczuk solved the V-Cube 7 in 4:32.99, and Brendan Hemsly solved it 31 times in an average of 4 minutes and 0.02 seconds.[2][3]

Verdes Innovations announced a competition, including the 5×5×5 (all brands), 6×6×6 and 7×7×7. The event was held October 26th in Essen, Germany. [4]

See also

- Pocket Cube (2×2×2)
- Rubik's Cube (3×3×3)
- Rubik's Revenge (4×4×4)
- Professor's Cube (5×5×5)
- V-Cube 6 - (6×6×6)
- Combination puzzles

References

Notes

1. ^ United States Patent 20070057455 (http://www.freepatentsonline.com/20070057455.html)
2. ^ Speedcubing.com 7x7x7 Unofficial World Records (http://www.speedcubing.com/records/recs_cube_777.html)
3. ^ Speedcubing.com 7x7x7 Unofficial World Records (http://www.speedcubing.com/records/recs_cube_777av.ht
4. ^ V-Cube Competition flyer (http://www.v-cubes.com/pdf/V-CUBES_COMPETITION.pc PDF (149 KB)

External links

- Verdes Innovations SA (http://www.v-cubes.com/index.php) Official site.
- Frank Morris solves the V-Cube 7 (http://www.youtube.com/watch?v=UrjmeYdVTlc)
- Program Rubik's Cube 3D Unlimited size (http://kubrub.googlepages.com/rubikscube)

Categories: Rubik's Cube | Combination puzzles | Mechanical puzzles | Puzzles