# ETHOS Rocket Oven – Cochabamba, Bolivia

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## Abstract

CECAM Bolivia, a small organization in Cochabamba, called for a more efficient bread oven that would consume less wood. The ETHOS Rocket Oven was based on a design by Aprovecho Research Center. The design was tested and adapted to meet CECAM's needs. The final product was able to bake a batch of bread within 15-20 minutes using 0.7 kilograms of wood, as well as passing CECAM's safety standards. The oven was a success, but there are still a few recommendations that would vastly improve the design.

## Introduction

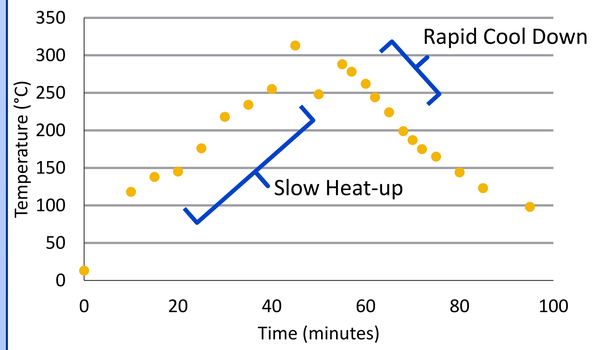
- CECAM Bolivia aims to support Bolivian families with few economic resources while caring for the environment
- Organization is very small, consisting of Freddy Candia, his family, and volunteers
- CECAM develops, funds, and builds sustainable technologies for poverty stricken families
- Nearby rural communities need an efficient means of baking bread
- The bread would provide health benefits to the rural communities
- The bakery would establish a micro-economy through which money could be retained within the community

## Project Description

Base design was an adaptation of the rocket stove

- Designed to burn efficiently and force hot air to heat up a cooking surface
- Want to incorporate the theory of a rocket stove into design by forcing the hot air to heat a central chamber (oven)
- Freddy had previously constructed a smaller model (Figure 1) which was tested for proof of concept
- Much could be improved in terms of efficiency and capacity (Table 1)

**Table 1.** Temperature of a Medium Sized Rocket Oven During a Test




**Improvement Areas:**

- Use maximum surface area for heat transfer
- Increase thermal capacity and insulation

**Figure 1.** Smaller Rocket Oven Model

## Results & Discussion

- The "Rocket-Style Pizza Oven" (Figure 2) found in the Aprovecho Research Center's "Capturing Heat Two" was used as a base conceptual design for the rocket oven
- This design implemented both suggested improvements

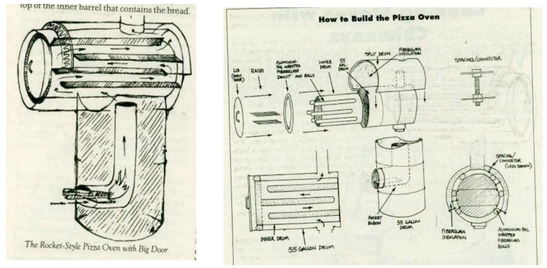



**Figure 2.** Base Conceptual Design

- Availability and cost of certain materials necessitated a number of changes to the original design.
- The final result can be seen in Figure 3.

| Safety Test for Cooking Stoves | | | | |
|---|---|---|---|---|
| Test Number | Test Description | Value Obtained | Value Factor | Total |
| 5.1.1 | Ran rag over sharp borders and edges to count number of snags or catches | 3 | 1.5 | 4.5 |
| 5.1.2 | Stability of oven when lit | 4 | 3 | 12 |
| 5.1.3 | Area from which combustion materials can be expelled from oven when cooking | 3 | 2.5 | 7.5 |
| 5.1.4 | Not applicable | N/A | 2 | 0 |
| 5.1.5 | Possibility of burning upon touching for children (<.9 m) and adults (.9 <h< 1.5) | 3 | 2 | 6 |
| 5.1.6 | Not-quantifiable | N/A | 2.5 | 0 |
| 5.1.7 | Temperature of handle vs ambient air | 4 | 2 | 8 |
| 5.1.8 | Temperature of chimney | 2 | 2.5 | 5 |
| 5.1.9 | Not applicable | N/A | 3 | 0 |
| 5.1.10 | Escapability of flames/ combustible materials | 4 | 4 | 16 |
| | | | Score | 59 |

**Tables 2/3.** Results of Safety Testing the ETHOS Rocket Oven

| Rubric for Safety Test | | |
|---|---|---|
| Ranking | Range | Adjusted Range |
| Mejor (Best) | 93 ≤ S ≤ 100 | 64 ≤ S ≤ 70 |
| Bueno (Good) | 84 ≤ S ≤ 92 | 59 ≤ S ≤ 64 |
| Regular (Okay) | 76 ≤ S ≤ 83 | 53 ≤ S ≤ 58 |
| Malo (Bad) | S ≤ 75 | S ≤ 52 |

## Conclusions

Tests including a safety test for cooking stoves (see Table 2/3) and efficiency tests, revealed that the refined rocket operated as follows:

- **Operational temperature**: 350 - 400 ° F
- **Time to heat up**: 15 min.
- **Time to cook 3 racks of bread**: 15-20 min
- **Wood Consumption**: 1.4 kg/hr
- **Safety Rating**: Bueno or Good

**Figure 3.** Completed ETHOS Rocket Oven

## Recommendations

- Redesign problem areas within the existing ETHOS Rocket Oven design
- Rethink and develop a simplified and repeatable construction process
- Increase portability by minimizing weight