

TEMPERATURE-REGULATED VENTILATED MATTRESS

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Introduction

Problem: Traditional temperature-regulated beds have uneven heating/cooling and limited ventilation

Solution: Mattress with precise temperature control, fans, and air flow channels

Stakeholder	Use
Hospital Patients	Prevent bed sores, cramps
Athletes	Therapy, inflammation reduction
Sensitive Sleepers	Uniform and precise temperature

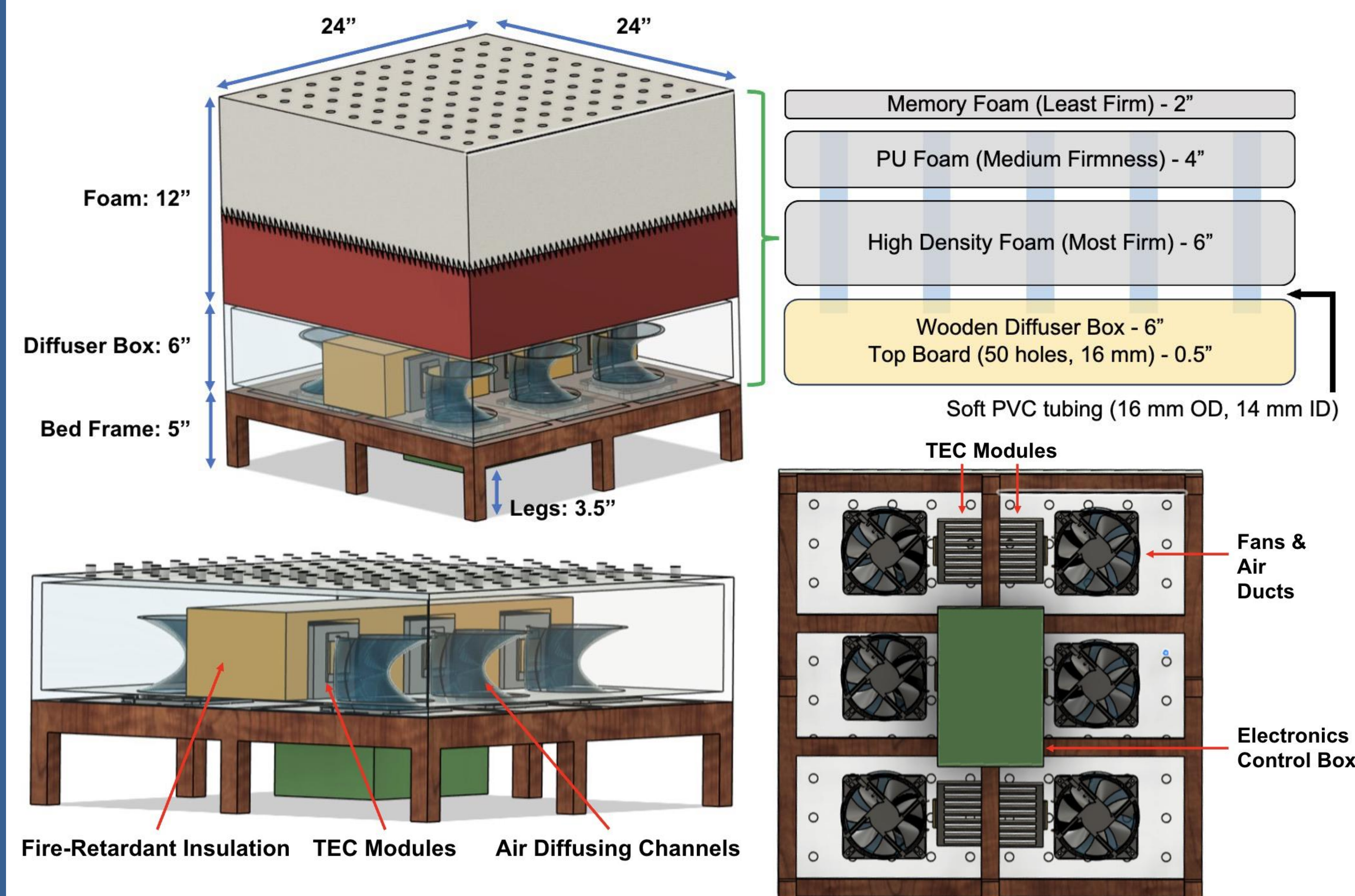
Key Customer Requirements

- Temperature regulation
- Efficient power usage
- Quiet
- Even temperature distribution
- Safe to use
- Durable and continuous operation
- User control

Technical Specifications

- 15°C – 30°C
- 2.5 kWh/night
- Noise Level: < 30 dB
- Temperature Sensing: $\pm 0.5^{\circ}\text{C}$
- Temperature Uniformity: $\pm 2^{\circ}\text{C}$
- Emergency Shutdown Temperature: 45°C
- Heat Resistance: 70°C for 1000 hours
- Remote Control Range: 10 m

Mechanical System Design



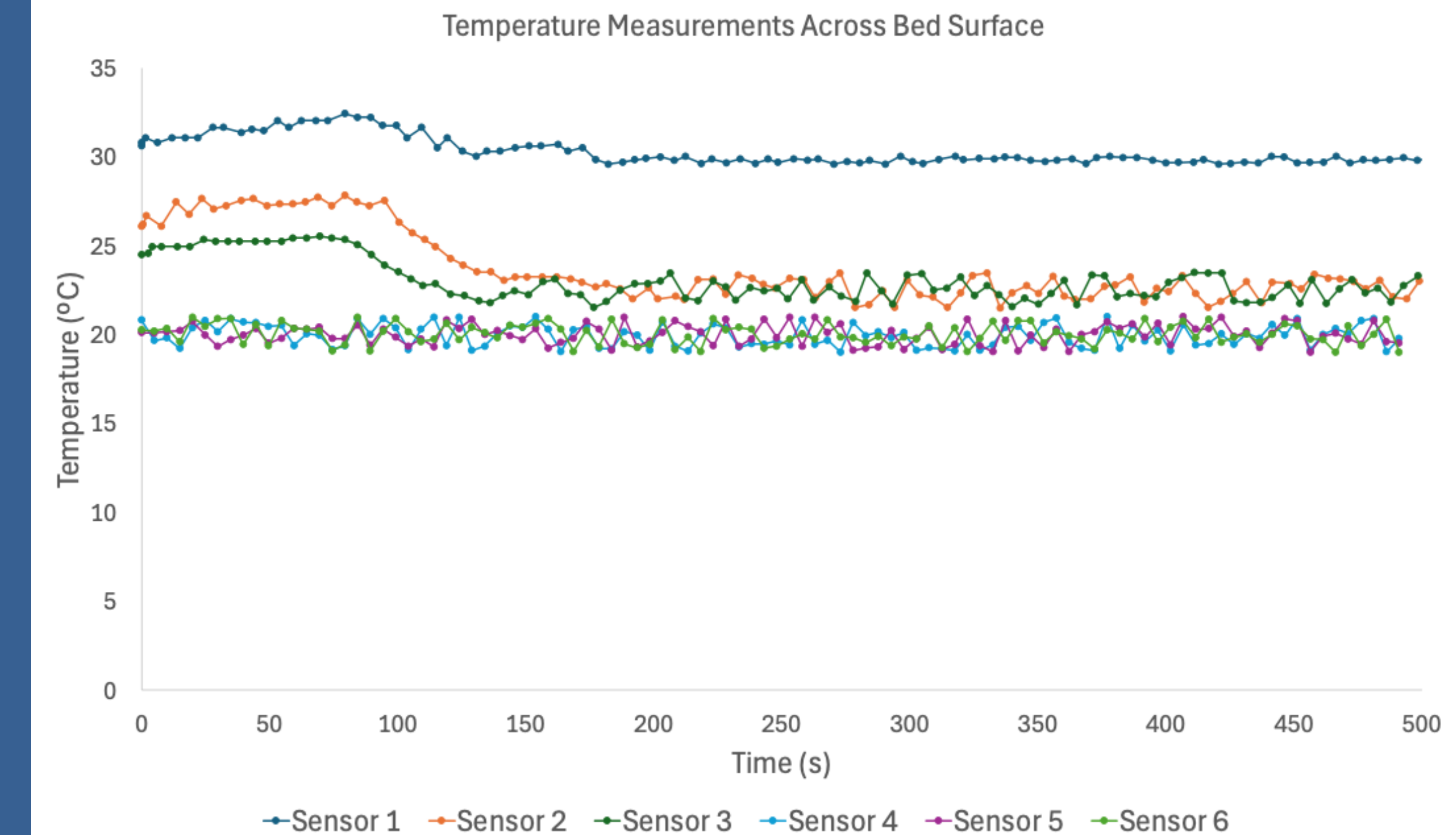
App Control

- Users select temperature and fan speed
- Each half of the bed can be controlled separately
- Control from up to 10 meters away

Heating-Cooling Mechanism

- Thermoelectric modules (TEC) use the Peltier Effect
- Applied current moves electrons between n- and p-type semiconductors to induce a temperature difference
- Heat sink, fans, and vents help remove waste heat

Testing and Results



- Sensors 1-3 monitor one side of the bed, using up to 50% duty cycle for the thermoelectric modules
- Sensors 4-6 monitor the other side with the modules disabled

Conclusions & Next Steps

Conclusions

- Proof of concept for internally ventilated and temperature-controlled mattress
- Air effectively channeled to user

Next Steps

- Improved venting mechanism
- Better insulation for TEC modules

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