



## Technologies for Exoskeletons

### ORNL Has Advanced the Enabling Technologies for Exoskeletons

Exoskeletons are defined as wearable machines that amplify the strength of humans. They have long been an engineering dream, however, their practical implementation was prevented by significant technological barriers. For the past 15 years, ORNL has pursued projects for the U.S. Dept. of Energy and the U.S. Dept. of Defense that have led to breakthroughs in the area of human-amplification controls and to successful demonstration of the basic human-strength amplification concept on a series of experimental test beds and prototypes.

Most recently, ORNL has demonstrated a set of enabling technologies to achieve realistic exoskeletons:

- A safe, clean, silent, low-temperature, portable power supply technology with high power and energy density
- A soft-tissue interface and sensing technology suitable for human-wearable exoskeleton controls
- An effective, high response bandwidth, high power density actuation technology
- A bilateral force feedback controls technology (allowing the human to “feel” the load effects) with contact (intentional or accidental) stability

### The State of Technology is Nearing Readiness for Full-Scale Implementation

With ORNL enabling technologies, practical exoskeletons have become near-term possibilities. Examples of applications envisioned include:

- Enhancing the endurance and load-carrying capabilities of dismounted soldiers
- Construction industry
- Assembly lines and manufacturing industry
- Rescue and first response operations
- Anti-terrorist and law enforcement
- Injury rehabilitation
- Ortho-support for the handicapped or elderly
- Most jobs and tasks involving possible injury due to heavy load lifting

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