

## The LOTO Process

1. Notify All Affected Parties
2. Shut Down Equipment
3. **Identify & Isolate Energy Sources**
4. Apply Locks & Tags
5. Create Zero Energy State
6. Test & Verify
7. Perform Work
8. Inspect & Restore

## The Zero Energy State

The most important step in any LOTO procedure is verifying that all energy sources are isolated and that the system is at a Zero-Energy State (ZES).

**Primary Energy** – energy responsible for doing the work. It can take many forms; electricity, pressure, heat, compression, tension, etc...

**Residual/Stored Energy** – potential energy that becomes “trapped” in the system by isolating the primary energy source. This energy is not being used to do the work, but when released, has the potential to be extremely hazardous. Stored energy must be accounted for and dissipated by bleeding off, or releasing the energy in a controlled manner.

**In 2020, OSHA assessed a proposed \$7.5 million in fines for violating the Lock Out Tag Out Standard.**



## The Control of Hazardous Energy

### Step 3 – Identification & Isolation of Energy

### Identify, Isolate & Eliminate Stored Energy

We all know what LOTO is; preventing the release of hazardous energy. In 2002, OSHA estimated that LOTO, when done correctly, saves about 120 lives a year and prevents 50,000 injuries.

One of the most important steps, and possibly one of the most time-consuming, is identifying all sources of hazardous energy; especially stored energy. Some stores are easy to spot, like back pressure on a hose. Others, such as stored electricity, can be especially tricky to locate.

- **Electricity** – This is the most obvious source of energy. Stored electrical energy may not be as easy to spot; for example battery backups, and capacitors. Many systems may also have secondary electrical supplies such as generators that start automatically when the primary energy source is disconnected.
- **Pneumatic/Air** – Pressurized air stores energy, and can be used to impart a tremendous force on other objects. Common examples include air hoses, spraying devices, air compressors, and air storage tanks.
- **Hydraulic** – Similar to air, energy is stored by pressurizing a fluid using an external source. Centralized hydraulic systems are fairly easy to isolate by locking out the main supply, and testing/bleeding until the line is deemed safe by a knowledgeable person. Non-centralized systems are more complex and require dedicated study to determine all isolation points. Consult with an expert on the system.

- **Kinetic/Springs** – Compressed springs have the ability to store enormous amounts of potential energy through compression.
- **Kinetic/Rotational** – Flywheels can store tremendous amounts of energy through momentum and inertia, and transmit this energy when engaged. Additionally, exposure to a rotating flywheel presents a severe contact hazard.
- **Gravitational** – All objects store gravitational energy equal to the object’s mass multiplied by its height above the ground. The resulting impact and crushing force due to gravitational energy can be massive. Examples include hydraulic arms holding an object off of the ground (skid steer bucket), or falling objects (tools).
- **Thermal** – Thermal energy can be stored in almost any object as heat. Steam pipes, oven components, and water are common examples.
- **Chemical** – Any pressurized liquid that is not water is considered chemical energy. This stored energy can be located downstream from lockout points, or in residual supply and return circuits.

Remember, LOTO saves lives, but only when all energy sources are identified. Take an extra few minutes to identify ALL of the energy sources; both primary and stored.