
Mechanical and Fluid Systems

# Deployable Emergency Shutoff Device Blocks High-Velocity Fluid Flows

## Controlling and metering flows in harsh environments

**NASA's Marshall Space Flight Center** has developed a device and method for blocking the flow of fluid from an open pipe. Motivated by the sea-bed oil-drilling catastrophe in the Gulf of Mexico in 2010, NASA innovators designed the device to plug, control, and meter the flow of gases and liquids. Anchored with friction fittings, spikes, or explosively activated fasteners, the device is well-suited for harsh environments and high fluid velocities and pressures. With the addition of instrumentation, it can also be used as a variable area flow metering valve that can be set based upon flow conditions. With robotic additions, this patent-pending innovation can be configured to crawl into a pipe then anchor and activate itself to block or control fluid flow.

## BENEFITS

- **Multifuctional:** Plugs, controls, and meters the flow of gases and liquids and reduces the amount of escaping oil while relief wells are drilled
- **Versatile:** Functions as a temporary plug during repair or as a permanent plug or flow meter, throttling to between 1 and 95 percent flow
- **Rugged and strong:** Features design components (mechanical configuration and cone shape) that lead to an effective device well-suited for harsh environments and high fluid velocities and pressures
- **Simple to operate:** Allows simple underwater guidance to the pipe; method of operation enables simple activation; does not require backfill with epoxy, cement, etc.
- **Variable-area flow meter:** When used with additional instruments, allows a greater turndown ratio than alternatives such as needle valves
- **Flexible deployment:** Operates remotely or robotically in harsh environments
- **Unique:** No other known product exists that plugs, controls, and meters fluid flow and is removable

technology solution

## THE TECHNOLOGY

### How it works

The device incorporates a metallic, variable area cone-shaped mechanism to restrict the cross-sectional area of pipe to throttle and control gas and liquid flow. The pointed shape allows easy insertion into a flowing pipe with minimal resistance. The device is anchored within the pipe using compression, lead screws, or pyrotechnic mechanisms when activated remotely. Actuators are used to mechanically change the device shape, which stops or controls pipe flow; with appropriate robotics, activation can be performed remotely. With proper pipe framing, nearly 100 percent flow blockage is possible. Rugged and strong, the device is well-suited for harsh environments and high fluid velocities and pressures.

For the oil industry, the device can reduce the amount of escaping oil from a broken pipe while relief wells are drilled. The device can then be removed or used as a valve to measure the amount of flow from inside the pipe, much like a control valve. In the fluid handling industry, the device can be used with additional instrumentation as a variable area flow meter that can be set based upon flow conditions to enhance flow metering accuracy, control pressure losses, or control flow in a closed-loop feedback.

### Why it is better

Millions of gallons of crude oil were released into the Gulf of Mexico during the seabed oil drilling catastrophe of 2010. Numerous strategies to stop or stem the oil flow (underwater vehicles, containment dome, cement seal "top kill") proved unworkable before the well was finally capped. Even more controversial than the escaping oil was the inability to monitor and measure the oil flow while repairs were attempted. The NASA innovation can be left in place to permanently plug a pipe, or it can be removed after necessary repairs. Other repair strategies are not removable so permanently block pipe access when used. Also unique is the device's ability to control flow in a wide range (1-95 percent of the original flow) and to measure flow while repairs are made. The first of its kind, this NASA technology can stop, measure, and meter fluid flow from an open or broken pipe and is removable when it is no longer needed.

## APPLICATIONS

The technology has several potential applications:

- Deployable emergency shutoff device above or under water
- Petroleum blowout prevention
- Variable area flow controller and
- meter for:
  - Chemical and mineral processing
  - Chemical plant flow metering of industrial processes
  - Healthcare
  - Environmental management

## PUBLICATIONS

Patent pending

More Information

National Aeronautics and Space Administration

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