National Aeronautics and Space Administration

technology opportunity

Self-Advancing, Step-Tap Drill Bit

For reduced fatigue, improved safety, and greater efficiency

Flight-certified, step-tap drill bits for threaded holes that stop at the required size step

Crew training using the step-tap drill bit in the Pistol Grip Tool (PGT) drill driver on a Shuttle leading edge test article

Co-inventor Charlie Camarda on STS 114 Return to Flight with step-tap drill bits

Drilling a test piece of previously damaged leading edge material with a prototype step-tap drill bit

NASA's Johnson Space Center invites interested companies to license its patented self-advancing, step-tap drill bit. Originally developed for Space Shuttle repair (it now flies on every Shuttle mission), this novel, stepped drill bit features a cutting edge that concurrently enlarges a hole as it cuts threads—a feature not available in other stepped drill bits. The drill bit advances itself into the work material similar to a screw, eliminating the need to apply external axial force. This unique technology greatly improves the safety and efficiency of handheld drilling while reducing operator fatigue, making it ideal for high-volume and heavy-duty construction applications and home shop use.

Benefits

- **Reduced fatigue**: Features a unique self-advancing component that eliminates the need for continuous axial force, decreasing physical work effort
- **Improved safety**: Reduces the risk of the work piece tearing or spinning in the operator's hand because the drill bit does not grab the work piece
- **Greater efficiency**: Allows operators to work more quickly and productively without the need to change drill bits and taps when drilling different sized holes

Applications

Construction and home shop use, especially:

- Drilling holes larger than 0.5 inch
- Drilling vertically oriented holes
- Repetitive drilling
- Overhead drilling

For More Information

If you would like more information about this technology, please contact:

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For information about other technology licensing opportunities, please visit:

Innovation Partnerships Office
NASA's Johnson Space Center
http://technology.jsc.nasa.gov

Technology Details

How It Works

The self-advancing, step-tap drill bit uses a cutting edge to simultaneously enlarge a hole and cut threads. The drill bit is stepped, enabling an increase in the diameter of the hole with each step. To prevent the threads from stripping caused by the required cutting forces between the drill bit and the work material, the thread pitch (number of threads per inch) and diameter increase for each step are adjusted for the material type and thickness. The diameters of the steps are in increments of 0.030–0.060 inch (0.8–1.5 mm). The tip typically has a diameter of 1/8–3/16 inch (3.2–4.8 mm).

The thickness of the work piece to be drilled and tapped determines the length of the pilot-drill section chosen, so that the pilot hole is completed before engagement of the first tap section. If the cutting-edge geometry of the drill bit is optimized for the material to be drilled, only a relatively small axial force (typically a few pounds) must be applied when drilling the pilot hole. Once the first tap section engages the pilot hole, no additional axial force is necessary because the thread engagement between the tap and the work piece provides the axial force, seamlessly advancing the drill bit. A stop-lip or shoulder at the shank end of the widest tap section prevents further passage of the drill bit through the hole.

Why It Is Better

Applied axial drilling forces for handheld drills can be quite large, often as much as 75 lb (about 330 N) when drilling holes up to approximately 1 inch (25 mm) in diameter. With non-self-advancing drills, an operator often must bear down with near full body weight to facilitate downward drilling. When using such non-self-advancing drills, vertical, overhead, and repetitive drilling is extremely fatiguing and limits worker productivity. In addition, applying a large axial force with a hand-held drill can be dangerous because the drill bit can grab the work piece, causing the work piece to spin or tear the drill and work piece from the operator's hand.

Other drilling technologies include drill bits that make a single-sized hole, step drills that enable hole enlargement, taps that thread one size of a pre-existing hole, and a simple combination of a single-sized drill and a tap (for tapping after a hole has been drilled). Combining any of these technologies will not result in a functional, self-advancing, step-tap drill. Rather, the innovation developed at Johnson Space Center is a precise combination of step size, cutting angle, thread advance, and flute design, producing a drill bit that all but eliminates the need to apply external axial force while concurrently cutting and threading a hole. This significantly reduces operator fatigue, increases safety and efficiency, and enables drilling larger holes in thinner materials with a standard, commercially available drill.

Partners licensing and commercializing this innovative technology can manufacture and market the drill bits in several optimized designs and sizes for purchase individually or as a set. Marketable variations include:

- A set designed to leave a tapped hole for threading standard-sized fasteners
- A set to leave a hole through which to pass the shank of standard-sized fasteners
- A set for large holes
- Sets optimized for metal, plastic, and brittle ceramics

Patents

Johnson Space Center has received patent protection (U.S. Patent No. 7,357,606) for this technology.

Licensing and Partnering Opportunities

This technology is part of NASA's Innovative Partnerships Program, which seeks to transfer technology into and out of NASA to benefit the space program and U.S. industry. NASA invites companies to inquire about the licensing possibilities for the Self-advancing Step-tap Drill Bit (MSC-23954-1) for commercial applications.

Fuentek is a contractor to NASA's Innovative Partnerships Program, providing support for the access and transfer of technology.