

REGO-FIX▲



Taper-to-Taper Technology Advances
Metalworking Toolholding

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Introduction

In metalworking machining systems, precision and quality are critical, and excessive amounts of vibration due to underperforming toolholding can result in scrapped parts and huge production losses.

One major cause of vibration is runout — a condition where the metalworking cutting tool fails to rotate true and on center. Out-of-balance, poorly manufactured toolholders generate vibration that increases exponentially from the toolholder to the cutting tool tip. So the longer the cutting tool, the higher the levels of runout.

While the complete elimination of runout and vibration is impossible, today's advanced toolholding systems can reduce both to levels that are close to undetectable. These advanced toolholding systems tend to fall into one of three classifications — mechanical, hydraulic or shrink-fit.

All three typically show comparable levels of performance. However, powRgrip, invented by the Swiss company REGO-FIX, incorporates a special taper-to-taper design, which has proven more beneficial in terms of precision, strength, repeatability, ease of use and versatility.

System Description

Vibrations tend to resonate more through solid surfaces. The vibration-dampening taper-to-taper, press-fit collet-holding design of the powRgrip system creates a juncture point, or gap, that essentially interrupts the waves of vibration to reduce their strength and severity.

The powRgrip system consists of three basic components — holders, collets and press-fit assembly mounting units. In manual or automatic configurations, the hydraulic press-fit assembly units quickly press collets into holders with up to 9 tons of force. The collets have high-precision tapers that match up with equally high-precision internal tapers in the holders, all of which creates the system's extreme levels of transferable torque.

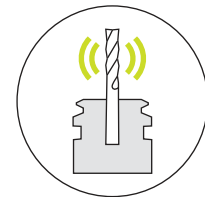
Unlike other clamping systems where heat or hydraulics are used, taper-to-taper systems capitalize on the mechanical properties of the holder material to generate tremendous gripping force. Interchangeable dies for both the manual and automatic powRgrip presses determine the pressure used to press the collet into the holder.

The operator selects and loads the die that fits the holder, and the press-fit assembly unit automatically applies the correct pressure. This intelligent die technology eliminates operator error, while the units' interlocked doors enclose the press-in area to prevent operator injury during the press-in and removal processes.

Recent studies conducted at the Fraunhofer IPK Institute for Production Systems and Design Technology, located in Berlin, Germany, indicate that while taper-to-taper toolholders, such as those of the powRgrip system, achieve comparable rigidity to shrink-fit-type holders, the former more than triple vibration dampening coefficients over those of the latter. The study attributes taper-to-taper toolholders' significant reductions in vibration to the interrupted surface interfaces between the toolholder and collet and between the collet and tool shank.

levels of performance

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Excellent vibration dampening.

taper-to-taper systems

Unlike other clamping systems where heat or hydraulics are used, taper-to-taper systems use the mechanical properties of the holder material to generate tremendous gripping force.

A special patented metal processing method creates a unique wear-resistant surface treatment on the powRgrip collets. This extremely hard surface finish contributes significantly to the system's longevity and repeatability.

All powRgrip collets accommodate through-coolant and are rated for up to 2,000 psi. Collets are also available with coolant flush channels/grooves that direct a coolant jet around cutting tool shanks even when using solid, non-through-coolant tools.

powRgrip system toolholders are balanced by design. And in terms of speed, holder assemblies are balanceable for use up to 42,000 rpm.

Features and Performance

Taper-to-taper collet-holding systems deliver extremely high levels of precision, and as a whole, their Total Indicated Runouts (TIRs) are typically less than 3 μm , which ensures accurate finished parts. Such precision optimizes the machining of complex, critical components through the use of High Speed Cutting (HSC) or High Performance Cutting (HPC) strategies. The lower the TIR, the less tool vibration, and the less vibration, the longer cutting tools last, which in turn reduces overall tooling costs.

The rigidity and strength of these toolholding systems yield the highest transferable torque against comparable systems. Taper-to-taper holders provide 1,100 Nm of torque on 1" tools, whereas other systems generate just over half of that strength.

In addition to precision and strength, the powRgrip system provides incredibly fast tool changeouts. Full clamping cycles take less than 10 seconds with the automatic assembly mounting unit. Plus, tools are completely safe to handle and ready to use immediately after that short loading cycle time.

The automatic press operates on standard 110V AC power and runs on 9 amps. Because it plugs in to any standard wall receptacle, the unit is portable and easily incorporates into any facility.

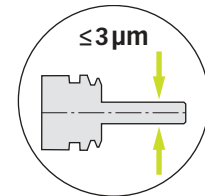
Likewise, Z-level tool length adjustments are equally simple with powRgrip tapered collets because every one has a Z-level adjustment screw. On any standard presetter, an operator can easily and precisely adjust this screw using an inexpensive adjustment tool, and repeatability of this Z-level adjustment is well within 10 μm .

Properly maintained powRgrip holders and collets sustain their high performance for at least 20,000 cycles. Over time, pressing a collet into a holder slowly burnishes the holder cavity to a more polished, higher precision surface finish that further increases the system's overall accuracy.

Each holder in this system holds any collet diameter — in metric or standard units — within its specified range. This drastically reduces the number of holders that must be kept in inventory to hold a wide variety of tool diameters. Taper-to-taper holders are also compatible with Weldon shank tools.

Applications

The powRgrip taper-to-taper collet-holding system accommodates tool diameters ranging from 0.2 mm to 25 mm and 1/16" to 1". It also accepts all standard taper types — such as BT, CAT, HSK and CAPTO —



Total system runout
TIR $\leq 3 \mu\text{m}$ at 3 x D.

high levels of precision

Taper-to-taper collet-holding systems deliver extremely high levels of precision, and as a whole their Total Indicated Runouts (TIRs) are typically less than 3 μm , which ensures accurate finished parts.

strength

Taper-to-taper holders provide 1,100 Nm of torque on 1" tools, whereas other systems generate barely over half of that strength

as well as standard forms, sizes and gauge lengths. Standard machining applications include drilling, reaming and milling — both roughing and finishing operations.

The system's special holders extend tool life during tapping operations by up to 150 percent when compared with rigid tapping holders. The special holders compensate for synchronization errors caused by the dynamic motion of spindle motors and linear motors that occurs during tapping.

Comparison to Other Systems

Other toolholding systems, such as shrink-fit, fail to deliver the same clamping force as taper-to-taper collet-holding systems, especially for smaller diameter tools. In these instances, the other toolholding systems are only about 45 percent as effective as taper-to-taper ones.

In addition to size limitations, shrink-fit systems that use heat present a safety risk. Operators must remove super-heated toolholders from a heating device with asbestos gloves, load in a cutting tool and place the assembly – holder and cutting tool – in a cooling tower, cooling attachment or on a table top. If the operator does not follow strict handling protocols, that action may result in serious burns.

Shrink-fit holders show no indications that they are dangerously hot, so anyone can accidentally injure themselves if the holders are not properly tagged or isolated. The heated holders also burn or vaporize any residual oil or coolant on the tool, and in many cases the resulting vapor is harmful and/or toxic.

In contrast to the controlled and consistent press-in parameters of a taper-to-taper toolholder, operators can alter the heating cycles of a shrink-fit holder. These alterations in temperature or length of heating cycle can damage the holder and cause it to wear out faster. Even under optimal heating conditions, the life cycle of the holder may only reach 5,000 uses — which is one quarter of the life of a taper-to-taper holder. And overall, shrink-fit holder life spans are typically much shorter.

Shrink-fit holders also lack versatility as compared with taper-to-taper holders. Separate shrink-fit holders are required for each cutting tool diameter, as well as for any long reach options. And, shrink-fit holders are not compatible with Weldon-shank tools, so if one is accidentally installed, it could potentially damage the holder or become permanently stuck and impossible to remove.

Shrink-fit system tool load/unload cycles take longer and require more power than do those of the powRgrip automatic assembly mounting unit for taper-to-taper holders. Shrink-fit systems tend to require up to 480V and 30 amps of power, which necessitates special electrical installations.

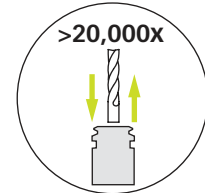
The task of presetting shrink-fit toolholders is a complex one because once the tool is inserted, it cannot be adjusted without a special induction and presetter machine. Balancing the holders also presents similar challenges. It can involve the adjustment of a series of screws, a process that is both time-consuming and difficult to complete with any degree of accuracy.

Summary

There are several types of cutting tool holder systems for metalworking machine tools. While most of those systems provide comparable levels of performance, one that incorporates a special taper-to-taper collet-holding design and surface coating further minimizes both detrimental tool runout and vibration to maximize productivity and precision, extend cutting tool life and provide quick tool changes, while helping to reduce overall production costs.

clamping force comparison

Other toolholding systems, such as shrink-fit, fail to deliver the same clamping force as taper-to-taper collet-holding systems, especially for smaller diameter tools.



Maximum clamping force and low runout, even after 20,000 tool changes.

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