APEX
ASSEMBLY & FABRICATION TOOLS

APEX **WHITEPAPER**

Much Is on the Line When Selecting Bits and Sockets

A typical assembly plant will invest a good deal of money in electric and pneumatic tools to install fasteners. Manufacturing engineers might conduct extensive research to find just the right combination of drive, clutch design and tool controller to ensure error-free fastening.

Given the sophistication of today's power tools, engineers might be tempted to discount the most critical component of the fastening process: the tools that drive the fastener. Because they connect power tools to fasteners, good-quality fastener drive tools (bits and sockets) are crucial for accurate, efficient and cost-effective fastening.

Because they must withstand thousands of fastening cycles a day, bits and sockets used on assembly lines must be highly durable and reliable. Unlike the bits and sockets sold in retail hardware stores, which might last for a few hundred cycles on the assembly line, assembly-grade bits and sockets are designed to last for tens of thousands of cycles, depending on the application.

Manufacturing managers should take into account their overall spending on bits and sockets rather than focusing only on the purchase cost per piece. While it may be tempting to purchase a lower quality bit or socket at a lower price, an assembly plant will almost always come out better when factors such as durability, frequent change-outs, and the risk of line stoppages or accidents due to a socket or bit failure are taken into account. This is called the total cost of ownership model. Studies have shown that an average plant can save thousands of dollars per year by using high-quality, assembly-grade bits and sockets.

To achieve consistent product quality, APEX heat-treats its bits and sockets using a salt bath process.

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Manufacturing Assembly-Grade Bits and Sockets

Advanced manufacturing processes are required to make a high-end, assembly-grade bit or socket. For one thing, precision fit and tight tolerances are critical for manufacturing these drive tools, so they can deliver higher torque than their retail-grade equivalents. And, given the high torque used to install fasteners on assembly lines, assembly-grade bits and sockets must be made of much tougher material than retail-grade products. Bits and sockets may pose significant safety hazard if they break apart and turn into high-speed flying objects.

Even among assembly-grade bits and sockets, there can be significant differences. The choice of material, manufacturing process, and heat treatment can affect how well bits and sockets perform on the assembly line. When it comes to superior quality assembly-grade bits and sockets, the old consumer adage, "you get what you pay for," absolutely applies.

Different Sockets for Different Applications

A variety of sockets are available for tightening nuts and bolts. Which to choose depends on the application. The following summarizes the differences among some common sockets:

- Fixed magnetic sockets hold fasteners in the driving position, even when operators are working straight down. Time-wasting motions are eliminated when starting fasteners and when working in hard-to-reach areas.
- Magnetic bolt-clearance sockets have spring-loaded or hollow cylinder magnets that allow bolts and studs to retract into the socket body as they run down.
- Fast-lead sockets, originally created by APEX, have specially machined openings that provide complete engagement with nuts almost instantly. Engagement is possible without starting and stopping power tools for each nut. These sockets increase productivity and extend tool life.

Also known as universal sockets or swivel sockets, universal wrenches allow the fastening tool to be positioned at as much as a 30-degree angle to the fastener axis.

High-grade alloy steel is among the essential raw materials for assembly-grade bits and sockets. Using a steel alloy with a high carbon content, such as 4150 for sockets, will allow a fastener drive tool to attain higher levels of hardness without sacrificing toughness. The higher hardness levels will effectively cause the bits and sockets to last longer and not wear out as quickly as with a lower hardness level tool. Lower carbon steels such as 4140 cannot provide the toughness at the higher hardness levels required to maintain the cycle life expected of an assembly-grade tool. APEX, the global leader in bits and sockets, uses proprietary materials that have been modified to optimize the quality of its products.

In addition, bits and sockets that are machined can be held to tighter tolerances than those that are forged. When manufactured on high-quality machine tools with the latest technology, bits and sockets run truer, holding tighter concentricity requirements than if they are forged, resulting in longer tool life and more precise fit in the application. And, unlike forging, machining processes provide tool manufacturers more flexibility in customizing bits and sockets for customers.

Because of the manufacturing processes that APEX employs, its sockets have hex tolerances that are up to 45 percent tighter on average than ASME (B107.17) standards and up to 42 percent tighter than DIN 475 standards. Tighter tolerances lead to more consistent fit to the fastener, which reduces the chances of cam-out, reduces excessive backlash when contacting the fastener and allows for more reliable torque transfer at the application. Reliable torque transfer readings are extremely important in today's assembly world where torque data is recorded on most critical fastening applications as a means of process verification and acceptance.

Heat Treatment

Achieving long tool life depends on choosing the right heat treatment for bits and sockets based on the application and the power tools they are used with.

Quality tool manufacturers typically produce assembly-grade bits and sockets at more than one level of heat-treat hardness. For example, APEX focuses on two heat-treat levels for screwdriving bits, which it designates with the following letter suffixes:

- X for the hardest heat treatment in the industry.
- R for a lower level of hardness.

In general, for screwdriver bits, X heat treatment is most suitable for low-torque applications, particularly if hardened fasteners are used. The X heat treatment is also recommended for use in applications requiring extreme wear resistance, such as high-volume production applications. In contrast, R heat treatment is required for higher torque applications to resist breakage due to twisting. The X heat treatment is most common, and typically, it should be chosen unless the specifics of an application or an existing problem suggest using R or a customized level of heat treatment.

While it may be tempting to purchase a lower quality bit or socket at a lower price, an assembly plant will almost always come out better when factors such as durability, frequent change-outs and line stoppages are taken into account. Studies have shown that an average plant can save thousands of dollars per year by using high-quality, assembly-grade bits and sockets.

Hardness levels should also be considered in applications requiring the use of sockets to drive fasteners. Selecting the heat treatment best-suited for a particular application may require some trial and error. The right heat treatment depends on the failure mode of the bit or socket. For example, if a bit breaks or shatters, a lower hardness may be necessary. While if the failure is from wear, a harder drive tool may work better. Should both breakage and wear occur with the same application, other variables may be at play. Engineers may need to consider differences among operators, different torque values, or different settings for their fastening tools.

To achieve consistent product quality, APEX heat-treats its bits and sockets using a salt bath process. In this process, the parts are totally immersed in molten salt. The temperature of the bath is uniformly maintained to within ±5° F of the set point. Because the salt-bath process combines conduction and convection heat transfer mechanisms, the heating rate is fast and uniform from each part's surface to its core. This results in a more consistent hardness range for the parts than other heat-treating methods. The resulting product is "through-hardened," to the core, not just surface-hardened.

Another benefit of the salt-bath process is that the heat-up time to equilibrium temperature is reduced relative to other heating methods. Consequently, the parts are not exposed to high temperatures for long.

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During quenching in molten salt baths, the uniform rate of heat transfer produces better controlled cooling conditions, which reduces the risk of quench cracks and distortions as compared to other processes. And because parts have minimum contact with the atmosphere while immersed in a molten salt bath, scaling, oxidation and decarburization are prevented.

With assembly-grade bits and sockets—like the fastening tools on which they're used—total cost of ownership is more important than the initial purchase price. Engineers are well-advised to look for bits and sockets that are durable and accurate enough to endure the daily rigors of their particular assembly applications. Ultimately, investing in a quality product will enable assemblers to install more fasteners with fewer bits and sockets.

For more information, call APEX Assembly & Fabrication Tools at 800-845-5629, email apex@apex-tools.com, or visit www.apex-tools.com.

APEX universal wrenches are now available with safety and anti-marring u-GUARD™ covers.

A SOLUTION FOR HARD-TO-REACH FASTENERS

In an ideal world, every nut and bolt would have unlimited clearance for the power tool and socket. On an assembly line with hundreds of unique applications, however, that's not always possible. Fortunately, there is a solution.

Universal wrenches provide access in hard-to-reach fastening applications, such as tightening bolts on the exhaust manifolds, engine mounts and transfer cases of large engines. These wrenches use a ball-and-socket design with a swivel pin to lock the socket and shank together.

Also known as universal sockets or swivel sockets, universal wrenches allow the fastening tool to be positioned at as much as a 30-degree angle to the fastener axis.

APEX offers three types of universal wrenches:

- The standard type consists of a socket assembled to a swivel head shank and a drive adapter available in a variety of sizes.
- The tension type features a spring-loaded collar beneath the socket to hold the socket in either a straight or angled position.
- The internal tension type offers more clearance while still allowing the socket to be held at any angle.

Universal wrenches can be used with any power tool, including impact tools, and they have no restrictions in terms of torque level or speed of the power tool.

The most popular are the 3/8-inch square-drive universal wrenches, which have hex openings ranging from 3/8 to 5/8 inch, socket diameters ranging from 5/8 to 7/8 inch, shank lengths ranging from 3 to 12 inches, and clearance depths ranging from 7/16 to 19/32 inch. Custom universal wrenches to attain an additional 10 degrees of angle or deeper clearance requirements are also available.

A staple for APEX for most of its 85 years in business, the universal wrench has undergone some major modifications over the years.

When customers became concerned that vibration and stress during extended operation produced small fractures and sharp raised surfaces around drive pins, APEX responded to these safety concerns by developing a line of universal wrenches with solid steel collars that covered the drive pins to shield workers from catastrophic failures. APEX engineers redesigned the wrenches to ensure that the collars, which were dubbed IronBand™, did not increase the outer diameter of the sockets, allowing them to easily replace conventional universal wrenches. In addition, IronBand often extended the operating life of the wrenches. The new single-piece shank improved accuracy by reducing run-out as much as 50 percent. It also reduced vibration by 50 percent, which improved the wrench's ergonomics.

To further reduce vibration, APEX developed a line of universal wrenches with a counterbore machined on the drive end that creates a close fit to the driving tool's spindle. Incorporated into the counterbore are two O-rings to significantly reduce wobble and increase straightness, which in turn have ergonomic benefits for operators. The counterbore also prevents run-out from the end of the socket to the tool head. Other benefits of the wrenches with counterbores are greater torque transfer, longer power tool life and quicker fastening times.

Another recent improvement APEX made is to offer its universal wrenches with its line of safety and anti-marring u-GUARD™ covers. Made of a low-durometer, thermoplastic urethane material, the u-GUARD D covers increase operator safety by significantly reducing or eliminating pinch points on universal wrenches and other free-spinning drive tools.

The u-GUARD also serves as a protective barrier between universal wrenches and finished workpieces, protecting polished and highly sensitive surfaces from in-system damage.

Because they are molded to match the universal wrench profile, the u-Guard covers do not take up excessive additional space. The covers still allow the wrenches to spin freely, and a low-sustained coefficient of friction between the covers and the wrenches minimizes loss of tool efficiency. The covers' bright orange color makes fastener alignment easier to manage and station monitoring smoother. In addition, the covers cannot easily be removed, which prevents unwanted tampering on the line.

In mid-2018, APEX will introduce another innovation that is designed to further enhance the life of its universal wrenches significantly. In researching how the universal wrenches fail, APEX determined that their pins and necks wear out due to tolerance gaps between them. Using new technology with the capability to hold tighter tolerances, APEX has significantly reduced the tolerance gaps between components in the assembly, and upgraded the shanks by adding more material to the necks. These changes reduce backlash in the assembly improving torque transfer and reducing wear on the pins without compromising the functionality of the universal wrench.