Determining the Quality of Sems Products

By Joe Greenslade

Sems fasteners are combination screw and washer assemblies. They are produced so that the washer is captivated on the screw, allowing it to rotate freely without falling off. This captivation is normally done by inserting the cold headed blank into the washer and then thread rolling the screw. The washer's inside diameter is larger than the screw's blank diameter, but smaller than the major diameter of the thread produced. The inside diameter of sems washers is smaller than the inside diameter of a comparable "over-the-threads" washer for the same size screw. The displacement of the screw's blank diameter in the thread rolling operation that creates the larger major diameter is what captivates the washer to create the assembly.

Sems fasteners provide their users with many advantages such as the reduction of different inventory items, the elimination of washers left out of product assemblies in crucial areas, and greater production efficiency. Sems fasteners are used in a variety of end products, but the greatest volumes are used in the automotive, appliance, electrical, and telecommunications industries.

The sems product and process were patented in the late 1930's. All the original patents on the products and the assembly equipment have now expired. In recent years many new fastener manufacturers have started to offer sems fasteners, but it is still considered a specialty area of manufacturing because of the special equipment and manufacturing knowledge that is required. Several manufacturers have tried to enter this field only to learn that to do it correctly and at a profit is much more difficult than may appear.

The issue of the quality of sems fasteners is obviously a little more complicated than simply that of a single screw or a single washer. The supplier and user must be concerned about all the aspects of quality of both the screw and the washer plus the quality of the assembly itself.

This article will address the quality requirements of sems fasteners. Suppliers and users should be aware that they may differ slightly from those of the individual part requirements. Answers to frequently asked questions have been covered. The actual documents covering sems fasteners and washers are ANSI/ASME B18.13 and ANSI/ASME B18.21.1. These specifications can be found in the ANSI/ASME documents and in the 6th Edition of the Industrial Fastener Institute Standards Book.

Dimensional Requirements

Head Height and Length

The basic dimensions of the screws and washers of a sems fastener are the same as those of the individual items except that, as stated above, the inside diameter of the sems washer is smaller than a comparable over-the-threads washer. The screw's head height (see Figure 1) is to be measured as a standard screw head height from the bottom of the head to its top. The washer is not to be included. The screw's length (see Figure 2 on page 30) is to be measured as a standard screw from the extreme end of the screw to the underside of the head on protruding head screws and the top of the head on flat head screws. It is somewhat difficult to exclude the washer in making these measurements, but is must be done to take correct measurements. The use of the "SEMS PLATE" on the Dimension-All Measuring System (see Figure 3 on page 30) makes taking these measurements simple.

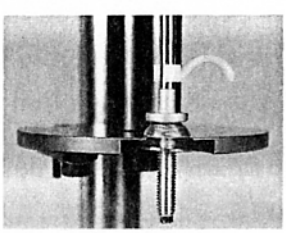

Figure 1.
Measuring Sems products head height with SEMSCHEK™ Dimension-All Dial.

First Thread Location

The location of the first thread on sems fasteners can be critical. Generally, the screws must be threaded within one pitch of the effective plane of the non-compressed washer on the side of the washer toward the end of the screw. An exception to this is socket head cap screw sems that must be threaded within 2 pitches of this reference point. The term "effective plane of the non-compressed washer" is used here to explain that this distance must be measured when the washer is not under any load and that it is

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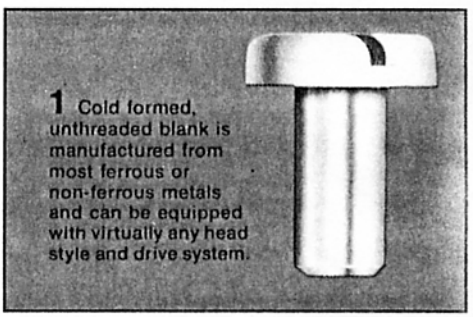
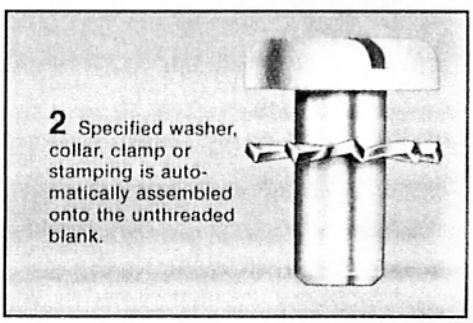
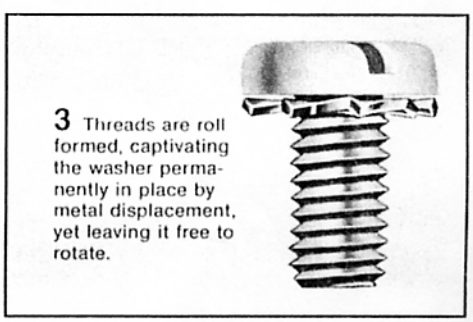
How Sems are made







Joe Greenslade is President of Greenslade and Company, Inc., of Rockford, Illinois, which specializes in supplying manufacturing and inspection products to the fastener industry. He has been active in the fastener industry since 1970. Prior to starting his firm in 1978 he worked in two major fastener producing companies in a variety of engineering, marketing, and management positions.

Mr. Greenslade is an Associate Member of the Industrial Fastener Institute (IFI) serving on several technical subcommittees relative to fastener quality. He is also a Member of the American Society of Mechanical Engineers serving on the ANSI/ASME B1 Thread Subcommittees and is an alternate member of the ANSI/ASME B18 Fastener Supplier Accreditation Subcommittee.

Mr. Greenslade is the author of over 40 fastener technology related articles, and is the inventor of several innovative patented fastener inspection devices. He is one of the industry's most frequent speakers on fastener quality subjects.

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product assembly when the screws are seated.

Hydrogen Embrittlement Testing

Hydrogen embrittlement is a major problem with electroplated sems that have hardened washers. The likelihood of hydrogen embrittlement goes up as the carbon content of the material and its hardness rise. Hardened sems washers are generally made of 1050 to 1060 steel hardened into the Rockwell C40's. To avoid hydrogen embrittlement all electroplated sems should be baked at 400 degrees F for 4 hours "at temperature" within one hour after plating.

Even when baking is done the parts should be tested for hydrogen embrittlement. This is done by driving the sems fasteners into hardened test plates until the washers are compressed. Then allow them to sit for 24 hours. Helical and conical washers are to be compressed completely flat and toothed washers are to be compressed to within .005 inches of flat. After 24 hours the screws are to be loosened and the washers are to be examined. If they are broken the parts should be rejected because this is evidence of hydrogen embrittlement.

Electroplated sems fasteners having hardened flat washers larger than the screw's head diameter should be tested by driving the screw in a hardened test plate through a spacer with an inside diameter slightly larger than the screw's head, tightening it to about 10% over the normal assembly torque, and letting it sit 24 hours. If the washer is broken after loosening, the parts should be rejected. This is a suggestion based on our own experience and is not covered in any specification.

Hydrogen embrittlement testing should never be omitted because of the tremendous liability associated with embrittlement failures in the field. Many such cases have resulted in claims against suppliers totaling hundreds of thousands of dollars.

Free Turning Washers

Sems washers must turn freely on the screw to function properly. Two conditions can occur to prevent washer rotation. First, the screw thread can be rolled too close to the washer, literally locking the washer into place. This is unacceptable and parts having this condition should be rejected. Secondly, sems fasteners coated with some of the new paint type of finishes can stick the washer to the screw's head. If these can be broken loose by holding the washer firmly between the fingers of one hand and twisting the screw head with the fingers of the other hand the parts should be accepted. This is because the initial tightening torque exerted when the washer contacts the product's surface probably will break the washers loose. If the washers cannot be broken loose by hand the parts may be considered rejectable.

Sems fasteners offer users many potential assembly benefits. They should be evaluated by the criteria stated above to assure that those potential benefits become actual benefits. It should always be remembered that all types of fasteners should be measured to assure proper fit and tested to assure proper function. Fastener quality can no longer be assumed or taken for granted. ❑