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PREVENTING HARDWARE DAMAGE AND RETURN DUE TO USE OF INCORRECT SCREWS

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ABSTRACT

In some instances, network equipment can be damaged during installation due to improper installation hardware be used on the equipment. For example, screws that are of an incorrect length (in particular, longer than prescribed in installation manuals) can sometimes damage a printed circuit board assembly (PCBA) or component of the equipment. Techniques are presented herein that introduce a foolproof design concept for converting a through hole to blind hole clinch nut for a rackmount bracket. A first aspect of the presented techniques encompasses adding a threaded protection cover to a clinch nut to prevent the excess protrusion of a screw. A second aspect of the presented techniques encompasses a customized blind clinch nut that can restrict (through, for example, a metal plate) the travel of a screw. A third aspect of the presented techniques encompasses adding a press fit metal cap that can restrict travel of a screw. A fourth aspect of the presented techniques encompasses a fastener having a swaged rim feature. Use of the presented techniques can help to reduce the number of products that are returned due to potential installation issues.

DETAILED DESCRIPTION

Using incorrect or improper screws (e.g., screws that are longer than prescribed) during the installation of networking equipment can cause printed circuit board assembly (PCBA) or component damage, such as shorts and/or burning. Thus, it would be advantageous to provide a solution that prevents inappropriately long screws used during the installation of networking equipment from damaging the equipment.

When network equipment is damaged, it is typically returned to the equipment vendor. Such returns can cause significant costs to be incurred by the vendor, such as an expenditure of man hours, the price of shipping, the time that is spent on failure analysis, etc. Those costs, in addition to business reputation, quality perceptions, and product replacement costs, cannot be ignored.

For a customer, such a return experience does not provide for a positive impression. Rather, it suggests to a customer that a product's design is not foolproof. Human error cannot be eliminated, but it can be nullified through "mistake proofing." Further, such issues can result in undesirable network outages, such as unscheduled network downtime.

Consider various examples through which network equipment may be damaged during installation due to use of improper installation hardware. In a first example, an accessory kit for a piece of equipment may include all of the fasteners that are required for the assembly of mounting brackets and ground lugs. Such fasteners may include screws that are of a proper sizing (e.g., length) for the intended use, as indicated in Figure 1, below.

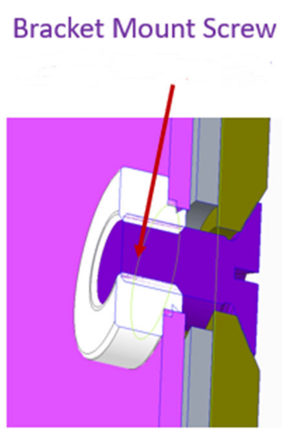

Figure 1: Properly sized Mounting Screw

Most customers outsource the installation of a piece of equipment to a third party. At a deployment site, a third-party installation operator may mistakenly use an incorrect screw (that is, for example, not part of the accessory kit) that may have a longer length than required. As shown in Figure 2, below, the result of such a mistake may include electrical component damage and damage to a printed circuit board assembly (PCBA).

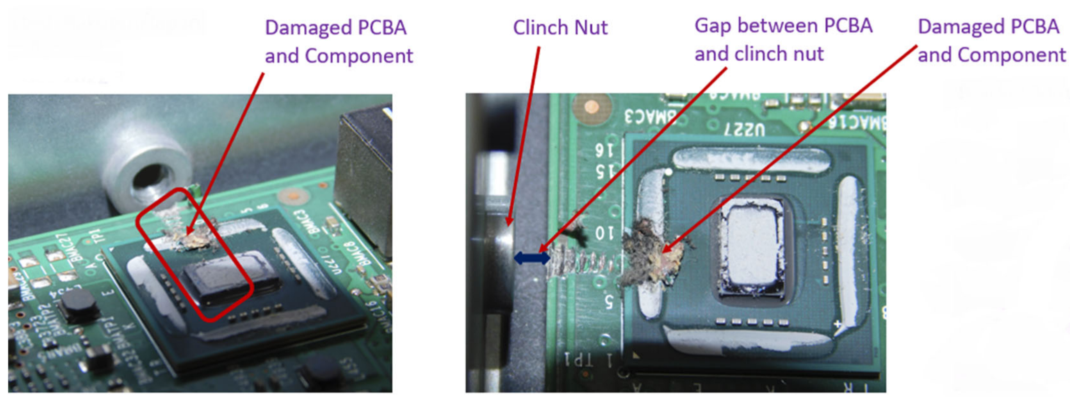

Figure 2: Illustrative Component and PCBA Damage

In a second example, within the chassis of a particular piece of equipment a backplane PCBA burn issue can occur at a ground lug installation area, as depicted in Figure 3, below. Such an issue can occur due to contact between a grounding lug screw and a backplane PCB in which the contact can result in an internal power and grounding short.

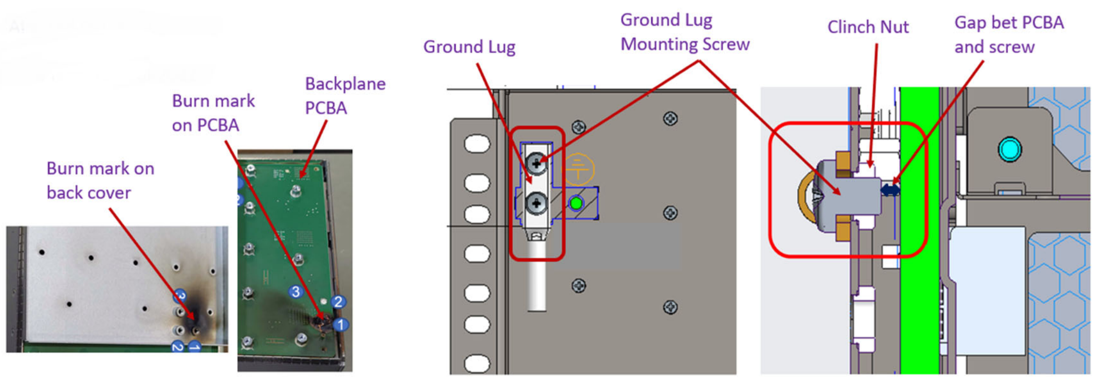

Figure 3: Illustrative PCBA Damage

Presented herein are various techniques that can be facilitated via a new mechanical fastener that can be assembled in the available space of a piece of equipment. A first aspect of the fastener encompasses adding a threaded protection cover to prevent the excess protrusion of a screw. Figure 4, below, presents different views of an example of such a threaded protection cover.

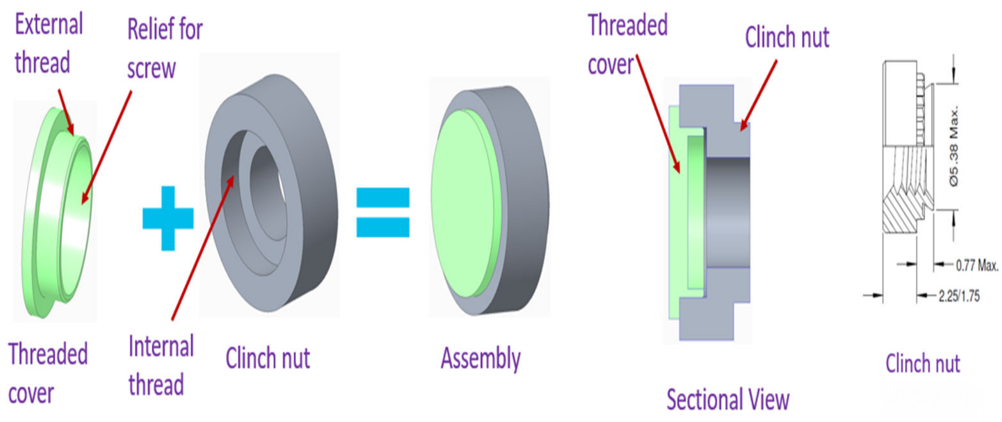

Figure 4: Exemplary Threaded Protection Cover

It is important to note that the profile of such a protection cover, as described and illustrated above, may be customized based on the particular screw that is to be used and also the available space.

A second aspect of the presented techniques encompasses a customized blind clinch nut. Under this aspect, a blind clinch nut may be developed that will restrict the travel of a rack mount bracket screw. Figure 5, below, presents different views of an example of such a customized blind clinch nut.

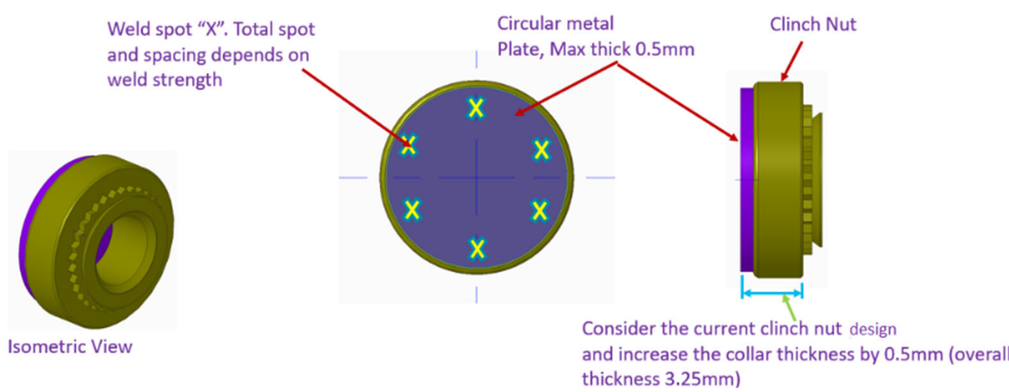

Figure 5: Exemplary Customized Blind Clinch Nut

As indicated in Figure 5, above, a circular metal plate may be spot-welded on to the opening of a clinch nut to block a through tap hole. It is important to note that the profile of a blind clinch nut, as described and illustrated above, may be customized based on the particular screw that is to be used and also the available space.

A Third aspect of the presented techniques encompasses a customized blind clinch nut. Under this aspect a blind clinch nut may be developed that will restrict the travel of a screw inside chassis.

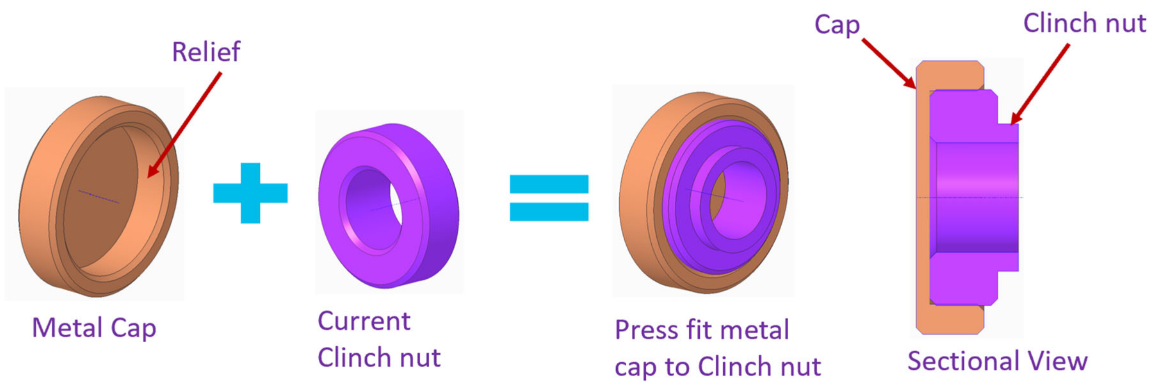

Figure 6: Exemplary Customized Blind Clinch Nut

As indicated in Figure 6, above, a metal cap may be press fitted on to the opening of a clinch nut to block a through tap hole. It is important to note that the profile of a blind clinch nut with metal cap, as described and illustrated above, may be customized based on the particular screw that is to be used and also the available space.

Comparing the design of a current clinch nut against, first, a clinch nut with a threaded protection cover (according to the first aspect of the techniques presented herein), second, a clinch nut with a welded plate (according to the second aspect of the presented techniques) and third, a clinch nut with metal cap, there will be an incremental cost increase. However, considering the severity of the above-described issues, various safety concerns, the impact of equipment return events, and customer satisfaction, such an incremental increase in cost is likely insignificant.

A fourth aspect of the presented techniques addresses various of the practical limitations of many commercially available self-clinching nuts. For example, the shortest length of such a blind nut cannot fit into the space that is available in a network equipment vendor's typical chassis. A longer nut would place significant restrictions on the dimensions of a PCB and related components, which would translate into a reduction in the real estate that is available for component placement. The minimum available length of such a blind nut is 11.4 millimetres (mm), whereas a network equipment vendor's typical design practices call for an available space in the range of 4 to 5 mm.

A manufacturing constraint arises in the case where the type of blind standoff that was described above has a short length. Namely, the blind hole cannot be fully tapped. This is because of a chamfer that exists at the entry point of a tapping tool. As a result, the initial few teeth of a tap cannot form a proper thread. Consequently, the active thread count could be less than the depth of a blind hole. If the length of blind nut (as described above) is restricted to 3.5 mm (to meet a common network equipment vendor requirement), only two effective threads would be possible for an M4x0.7mm fastener, which is not sufficient to provide for the structural stability of the rack mount hardware.

As indicated previously, the shortest length of 11.4 mm for the style of self-clinching nut that was described above will not fit into the space that is typically available between a PCB and a chassis, as depicted in Figure 7, below.

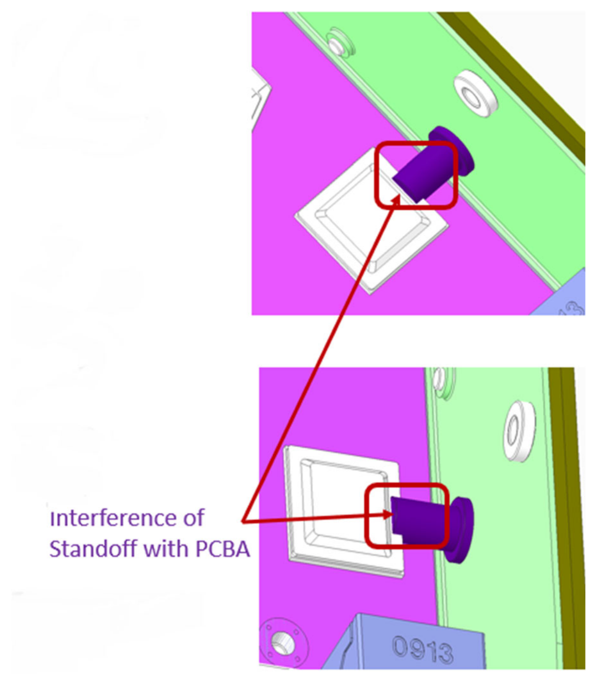

Figure 7: Illustrative Standoff Interference

To accommodate a longer such fastener, the size of a PCB would need to be reduced (resulting in less space for components) or locally relieved (resulting in an increased cost).

The fourth aspect of the techniques presented herein, as introduced above, addresses the above-described limitations through a self-clinching fastener having a swaged rim feature. Figure 8, below, presents different views of an example of such a swaged fastener.

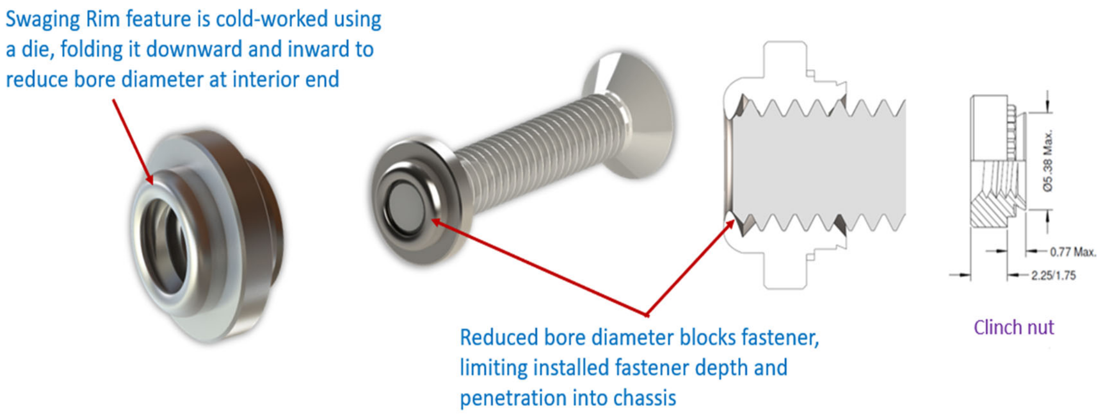

Figure 8: Exemplary Swaged Fastener

As described and illustrated in the above narrative, there exists an industry problem where inappropriately long screws are easily substituted into a product, inadvertently causing internal component damage. As further noted, blind nuts have been used to help prevent this problem in the past. Due to increasing internal product space constraints, however, the currently available blind nuts now protrude too far into a product, creating component interference themselves, and as a result they are, unfortunately, unusable as designed. This unsuitability stems from blind nuts being significantly longer than their "thru-hole" versions, as manufacturers must make allowance for a thread-tapping tool and the extra end material that is used in typical blind applications (e.g., an 11.5 mm blind nut versus a 2.5 mm thru-hole component depth). The required approximately 8 to 9 mm of extra depth is increasingly unacceptable for designs where "every mm matter" and where a design often cannot accommodate more than 3 mm of intrusion into a chassis.

What is needed, therefore, is a means to prevent inappropriate fastener protrusion into equipment that additionally requires a minimum installed depth into a chassis (of generally less than 3 mm) and that is highly cost-effective, as a network equipment vendor will likely use hundreds of thousands of such of nuts annually. Such a means does not presently exist within the industry and the techniques presented herein directly address this problem with a "minimum installed depth at minimum cost" orientation, employing approaches that consume the absolute minimum depth possible while being producible using standard forming methods, thereby minimizing the cost of additional parts.

In summary, techniques have been presented herein that introduce a foolproof design concept for converting a through hole to blind hole clinch nut for a rackmount bracket. A first aspect of the presented techniques encompasses adding a threaded protection cover to a clinch nut to prevent the excess protrusion of a screw. A second aspect of the presented techniques encompasses a customized blind clinch nut that can restrict (through, for example, a metal plate) the travel of a screw. A third aspect of the presented techniques encompasses a fastner having a press fit metal cap to prevent the excess protrusion of a screw. A fourth aspect of the presented techniques encompasses a fastener having a swaged rim feature.