A Set of Rules for Module-Fixture Attachment and Detachment

V 1.0
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Introduction

We attach a module to fixtures with screws several times in the course of construction. This means that on the order of 10000 instances of screwing/unscrewing actions will be performed to build 700 modules. In case of slipping screwdriver or a screw a module may be damaged (usually scratched). A particular screwing method was developed to minimize such occurrences. The method was verified on a dummy module, which was attached and then detached from a fixture 101 times.

The method

There are two basic problems with the screwing action:
1) it is performed by a human being (i.e. not-so-reliable creature requiring little or no education to perform the job),
2) a wrong screwing technique is sometimes used, resulting in potentially dangerous vertical motion of the screwdriver.

To alleviate the effect of the problem (1), we recommend to:
a) relax emotionally and focus on the job,
b) additionally consciously relax hands and wrists.

The exact methods used to achieve these goals vary with individuals. Some may even require drag intake (coffee, tea, and other substances).

To avoid the problem (2), we recommend the following mechanical procedure:
- The screwdriver is operated with two hands. One (non-leading) hand only holds the top (rotatable) part of the screwdriver. It performs no motion during (un)screwing motion whatsoever. The absence of vertical displacement of the screwdriver prevents the module from being scratched in case of the screwdriver and screw disengagement. The position is illustrated in Figure 1.
- The second (leading) hand performs the rotating motion in *horizontal* plane only. This means that the rotating fingers should be *horizontal* as well. The ***correct*** hand position is shown in Figure 1. The ***wrong*** position is shown in Figure 2 for comparison.

- In the course of rotating the screwdriver the most disturbances are introduced when the rotating hand touches the tool. We recommend that the touch be slow and gentle.
- In general, all operations should be very slow. The screws are very small and light, with diameter of about 5% that of a finger. Therefore the sensory feedback is easily missed for a fast "hard" motion.
- Particular attention should be paid to the process of placing and removing a screw. Figure 3 displays the use of plastic tweezers holding the screw just before the removal. The tweezers should be at the proper angle, so that the holding hand does not touch the module. The screw may cling to the screwdriver sometimes; therefore we recommend moving the screw/driver pair together to a safe place away from the module before disengagement. ***No object should be moved over the surface of the module!*** Flying screws are almost as dangerous as flying screwdrivers.

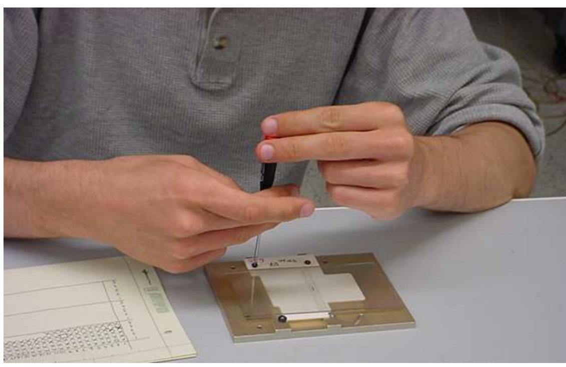

Figure 1. ***Correct*** hand position.

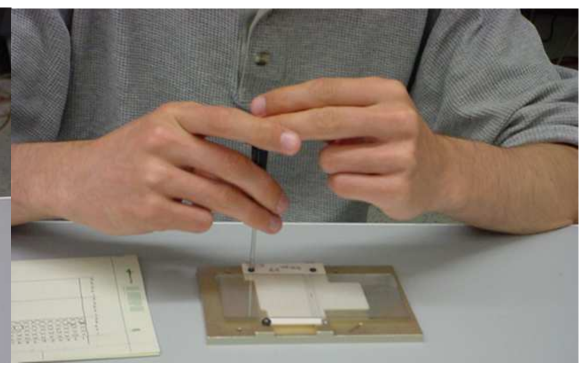

Figure 2. ***Wrong*** hand position.

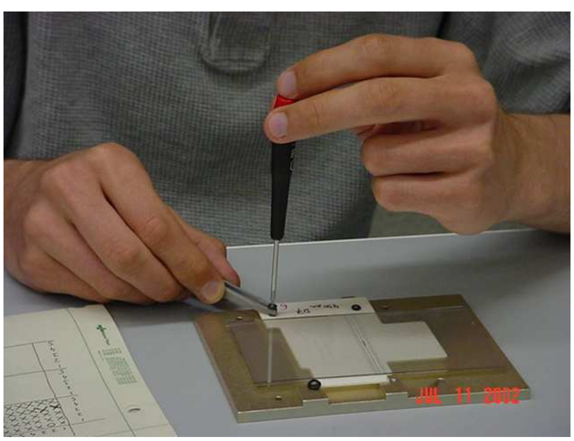

Figure 3. Screw pick-up with plastic tweezers.