# Analysis on Thin Layer Activation's effective dose and viability for *in site* experiments in the industry

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The Thin Layer Activation is a nuclear method used to measure wear/wear rate on machineries, however, it produces nuclear activity and effective dose on personnel present in the area. This report presents simulations and experiments to evaluate how viable Thin Layer Activation experiments are for *in site* applications in the industry from the nuclear safety perspective. The methodology consists of simulating the *worst-case scenario* for this matter using the MCNP-X code to obtain the effective dose for such worker through the F5 function and the de/df cards for flux to effective dose (µSv.h$^{-1}$) conversion [1]. Proving this scenario is safe for workers from the common public will also prove the Thin Layer Activation safe for such environment with fewer restrictions. Later, a reference experiment using a calibrated source was conducted with different distances from source to dosimeter and these experiments were also simulated and the results compared. This step was conducted to attest how reliable are the simulations' results.

The simulated scenario is composed of the engine and, inside the engine's carapace, a small region of activated material, as would happen in the application. The dose was calculated using the conversion cards for Anteroposterior (AP) position placed 40 cm far from the source. For a worker from the common public, with a 40 hrs/week workload, the maximum dose is 0.84 µSv.h$^{-1}$ [2]. The source is composed of $Co^{56}$ with a total activity of 3 MBq. Figure 1 shows the simulated engine.

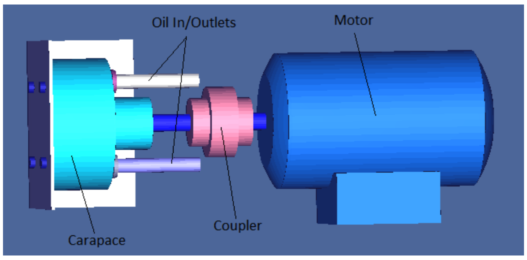


Figure 1. Simulated engine

For this scenario the resultant effective dose in the worker was 8.32 µSv.h$^{-1}$, which is above the established limit. This indicates the necessity of a method to reduce the effective dose. Since the goal is to change the working conditions of the machinery and factory/workplace as little as possible, the choice of protection was lead shielding. The advantage is that it doesn't require personnel training or imposed circulation restrictions. Adding a 5.1 cm lead shielding around the source/engine the dose in the worker, for the same position, was registered as 0.29 µSv.h$^{-1}$, which still leaves a breathing room and proves this experiment is viable in the previously mentioned conditions.

As for the reference experiment, the simulations returned an effective dose 10% smaller on average than the registered by the dosimeter after the deduction of the background present in place. This result was expected since personal dosimeters have low precision and often are calibrated to show doses slightly higher than it actually should.

It is also important to note: the total activity can be lowered to ¼ and still return reliable results on wear rate; the simulated engine is small, a larger machinery would passively keep workers further away from the source, reducing the effective dose and; the isotope of choice ($Co^{56}$) has high energy emission lines, a different isotope could be used in the activation. These are all possible variations of the simulated scenario, which as described is the worst case. Thus, Thin Layer Experiments is a viable option for wear measurement even *in site*, which in many cases eliminate the possibility of using nuclear techniques.

## References

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