# Neutron Activation Analysis of Airborne Thorium Liberated During Welding Operations

*D. C. Glasgow, L. Robinson, J. T. Jankovic (ORNL)*

## INTRODUCTION

Typically, reactive metals such as aluminum are welded using a thoriated tungsten welding electrode which is attached to a source of argon gas such that the local atmosphere around the weld is inert. The metal is heated by the arc formed between the electrode and the grounded component to be welded. During this process, some of the electrode is vaporized in the arc and is potentially liberated to the surrounding air. This situation may result in a hazardous airborne thorium level. Because the electrode is consumed during welding, the electrode tip must be repeatedly dressed by grinding the tip to a fine point so that the optimal welding conditions are maintained. These grinding activities may also release thorium to the air. Data generated in the 1950's suggested that these electrodes posed no significant health hazard and seemed to justify their exemption from licensing requirements for source material.[1] Since that time, other studies have been performed and present conflicting results as to the level of risk.[2,3] Values both above and below the health protection limit in use in the United States, have been reported in the literature recently.[2,3] This study is being undertaken to provide additional data which may be useful in evaluating both the chemical toxicity risk and radiological dose assessment criteria associated with thoriated tungsten welding operations.

## SAMPLING PROCEDURE

Air from nearby welding and grinding operations was pumped at a known rate through high efficiency cellulose-based filters which were then analyzed for thorium by neutron activation analysis. Several sample collection problems were encountered both due to the small particle size

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## DISCLAIMER



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## SAMPLING PROCEDURE

Air from nearby welding and grinding operations was pumped at a known rate through high efficiency cellulose-based filters which were then analyzed for thorium by neutron activation analysis. Several sample collection problems were encountered both due to the small particle size

and to the presence of thorium electrostatically adhering to the walls of the plastic filter cassettes. After swabbing the cassettes with a damp piece of filter paper, it was determined that as much as 30 percent of the total thorium was stuck to the walls and not on the filters. A grounded metal sampling head was constructed to cut down on the static attraction. In addition, the filter samples themselves were brittle and easily crushed presenting a possible sample loss mechanism.

## ANALYSIS PROCEDURE

Samples are irradiated for 120 seconds at the Oak Ridge National Laboratory's High Flux Isotope Reactor in a fluence rate of 4E+14 $n/cm^2 \cdot s^{-1}$. Counting begins after a 10-14 day period to allow $^{187}W$ to decay. Unexposed cellulose filters were analyzed as blanks and were found to be quite contamination free. The samples were separated from the stiff filter supports by carefully slipping a pair of precision forceps between the two. The filters were then carefully folded to match the dimensions of the irradiation containers. Comparative standards were prepared by pipetting thorium ICP liquid standard onto Whatman 42 ashless filter paper such that a close approximation of the sample geometry was assured. Samples and associated standards were counted on the same high purity germanium detector at the same geometry. Analysis was accomplished by counting $^{233}Pa$ produced by the $^{232}Th$ $(n,\gamma)$ $^{233}Th$ reaction followed by beta decay to $^{233}Pa$. The technique easily met the required detection limits of 1 ng. Preliminary data from electrode dressing operations suggest that the amount on thorium released to the surrounding air can be significant. Table 1 shows some blank, and field sample data from electrode dressing activities. A detailed discussion of the results and experiment parameters will be presented.

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TABLE 1

Preliminary Data

| Sample Type | Thorium (μg) |
|---|---|
| Cellulose Blank | < 8E-4 |
| Whatman 42 Blank | < 8E-4 |
| Field Sample[1] | 7.75 ± 0.06 |
| Filter Cassette | 3.79 ± 0.09 |

[1]Sample taken from electrode grinding activities.