THALLIUM - 201
[Tl-201]

PHYSICAL DATA

Gamma Energies: 70.8 keV (46.5% abundance)
68.9 keV (27.4%)  
80.3 keV (20.5%)  
167.4 keV (10.0%)  
135.3 keV (2.7%)  

[No beta particles emitted by Tl-201]

Specific Gamma Ray Constant: 0.0441 mrem/hour at 1 meter per 1 millicurie or 441 mrem/hour at 1 cm per millicurie

Physical Half-Life: 3.04 days (73.06 hours)
Biological Half-Life: 5.00 days (Tl-201 Solution)
Effective Half-life: 1.89 days (Tl-201 Solution)
Biological Half-Life: 11.00 days (Thallous Chloride)
Effective Half-Life: 2.40 days (Thallous Chloride)

Specific Activity: 2.159 x 10⁵ curies/gram (calculated)

RADIOLOGICAL DATA

• Critical Organ (Biological Destination): Lower Large Intestine
• Critical Organs (Thallous Chloride): Kidney, Heart, Whole Body
• Target Organ for Radiopharmaceuticals: Heart (Stress Tests)
• Carrier or compound (radiopharmaceutical) dependent
• Routes of Intake: Ingestion, Inhalation, Puncture/Injection, Wound, Skin Contamination (Absorption)
• External & internal exposure and contamination concerns from Tl-201

Committed Dose Equivalent (CDE) (Organ Doses): 1.00 mrem/uCi (puncture/maximum organ)

Annual Limit on Intake (ALI):

• 20 mCi (all compounds / oral ingestion / CEDE / Whole Body / 5 rem)
• 20 mCi (all compounds / inhalation / Class "D" / CEDE / WB / 5 rem)

* [1.0 ALI = 20 mCi ingested = 5,000 millirem CEDE / Whole Body]

Skin Contamination Dose Rate (electrons): 844 mrem/hour per uCi/cm²

• [Dose to basal cells at a tissue depth of 7 mg/cm² or 0.007 cm in tissue with no air reflection]

Skin Contamination Dose Rate (Extremity Skin / e⁻ dose): Negligible

• [Dose to skin of extremities at a tissue depth of 30-50 mg/cm² or 0.03 cm]
SHIELDING:

- **Half-Value Layer (HVL/lead):** 0.006mm = 0.0006cm
- **Tenth-Value Layer (TVL/10/lead):** 0.15 mm = 0.015 cm = 0.006"
- **Attenuation Coefficient (100/lead):** 0.98 mm = 0.098 cm = 0.039"
- **Attenuation Coefficient (1,000/lead):** 2.10 mm = 0.210 cm = 0.083"
- **Attenuation Coefficient (10,000/lead):** 3.30 mm = 0.330 cm = 0.130"

SURVEY INSTRUMENTATION:

- Survey meter equipped with a 1" x 1" or a low-energy NaI scintillation probe is preferred for the detection of Tl-201 contamination.
- Surveys meters equipped with a G-M pancake/frisker (15.5 cm² surface area) should **NOT** be used because they exhibit such low counting efficiency (< 0.5%) for the detection of low-energy Tl-201 gamma rays.
- Indirect counting using a liquid scintillation counter (LSC) or gamma counter should be used to detect removable Tl-201 contamination on smears, swabs, or swipes.

PERSONNEL RADIATION MONITORING DOSIMETERS (Whole Body and Finger Tabs): **REQUIRED** when handling > 1.0 millicurie of Tl-201 at **any** time.

DOSE RATES from unshielded 1.0 millicurie isotropic point source of Tl-201:

<table>
<thead>
<tr>
<th>DISTANCE</th>
<th>MILLIREM/HOUR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00 cm</td>
<td>441.00</td>
</tr>
<tr>
<td>10.00 cm</td>
<td>4.41</td>
</tr>
<tr>
<td>100.00 cm</td>
<td>0.044</td>
</tr>
<tr>
<td>6.0 in</td>
<td>1.9</td>
</tr>
</tbody>
</table>

REGULATORY COMPLIANCE INFORMATION

- **Derived Air Concentration (DAC):** 9.0E-6 uCi/mL (all compounds) (Occupational)
- **Airborne Effluent Release Limit:** 3.0E-8 uCi/mL (all compounds) [Annual Average]
  
  * [Applicable to the assessment & control of dose to the public (10 CFR 20.1302). If this concentration were inhaled continuously for over one year the resulting TEDE would be 50 millirem].

- **Unrestricted Area Removable Contamination Limit:** 1,000 dpm/100 cm²
- **Container Labeling Quantity [10 CFR 20.1905]:** ≥ 1 mCi
- **Urinalysis:** Not Required; however, may be requested by RSS personnel after a radioactive spill or a suspected intake.
GENERAL RADIOLOGICAL SAFETY INFORMATION

• Inherent Volatility (STP): Insignificant / Negligible

• Tl-201 is used in clinical & research diagnostic scanning and imaging.

• Whole body & extremity exposures, skin contamination (dose), ingestion, inhalation, puncture/injection, absorption through skin, and area contamination are primary radiological safety concerns.

• Drying can cause airborne Tl-201 dust contamination and rapid boiling can cause airborne Tl-201 aerosol contamination.

• Expelling Tl-201 solutions through syringe needles and pipette tips can generate airborne aerosols.

• Always wear a lab coat and disposable gloves when handling Tl-201.

• Monitor personnel, work areas, and floors using a survey meter equipped with a 1" x 1" or a low-energy NaI scintillation probe for Tl-201 contamination. A survey meter equipped with a G-M pancake/frisker probe (15.5 cm² surface area) should NOT be used for the detection of Tl-201.

• Monitor for removable surface contamination by smearing, swiping, swabbing, or wipe-testing where Tl-201 is used. Count smears or swabs in a liquid scintillation counter (LSC) or gamma counter.

• Tl-201 (Thallous Chloride) is supplied in isotonic solution as a sterile, non-pyrogenic diagnostic radiopharmaceutical for intravenous administration. Thallous ions mimic potassium's biological behavior.

• Tl-201 (intravenous injection) is used in conjunction with maximum exercise stress testing for myocardial imaging.

• Thallous Chloride (Tl-201) clears rapidly from the blood with maximum concentration by normal myocardium within about 10 minutes; other organs include the thyroid, liver, kidneys, and stomach.

• Recommended radiopharmaceutical dose is approximately 1-2 millicuries.

• Not known if Tl-201 is excreted in human milk (nursing mothers)

• Mainly used for detection of myocardial infarction (cell damage due to lack of oxygen to cells) and/or ischemia [reduced blood flow due to restriction or actual obstruction of a blood vessel or coronary artery (myocardial ischemia)].

• In a cardiac perfusion study using Tl-201 chloride, an abnormality is demonstrated by the absence of activity or greatly reduced activity in the area of the myocardium.