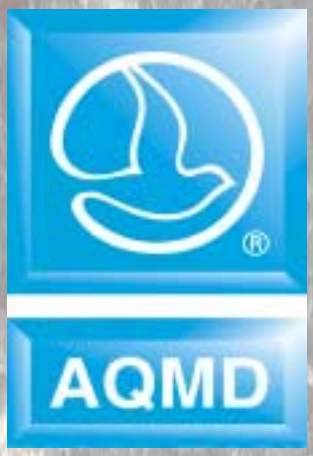

RISK ASSESSMENT PROCEDURES for RULES 1401 and 212

VERSION 6.0

AUGUST 18, 2000

FOREWORD

This Version 6.0 has been revised to show the significant amendments to Rule 1401, amended on March 17, 2000, which removed the requirement to assess cumulative risk from toxic emissions from units permitted after 1990 located within 100 meters of the new permit application. Chronic RELs for 76 compounds have also been added to the tables due to the amendment of Rule 1401 on August 18, 2000.

This also serves to remind the user of this document that Rule 1402 – Control of Toxic Air Contaminants from Existing Sources was amended on March 17, 2000 to establish an Action Risk Level of 25-in-one million for the entire facility.

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INTRODUCTION

Risk assessment procedures, including procedures for a simple risk screening, were developed by South Coast Air Quality Management (AQMD) staff for the adoption of Rule 1401 - New Source Review for Toxic Air Contaminants, in June 1990.
The purpose of this document is to:

- assist applicants and engineers to help evaluate Rule 1401 compliance;
- provide explanations and sample calculations; and
- provide industry worksheets.

This document describes the procedures for preparing risk assessments under Rule 1401 and Rule 212 – Standards for Approving Permits. It is intended to be a "living" document. That is, as new toxic air contaminants (TACs) are added, risk values changed, or procedures revised, the document will be updated. Past procedures will be archived and TAC listings have been separated by the time period of significant Rule 1401 changes (see attachments).

Background

Rule 1401, adopted June 1, 1990 and amended December 7, 1990, specified limits for maximum individual cancer risk (MICR) and excess cancer cases for new, relocated, or modified equipment which emits carcinogenic air contaminants. The rule was amended July 10, 1998 to include non-carcinogenic compounds. Subsequent amendments to the rule in 1999 added new compounds to the list of TACs and added or changed risk values and Reference Exposure Limits (RELs) for compounds already listed.

The rule was amended on March 17, 2000 to remove the requirement to assess cumulative risk from emissions from units permitted after 1990 located within 100 meters of the new equipment under evaluation for permit. It was again amended on August 18, 2000 to add chronic RELs for 76 compounds and to remove acetone from the list of toxic air contaminants with proposed risk levels.

Requirements

This document is limited to the procedures for determining cancer and non-cancer health effects.

Rule 1401 applies to applications deemed complete on or after June 1, 1990. In general, it applies only if there is an increase in TAC emissions from new, relocated, or modified equipment. However, equipment installed without a required permit to construct is also included. It applies to equipment previously exempt by Rule 219 only if the applicant fails to apply for a permit within one year following loss of exempt status. There are a few exemptions listed at the end of the rule.

Rule 1401 requires risk assessments only for TACs listed in the rule at the time the application is deemed complete. Copies of all tables for risk analysis are included at the end of this document as attachments.

The following requirements must be met before a permit is granted for affected equipment.

- The cumulative increase in maximum individual cancer risk (MICR) shall not exceed:
  one in a million (1×10^{-6}) if T-BACT is not used; or,
  ten in a million (10×10^{-6}) if T-BACT is used;

- The cumulative cancer burden (increase in cancer cases in the population) shall not exceed 0.5; and,

- For target organ systems, neither the cumulative increase in total chronic hazard index (HIC) nor the total acute hazard index (HIA) shall exceed 1.0 for any target organ system, or an alternate hazard index level deemed to be safe.

Rule 212 (c)(3) requires public notification if the MICR, based on Rule 1401, exceeds one in a million (1×10^{-6}), due to a project's proposed construction, modification, or relocation for facilities with more than one permitted equipment, or facilities under RECLAIM or Title V, regardless of the number of equipment, unless the applicant can show the total facility-wide MICR is below ten in a million (10×10^{-6}). For facilities with a single permitted equipment, the MICR level must not exceed ten in a million (10×10^{-6}). The circulation and distribution of the notifications must meet the criteria in Rule 212.

The current version of AQMD rules may be obtained on the website http://www.aqmd.gov.

RULE 1401

New Source Review for Toxic Air Contaminants

Applicability:

- Increase in Toxic Air Contaminants (TACs) from new, relocated, or modified equipment
- Equipment installed without required permit to construct
- Equipment previously exempt by Rule 219 if applicant fails to apply for a permit within one year from loss of exempt status
- Non-carcinogenic compounds also included for applications deemed complete on or after 9/8/98 (chronic) and 2/10/99 (acute)

Requirements for health risk assessment:

- Risk assessments only for TACs that are listed in the rule when the application is deemed complete
- MICR shall not exceed one in one million if T-BACT is not installed
- MICR shall not exceed ten in one million if T-BACT is installed
- Cancer burden shall not exceed 0.5
- Chronic Hazard Index and Acute Hazard Index shall not exceed 1.0 for any target organ system
- Exemptions

OVERVIEW

This document provides several tiers for preparing a risk assessment, from a quick look-up table to a detailed risk assessment involving air quality modeling analysis. Permit applicants may use any of these tiers to demonstrate compliance with the risk limits of Rule 1401. The applicant should include a copy of the risk assessment with the permit application.

The tiers are designed to be used in order of increasing complexity. If compliance cannot be demonstrated using one tier, the permit applicant may proceed to the next tier. A permit applicant who can show compliance by using a lower tier does not need to perform the higher tiers. In general, for most permits, a detailed analysis is not required. The tiers are:

- Screening Emission Levels
- Screening Risk Assessment
- Screening Dispersion Modeling
- Detailed Risk Assessment

In addition, this document briefly discusses the Best Available Control Technology for Toxics (T-BACT) identification process for Rule 1401.

PRELIMINARY TASKS

Before conducting any of these risk assessment tiers, three preliminary tasks must be performed:

1. **Determine if the permitting action or equipment source is exempt from the provisions of Rule 1401.** Exemptions are granted for:

   √ permit renewal or change of ownership;
   √ modifications with no increase in risk;
   √ functionally identical equipment replacement;
   √ equipment previously exempt under Rule 219 and filing for a permit to operate within one year of losing the exemption;
   √ modifications to terminate research projects; and
   √ emergency ICEs exempt under Rule 1304.

   An additional exemption is granted for demonstrations of contemporaneous emission reductions such that no receptor experiences a total increase in MICR of greater than one in one million and the contemporaneous reduction occurs within 100 meters of the equipment.

   If the equipment falls under one of these exemptions, no further risk assessment is required.

2. **Identify the toxic air contaminants (TAC) emitted by the source**. The risk assessment must include those TACs emitted by the source which were listed in the rule when the permit application was deemed complete by the AQMD. Sets of tables corresponding to each rule revision are included at the end of this document as attachments. Determine the date on which the application was deemed complete and refer to the appropriate set of tables. Table 1A lists the TACs subject to Rule 1401 and Rule 212.

   For guidance, California Air Resources Board (CARB) has prepared a table listing devices and processes as they relate to the types of emissions and the specific contaminants emitted. This table is available on the CARB webpage at: www.arb.ca.gov/ab2588/ab2588.htm. Click on "Inventory Guidelines", and then on "Appendix C - Facility Guideline Index." Please note that this table is not an exhaustive list. Facilities are, therefore, advised to use this table for guidance only.

   If no TACs listed in the applicable version of Rule 1401 are emitted by the equipment, no further risk assessment is required.

3. **Estimate the quantity of emissions from the source.** The appropriate emission estimation technique depends on the type of source. Techniques include emission testing, a mass balance or other engineering calculation, or emission factors for specific types of processes. The emissions used for the risk calculation should be post-control emissions (that is, reductions in emissions due to enforceable controls and permit conditions should be taken into account). AQMD permitting staff should be consulted regarding approved techniques for identifying contaminants and estimating emissions for specific sources.

   The AQMD also has a broader mandate to ensure that permits are not granted to facilities which may endanger public health (California Health and Safety Code Section 41700). In addition, under Rule 212, the applicant may be required to evaluate other compounds that are determined to be potentially toxic. Therefore, an applicant may be required to evaluate risks from compounds not listed in Table I as part of the permitting process if they are a concern for a specific source. These may include substances with irritant effects or other adverse health effects.

Tier 1: Screening Emission Levels

OVERVIEW OF TIER 1

Tier 1 involves a simple look-up table (Table 1A) in which the equipment's emissions or source-specific units (Tables 1B, 1C, or 1D) are compared to Screening Levels. Both the Pollutant and Source Screening Levels are pollutant emission and source operating parameters, respectively, which are not expected to produce a MICR greater than one in one million nor a hazard index greater than one.

Tier 1 can be used by applicants to determine whether or not detailed risk analysis will be required when filing for a permit. It can also be used by applicants and AQMD staff to determine whether a permit is required based on the preamble to Rule 219 – Equipment not Requiring a Written Permit Pursuant to Regulation II.

Tier 1 may be used only for a single emission source and a single toxic air contaminant. However, it can be used for multiple pollutants if the screening procedure on the next page is followed. Tier 1 screening may not be used if the source emission rate is highly variable in daily operation.

INSTRUCTIONS FOR TIER 1

The Tier 1 analysis is performed as follows:

1. Determine the TAC's maximum annual emissions or industry-specific units or, for a non-cancer acute TAC, determine the maximum hourly emissions.
2. Compare to the Screening Levels for that contaminant in Table 1A, 1B, 1C, or 1D as appropriate. Columns are labeled with the distance to the nearest receptor.
3. If the maximum annual emissions or industry-specific units or the maximum hourly emissions do not exceed the Screening Levels, the equipment will generally be in compliance with Rule 1401 and not require notice under Rule 212 for toxics.
4. If the maximum annual emissions or the maximum hourly emissions exceed the Screening Levels, proceed to Tier 2.

The Screening Levels in Tables 1A, 1B, 1C, and 1D were determined by back calculation, using the highest concentration values (X/Q) established in Tables 2 through 7 that would not exceed a cancer risk of one in a million or a chronic or acute hazard index of 1.

MULTIPLE POLLUTANT SCREENING LEVEL PROCEDURE

1. Calculate the Pollutant Screening Index for each pollutant (PSI_p). For each carcinogenic and/or chronic compound, divide the maximum annual emissions (in pounds per year) of each pollutant (Qyr) by the Pollutant Screening Level (PSL_p) in pounds per year, as contained in Table 1A. For each acute compound, divide the maximum hourly emission (Qhr) of each pollutant by the Pollutant Screening Level (PSL_p) as contained in Table 1A.

$$PSI_{\text{cancer and/or chronic}} = Qyr / PSL_p$$

$$PSI_{\text{acute}} = Qhr / PSL_p$$

2. Calculate the Application Screening Index (ASI). Sum up the individual Pollutant Screening Indices for all chronic and carcinogenic pollutants (PSI_p) and, separately, for all acute pollutants.

$$ASI_{\text{cancer and/or chronic}} = \Sigma\ PSI_p$$

$$ASI_{\text{acute}} = \Sigma\ PSI_p$$

3. Neither the cumulative cancer/chronic hazard nor acute hazard index can exceed 1.

Refer to the Example 1 for multiple pollutant screening.

If step 3 cannot be met, proceed to Tier 2.

Tier 2: Screening Risk Assessment

OVERVIEW OF TIER 2

Tier 2 is a screening risk assessment, which includes procedures for determining the level of risk from a source for MICR, Cancer Burden, and Acute and Chronic Hazard Indices. If the estimated risk from Tier 2 screening is below a level of concern, then a more detailed evaluation is not necessary. Examples of calculations are provided at the end of the description of Tier 4 risk assessment.

If the screening risk assessment results in a risk estimate that exceeds the risk limits or the permit applicant feels that a more detailed evaluation would result in a lower risk estimate, the applicant has the option of conducting a more detailed analysis using Tier 3 or 4.

To perform a Tier 2 screening risk assessment, the following information is needed:

- Maximum annual **emissions** of each carcinogen and non-cancer chronic TAC, and the maximum hourly emissions of each non-cancer acute TAC;
- The **distance** from the source to the nearest off-site receptor(s);*
- Certain source characteristics, such as **stack height** and/or **building dimensions**;
- **Operating schedule**: whether the source will operate more or less than 12 hr/day; and
- **Geographic location** of the source (i.e., city).

* In order to perform a screening risk assessment, it is necessary to identify the nearest receptor location. Receptor locations include residential, commercial and industrial areas, and other locations where sensitive populations may be located. Residential receptor locations include current residential land uses and areas which may be developed for residential uses in the future, given land use trends in the general area. Commercial/industrial receptor locations include areas zoned for manufacturing, light or heavy industry, or retail activity. Sensitive receptor locations include schools, hospitals, convalescent homes, day-care centers, and other locations where children, chronically ill individuals or other sensitive persons could be exposed to TACs.

When identifying receptor locations in order to calculate MICR or chronic hazard index, the potential for chronic (long-term) exposure should be considered. Land uses at which it is not possible for individuals to be exposed on a long-term basis, should not be considered receptor locations for purposes of calculating MICR or chronic hazard index. Examples of such locations include permanent bodies of water, flood channels, or roadways. When identifying receptor locations to calculate acute hazard index, all off-site locations where there is the potential for acute exposure should be considered.

This information is used to determine inputs into the equation for calculating MICR. The cancer burden must also be estimated. Methods for calculating MICR, cancer burden, chronic hazard index (HIC), and acute hazard index (HIA) are provided.

Tier 2 is designed for a single emission source. If this worst-case approach does not demonstrate compliance with the risk limits, proceed to Tier 3.

INSTRUCTIONS FOR CALCULATING MAXIMUM INDIVIDUAL CANCER RISK (MICR)

The MICR Calculation Worksheet in Appendix I can be used to help with the calculation. This worksheet can be included in the permit application as documentation of the MICR calculation.

The equation for calculating MICR is:

$$\mathbf{MICR = Q_{tons} \times X/Q \times MET \times U \times MP \times LEA}$$

Term	Description	Where to Find*
Q_{tons}	Maximum emission rate in tons/yr	Emission estimate specific to source
X/Q	Dispersion factor in $(ug/m^3)/(tons/yr)$	Table 2A, 3A, 4A or 5A
MET	Meteorological correction factor	Table 2B, 3B, 4B or 5B
U	Unit risk factors in $(ug/m^3)^{-1}$	Table 8
MP	Multi-pathway factor (if applicable)	Table 8
LEA	Lifetime exposure adjustment factor	Table 9

Step 1: Determine Appropriate Risk Tables*

The first step is to determine when the application was deemed complete. Find the risk tables in the attachments corresponding to the date when the application was deemed complete. Only that set of tables should be used to calculate the risk for this equipment.

Step 2: Estimate Emission Rate (Q_{tons})

As the second step, the maximum annual emissions of the TAC in tons/year (Q_{tons}) must be estimated. The emission rate must be expressed in tons/year because the dispersion factors (X/Q) are expressed in tons/year.

Step 3: Determine Release Type

Determine whether the source is best characterized as a point source or a volume source:

- A **point source** is one that releases its emissions through a stack (designed with acceptable stack height).
- A **volume source** is assumed when the emissions are released inside of a building vent or from fugitives.

For sources that are a combination of point and volume releases, use the table that will result in the highest X/Q value, or apportion the emissions between the point and volume sources.

Step 4: Determine Release Height

For a **point source**, determine the **stack height**, which is the distance from ground level to the top of the stack.

For a **volume source**, determine the **building height**, which is the distance from ground level to the top of the building in which the source is located, and the **floor area**, which is the dimensions (length x width) of the building in which the source is located. If the stack or building height falls between two entries in the tables, use the lower of the two heights.

Acceptable Stack Height. Although a taller stack provides better dispersion, there are limits to the degree to which this factor can be incorporated into the risk assessment. Rule 1401 specifies that the stack height used to determine risk shall not exceed the "Acceptable Stack Height" for the source. Acceptable stack height is defined as 2.5 times the height of the equipment or 2.5 times the height of the building housing the equipment, and may not exceed 65 meters (213 feet), unless the applicant demonstrates to the satisfaction of the AQMD that a greater height is necessary. For example, for a building that is 14 feet high, the acceptable stack height is 35 feet, measured from ground level. If the physical stack height exceeds 35 feet, the risk must be calculated using the 35-foot value unless the applicant demonstrates that the greater height is necessary.

An **area source** is similar to a volume source in that the emissions take place over an area (as opposed to a point such as from a stack). However, in an area source, the pollutants are released at a uniform height. Examples of area sources are storage piles, slag dumps, lagoons or ponds, and liquid spills. Toxic hydrocarbon emissions from storage tanks are also often treated as elevated area sources. Use Tier 3 or 4 for area sources.

Step 5: Determine Operating Schedule

Determine whether the equipment will operate:

- 12 hr/day or less; or
- more than 12 hr/day

Step 6: Identify Tables for Dispersion Factor (X/Q) and Meteorological Correction Factor (MET)

Four sets of tables are provided for X/Q and MET factors. The selection of the appropriate table is discussed below:

Release Type	Operating Schedule of Equipment	Table for X/Q	Table for MET
Point	≤ 12 hr/day	Table 2A	Table 2B
	> 12 hr/day	Table 3A	Table 3B
Volume	≤ 12 hr/day	Table 4A	Table 4B
	> 12 hr/day	Table 5A	Table 5B

Step 7: Identify Type of Receptor and Distance from Receptor

Identify the nearest receptor locations. Receptor locations are off-site locations where persons may be exposed to emission of a TAC from the equipment. Receptor locations include residential, commercial, and industrial land use areas, and other locations where sensitive populations may be located.

Residential receptor locations include current residential land uses and areas that may be developed for residential uses in the future, given land use trends in general areas.

Worker receptor locations include areas zoned for manufacturing, light or heavy industry, retail activity, or other locations that are regular work sites.

Sensitive receptor locations include schools, hospitals, convalescent homes, day-care centers, and other locations where children, chronically ill individuals, or other sensitive persons could be exposed.

When identifying receptor locations to calculate MICR, the potential for chronic (long-term) exposure should be considered. Land uses at which it is not possible for individuals to be exposed on a long-term basis, either presently or in the future, should not be considered receptor locations for purposes of calculating MICR. Examples of such locations include permanent bodies of water, flood channels, or roadways.

For a point source, the receptor distance is the distance from the center of the stack to the nearest receptor location.

For a volume source, the receptor distance is the distance from the center of the building to the nearest receptor location.

Experience shows that in most cases, the receptor distance will be 50 meters or more. However, the table also provides X/Q values from a 25-meter distance. The 25-meter distance should be used for those unusual circumstances in which there is a receptor located very close to the source, for example, a residence located with the business, or a sensitive receptor located less than 50 meters from the source.

If the closest receptor location is a worker receptor, then the MICR must also be calculated from the closest residential or sensitive receptor. The greater of the two MICR values is used to determine compliance with the risk limits in the rule.

Care should be taken when estimating these distances since concentrations decrease rapidly with increasing distance. It is acceptable to linearly interpolate to estimate dispersion factors between the downwind distances given in the tables. If the receptor lies over 1,000 meters from the source, use the listing for 1,000 meters.

What is a Dispersion Factor (X/Q)?

The concentration of a contaminant decreases as it travels away from the site of release and spreads out or "disperses." Dispersion factors (X/Q) are numerical estimates of the amount of dispersion that occurs under specific conditions.

The amount of dispersion depends on the distance traveled, the height of release and meteorological conditions such as wind speed and atmospheric stability.

The dispersion factors for the screening risk assessment procedure give the estimated annual average ground-level concentration (ug/m^3) resulting from a source emitting one ton/year of a contaminant.

Step 8: Select X/Q Value

Select the appropriate X/Q value from the table based on the **release height** and the **receptor distance.**

Step 9: Select Meteorological Correction Factor (MET)

Figure 1 at the end of the tables provides the locations of meteorological stations in the AQMD used for these calculations. Determine the station appearing in this figure that is closest to the facility and select the MET factor from the appropriate table (Table 2B, 3B, 4B or 5B).

What is a Meteorological Correction Factor (MET)?

Because local meteorology varies from location to location, the amount of dispersion will also vary with location of the source. Meteorological correction factors (MET) adjust for differences due to the geographic location of sources.

In order to derive the MET factors, dispersion modeling was performed at all the AQMD meteorological stations (see Figure 1). It should be noted that West Los Angeles generally yielded the highest concentrations at every downwind distance and was used as the basis of the dispersion factors. Correction factors were developed for the other 34 meteorological stations by dividing their predicted concentrations with those predicted at West Los Angeles with the highest factor chosen from the receptors at 50, 75, and 100 meters for each station.

The MET factors are different for point and volume sources and for different operating schedules (> or $\leq$ 12 hr/day). See the table under Step 6 - Identify Tables for Dispersion Factor (X/Q) and Meteorological Correction Factor (MET).

Step 10: Identify Unit Risk Factor (U)

Using Table 8, identify the unit risk factor (U) for the TAC.

What is a Unit Risk Factor (U)?

The unit risk factor is a measure of the cancer potency of a carcinogen. The unit risk factor is the estimated probability that a person will contract cancer as a result of inhalation of a concentration of 1 ug/m^3 of the TAC continuously over a period of 70 years.

The unit risk factors in these procedures were approved by the Scientific Review Panel and prepared by the state Office of Environmental Health Hazard Assessment (OEHHA).

Step 11: Identify Multi-pathway Factor (MP)

Using Table 8, identify the multi-pathway adjustment (MP) factor for the TAC, if applicable. If no MP factor is listed, use a MP factor of 1.

What is a Multi-pathway Adjustment Factor (MP)?

The multi-pathway adjustment factor (MP) is used for substances that may contribute to risk from exposure pathways other than inhalation. These substances deposit on the ground in particulate form and contribute to risk through ingestion of soil or backyard garden vegetables or through other routes. The MP factor estimates the total risk associated with a given inhalation risk. MP factors are provided in Table 8.

These factors allow sources that emit multi-pathway pollutants to use the risk screening procedure rather than proceeding directly to preparing a detailed risk assessment.

The MP factors are to be used only in urban residential exposure situations. If the facility is in the vicinity of other potential routes of population exposure such as agricultural areas, drinking water reservoirs, lakes or ponds used for fishing, or areas used for livestock grazing, then these MP screening assumptions are not appropriate and a more detailed multi-pathway assessment (Tier 4) must be performed.

For a more detailed description of the derivation of the multi-pathway factors, please see Appendix II.

Step 12: Select Lifetime Exposure Adjustment (LEA)

Using Table 9, select the appropriate LEA factor.

What is the Lifetime Exposure Adjustment (LEA)?

In order to protect public health, and in accordance with the recommendations of OEHHA, a 70-year lifetime exposure is assumed for all receptor locations except for off-site workers (i.e., receptor locations in commercial or industrial areas). The LEA for all residential or sensitive receptors is 1.0.

It is recognized that exposures for off-site workers in commercial or industrial areas are less than 70 years. The CAPCOA Risk Assessment Guidelines suggest an adjustment for these off-site workers. For receptor locations where there are off-site workers, an adjustment is used to account for a working lifetime of 8 hr/day, 240 days/yr for 46 years. When the equipment operates 24 hours/day, 365 days/year, the LEA for an off-site worker is 0.14 (i.e., [8 hr/day x 240 days/yr x 46 yr]/[24 hr/day x 365 days/yr x 70 yr]). For all other equipment operating schedules, the LEA for an off-site worker is 0.66 (46 yr/70 yr).

Only the LEA factors in Table 9 should be used. Do not prorate the LEA for other operating schedules.

For equipment located in an industrial/commercial area where the MICR is adjusted by one of the LEAs given above, an additional MICR must be calculated for the closest residential receptor. The screening risk calculations for both the commercial/industrial MICR and the residential MICR should be shown and the greater of the two values is used to determine compliance with Rule 1401.

For residential receptor locations, a LEA factor of 1.0 is used. A LEA factor of 1.0 is also used for sensitive receptor locations, such as schools, day-care, hospitals, nursing homes, and convalescent hospitals, as a health-protective assumption.

MICRS FOR MULTIPLE TOXIC AIR CONTAMINANTS

If the equipment emits more than one TAC, the total MICR must be calculated. The total MICR is the sum of the MICRs for each of the TACs emitted by the source.

INSTRUCTIONS FOR CALCULATING CANCER BURDEN

The cancer burden is an estimate of the increased number of cancer cases as a result of exposures to TAC emissions from the equipment. The cancer burden for a population unit (city, census tract, sub-area or grid) is the product of the number of persons in the population and the estimated individual risk from TACs.

The following procedure may be used to perform an acceptable screening analysis for cancer burden due to a single source of TAC:

- Calculate MICR as previously outlined.

- Estimate the distance at which the MICR falls below one in one million. This distance can be estimated by back-calculating the distance that would result in a MICR of one in one million, using the X/Q values in Table 2A through 5A.

- Define a zone of impact in the shape of a circle. The radius (r) of this circle is the distance between the source and the point at which the risk falls below one in one million. The area of this circle is calculated using the equation for the area of a circle, which is $3.14\ r^2$.

- Estimate the residential population within this zone of impact based on census data or a worst-case estimate. Generally, population in the Basin is less that 4,000 persons/km^2, but some areas are as high as 7,000 persons/km^2. Additionally, the commercial/industrial population should be estimated.

- Calculate cancer burden by multiplying the total population in the zone of impact by the maximum individual cancer risk. The screening cancer burden estimate is the sum of the excess cancer burden calculated for residential and worker populations.

If the dispersion factors in Tables 2A through 5A are not able to estimate the distance at which MICR falls below one in one million, then a more refined risk assessment is warranted.

INSTRUCTIONS FOR CALCULATING ACUTE AND CHRONIC HAZARD INDEX (HIA AND HIC)

Some TACs increase non-cancer health risk due to short term (acute) or long term (chronic) exposures. The screening risk assessment for those TACs must estimate acute and/or chronic hazard index as applicable. Like the calculation procedure for MICR, one must first identify when the application was deemed complete and select the appropriate set of risk tables found in the attachments.

Reference Exposure Level (REL) is used as an indicator of potential adverse non-cancer health effects. An REL is a concentration level (ug/m^3) or dose (mg/kg-day) at which no adverse health effects are anticipated. RELs are provided in Table 8.

When only one TAC is considered, the hazard index calculated is referred to as the **individual substance hazard index**. When several TACs affect the same organ system in the body (e.g., respiratory system, nervous system, reproductive system), there can be a cumulative effect on the target organ. In these cases, the **total hazard index** is evaluated. This is the summation of the individual HIs for all TACs that affect the same target organ (see Tables 10-A and 10-B).

Detailed procedures for calculating total hazard index are provided in the 1993 CAPCOA Risk Assessment Guidelines. The equations used to calculate the chronic and acute Hazard Index (HIC & HIA) per target organ are as follows:

$$\text{Total HIC}_{\text{target organ}} = \{\Sigma\,[\text{Qyr}_{\text{TAC}} \mathbf{x}\ (\text{X/Q})\ \mathbf{x}\ \text{MET}\ \mathbf{x}\ \text{MP}]/\text{Chronic REL}_{\text{TAC}}\}_{\text{target organ}}$$

$$\text{Total HIA}_{\text{target organ}} = \{\Sigma\,[\text{Qhr}_{\text{TAC}} \mathbf{x}\ (\text{X/Q})_{\text{hr}}]/\text{Acute REL}_{\text{TAC}}\}_{\text{target organ}}$$

Note that the chronic HI is based upon an annual average emission per year whereas the acute HI is based upon a maximum one-hour emission level (except for a few compounds) and the acute HI does not require the use of a meteorological correction factor (MET).

ACUTE HAZARD INDICES FOR COMPOUND HAVING RELS AVERAGED OVER 4, 6, OR 7 HOURS

Currently, there are only eight acute compounds, as specified in the table below, which have RELs developed over average 4, 6, or 7 hours exposure times. All other acute compounds have RELs developed over maximum one-hour exposure.

Compounds with Acute RELs Averaged Over 4, 6, or 7 Hours

CHEMICAL NAME	CAS #	Acute REL	Avg. Time (hours)
Arsenic and arsenic compounds, inorganic	7440-38-2	1.90E-01	4
Benzene (including benzene from gasoline)	71-43-2	1.30E+03	6
Carbon disulfide	75-15-0	6.20E+03	6
Carbon tetrachloride	56-23-5	1.90E+03	7
Chloroform	67-66-3	1.50E+02	7
Ethylene glycol ethyl ether (EGEE)	110-80-5	3.70E+02	6
Ethylene glycol monoethyl ether acetate	111-15-9	1.40E+02	6
Ethylene glycol monomethyl ether	109-86-4	9.30E+01	6

For acute compounds with RELs based on maximum one-hour exposure, the equation to estimate the acute hazard indices for these compounds is:

$$HIA = [Q_{hr} \times (X/Q)_{max}]/REL$$

For the eight compounds having RELs averaged over 4, 6, or 7 hours, adjustment factors (AF) have been developed, using air quality models for point and volume type sources, to reflect the risk based on the averaging times. These adjustment factors are listed in Table 8B and 8C, based on the specified averaging times and source proximity to the nearest meteorological stations. The acute hazard indices for these compounds are estimated using the following equation:

$$HIA = [(Q_{hr} \times (X/Q)_{max})/REL] \times AF$$

Where,

AF is the adjustment factor developed for compounds with RELs averaged over 4, 6, and 7 hours.

PROCEDURE FOR ALTERNATE HAZARD INDEX LEVEL EXEMPTION

Rule 1401 provides an exemption from the hazard index limit of 1.0 in cases in which a higher exposure level is deemed to be safe. Under this exemption, the HIC and/or HIA limit of 1.0 does not apply if the applicant substantiates to the satisfaction of the AQMD that at all receptor locations and for every target organ system, the total chronic and acute HI levels resulting from emissions from the equipment or will not exceed alternate HI levels determined by OEHHA to be protective against adverse health effects. This applies only to TACs listed in Rule 1401 at the time the application was deemed complete. Refer to the attachments for the appropriate list of TACs.

Applicants should indicate in their permit application that they wish to apply for an exemption under the alternative hazard index provisions of the rule. The permit application should include both a risk assessment estimating the HIA and HIC levels and relevant information supporting the exemption. Depending on the particular health risks in question, additional information such as characterization of the surrounding population, the location of sensitive receptors, or other data may be required.

AQMD will consult with OEHHA regarding the request for the alternative HI level. If OEHHA finds that the levels of exposure to the public will not exceed levels that are protective against adverse health effects, the application will be eligible for the exemption.

In some cases, OEHHA may establish a general policy recommending different acceptable exposure levels for different exposed populations. For example, if exposure to a certain compound is particularly harmful to children but less of a concern for adults, OEHHA may determine as a general policy that higher exposure levels are acceptable in locations where children would not be exposed. OEHHA policy in these cases would be a basis for eligibility for the alternate hazard index exemption.

Tier 3: Screening Dispersion Modeling

Tier 3 uses a screening dispersion modeling computer program to estimate risk. This tier requires significantly more expertise than Tiers 1 and 2. Applicants should consult AQMD modeling staff before conducting a Tier 3 analysis. For guidance on performing a Tier 3 analysis contact:

Tom Chico	(909) 396-3149
Yi-Hui Huang	(909) 396-3176

Tier 3 screening modeling should only be used for a single emission source. If there are multiple emission sources, Tier 4 must be used.

To perform a Tier 3 analysis, the following is needed:

- Air dispersion modeling expertise;
- A personal computer with a 386 or higher processor;
- An EPA-approved dispersion modeling computer program such as T-SCREEN or SCREEN3; and
- Additional release characteristics such as velocity, temperature, stack diameter.

It should be noted that TSCREEN and SCREEN3 estimate peak one-hour concentrations for HIA calculations. These concentrations must be multiplied by 0.1 to estimate annual average concentrations for the MICR and HIC calculations.

Dispersion modeling results from TSCREEN or SCREEN3 can be used in conjunction with the Health Risk Assessment (HRA) program developed by CARB and OEHHA. The HRA program calculates MICR and cancer burden (and also hazard index for non-cancer health effects) for a given dispersion factor. Multi-pathway analysis is included. Before the program can be used, the dispersion factor must be available. The HRA program user's guide and computer program can be obtained from CARB through the Internet (www.arb.ca.gov.; go to software), or by calling (916) 323-4327 and requesting a hard-copy for a $20.00 fee. OEHHA's website is http://www.calepa.cahwnet.gov/oehha/.

Information on downloading EPA-approved screening models and documentation can be obtained from EPA's OAQPS website (http://www.epa.gov/scram001.htm) including EPA instructions on the use of screening dispersion modeling.

If the MICR, HIC, and HIA do not exceed the rule limits, the equipment complies with Rule 1401. If any risk value exceeds the rule limits, proceed to Tier 4.

Tier 4: Detailed Risk Assessment

Tier 4 is a detailed risk assessment using an EPA-approved dispersion model. This step is an option if neither Tier 2 nor 3 can demonstrate compliance, or if the applicant wishes to obtain a more refined estimate of the cancer and non-cancer risk. Since Tier 4 involves detailed modeling using actual meteorological data from the closest air monitoring station, it will often result in a less conservative estimate of the risk than Tier 2 or 3.

A detailed risk assessment should only be performed by individuals with experience and training in air quality modeling and risk assessment. In addition, AQMD modeling staff should be consulted before performing a detailed risk assessment. For guidance on performing a detailed risk assessment contact:

Tom Chico	(909) 396-3149
Yi-Hui Huang	(909) 396-3176

Written guidance on preparing a detailed risk assessment may be obtained from the CAPCOA Air Toxics “Hot Spots” Revised 1992 Risk Assessment Guidelines, dated October 1993, which is available from the AQMD Public Information Center:

(909) 396-3600

The meteorological data for input into the model can be downloaded from http://www.aqmd.gov/smog

EXAMPLE NO. 1: MICR, CANCER BURDEN, HIA, & HIC CALCULATION

The equipment is a spray booth, operating 24 hr/day, located in an industrial and residential area. There are multiple TACs emitted from this booth. Some of the TACs are carcinogenic and some have chronic and acute non-cancer risks.

The application was deemed complete on September 1, 1999
The nearest receptor distances:
Worker (Industrial) = 328 ft (100 meters)
Residential = 492 ft (150 meters)
Operating Schedule: 24 hr /day, 365 days/yr (i.e., equipment actually sprays 24 hr/day)
Stack height = 28 ft
Plant location: Ontario, CA
Pollutants: Hexavalent chromium, Xylene, Cadmium, Toluene-2,4-diisocyanate, and Perchloroethylene

Emission rates for the TACs are listed in Table A below.
Note: The maximum hourly emissions should be estimated based on the maximum gallons of paint that could be sprayed in any hour.

Table A

Toxic Air Contaminant	Emission Rate		
	Qhr(Max.) (lbs/hr)	Qyr (lbs/yr)	QYR (tons/yr)
Cadmium	2.7×10^{-6}	0.0189	9.46×10^{-6}
Hexavalent chromium	2.5×10^{-6}	0.0175	8.76×10^{-6}
Perchloroethylene	3.8×10^{-4}	2.628	1.31×10^{-3}
Toluene-2,4-diisocyanate	1.1×10^{-3}	78.84	3.94×10^{-2}
Xylene	0.04	262.80	1.31×10^{-1}

(The TACs and emission rates are used for the purpose of illustration only.)

First, identify the appropriate risk assessment tables (included in the appendices) based upon when the application was deemed complete. In this case, the tables for applications deemed complete on or after August 13, 1999 through August 17, 2000 (i.e., Permit Application Package "F") are used.

Second, calculate MICR for those TACs that have Unit Risk Factors from Table 8A. Table B below identifies the TACs for MICR calculations.

Table B

Toxic Air Contaminant (TAC)	UNIT RISK FACTOR
Cadmium	4.20×10^{-3}
Hexavalent Chromium	1.50×10^{-1}
Perchloroethylene	5.90×10^{-6}
Toluene-2,4-diisocyanate	1.10×10^{-5}
Xylene	None

Based on the above table, MICR will be evaluated for residential and worker receptors for cadmium, hexavalent chromium, perchloroethylene and toluene-2,4-diisocyanate. Xylene does not have a unit risk factor and so this compound will not be included in the MICR calculations.

From Table 8A, we can also determine which of the substances is carcinogenic, chronic, and/or acute. The results are as follows:

TAC	MICR (cancer)	HIC (chronic)	HIA (Acute)
Cadmium	√		
Hexavalent chromium	√ (MP)		
Perchloroethylene	√	√	√
Toluene-2,4-diisocyanate	√		
Xylene			√

MP indicates that the multi-pathway adjustment factor will be different than 1.0.

Next, for chronic and acute substances, review Table 10-A & 10-B to determine the target organs affected by these TACs due to chronic and/or acute toxicity. Table C below indicates the target organs affected by the chronic TACs with chronic toxicity. In the table, check marks (√) indicate the affected target organs.

TABLE C (CHRONIC TOXICITY)

TAC	GI/LV	KIDNEY	RESP
Perchloroethylene	√	√	√

GI/LV: Gastrointestinal System and Liver
KIDNEY: Kidneys
RESP: Respiratory System

Similarly, after reviewing Table 10-B for acute exposure, we find the target organs affected by the acute TACs. In Table D check marks (√) indicate the target organs.

TABLE D (ACUTE TOXICITY)

TAC	CNS/PNS	EYE	RESP
Perchloroethylene	√	√	√
Xylene		√	√

CNS/PNS: Central or Peripheral Nervous System
EYE: Eye
RESP: Respiratory System

TIER I: SCREENING EMISSION LEVELS

The nearest receptor location should be used, in this case the worker location of 100m should be used. Since there are several pollutants, the Multiple Pollutant Screening Level Procedure could be used.

Please note that this step is used to approximate the equipment potential risk.

For Tier 1, the annual emissions and/or maximum hourly emissions of TACs should be compared with the Screening Levels for the contaminant in Table 1A, 1B, 1C, or 1D as appropriate. Since this example has multiple pollutants, the Pollutant Screening Index should be calculated for each pollutant per procedure specified on page 9.

For Carcinogenic and/or Chronic Compounds:

Calculate the Pollutant Screening Index for each pollutant (PSI_p).

$$PSI_p = Qyr_p / PSL_p$$

The Qyr is based upon the annual emissions of each TAC (lbs/yr). The PSLs are found in Table 1A and are expressed in lb/yr.

Sum up the individual Pollutant Screening Indices for each pollutant ($\sum PSI_p$).

TAC	Qyr_p	PSL_p	PSI_p
Cadmium	0.0189	0.06	0.315
Hexavalent chromium	0.0175	0.0018	9.722
Perchloroethylene	2.628	43.80	0.06
Toluene-2,4-diisocyanate	78.84	23.5	3.35
		$\sum PSI_p =$	13.45

Calculate the Application Screening Index (ASI).

$$ASI_{\text{cancer and/or chronic}} = \Sigma\ PSI_p = 13.45$$

For Acute Compounds:

Calculate the Pollutant Screening Index for each pollutant (PSI_p).

$$PSI_p = Qhr_p / PSL_p$$

The Qhr is based upon the maximum hourly emissions (lb/hr). The PSLs for acute compounds are found in Table 1A and are expressed in lb/hr.

Sum up the individual Pollutant Screening Indices for each acute pollutant ($\sum PSI_p$).

TAC	Qhr_p	PSL_p	PSI_p
Perchloroethylene	3.8×10^{-4}	53.55	7.1×10^{-6}
Xylene	0.04	58.90	0.00068
		$\sum PSI_p =$	0.00069

Calculate the Application Screening Index (ASI).

$$ASI_{acute} = \Sigma\ PSI_p$$

Please note that the cumulative cancer/chronic risk cannot exceed 1. In this example, this facility did not pass Tier I since the ASI exceeds 1 for cancer/chronic, even though, the ASI for acute is below 1. If this Tier I screening were calculated to be less than 1, the applicant would not have to proceed with further risk screening assessment procedures.

Tier II: Screening Risk Assessment

U, REL and MP values are taken from Table 8A in Permit Application Package "F".
(X/Q) values for cancer and chronic exposures are taken from Table 3A. This table is for a point source operating > 12 hr/day, for a stack height of 28 feet, and a receptor distance of 100 meters for worker, and 150 meters for residential.
The value for the $(X/Q)_{hr}$ for acute exposures is taken from Table 6, which is for point source. If it were a volume source Table 7 would be used.
LEA = 0.14 (source operates 24 hr/day as closest receptor is an industrial park) from Table 9.
MET = 1.28 for Pomona (closest to Ontario) - from Table 3B.

These values are summarized below:

(1) Worker:

TAC	U $(ug/m^3)^{-1}$	REL ug/m^3 Acute	REL ug/m^3 Chronic	X/Q (chronic & carcinogenic) $(ug/m^3)/(tons/yr)$	$(X/Q)_{hr}$ for acute $(ug/m^3)/(lbs/hr)$	MP for MICR	MP for HIC
Cadmium	4.20×10^{-3}	n/a	n/a	5.32	n/a	1	n/a
Hexavalent chromium	1.50×10^{-1}	n/a	n/a	5.32	n/a	1.01	n/a
Perchloro-ethylene	5.90×10^{-6}	20,000	40	5.32	295.2	1	1
Toluene-2,4-diisocyanate	1.10×10^{-5}	n/a	n/a	5.32	n/a	1	n/a
Xylene	n/a	22,000	n/a	n/a	295.2	n/a	n/a

n/a - not applicable

(2) Residential: This example uses a 150m distance to the closest receptor. Using Table 3A, an interpolation between the downwind distance of 100 and 200m must be done to determine the carcinogenic, acute, and chronic X/Q.

TAC	U $(ug/m^3)^{-1}$	REL ug/m^3 Acute	REL ug/m^3 Chronic	X/Q (chronic & carcinogenic) $(ug/m^3)/(tons/yr)$	$(X/Q)_{hr}$ for acute $(ug/m^3)/(lbs/hr)$	MP for MICR	MP for HIC
Cadmium	4.20×10^{-3}	n/a	n/a	3.62	n/a	1	n/a
Hexavalent chromium	1.50×10^{-1}	n/a	n/a	3.62	n/a	1.01	n/a
Perchloro-ethylene	5.90×10^{-6}	20,000	40	3.62	202.4	1	1
Toluene-2,4-diisocyanate	1.10×10^{-5}	n/a	n/a	3.62	n/a	1	n/a
Xylene	n/a	22,000	n/a	n/a	202.4	n/a	n/a

n/a - not applicable

MICR CALCULATION

$$MICR = \Sigma\, Qyr \times (X/Q) \times U \times MET \times MP \times LEA$$

(1) Worker:

TAC	Qyr (tons/yr)	X/Q	U	MET	MP	LEA	MICR
Cadmium	9.46×10^{-6}	5.32	4.20×10^{-3}	1.28	1	0.14	3.78×10^{-8}
Hexavalent Chromium	8.76×10^{-6}	5.32	1.50×10^{-1}	1.28	1.01	0.14	1.26×10^{-6}
Perchloro-ethylene	1.31×10^{-3}	5.32	5.90×10^{-6}	1.28	1	0.14	7.37×10^{-9}
Toluene-2,4-diisocyanate	3.94×10^{-2}	5.32	1.10×10^{-5}	1.28	1	0.14	4.13×10^{-7}
Total							**1.72×10^{-6}**

(2) Residential:

TAC	Qyr (tons/yr)	X/Q	U	MET	MP	LEA	MICR
Cadmium	9.46×10^{-6}	3.62	4.20×10^{-3}	1.28	1	1.0	1.84×10^{-7}
Hexavalent Chromium	8.76×10^{-6}	3.62	1.50×10^{-1}	1.28	1.01	1.0	6.15×10^{-6}
Perchloro-ethylene	1.31×10^{-3}	3.62	5.90×10^{-6}	1.28	1	1.0	3.58×10^{-8}
Toluene-2,4-diisocyanate	3.94×10^{-2}	3.62	1.10×10^{-5}	1.28	1	1.0	2.01×10^{-6}
Total							**8.38×10^{-6}**

Please note that the higher of the worker and residential cancer risks needs to be selected. This value will be entered in MICR field in the NSR, 1401 section. In this example, the maximum cancer risk is at the residential receptor.

CANCER BURDEN CALCULATION

Cancer burden should always be calculated if the MICR exceeds 1 in a million, regardless of the type of receptor.

It is necessary to determine a cancer burden for risk at the residential receptor since the residential risk was determined to be higher than the commercial risk. MICR for residential receptors was calculated to be **8.38×10^{-6}**.

Estimate of distance at which MICR falls below one in one million.
The distance at which the MICR falls below one in one million requires you to take the reciprocal of the calculated MICR multiplied by 1.0×10^{-6}. This factor (F) will be the multiplier to the X/Q value used in determining the MICR.

$$F = (1 / MICR) \times 1.0 \times 10^{-6}$$

$$F = (1/8.38 \times 10^{-6}) \times 1.0 \times 10^{-6}$$

$$F = 0.12$$

Determination of the new Downwind Distance will be based upon a X/Q value calculated from the originally used X/Q value multiplied by F.

Therefore,

$$\text{New X/Q} = 3.62 \times 0.12$$

$$\text{New X/Q} = 0.43$$

Using Table 3A, the New X/Q lies between Downwind Distances of 300 to 500m. Interpolating for the new Downwind Distance gives,

$$\text{New Downwind Distance} = \frac{[\ 500\text{m} - 300\text{m}\ ]}{[0.97 - 0.40]} \times [0.97 - 0.43] + 300\text{m}$$

$$\text{New Downwind Distance} = 489.5\ \text{m} = 0.4895\ \text{km}$$

This new Downwind Distance is where the MICR will fall below one in one million.

Define Zone of Impact
The zone of impact (ZI) is calculated using the New Downwind Distance as the radius of a circle and calculating the area of that circle.

Therefore,

$ZI = 3.14\ r^2$

$ZI = 3.14\ (0.4895km)^2$

$ZI = 0.75\ km^2$

Estimate the population within the ZI
ZI should include both worker and residential populations.

Where census data is available it should be used. Where there is no census data, 7000 persons/km^2 should be used for the areas with high population densities and 4000 persons/km^2 should be used for areas with low population densities.

In this example we have no census data, therefore,

Zone of Impact Population = ZI x Population Density

Zone of Impact Population = 0.75 km^2 x 7,000 persons/ km^2

Zone of Impact Population = 5,250 persons

Calculate Cancer Burden
Cancer Burden (CB) is the zone of impact population multiplied by the calculated MICR.

Therefore,

CB = 5,250 persons x 8.38 x 10^{-6}

CB = 0.044

Hazard Index Calculations

Acute and Chronic Hazard Indices should be calculated for each target organ.

Acute Hazard Index:

$HIA = [Q_{hr} \times (X/Q)_{hr}]/REL$

Based on Table 10-B, the target organs for the TACs have been listed.

Note: The X/Q values in Table 6 are based upon the maximum hourly emission rates. It should also be noted that the X/Q for residential: receptor (150m) is estimated using interpolation between the downwind distance of 100 and 200m.

Perchloroethylene:
Affects central or peripheral nervous system (CNS/PNS), eye, and respiratory organs.

The Acute Hazard Index for Perchloroethylene is calculated as follows:

Worker: HIA = [3.8 x10^{-4} x 295.2]/20,000
= 0.0000056
CNS/PNS 0.0000056
Eye 0.0000056
Respiratory 0.0000056

Residential: HIA = [3.8 x10^{-4} x 202.4]/20,000
= 0.0000038

CNS/PNS: 0.0000038
Eye: 0.0000038
Respiratory 0.0000038

Xylene:
Affects eye, and respiratory organs.

The Acute Hazard Index for Xylene is calculated as follows:

Worker: HIA = [0.04 x 295.2]/22,000
= 0.00054
Eye: 0.00054
Respiratory: 0.00054

Residential: HIA = [0.04 x 202.4]/22,000
= 0.00037
Eye: 0.00037
Respiratory: 0.00037

Chronic Hazard Index:
HIC = Σ [(QYR) **x** (X/Q)chronic **x** MET **x** MP]/(Chronic REL)]

Based on Table 10-A, the target organs for the TACs for chronic have been listed. The Chronic Hazard Index for the TACs in this example are calculated as follows:

Perchloroethylene:
Affects kidneys, gastrointestinal system and liver, and respiratory organs.

The residential chronic hazard index for perchloroethylene is:

HIC = [1.31 x 10^{-3}x 3.62 x 1.28 x 1]/40 = 1.52 x 10^{-4}
Kidneys: 1.52 x 10^{-4}
Gastrointestinal and liver: 1.52 x 10^{-4}
Respiratory: 1.52 x 10^{-4}

The worker chronic hazard index is:

HIC = [1.31 x 10^{-3}x 5.32 x 1.28 x 1]/40 = 2.23 x 10^{-4}
Kidneys: 2.23 x 10^{-4}
Gastrointestinal and liver: 2.23 x 10^{-4}
Respiratory: 2.23 x 10^{-4}

In summary:

I. **MICR:**

Worker:

TAC	MICR
Cadmium	3.78×10^{-8}
Hexavalent Chromium	1.26×10^{-6}
Perchloroethylene	7.37×10^{-9}
Toluene-2,4-diisocyanate	4.13×10^{-7}
Xylene	n/a
Total	**1.72×10^{-6}**

Residential:

TAC	MICR
Cadmium	1.84×10^{-7}
Hexavalent Chromium	6.15×10^{-6}
Perchloroethylene	3.58×10^{-8}
Toluene-2,4-diisocyanate	2.01×10^{-6}
Xylene	n/a
Total	**8.38×10^{-6}**

II. **Cancer Burden:**

CB = 0.044

III. **Acute Hazard Index (HIA) and Chronic Hazard Index (HIC):**
By Target Organs for Acute:

(1) Worker:

TAC	HIA		
	CNS/PNS	EYE	RESP
Perchloroethylene	5.1×10^{-6}	5.1×10^{-6}	5.1×10^{-6}
Xylene		5.4×10^{-4}	5.4×10^{-4}
Total	**5.1×10^{-6}**	**5.4×10^{-4}**	**5.4×10^{-4}**

(2) Residential:

TAC	**HIA**		
	CNS/PNS	GI/LV	RESP
Perchloroethylene	3.5×10^{-6}	3.5×10^{-6}	3.5×10^{-6}
Xylene		3.7×10^{-4}	3.7×10^{-4}
Total	**3.5×10^{-6}**	**3.7×10^{-4}**	**3.7×10^{-4}**

By Target Organs for Chronic:

(1) Worker:

TAC	**HIC**		
	KIDNEYS	GI/LV	RESP
Perchloroethylene	2.23×10^{-4}	2.23×10^{-4}	2.23×10^{-4}
Total	**2.23×10^{-4}**	**2.23×10^{-4}**	**2.23×10^{-4}**

(2) Residential:

TAC	**HIC**		
	KIDNEYS	GI/LV	RESP
Perchloroethylene	1.52×10^{-4}	1.52×10^{-4}	1.52×10^{-4}
Total	**1.52×10^{-4}**	**1.52×10^{-4}**	**1.52×10^{-4}**

RESULT:

For this example, if the spray booth is equipped with T-BACT, the evaluations indicate that MICR, Cancer Burden, HIC and HIA are all below the risk limits of Rule 1401.

- ***MICR for residential and commercial receptors exceeds 1×10^{-6} (one in one million) but it is below 10×10^{-6} (ten in one million).***
- ***Cancer burden is less than 0.5***
- ***Hazard Indices (HIA and HIC) do not exceed 1.0 for each target organ.***
- ***Provided this equipment is installed with T-BACT and all other requirements are complied with, a permit would be issued.***

EXAMPLE NO. 2: MICR, HIA, HIC, & CANCER BURDEN CALCULATION FOR PLATING OPERATIONS

This example is a nickel plating operation with special attention to the use of emission factors. The plating line consists of an electrolytic nickel plating tank equipped with air agitation, a sodium hydroxide tank, and a hydrogen chloride tank. The facility operates 8 hours per day and is located in an industrial and residential area.

The application was deemed complete on September 1, 1999
Volume source: Building dimensions 40'(W) x 70'(L) x 17'(H)
The nearest receptor distances are:
Worker (Industrial) = 100 meters
Residential = 500 meters
Operating Schedule: 8 hr /day, 3 days/wk, 50 wks = 1200 hrs/yr
Plant location: Azusa, CA

Nickel Plating tank:

Maximum rectifier capacity:	1000 Ampere-hr/hr
Average ampere usage:	500 Ampere-hr/hr
Air agitation:	Yes

Sodium Hydroxide Tank:

Tank Dimension:	8’(L) x 4’(W) x 4’(H)
Solution temperature:	70^{o} F
Sodium hydroxide wt%:	10 %

Hydrogen Chloride Tank:

Tank Dimension:	4’(L) x 4’(W) x 4’(H)
Solution temperature:	70^{o} F
Sodium hydroxide wt%:	20 %

Emission Factors:

AQMD and the Metal Finishers Association of Southern California conducted several tests to establish emission factors (EF) for nickel emissions from nickel plating (with and without air agitation), sodium hydroxide emissions from a caustic spray parts cleaning line and from electrocleaning tank, and hydrogen chloride emissions from HCl metal etching tank. The results are summarized as follows:

EF for nickel emissions:

For electrolytic plating:

With air agitation:	0.172 mg/amp-hr
Without air agitation:	0.057 mg/amp-hr

For electroless plating:
Without air agitation: 7.47×10^{-7} lb / (hr – ft^2_{tank})

EF for sodium hydroxide emissions:

Spray tunnel: 3.19×10^{-4} lb / (hr - gpm - % NaOH)
Where gpm is nozzle spray rate in gallons per minute

Electro-cleaning tank: 5.38×10^{-7} lb / (hr – ft^2_{tank} - % NaOH)

Note: The EF for sodium hydroxide tank without the rectifier is assumed to be the same as the one with the rectifier.

EF for hydrogen chloride emissions:

HCl etching tank: 3.00×10^{-5} lb / (hr – ft^2_{tank} - % acid)

Note: Because of its relatively high vapor pressure, the dissolved hydrogen chloride gas in the solution can escape as air emissions whether the tank is idle or active. According to the test results, the idle emissions can be 64% or greater than the emissions during active etching. For these reasons, annual emissions should be based on 24 hrs/day or 8760 hrs/yr.

Note: In the January 1999 Rule 1401 staff report, these emission factors are presented in mg/amp-hr as well as lb/hr-scfm and lb/hr-ft^2_{tank}. For the purpose of permit evaluation, use the emission factors as listed above.

The maximum yearly and hourly emissions are estimated as follows:

Nickel:

Qyr (lb/yr) = Annual usage(amp-hr/yr) x EF(mg/amp-hr) x 1 lb/454,000 mg
Qhr (lb/hr) = Max. hourly usage(amp-hr/hr) x EF(mg/amp-hr) x 1 lb/454,000 mg

Operating hours = 8 hrs/day x 3 days/wk x 50 wks/yr = 1200 hrs/yr
Annual ampere usage = 500 amp-hr/hr x 1200 hrs/yr = 600,000 amp-hr/yr
Maximum hourly ampere usage = 1000 amp-hr/hr (rectifier capacity)
EF = 0.172 mg/amp-hr (electrolytic plating with air agitation)

Qyr (lb/yr) = 600,000 amp-hr/yr x 0.172 mg/amp-hr x 1 lb/454,000 mg
= 0.227 lb/yr
Qhr (lb/hr) = 1000 amp-hr/hr x 0.172 mg/amp-hr x 1 lb/454,000 mg
= 3.8×10^{-4} lb/hr

Sodium hydroxide:

Tank surface area = 8 ft x 4 ft = 32 ft^2
Operating hours = 8 hrs/day x 3 days/wk x 50 wks/yr = 1200 hrs/yr

Qyr (lb/yr) = Tank surface area(ft^2) x EF (lb / (hr– ft^2 $_{tank}$-%NaOH) x wt% of NaOH x hours/yr
Qhr (lb/hr) = Average hourly emissions x 1.25

Note: maximum hourly emissions for caustic tank was assumed to be 25% more than average hourly emissions

Qyr (lb/yr) = 32 ft^2 x 5.38 x 10^{-7} lb / (hr – ft^2 $_{tank}$ - % NaOH) x 0.10 x 1200 hrs/yr
= 0.0021 lb/yr
Qhr (lb/hr) = 32 ft^2 x 5.38 x 10^{-7} lb / (hr – ft^2 $_{tank}$ - % NaOH) x 0.10 x 1.25
= 2.15 x 10^{-6} lb/hr

Hydrogen chloride:

Tank surface area = 4 ft x 4 ft = 16 ft^2
Operating hours = 8760 hrs/yr

Qyr (lb/yr) =Tank surface area(ft^2) x EF (lb / (hr– ft^2 $_{tank}$-%HCl) x wt% of HCl x 8760 hrs/yr
Qhr (lb/hr) = Average hourly emissions x 1.25

Note: maximum hourly emissions for HCl tank was assumed to be 25% more than average hourly emissions

Qyr (lb/yr) = 16 ft^2 x 3 x 10^{-5} lb / (hr – ft^2 $_{tank}$ - % HCl) x 0.20 x 8760 hrs/yr
= 0.841 lb/yr
Qhr (lb/hr) = 16 ft^2 x 3 x 10^{-5} lb / (hr – ft^2 $_{tank}$ - % HCl) x 0.20 x 1.25
= 1.2 x 10^{-4} lb/hr

Emission rates for the TACs are listed in Table A below.

Table A

Toxic Air Contaminant	Emission Rate		
	Qhr(Max.) (lbs/hr)	**Qyr (lbs/yr)**	**Qyr (tons/yr)**
Nickel	3.8×10^{-4}	0.227	1.14×10^{-4}
Sodium hydroxide	2.15×10^{-6}	0.0021	1.05×10^{-6}
Hydrogen chloride	1.2×10^{-4}	0.841	4.2×10^{-4}

First, Identify the appropriate risk assessment tables (included in the Attachments) based upon when the application was deemed complete. In this case, the tables for applications deemed complete on September 1, 1999 are included in Permit Application Package "F" in the Attachments to this document.

Second, The MICR is calculated for those TACs that have appropriate Unit Risk Factors from Table 8. Table B below identifies the TACs for MICR calculations.

Table B

Toxic Air Contaminant (TAC)	UNIT RISK FACTOR	CHRONIC REL	ACUTE REL
Nickel	2.6×10^{-4}	None	6.00
Sodium hydroxide	None	None	8.00
Hydrogen chloride	None	None	2.10×10^{3}

Based on the above table, MICR will be evaluated for residential and worker receptors for nickel.

From Table 8, determine which of the substances is carcinogen, chronic, and/or acute. The results are as follows:

TAC	MICR (cancer)	HIC (chronic)	HIA (Acute)
Nickel	√		√
Sodium hydroxide			√
Hydrogen chloride			√

Next, for chronic and acute substances, Table 10-A & 10-B need to be reviewed to determine the target organs affected by these TACs due to chronic and/or acute toxicity.

Table C below indicates the target organs affected by the TACs with acute toxicity. In the table check marks (√) indicate the affected target organs.

TABLE C (ACUTE TOXICITY)

TAC	SKIN	IMMUN	EYE	RESP
Nickel		√		√
Sodium hydroxide	√		√	√
Hydrogen chloride			√	√

SKIN: Skin
IMMUN: Immune system
EYE: Eye
RESP: Respiratory System

TIER I: SCREENING EMISSION LEVELS

For Carcinogenic and/or Chronic Compounds:

Calculate the Pollutant Screening Index for each pollutant (PSI_p).

$$PSI_p = Qyr_p / PSL_p$$

The Qyr is based upon the annual emissions of each TAC (lbs/yr). The PSLs are found in Table 1A and are expressed in lb/yr.

Sum up the individual Pollutant Screening Indices for each pollutant ($\sum PSI_p$).

TAC	Qyr_p	PSL_p	PSI_p
Nickel	0.227	0.99	0.23
		$\sum PSI_p$ =	0.23

Note: none of the TACs in this example are chronic substances.

Calculate the Application Screening Index (ASI).

$$ASI_{cancer\ and/or\ chronic} = \Sigma\ PSI_p = 0.23$$

For Acute Compounds:

Calculate the Pollutant Screening Index for each pollutant (PSI_p).

$$PSI_p = Qhr_p / PSL_p$$

The Qhr is based upon the maximum hourly emissions (lb/hr). The PSLs for acute compounds are found in Table 1A and are expressed in lb/hr.

Sum up the individual Pollutant Screening Indices for each acute pollutant ($\sum PSI_p$).

TAC	Qhr_p	PSL_p	PSI_p
Nickel	3.8×10^{-4}	0.016	0.024
Sodium hydroxide	2.15×10^{-6}	0.021	1.02×10^{-4}
Hydrogen chloride	1.2×10^{-4}	5.62	2.14×10^{-5}
		$\sum$ PSIp =	0.024

Calculate the Application Screening Index (ASI).

$$ASI_{acute} = \Sigma\ PSI_p = 0.024$$

Please note that the cumulative cancer/chronic risk did not exceed 1 and the cumulative acute hazard index did not exceed 1. In this example, this facility did pass Tier I since the ASI did not exceed 1 for cancer/chronic and 1 for acute. Since this Tier I screening was calculated to be less than 1, the applicant would not have to proceed with further risk screening assessment procedures.

Tier II: Screening Risk Assessment

U, REL and MP values are taken from Table 8 in Permit Application Package "F".
(X/Q) values for cancer and chronic exposures are taken from Table 4A. This table is for a volume source operating < 12 hr/day, for an area of less than 3000 ft^2, and a receptor distance of 100 meters for worker, and 500 meters for residential.
The value for the $(X/Q)_{hr}$ for acute exposures is taken from Table 7 because this is a volume source.
LEA = 0.66 for worker and 1 for residential
MET = 0.8 for Azusa - from Table 4B.

These values are summarized below:

(3) Worker: Using 100m receptor

TAC	U ($ug/m^3)^{-1}$	REL (ug/m^3) Acute	REL (ug/m^3) Chronic	X/Q (chronic & carcinogenic) (ug/m^3)/(tons/yr)	$(X/Q)_{hr}$ for acute (ug/m^3)/(lbs/hr)	MP for MICR	MP for HIC
Nickel	2.6×10^{-4}	6.00	n/a	3.95	309	1	n/a
Sodium hydroxide	n/a	8.00	n/a	n/a	309	n/a	n/a
Hydrogen chloride	n/a	2.1x103	n/a	n/a	309	n/a	n/a

n/a – not applicable

(4) Residential: Using 500m distance to the closest receptor.

TAC	U ($ug/m^3)^{-1}$	REL (ug/m^3) Acute	REL (ug/m^3) Chronic	X/Q (chronic & carcinogenic) (ug/m^3)/(tons/yr)	$(X/Q)_{hr}$ for acute (ug/m^3)/(lbs/hr)	MP for MICR	MP for HIC
Nickel	2.6×10^{-4}	6.00	n/a	0.17	24.1	1	n/a
Sodium hydroxide	n/a	8.00	n/a	n/a	24.1	n/a	n/a
Hydrogen chloride	n/a	2.1x103	n/a	n/a	24.1	n/a	n/a

n/a – not applicable

MICR CALCULATION

$$MICR = \Sigma\, QYR \times (X/Q) \times U \times MET \times MP \times LEA$$

(1) Worker:

TAC	Qyr (tons/yr)	X/Q	U	MET	MP	LEA	MICR
Nickel	1.14×10^{-4}	3.95	2.6×10^{-4}	0.80	1	0.66	6.2×10^{-8}

(2) Residential:

TAC	Qyr (tons/yr)	X/Q	U	MET	MP	LEA	MICR
Nickel	1.14×10^{-4}	0.17	2.6×10^{-4}	0.80	1	1	4.03×10^{-9}

Please note that a comparison between the worker and residential cancer risks need to be made and the higher value will be entered in MICR field in the NSR, 1401 section. In this example, the maximum cancer risk is at the worker receptor.

HAZARD INDEX CALCULATIONS

Acute and Chronic Hazard Indices should be calculated for each target organ.

Note: Presently, there are no State finalized chronic RELs for any of the compounds in this example.

Acute Hazard Index:

For all acute compounds with RELs developed over 1 hour average, the acute hazard indices are estimated using the equation below:

$$HIA = [Q_{hr} \times (X/Q)_{max}]/REL$$

Based on Table 10-B, the target organs for the TACs have been listed.

Nickel:
Affects Immune and respiratory Systems.

Note: The X/Q values in Table 6 are based upon the maximum hourly emission rates.

The Acute Hazard Index for Nickel is calculated as follows:

Worker: $HIA = (3.8 \times 10^{-4} \times 309)/6$
= 0.02
Immune and respiratory systems: 0.02

Residential: $HIA = (3.8 \times 10^{-4} \times 24.1)/6$
= 0.0015
Immune and respiratory systems: 0.0015

Sodium Hydroxide:
Affects skin, eye, and respiratory Systems.

Note: The X/Q values in Table 6 are based upon the maximum hourly emission rates.

The Acute Hazard Index for sodium hydroxide is calculated as follows:

Worker: HIA = $(2.15 \times 10^{-6} \times 309)/8$
= 0.00008
Skin, eye, and respiratory systems: 0.00008

Residential: HIA = $(2.15 \times 10^{-6} \times 24.1)/8$
= 0.000006
Skin, eye, and respiratory systems: 0.000006

Hydrogen chloride:
Affects Eye, and respiratory Systems.

Note: The X/Q values in Table 6 are based upon the maximum hourly emission rates.

The Acute Hazard Index for sodium hydroxide is calculated as follows:

Worker: HIA = $(1.2 \times 10^{-4} \times 309)/2100$
= 0.00002
Eye and respiratory systems: 0.00002

Residential: HIA = $(1.2 \times 10^{-4} \times 24.1)/2100$
= 0.0000014
Eye and respiratory systems: 0.0000014

In summary:

I. **MICR:**

(1) Worker:

TAC	MICR
Nickel	6.2×10^{-8}

(2) Residential:

TAC	MICR
Nickel	4.03×10^{-9}

II. **Acute Hazard Index (HIA):**

By Target Organs for Acute:

(1) Worker:

TAC	HIA
	RESP
Nickel	0.02
Sodium hydroxide	0.00008
Hydrogen chloride	0.00002
Total	**0.02**

(2) Residential:

TAC	HIA
	RESP
Nickel	0.0015
Sodium hydroxide	0.000006
Hydrogen chloride	0.0000014
Total	**0.0015**

RESULT:

For this example, the evaluations indicate that MICR for residential and commercial, and HIA are all below the risk limits of Rule 1401.

CANCER BURDEN CALCULATION

For this example, an analysis is not required to determine a cancer burden because the total MICR is below 1×10^{-6}.

EXAMPLE NO. 3: HIA CALCULATION FOR COMPOUNDS WITH RELS AVERAGED OVER 4, OR 6, OR HRS

***Note**: Presently there are eight acute compounds (see table below) which have RELs averaged over 4, 6, or 7 hours. For these compounds the acute hazard indices are estimated using the adjustment factors that are developed for these averaging times. The acute hazard indices for these compounds are estimated using the equation listed below:*

$HIA = [(Q_{hr} \times (X/Q)_{max})/REL] \times AF$

Where,

AF is the adjustment factor developed for compounds with RELs averaged over 4, 6, or 7 hours and listed below based on the source types (point or volume) and locations.

Compounds with Acute RELs Averaged Over 4, 6, or 7 Hours

CHEMICAL NAME	CAS #	Acute REL	Avg. Time (hours)
Arsenic and arsenic compounds, inorganic	7440-38-2	1.90E-01	4
Benzene (including benzene from gasoline)	71-43-2	1.30E+03	6
Carbon disulfide	75-15-0	6.20E+03	6
Carbon tetrachloride	56-23-5	1.90E+03	7
Chloroform	67-66-3	1.50E+02	7
Ethylene glycol ethyl ether (EGEE)	110-80-5	3.70E+02	6
Ethylene glycol monoethyl ether acetate	111-15-9	1.40E+02	6
Ethylene glycol monomethyl ether	109-86-4	9.30E+01	6

Ethylene glycol ethyl ether (EGEE) with its REL averaged over 6 hours is used in the following example.

The equipment is a spray booth, operating 8 hr/day, located in an industrial and residential area. There are multiple TACs emitted from this booth. The TACs have carcinogenic and acute non-cancer risks.

Assumptions:

The application was deemed complete on April 1, 1999

The nearest receptor distances are:

Worker (Industrial) = 500 meters

Residential = 1000 meters

Operating Schedule: 8 hr /day, 1 day/wk, 5 wks/yr = 40 hrs/yr

Stack height = 28 ft

Plant location: West Los Angeles, CA

The coating material contains lead chromate and EGEE.
Maximum daily coating sprayed: 0.5 gal/day = 2.5 gal/yr
Maximum hourly coating sprayed: 0.5 gal/hr

From MSDS sheets:
Lead chromate: 5 wt%
EGEE: 6 wt%
Coating density: 10 lb/gal

Percent by weight of lead and hexavalent chromium in lead chromate are estimated as follows:
Lead = (MW of Pb / MW of PbCrO4) x wt% of lead chromate in paint
= (207 lb Pb/323 lb PbCrO4) x 0.05 = 0.032 = 3.2 wt%

Hexavalent chromium = (MW of Cr^{+6} / MW of PbCrO4) x wt% of lead chromate in paint
= (52 lb Cr^{+6}/323 of PbCrO4) x 0.05 = 0.008 = 0.8 wt%

The maximum yearly and hourly emissions are estimated as follows:
Lead:
Qyr (lb/yr) = 2.5 gal/yr x 10 lb/gal x 0.032 = 0.8
Qhr (lb/hr) = 0.5 gal/hr x 10 lb/gal x 0.032 = 0.16

Hexavalent Chromium:
Qyr (lb/yr) = 2.5 gal/yr x 10 lb/gal x 0.008 = 0.2
Qhr (lb/hr) = 0.5 gal/hr x 10 lb/gal x 0.008 = 0.04

EGEE:
Qyr (lb/yr) = 2.5 gal/yr x 10 lb/gal x 0.06 = 1.5
Qhr (lb/hr) = 0.5 gal/hr x 10 lb/gal x 0.06 = 0.3

Emission rates for the TACs are listed in Table A below.

Table A

Toxic Air Contaminant	**Emission Rate**		
	Qhr(Max.) (lbs/hr)	**Qyr (lbs/yr)**	**QYR (tons/yr)**
Lead	0.16	0.8	0.0004
Hexavalent chromium	0.04	0.2	0.0001
EGEE	0.3	1.5	0.0008

Calculate the MICR and Cancer Burden using the same method as in the previous example. The results of the calculations are:

MICR:

Worker:

TAC	MICR
Lead	5.7×10^{-10}
Hexavalent Chromium	1.8×10^{-6}
Total	**1.8×10^{-6}**

Residential:

TAC	MICR
Lead	2.4×10^{-10}
Hexavalent Chromium	8.0×10^{-7}
Total	**8.0×10^{-7}**

Cancer Burden:

CB = 0.026

Hazard Index Calculations

Acute and Chronic Hazard Indices should be calculated for each target organ. The calculation of the acute hazard index for compounds with RELs developed based on 4, 6, or 7 averaging hours is slightly different than the calculation for compounds with RELs developed based on 1 hour average.

Note: Presently, no chronic RELs are developed for any of the compounds in this example, therefore no HIC is calculated.

Acute Hazard Index:

For all acute compounds with RELs developed based on a 1 hour average, the acute hazard indices are estimated using the equation below:

$$HIA = [Q_{hr} \times (X/Q)_{max}]/REL$$

For acute compounds with RELs developed based on 4, 6, or 7 hours average, the acute hazard indices are estimated as follows:

$$HIA = [(Q_{hr} \times (X/Q)_{max})/REL] \times AF$$

Where,

AF is REL adjustment factor developed for compounds with REL averaged over 4, 6, or 7 hours and listed in **Table 8B** based on the source types (point or volume) and location of the source.

Based on Table 10-B, the target organs for the TACs have been listed.

EGEE:

Affects Reproductive System.

The REL for EGEE is averaged over 6 hours. From Table 8B, the AF for EGEE is 0.83 since it is a point source in West Los Angeles.

Note: The X/Q values in Table 6 are based on the maximum hourly emission rates.

The Acute Hazard Index for EGEE is calculated as follows:

Worker: HIA = [(0.3 x 24.8)/370] x 0.83
= 0.017
Reproductive: 0.017

Residential: HIA=[(0.3 x 8.3)/370] x 0.83
= 0.006
Reproductive: 0.006

In summary:

Acute Hazard Index (HIA):

By Target Organs for Acute:

(1) Worker:

TAC	HIA
	REPR
EGEE	0.017
Total	**0.017**

(2) Residential:

TAC	HIA
	REPR
EGEE	0.006
Total	**0.006**

RESULT:

For this example, if the spray booth is equipped with T-BACT, the evaluations indicate that MICR for residential and commercial, and HIA are all below the risk limits of Rule 1401.

- ***MICR for commercial receptor exceeds 1 x 10^{-6} (one in one million) but it is below 10 x 10^{-6} (ten in one million).***
- ***The evaluation indicates cancer burden is less than 0.5***
- ***Hazard Indices (HIA) do not exceed 1.0 for each target organ.***
- ***Provided this equipment is installed with T-BACT, a permit would be issued.***

EXAMPLE NO. 4: CONTEMPORANEOUS RISK REDUCTION

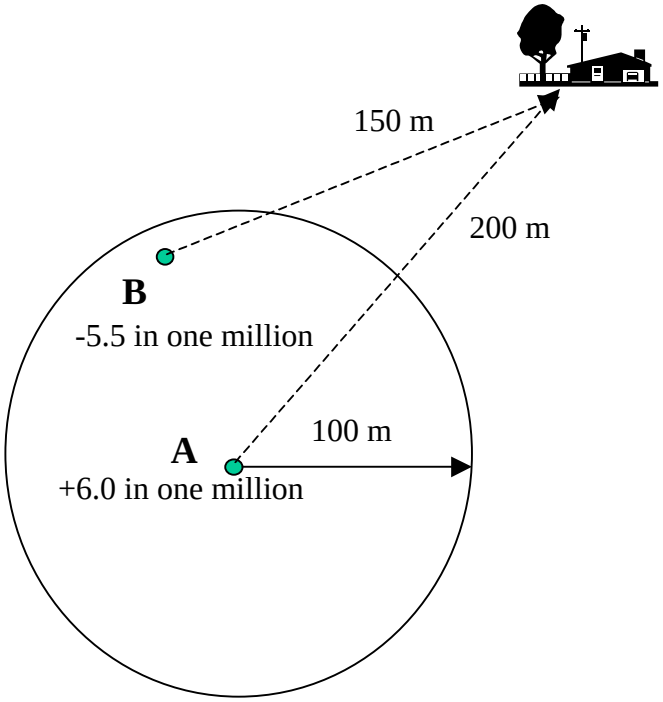
Rule 1401(g)(2)(A): The requirements of paragraph (d)(1) and (d)(4) shall not apply if the applicant demonstrates that a contemporaneous risk reduction resulting in a decrease in emissions will occur such that both of the following conditions are met:

(i) no receptor location will experience a total increase in MICR of greater than one in one million due to the cumulative impact of both the permit unit and the contemporaneous risk reduction, and

(ii) the contemporaneous risk reduction occurs within 100 meters of the permit unit.

T-BACT shall be used on permit units exempted under this subparagraph if the MICR from the permit unit exceeds one in one million (1×10^{-6}).

Note: All permit applications associated with the increases and decreases in risk for contemporaneous risk reduction must be submitted together and the reduction in risk must occur before the start of operation of the equipment that will have an increase in risk.

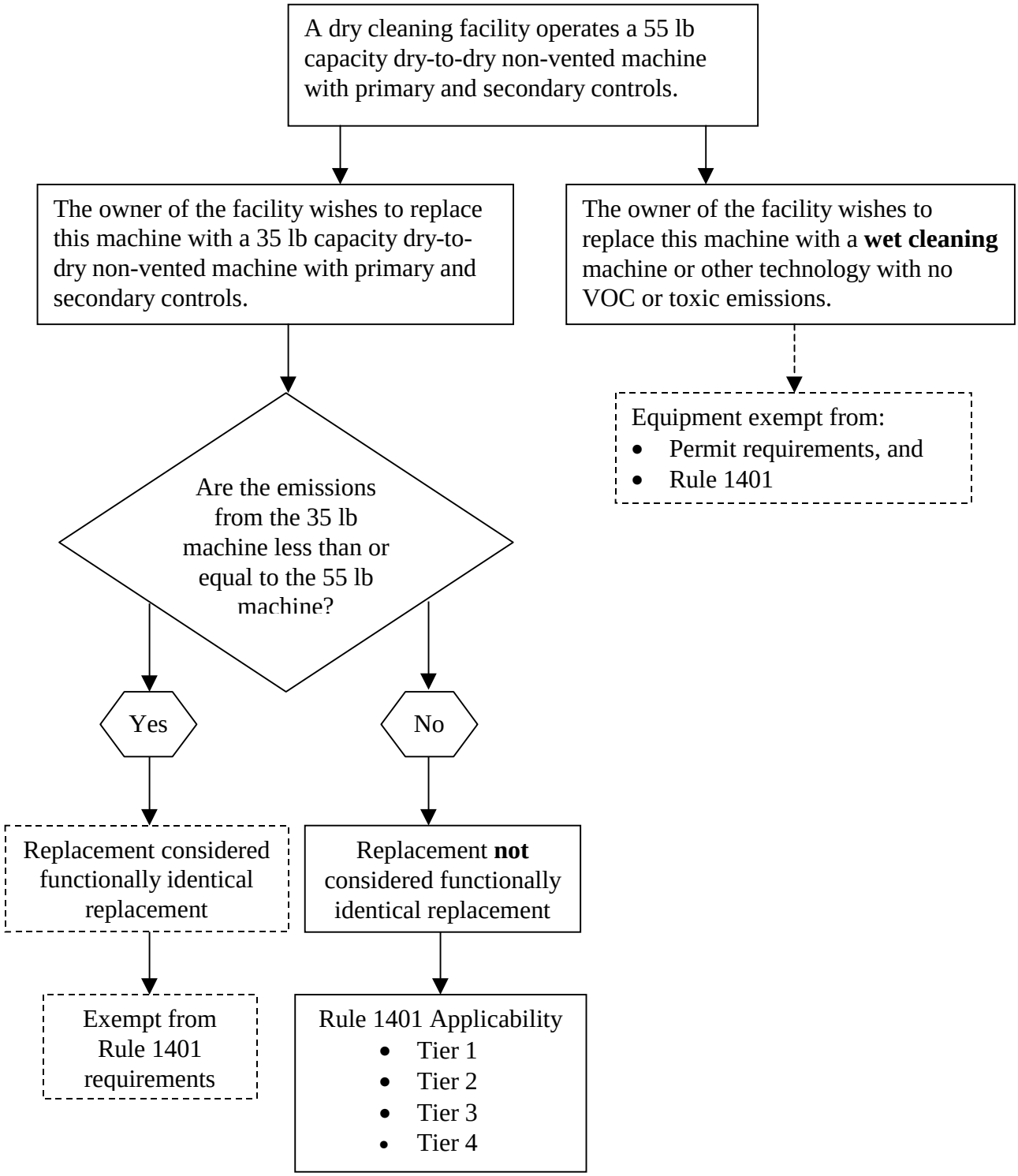


Assumptions:
Units A and B: Only have cancer impacts
Unit A: New equipment, installed with T-BACT, MICR = 6.0 in one million
Unit B: Existing equipment with decreased MICR of 5.5 in one million due to change in operating conditions or process
The residence is the nearest receptor for both A and B
Unit B emissions, prior to modification, resulted in an 8 in a million risk for the nearest receptor. After modification, Unit B risk is 2.5 in a million which is a decrease of 5.5 in a million.
Therefore, the increased risk for the receptor is the MICR for Unit A less the decrease in risk for Unit B 6.0 – 5.5 = **0.5 in a million**.

RESULT:

- ***Equipment was installed using T-BACT.***
- ***No receptor experiences an increase in risk greater than one in a million.***
- ***The contemporaneous risk reduction occurs within 100 meters of the new equipment.***
- ***If all other rule requirements are met, a permit would be issued.***

EXAMPLE NO. 5: FUNCTIONALLY IDENTICAL EQUIPMENT REPLACEMENT



T-BACT

T-BACT is not required if the MICR is less than or equal to one in a million. If cancer risk is greater than one in a million, T-BACT is required and must reduce risk to less than or equal to 10 in a million.

SIC Codes, which describe industry types or classifications, or SCC Codes, which describe emitting processes or equipment, can be used to help identify T-BACT. If no standard is available, AQMD staff works with the applicant to identify T-BACT when required.

AQMD staff is continually examining and updating control technologies that comply with the definition presented in Rule 1401(c)(2). However, in many situations T-BACT is equivalent to BACT. The applicant is encouraged to contact the AQMD permit processing division for current T-BACT information.

T-BACT EXAMPLES

Type of Industry:	*Petroleum*
Type of Emitting Process:	***Sulfur Recovery Unit***
Specific TAC Emissions:	***Benzene, Formaldehyde***
Applicable BACT:	*Thermal Oxidizer*
T-BACT:	*Thermal Oxidizer*

BACT = T-BACT

With T-BACT, risk is between 1 and 10 in one million

T-BACT is acceptable

Type of Industry:	*Metal Plating*
Type of Emitting Process:	***Nickel Plating, Chromium Plating***
Specific TAC Emissions:	***Nickel, Hexavalent Chromium***
Applicable BACT:	*Wet Scrubber*
T-BACT:	*HEPA*

With T-BACT, risk is between 1 and 10 in one million

T-BACT is acceptable

REFERENCES

Chico, Thomas. 1994. *Development of Modeling and Screening Risk Assessment Procedures for Dry Cleaning Facilities.* South Coast AQMD.

Chico, Thomas. 1994. *Development of Modeling and Screening Risk Assessment Procedures for Volume-Type Sources.* South Coast AQMD.

APPENDIX I

Calculation Worksheets

MICR Calculation Worksheet
Acute Hazard Index (HIA) Calculation Worksheet
Chronic Hazard Index (HIC) Calculation Worksheet

MICR CALCULATION WORKSHEET

Facility Name: _____

Facility Address: _____

Description of Equipment: _____

Equipment is (circle one): **Point Source** or **Volume Source**

Toxic Air Contaminants Emitted by Equipment	Maximum Annual Emissions in lb/yr	Maximum Annual Emissions in tons/yr(Qtons)	U (Table 8 or 8A)	MP (Table 8 or 8A)
1.				
2.				
3.				

Equipment operates (circle one) **≤ 12 hr/day** or > **12 hr/day**

If equipment is a **point source**, enter:

Stack Height: _____ ft

If equipment is a volume source enter

Building Height: _____ ft & **Floor Area:** _____ ft^2

Distance **to nearest residential or sensitive receptor:** _____ meters

Distance to **nearest off-site worker receptor:** _____ meters

Nearest **AQMD meteorological station:** _____ (Table 11 & Fig 1)

Select **X/Q and MET Tables** as follows (circle tables selected)

	Point Source	Volume Source
≤ 12 hr/day	Tables 2A, 2B	Tables 4A, 4B
> 12 hr/day	Tables 3A, 3B	Tables 5A, 5B

X/Q value for nearest residential/sensitive receptor: _____

X/Q value for nearest off-site worker receptor: _____

MET value _____

LEA value for nearest off-site worker receptor: _____ (Table 9)

MICR CALCULATION

Contaminants	Q_{tons}		X/Q		MET		U		MP		LEA		MICR
1.		**x**		**x**		**x**		**x**		**x**		=	
2.		**x**		**x**		**x**		**x**		**x**		=	
3.		**x**		**x**		**x**		**x**		**x**		=	

MICR =_____

HIA CALCULATION WORKSHEET

Target Organ: _____

Facility Name: _____

Facility Address: _____

Description of Equipment: _____

Equipment operates (circle one) **≤ 12 hr/day** or **> 12 hr/day**

Equipment is (circle one): **Point Source** or **Volume Source**

If equipment is a **point source**, enter:

Stack Height: _____ ft

If equipment is a volume source enter

Building Height: _____ ft & **Floor Area**: _____ ft^2

Distance **to nearest residential or sensitive receptor:** _____ meters

Distance to **nearest off-site worker receptor**: _____ meters

Nearest **AQMD meteorological station:** _____

Select **X/Q_{hr}:** _____

Select **AF** for compounds with 4, 6, or 7 hour averaging times: _____

Toxic Air Contaminants Emitted by Equipment	Maximum Hourly Emissions in lb/hr	Peak Hourly Dispersion Factor X/Q-hr *	Acute Reference Exposure Level (REL) **	Adjustment Factor (AF)
1.				
2.				
3.				

* From Table 6 if Point Source, or, from Table 7 if Volume Source

** From Table 8 or 8A

ACUTE HAZARD INDEX (HIA) CALCULATION:

$[Qhr \times (X/Q)_{hr}] / (Acute\ REL) \times AF$

Contaminants	Q_{hr}		X/Q-hr		REL		AF		HIA
1.		**x**		/		**x**		=	
2.		**x**		/		**x**		=	
3.		**x**		/		**x**		=	

HIC CALCULATION WORKSHEET

Target Organ: _____

Facility Name: _____

Facility Address: _____

Description of Equipment: _____

Equipment operates (circle one) **≤ 12 hr/day** or **> 12 hr/day**

Equipment is (circle one): **Point Source** or **Volume Source**

If equipment is a **point source**, enter:

Stack Height: _____ ft

If equipment is a volume source enter

Building Height: _____ ft & **Floor Area**: _____ ft^2

Distance **to nearest residential or sensitive receptor:** _____ meters

Distance to **nearest off-site worker receptor**: _____ meters

Nearest **AQMD meteorological station:** _____

Select **X/Qyr** from Tables 2A, 3A, 4A or 5A

Select MET from 2B, 3B, 4B, or 5B

Select Chronic REL and MP from Table 8 or 8A

Toxic Air Contaminants Emitted by Equipment	Maximum Annual Emissions in lb/yr	Maximum Annual Emissions in tons/yr (Qyr)	Dispersion Factor (X/Q)	Chronic Reference Exposure Level (REL)	Meteorological Correction Factor (MET)	Multi-pathway Adjustment Factor (MP)
1.						
2.						
3.						

CHRONIC HAZARD INDEX (HIC) CALCULATION:

Σ [(Qyr) x (X/Q) x MET x MP] / (Chronic REL) for each TAC

Contaminants	Qyr		X/Q		MET		MP		REL		TAC
1.		**x**		**x**		**x**		/		=	
2.		**x**		**x**		**x**		/		=	
3.		**x**		**x**		**x**		/		=	

APPENDIX II

Derivation of Tier 2 Multi-pathway Adjustment Factors (MP) and Meteorological Correction Factors (MET)

DERIVATION OF TIER 2 MULTI-PATHWAY ADJUSTMENT FACTORS (MP) AND METEOROLOGICAL CORRECTION FACTORS (MET)

MULTI-PATHWAY FACTORS (MP)

Toxic air contaminants enter the body through a number of routes: inhalation; absorption through the skin; and ingestion from contaminated food, water, milk and soil. To account for uptake of toxics through routes of exposure other than inhalation, risk assessments often include a "multi-pathway" exposure analysis.

To simplify the screening risk assessment, multi-pathway adjustment (MP) factors were developed. The inhalation risk is multiplied by the MP factors to account for the additional health risk due to other pathways of exposure.

AQMD has previously developed multi-pathway factors in its risk assessment and screening procedures. For this update of the risk assessment procedures, the methodology has been updated and multi-pathway factors have been developed for additional compounds.

The MP factors were developed using HRA 96, version 2.0E, a multi-pathway exposure model developed jointly by the California Air Resources Board and the Office of Environmental Health Hazard Assessment. Assumptions and parameters used to develop the MP factors are:

- Emission rate = 1 gram/second
- X/Q = 1
- Deposition velocity = 0.02 m/sec
- 70-year exposure
- Fraction of homegrown fruits and vegetables consumed = 10%
- Pathways/sources include inhalation, ingestion of soil (pica), homegrown vegetables, mother's milk for one year, and skin contact.
- The MP factor is the ratio of total risk to inhalation risk.

METEOROLOGICAL CORRECTION FACTORS (MET)

In order to derive the meteorological correction (MET) factors, detailed air dispersion modeling was performed for all 35 AQMD meteorological stations. It was noted that West Los Angeles (LA on Figure 1) generally yielded the highest concentrations at every downwind distance. MET correction factors were developed for the other 34 meteorological stations by dividing their predicted concentrations by those for West Los Angeles, with the highest factor chosen among the receptors at 50, 75, and 100 meters for each station.

APPENDIX III

PROCEDURES FOR ADDRESSING NON-DETECTED COMPOUNDS AND BLANKS IN RISK ASSESSMENT

Procedures for Addressing Non-detected Toxic Air Contaminants and Blanks in Risk Assessment

INTRODUCTION

This appendix describes new guidelines for estimating emissions of non-detected toxic air contaminants (TACs) and using blanks in emissions estimations for purposes of preparing health risk assessments for Rules 1401, 1402 and the Air Toxics "Hot Spots" program (AB 2588). Procedures are the same for preparing risk assessments for Rules 1401, 1402 and AB2588, however the lists of compounds are different. Rule 1401 uses only unit risk factors approved by the Scientific Review Panel and prepared by the state Office of Environmental Health Hazard Assessment (OEHHA), whereas Rule 1402 and AB2588 use different sources for risk factors, including draft numbers.

Under previous policy, the AQMD required that if a TAC could be present in emissions from a source but not detected during air testing, it must be assumed to be present below the limit of detection (LOD). This approach has been applied to stack testing, to measurements such as laboratory analysis of materials, and other monitoring and measurement methods. The concentration of non-detected TACs were to be reported as one-half (1/2) of the LOD.

Concerns were raised that this policy of carrying undetected TACs through a health risk assessment at half of the LOD could inflate risk estimates and might require facilities to install control equipment for emissions that may not be present. In addition, it would not be possible to detect the TAC after its emissions had been controlled and reduced.

Also, in the past, the AQMD did not allow any adjustments in the measured values of samples based on the results of field blanks. Concerns were raised that in certain cases the concentration of TACs measured in field blanks should be deducted from the actual measured samples.

To address these concerns, AQMD staff worked closely with affected facilities such as publicly owned treatment works (POTWs) and others during previous rulemaking efforts for Rules 1401 and 1402 to develop new guidelines for addressing non-detected TACs and blanks in risk assessment.

OVERVIEW

The new approach begins with an initial level of screening to determine whether or not a TAC is likely to be present and therefore should be tested for. If the conditions in the screening guidelines are met, no further testing or analysis is required. If a TAC does not pass the screening guidelines, the facility must quantify and report the emissions of the compound through testing or other methods as approved by the AQMD. The reported emission levels are calculated based on the number of test runs or analyses that are below the LOD.

SCREENING GUIDELINES

For a TAC to be excluded from testing or analysis and hence quantification for health risk assessment, it must meet either condition A, B, or C listed below.

Proof for exclusion of any TAC based on literature studies on physical nature or chemistry of the compounds to substantiate the findings, and any prior analysis or testing shall be deemed complete for AQMD approval. Any prior testing must have been conducted according to AQMD's approved test methods or other recognized standards, as approved by the AQMD.

If a list of TACs to be tested for is agreed upon but is subsequently discovered by the facility or the AQMD that additional compounds may be present, the AQMD may require that the facility test for the presence of the additional TACs.

The screening criteria to be used for determining the presence of TACs are the following.

Condition A: No likelihood of the presence of a TAC

A facility may choose to demonstrate that there is no likelihood of a TAC being present in the raw materials, process streams or materials introduced into the equipment or process. The methodology or documentation to show proof of the non-existence of the TAC must be deemed complete with the source test protocol or test method analysis protocol for AQMD approval. If the evidence to substantiate the absence of a TAC is insufficient, or the AQMD has reason to believe that the TAC may be present, it must be tested for and quantified (see Cases 1, 2, and 3).

For example, a facility operator can demonstrate the absence of cadmium in emissions from the melting of lead ingots in a pot furnace by presenting the following documentation:

- Certified analysis of the lead ingots showing that cadmium is not a constituent of the ingot.
- Description of the process substantiating that no other material is added to the furnace that will contribute to cadmium emissions. The operator must also provide analysis for the fuel used in the process to demonstrate that it does not contain cadmium.
- Documentation substantiating that melting lead ingots without cadmium present in the ingot in a pot furnace will not result in the emissions of cadmium when the firebricks or pot liner are heated during the melting operations.

In addition, the facility operator may submit test results based on tests performed within the last two years, or a longer period if the facility can demonstrate that no significant changes have occurred to the AQMD-approved test method, process equipment or process materials, that indicate cadmium was reported as below LOD.

Condition B: Absence of a TAC or its precursors in the process

If there is any evidence that precursors, which could lead to formation of a TAC during a process or reaction, may be present, then a facility may have to test for the TAC. To be excluded from testing and quantification requirements, the facility must provide documentation to demonstrate, based on test results, that none of the essential precursors are present in the material or process. This is similar to the previous criteria and differs only in that precursor compounds that could contribute to the formation of the subject TAC must also be identified as not being present.

An example is emission of dioxins from a waste incinerator. In this case, test data may be available to show that there are no dioxins present in the waste stream being incinerated. However, the presence of chlorine and hydrocarbons in the combustion process could result in the formation of products of incomplete combustion (PICs) such as dioxins or other toxic compounds. Testing for these compounds would be required unless the facility operator demonstrates that none of the essential precursors are present in the waste stream or the process itself.

CONDITION C: SPECIAL TAC LIST FOR POTWS

Unlike other industrial sources whose potential toxic air emissions are relatively well defined and which contain limited species, proving the absence of TACs from emissions from POTWs is more difficult. This is because the instantaneous discharge of wastewater from various residential, commercial and industrial system users could potentially result in the presence of different toxic contaminants in the influent sewage. Therefore, it is recommended that a special TAC list be developed for POTWs to select appropriate TACs for testing and determination of health risk associated with air emissions from liquid phase and sludge treatment processes.

The special TAC list for POTWs will be approved by the AQMD with consideration given to information including but not limited to the following:

1. The Pooled Emission Estimating Program (PEEP) identified and selected compounds under the AB 2588 emissions inventory program, as approved by the AQMD.

2. The Joint Emissions Inventory Program (JEIP) identified and selected compounds under AQMD Rule 1179 inventory requirements, as approved by the AQMD.

3. TACs that have a reasonable likelihood of being present in the air emissions of POTWs, based on other test results or information sources, as approved by the AQMD.

Additionally, based on the specific sources of sewage for certain POTWs, specific TACs in addition to the ones identified through the above steps could be added or deleted from the list on a case-by-case basis.

Based on the special TAC list for POTWs as developed from the above procedure and subject to approval by the AQMD, facilities will be required to quantify the listed compounds through testing or other methods approved by the AQMD for inclusion in the health risk assessment. The facility will not have to test for compounds not included in the special TAC list for POTWs, and the inclusion of non-listed TACs in the health risk assessment is not required. However, if after the industry-specific list is developed and approved, the facility or the AQMD later discovers information that additional TACs may be present, the AQMD may revise the industry-specific list and may require the facility to quantify emissions of such TACs that were previously excluded from quantification.

QUANTIFICATION OF EMISSIONS BASED ON SOURCE TEST RESULTS

The cases listed below explain the process for quantification of emissions based on the source test results.

Treatment of Test Runs Below LOD

If some test runs are below LOD, quantification of the TAC depends on the percent of the test runs and analyses that are below LOD. Three possible scenarios are discussed below. In all of these cases, all of the following three conditions must be met:

1. All tests should be performed using AQMD-approved test methods, triplicate sample runs and AQMD-approved detection limits. When non-detected values are reported, the actual analytical limit of detection for all runs and the number of sample runs shall be reported; and

2. The data from the analyses or tests were obtained within a period of two (2) years prior to the time the data is to be used by the AQMD, unless the facility demonstrates to the AQMD's satisfaction that earlier test data remain valid due to lack of significant changes in test methods, process equipment or process materials; and

3. For cyclic operations or variations in feedstock, the tests or analyses conducted should be representative of the variations in loads, feed rates and seasons, if applicable. In such cases, an adequate number of test runs should be conducted for all cyclic or seasonal operations.

Case #1: TAC is not detected in any test runs or analyses

In situations in which all test runs and analyses consistently indicate levels below the LOD, the compound can be identified as "not detected" and its inclusion in the health risk assessment will not be required, provided all three conditions listed above are met.

Case #2: TAC is detected in less than 10% of the test runs or analyses

In situations in which a compound has been detected and the percentage of samples in which it is detected is less than ten percent, and provided that all three conditions listed above are met, the following procedure shall be used to average the results:

1. For those runs or analyses that were below LOD, assign zero.
2. Average the measured values obtained for the runs that were above LOD with zero values for the runs below LOD and report the final average result for use in the risk estimation.

Case #3: TAC is detected in 10% or more of the test runs or analyses

In cases in which ten or more percent of the test runs and analyses show measured values of a TAC above the LOD, and provided that all three condition listed above are met, the following procedure shall be used to average the results:

1. For those runs or analysis that were below LOD, assign one half (1/2) of the corresponding LOD for each run.
2. Average the measured values obtained for the runs that were above LOD with 1/2 LOD values for the runs below LOD and report the final average result for use in the risk estimation.

In cases in which there are fewer than ten samples (for example, two triplicate samples have been taken) and a TAC has been detected in one or more samples, the following procedures shall be used.

- If the TAC is detected in one sample, use Case #2.
- If the TAC is detected in two or more samples, use Case #3.

Use of Field Blanks

Field blank values may be subtracted from sample values under the conditions specified below. In order to use these procedures, it will be necessary to obtain from the AQMD, prior to the test or analyses, a determination as to the maximum allowable value for the blank.

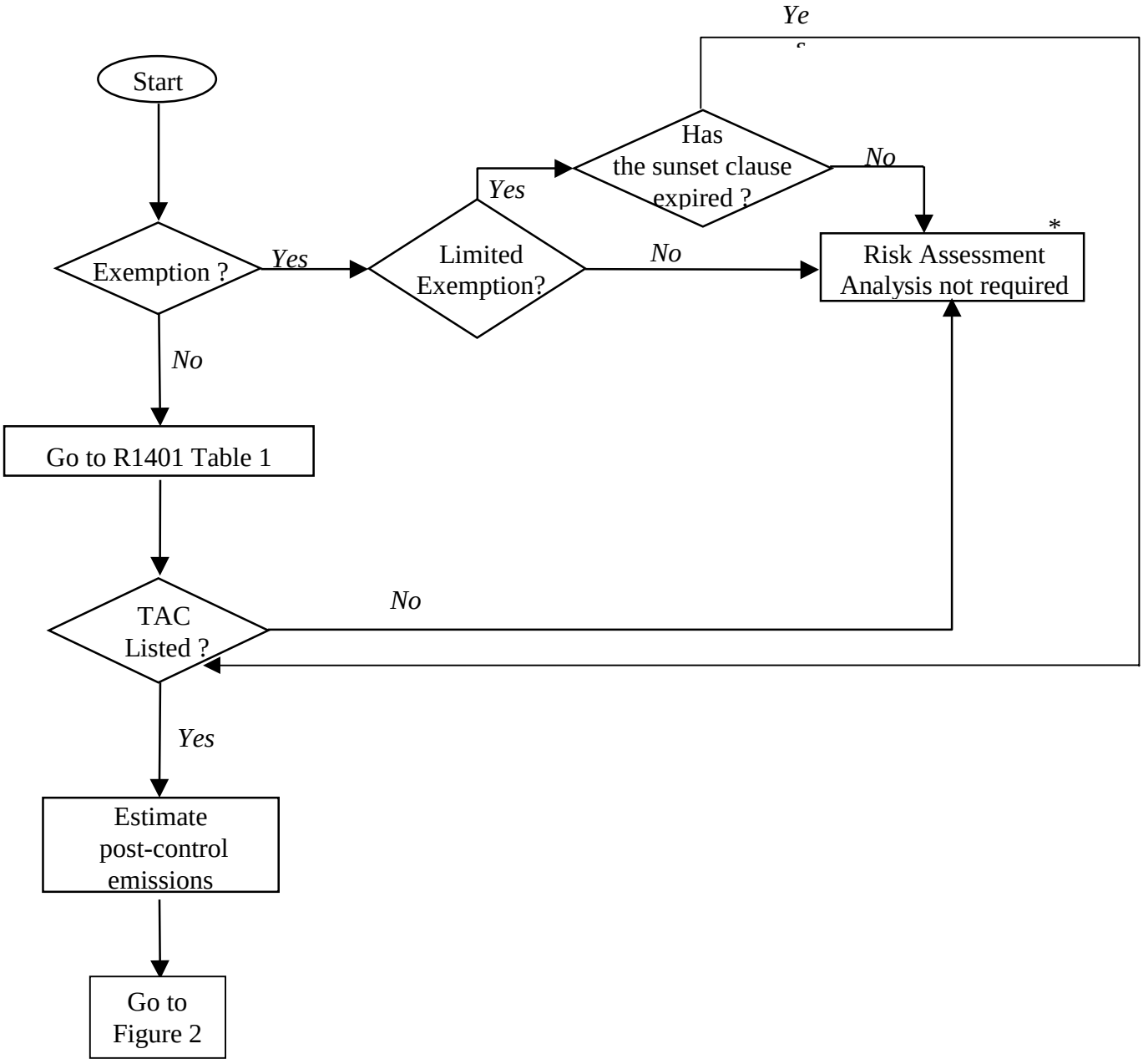
If the level of the TAC in the field blank is less than or equal to the maximum allowable blank, the field blank may be subtracted. The data must be reported with and without the correction. If the level of the TAC in the field blank is greater than the maximum allowable blank and the concentration of the sample is greater than 3 times the field blank value, then the maximum allowable field blank value can be subtracted. The data must be reported with and without correction.

APPENDIX IV

FLOW CHARTS AND DIAGRAMS

Note: **The reader needs to ascertain the date in which the subject equipment's permit application was deemed complete. This date is used to identify the correct set of permitting tables (see Attachments) to be used for permit processing.**

Figure 1
Preliminary Tasks



* Consult with AQMD staff for other TACs not listed in Table 1, which potentially endanger public health or may require a Rule 212 evaluation.

Figure 2
Screening Levels: Tier 1

Tier 1 involves comparing emissions from a piece of equipment to Screening Levels

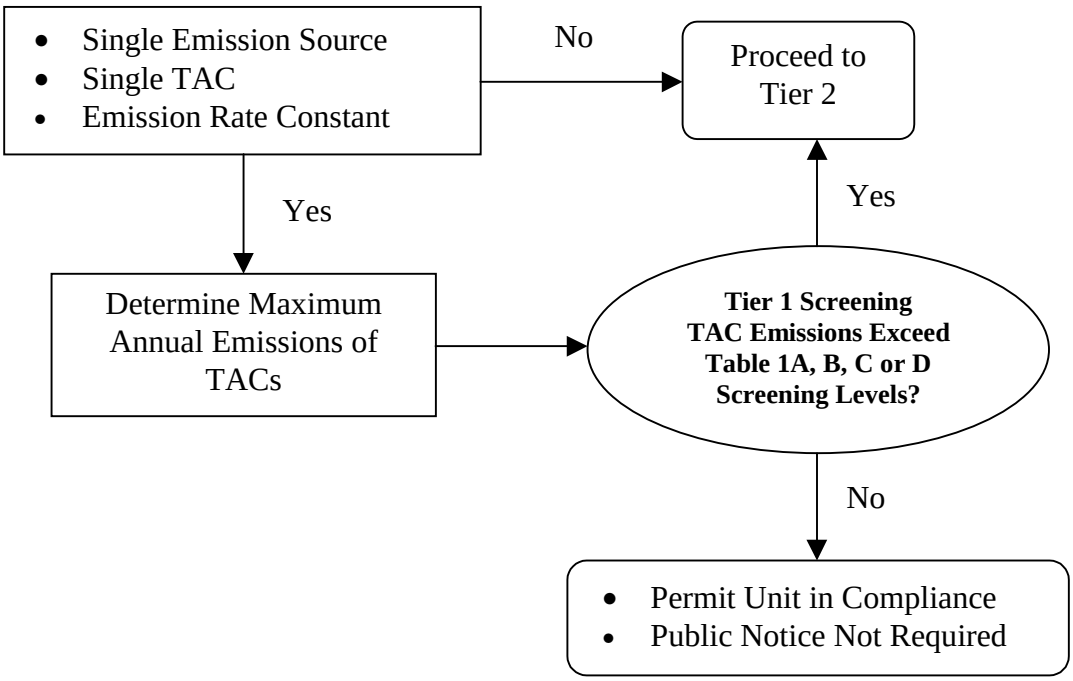
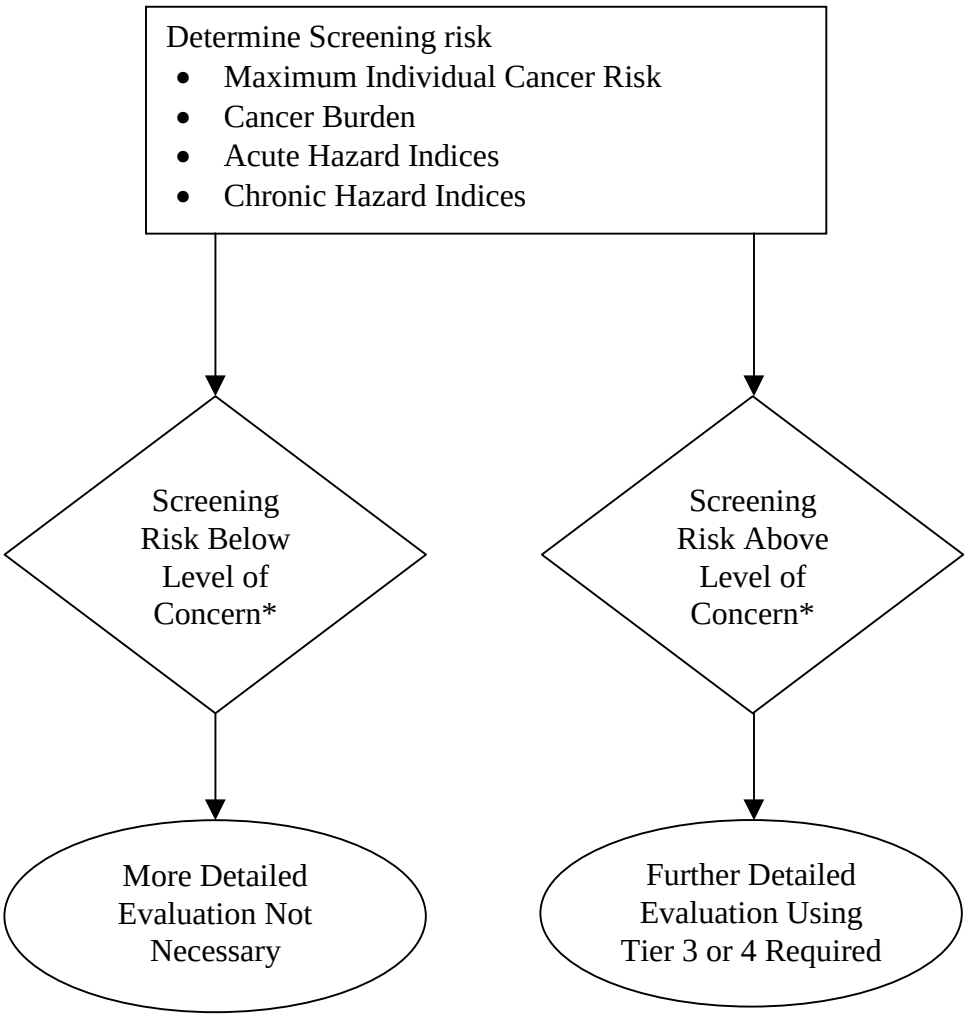


Figure 3A
Screening Levels: Tier 2

Tier 2 is a screening risk assessment, which includes procedures for determining level of risk from MICR, Cancer Burden, and Acute & Chronic Hazard Indices

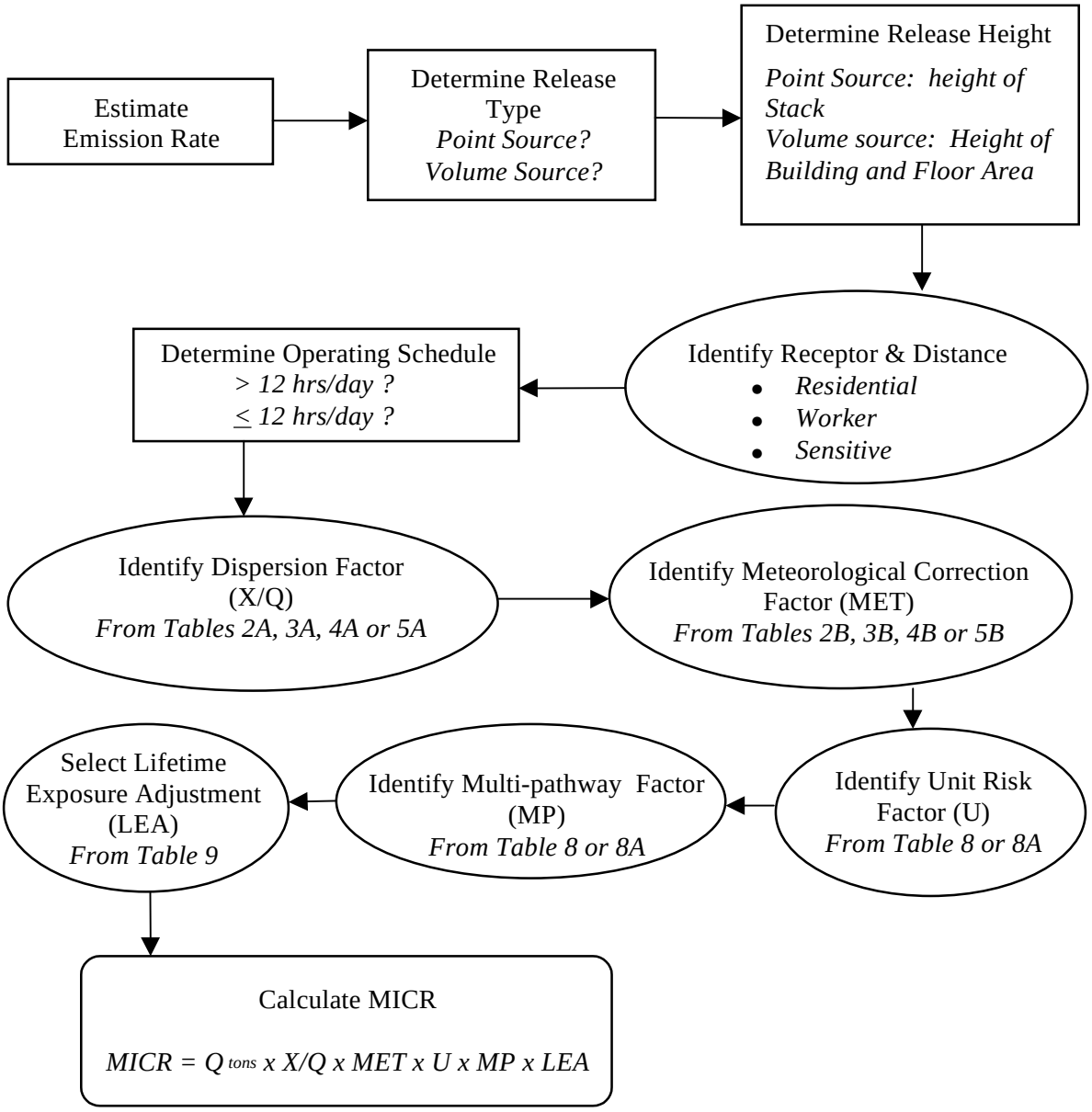


* *Level of Concern:*

- *MICR exceeds one in one million with no T-BACT*
- *MICR exceeds 10 in one million with T-BACT*
- *Cancer burden exceeds 0.5*
- *HIA or HIC exceeds 1 for any target organ system*

Figure 3B
Screening Levels: Tier 2

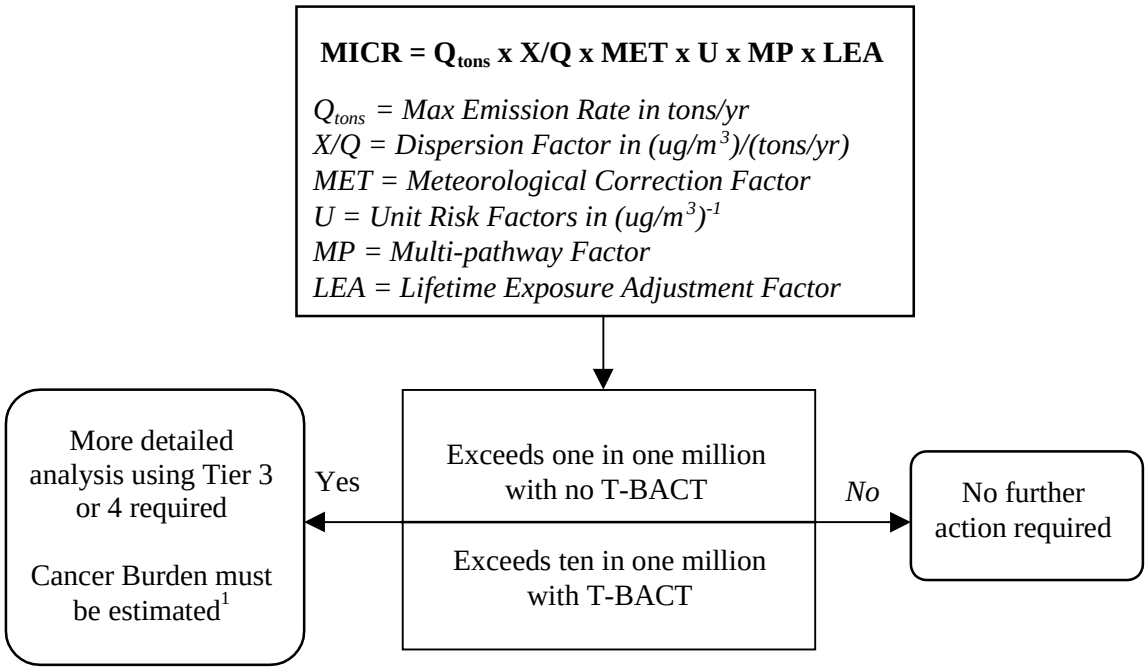
Maximum Individual Cancer Risk (MICR)



If MICR exceeds one in a million, cancer burden must also be estimated (See Figure 4)

Figure 3C
Screening Levels: Tier 2

Maximum Individual Cancer Risk (MICR)



[1] *For estimating Cancer Burden, see Figure 4*

If the source emits more than one TAC, the total MICR must be calculated. The total MICR is the sum of the MICRs for each of the TACs emitted by the source.

Figure 3D
Screening Levels: Tier 2

Dispersion Factor (X/Q): Numerical estimates of the amount of decrease in concentration of a contaminant as it travels away from the site of release.

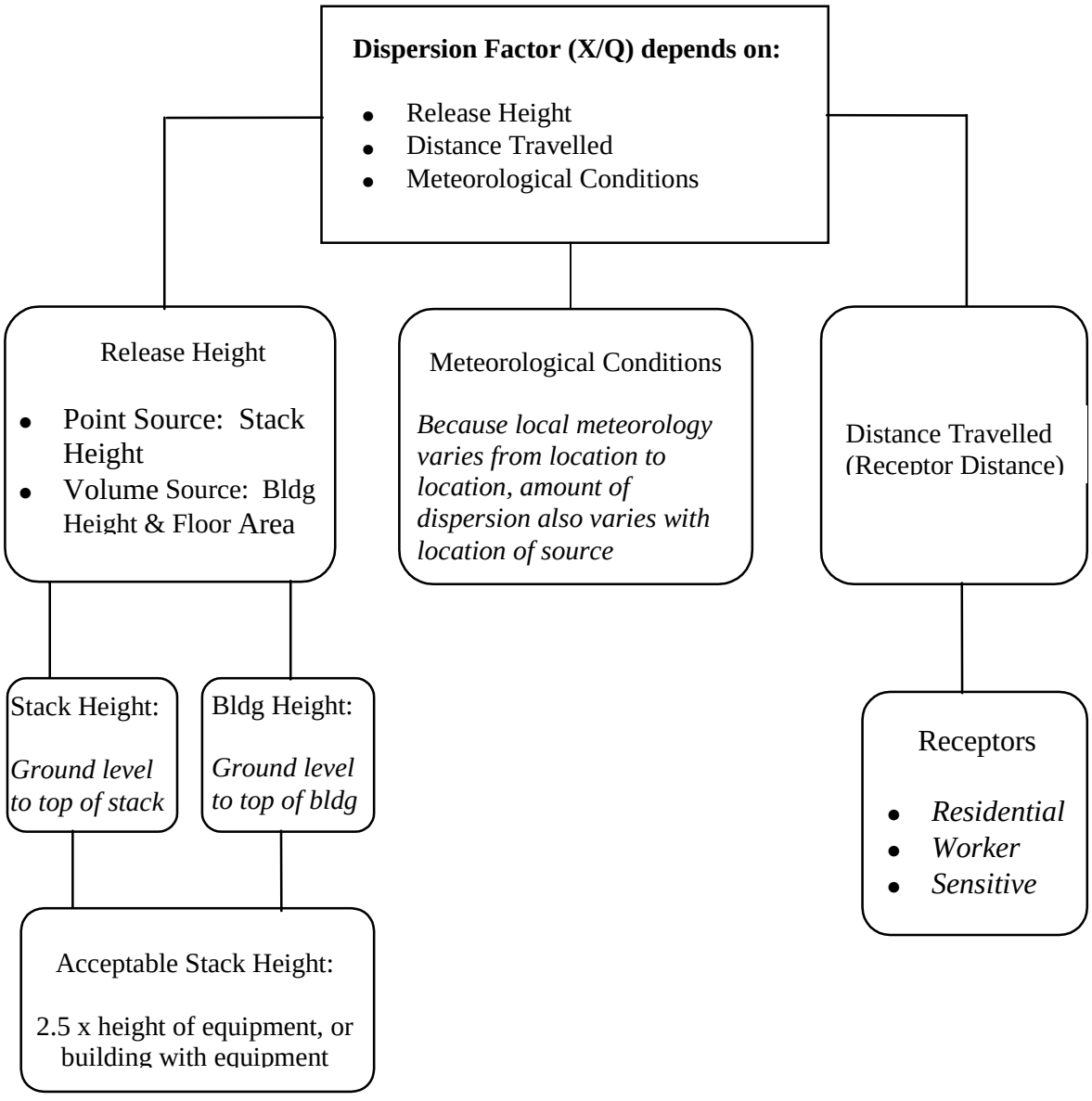


Figure 3E
Screening Levels: Tier 2

Unit Risk Factor (U)

Unit Risk Factor (U)

- *Measure of the cancer potency of a carcinogen*
- *Estimated probability that a person will contract cancer due to inhalation of 1 ug/m^3 of TAC continuously over period of 70 years*

Figure 3F
Screening Levels: Tier 2

Multi-pathway Adjustment Factor (MP)

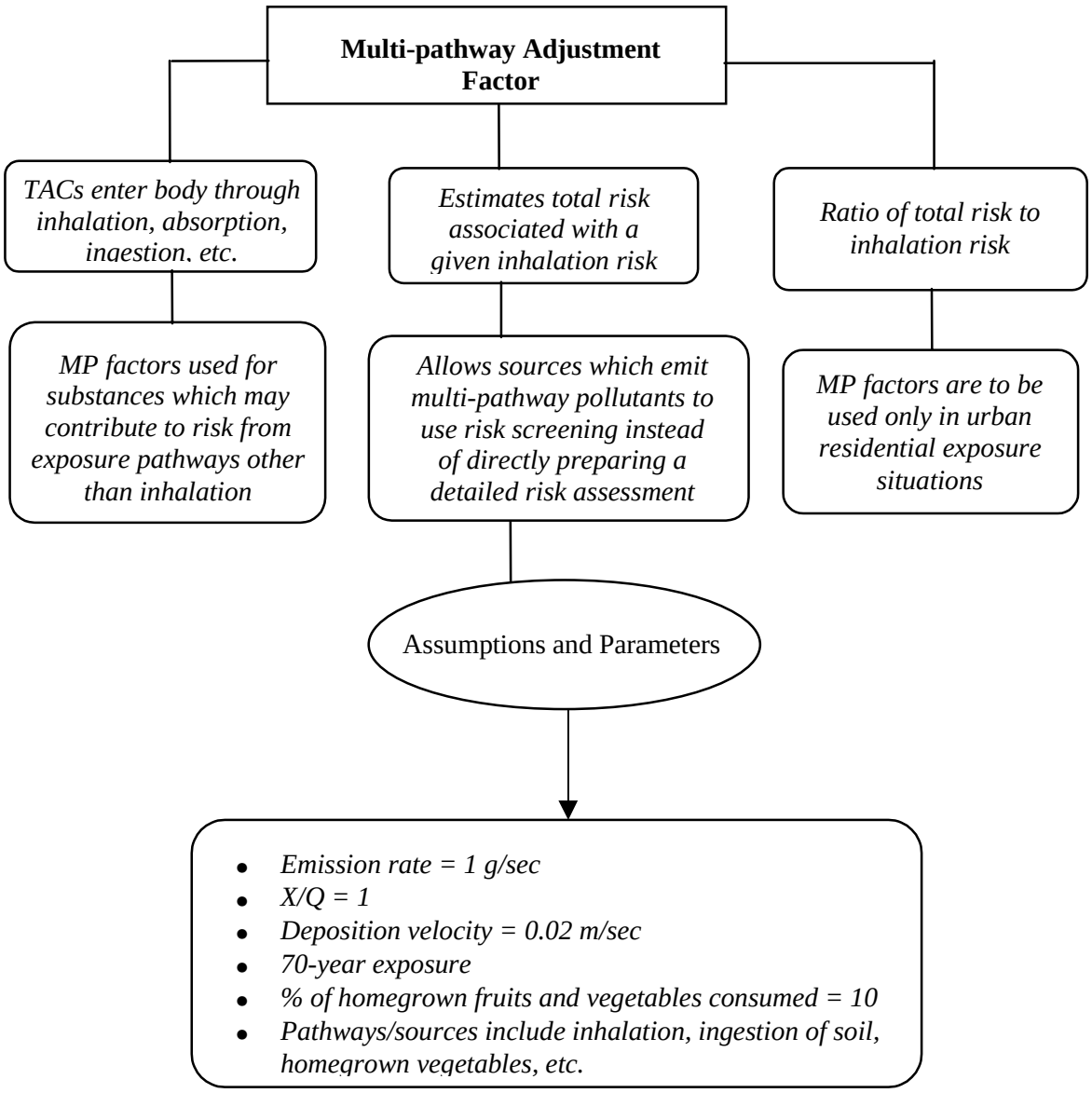


Figure 3 G
Screening Levels: Tier 2

Lifetime Exposure Adjustment (LEA)

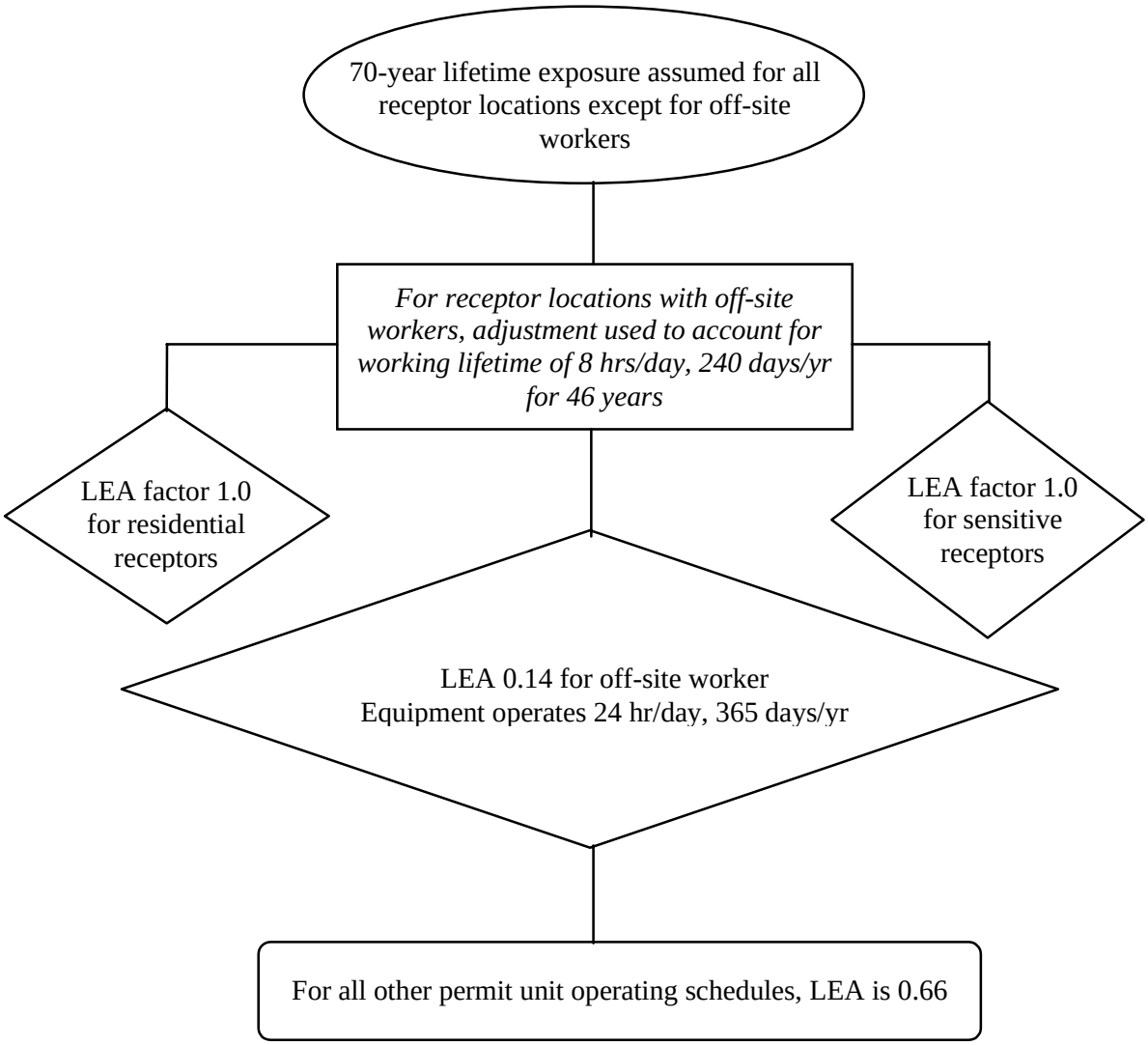


Figure 4
Cancer Burden

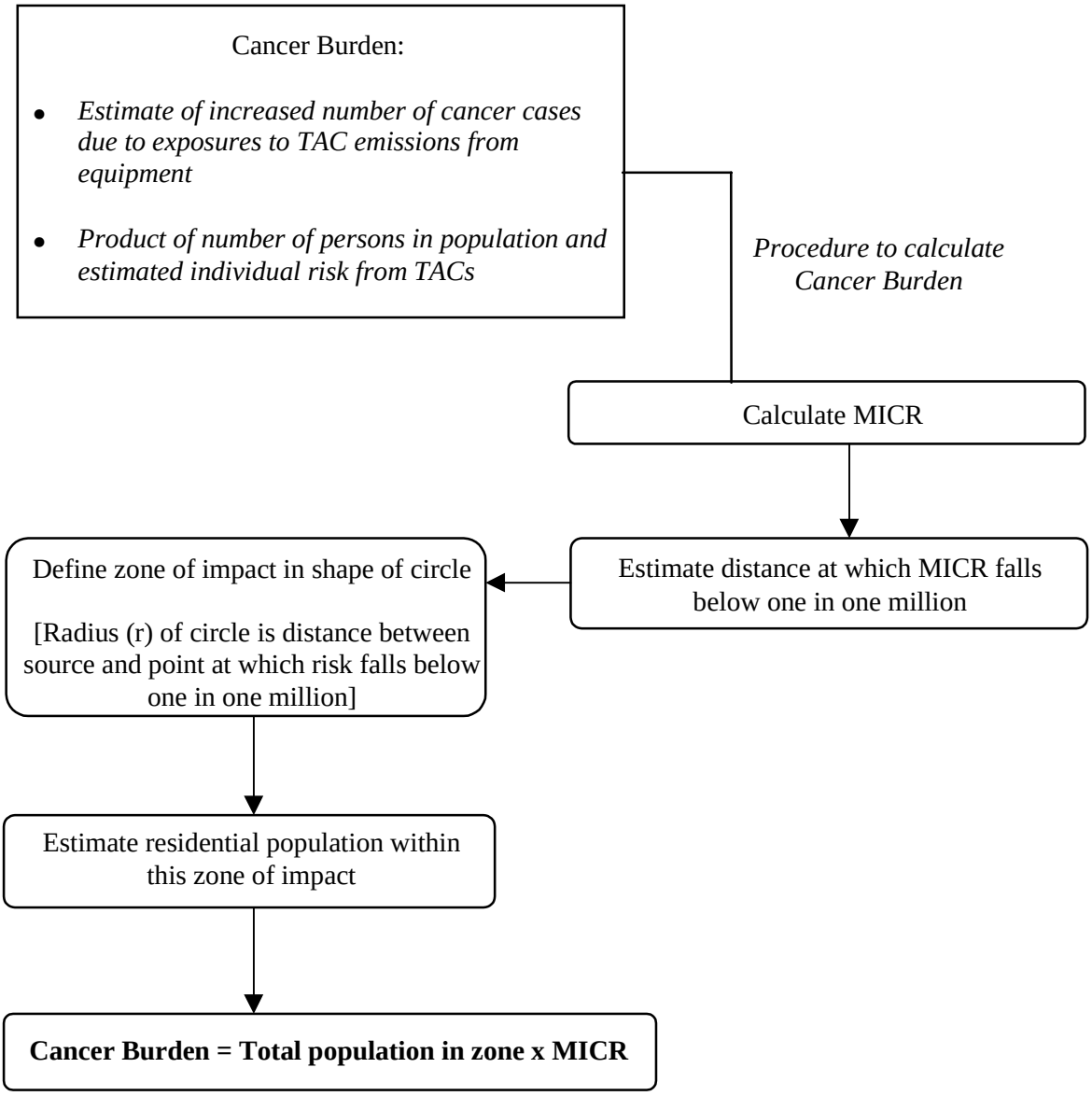
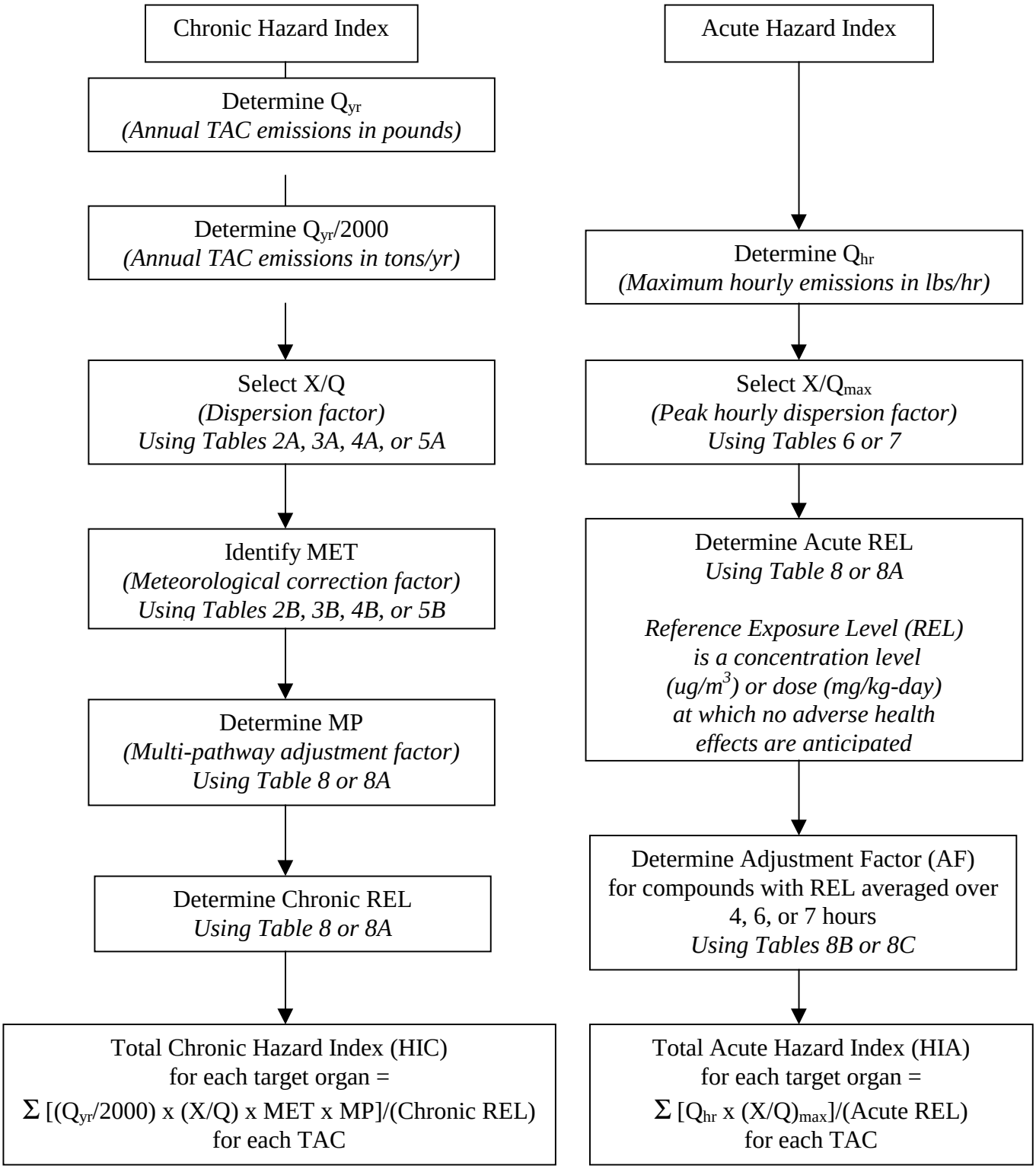


Figure 5
Chronic and Acute Hazard Index (HIC and HIA)



APPENDIX V

RULE 1401 EXEMPTIONS PROVISIONS

Exemption Provisions

Rule 1401 (g)(1)(A): Permit Renewal or Change of Ownership

Any equipment which is in continuous operation, without modification or change in operating conditions, for which a new permit to operate is required solely because of permit renewal or change of ownership.

Rule 1401 (g)(1)(B): Modification with No Increase in Risk

A modification of a equipment that causes a reduction or no increase in risk (cancer burden, MICR, or acute or chronic HI) at any receptor location.

Rule 1401 (g)(1)(C): Functionally Identical Replacement

A equipment replacing a functionally identical equipment provided there is no increase in the maximum rating or increase in emission of any TAC (and therefore no increase in risk).

Rule 1401 (g)(1)(D): Equipment Previously Exempt Under Rule 219

Equipment which previously did not require a written permit pursuant to Rule 219 that is no longer exempt, provided the equipment was installed prior to the Rule 219 amendment eliminating the exemption and a complete application is filed within 12 months after the Rule 219 amendment removing the exemption.

Rule 1401 (g)(1)(F): Emergency Internal Combustion Engines

Emergency internal combustion engines that are exempted under Rule 1304.

Rule 1401 (g)(1)(G): Wood Product Stripping

Wood product stripping units, provided that the risk increases due to emissions from the equipment and all other equipment located within 100 meters owned or operated by the applicant for which complete applications were deemed complete on and after July 10, 1998 will not exceed a MICR of 100 in one million (1×10^{-4}) or a total acute or chronic hazard index of five at any receptor location. This exemption shall not apply to permit applications received after January 10, 2000, or sooner if the Executive Officer makes a determination that T-BACT is available to

enable compliance with the requirements of paragraphs (d)(1), (d)(2) and (d)(3).

Rule 1401 (g)(2): Contemporaneous Risk Reduction

Simultaneous risk reduction such that an increase in MICR or HI from a equipment will be mitigated by a risk reduction from another equipment within 100 meters and the net impact on any receptor will be less than or equal to an increased MICR of 1 in 1 million or an HI of 1, provided that both applications for the increase and decrease are deemed complete together, the risk reduction occurs first, and the reduction is enforceable.

ATTACHMENTS

PERMIT APPLICATION PACKAGES
INCLUDING TABLES