South Coast Air Quality Management District

RISK ASSESSMENT PROCEDURES for Rules 1401 and 212

Version 7.0

July 1, 2005

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effective July 1, 2005

INTRODUCTION

Risk assessment procedures, including procedures for a simple risk screening, were developed by South Coast Air Quality Management District (AQMD) staff for the adoption of Rule 1401 - New Source Review of 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 and Issuing Public Notice. 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. This version of "Risk Assessment Procedures for Rules 1401 and 212" is based on "The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments" ("Guidance Manual") finalized by the state Office of Environmental Health Hazard Assessment (OEHHA) in August 2003 and the "(California) Air Resources Board (CARB) Recommended Interim Risk Management Policy for Inhalation-Based Residential Cancer Risk" ("Interim Policy") issued on October 9, 2003. The Guidance Manual may be found at: http://www.oehha.org/air/hot_spots/HRAguidefinal.html. The Interim Policy may be found at: http://www.arb.ca.gov/toxics/harp/docs/rmpolicy.PDF. The Guidance Manual and Interim Policy supercede the risk assessment methods presented in "The California Air Pollution Control Officer's Association (CAPCOA) Air Toxics Hot Spot Program; Revised 1992; Risk Assessment Guidelines", which was completed in October 1993. 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. 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. And, the rule has been amended several times to change the list of regulated compounds (both additions and deletions) and their corresponding risk values (cancer potency factors and reference exposure levels).

Requirements

This document describes 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 one million (1×10^{-6}) if Best Available Control Technology for Toxics (T-BACT) is not used; or,
  ten in one 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 either the total chronic hazard index (HIC) nor the total acute hazard index (HIA) due to total emissions from the affected permit unit 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 one million (1×10^{-6}), due to a project's proposed construction, modification, or relocation for facilities with more than one permitted 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.

Revisions

The major revisions to this document include the following:

- The use of cancer potency factors (instead of unit risk factors) to allow for daily breathing rate and body weight variation;
- The accommodation of the OEHHA "tier" approach (facility data and stochastic calculations), "derived" risk calculations (two dominant pathways), and "adjusted" assumptions (most significantly, the residential breathing rate established by CARB's Interim Policy);
- The revised multipathway profiles for the resident and worker; and
- The multipathway factors for the resident and worker.

These terms are described in greater detail in the following chapters. The first three come from the recent revisions to the state Guidance Manual. The last one is unique to the AQMD and these procedures.

The following tables summarize important information regarding Rule 1401 and risk assessment requirements.

RULE 1401

New Source Review of 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

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 an analysis for the higher tiers. In general, for most permits, a detailed analysis is not required. The tiers are:

- Tier 1: Screening Emission Levels
- Tier 2: Screening Risk Assessment
- Tier 3: Screening Dispersion Modeling
- Tier 4: Detailed Risk Assessment

Please note that the OEHHA Guidance Manual "Tier" approach differs from these AQMD Risk Procedures "Tier" compliance. The OEHHA Tiers refer to the incorporation of facility data and stochastic modeling; however, regulatory compliance may only be demonstrated with an OEHHA Tier-1 calculation. In contrast, the AQMD Tiers refer to increasing complexity and regulatory compliance may be demonstrated with any AQMD Tier.

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. **Identify the toxic air contaminants (TAC) emitted by the permit unit**. The risk assessment must include those TACs emitted by the permit unit which were listed in the rule when the permit application was deemed complete by AQMD staff. 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.

2. **Determine if the permitting action or equipment 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 removing the Rule 219 exemption;
   √ modifications to terminate research projects;
   √ 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.

3. **Estimate the quantity of emissions from the permit unit.** 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 (Table 1B) are compared to Screening Levels. The Screening Levels are pollutant emission thresholds 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 paragraph (s)(2) in 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 Multiple Pollutant Screening Level Procedure (described below) is followed.

INSTRUCTIONS FOR TIER 1

The Tier 1 analysis is performed as follows:

1. Determine the maximum annual emissions (for cancer and non-cancer chronic TACs) or determine the maximum hourly emissions (for non-cancer acute TACs). For perchloroethylene dry cleaners, determine the average monthly perchloroethylene usage (in gallons).
2. Compare the emissions to the Screening Levels for that contaminant in Table 1A. For perchloroethylene dry cleaners, compare the monthly usage rate to the limits in Tables 1B. Columns are labeled with the distance to the nearest receptor.
3. If the maximum annual emissions or the maximum hourly emissions do not exceed the Screening Levels, the equipment will comply with Rule 1401 and not require notice under Rule 212 for toxics. For perchloroethylene dry cleaners, the monthly usage must be less than the limits in Tables 1B.
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 or 1B were determined by back calculation, using the highest concentration values (X/Q) established in Tables 2A, 3A, 4A, 5A, 6, and 7 that would not exceed a cancer risk of one in one 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.

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

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

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.

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

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

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

Refer to Example 1 (starting on page 24) 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 Rule 1401 limits, then a more detailed evaluation is not necessary. Examples of calculations are provided at the end of the description of Tier 4 risk assessment. (See page 24.)

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 permit unit to the nearest off-site receptor(s);*
- Certain source characteristics, such as **stack height** and/or **building dimensions**;
- **Operating schedule**: whether the permit unit will operate more or less than 12 hr/day; and
- **Geographic location** of the permit unit (i.e., city).

* In order to perform a screening risk assessment, it is necessary to identify the nearest receptor location. For the purpose of calculating the MICR and chronic HI, a receptor is any location outside the boundaries of the facility at which a person could experience chronic exposure. For the purpose of calculating the acute HI, a receptor is any location outside the boundaries of the facility at which a person could experience acute exposure. 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.

MICR is calculated as follows:

MICR = Cancer Potency (CP) x Dose-Inhalation (DI) x Multipathway Factor (MP)

Where:

$$DI = x\ C_{air}\ x\ DBR\ x\ EVF\ 10^{-6}\text{; and}$$
$$C_{air} = Q_{tons}\ x\ X/Q\ x\ AF_{ann}\ x\ MET$$

Therefore, the equation for calculating MICR is:

$$MICR = CP\ x\ Q_{tons}\ x\ X/Q\ x\ AF_{ann}\ x\ MET\ x\ DBR\ x\ EVF\ x\ 10^{-6}\ x\ MP$$

Term	Description	Where to Find
CP	Cancer Potency $(mg/kg\text{-}day)^{-1}$	Table 8A
DI	Dose through inhalation (mg/kg/day)	Calculated value
MP	Multi-pathway factor (if applicable)	Table 8A
10^{-6}	Micrograms to milligrams conversion, liters to cubic meters conversion	not applicable
C_{air}	Annual average 24 hour per day concentration in air ($\mu g/m^3$)	Calculated value
DBR	Daily breathing rate (L/kg body weight-day)	Table 9A
EVF	Exposure Value Factor (unitless)	Table 9B
Q_{tons}	Maximum emission rate (tons/yr)	Emission estimate specific to permit unit
X/Q	Dispersion factor [$(\mu g/m^3)/(tons/yr)$]	Table 2A, 3A, 4A or 5A
AF_{ann}	Annual concentration adjustment factor (unitless)	Table 2C or 3C
MET	Meteorological correction factor (unitless)	Table 2B, 3B, 4B or 5B

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 permit unit 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 otherwise assumed, especially when the emissions are released unrestricted by any physical means (pipes or vents and/or vacuum or fan), including releases inside of a building or as fugitive emissions.

For permit units that have both 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 permit unit is located, and the **floor area**, which is the dimensions (length x width) of the building in which the permit unit 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 permit unit. 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 AQMD staff 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 open top and floating roof 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), Meteorological Correction Factor (MET), and Annual Concentration Adjustment Factor (AF_{ann})

Several tables are provided for X/Q, MET, and AF_{ann} factors. The selection of the appropriate table is discussed below:

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

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 for a 25-meter distance. The 25-meter distance should be used for circumstances in which there is a receptor located very close to the permit unit, for example, a residence located with a business, another business adjacent to the facility, or a sensitive receptor located less than 50 meters from the permit unit.

If the closest receptor location is a worker receptor, then the MICR must also be calculated for 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 permit unit, use the listing for 1,000 meters.

Step 8: Select X/Q Value

Select the appropriate X/Q value from the table based on the **source characteristics** (i.e., stack height for point sources and building height and building area for volume sources) and the **receptor distance.**

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.

An Alternative Set of Dispersion Factors (X/Q)
for Tier 2 Analysis Only
for Combustion Sources (Boilers and Internal Combustion Engines) Only

The Southern California Gas Company (working with AQMD staff) has developed a Health Risk Assessment Program for boilers and internal combustion engines fired by natural gas. This program is titled: Southern California Gas Company: Dispersion Modeling and Health Risk Assessment, External and Internal Combustion Equipment, Version 1.5. This file contains an Excel program to conduct a risk assessment (according to the previous AQMD Risk Assessment Procedures, Version 6.0) and the documentation on how to use the program. The program can be downloaded from:

http://www.socalgas.com/business/resource_center/aq_health_risk_tools.shtml.

For a **Tier 2 analysis only**, the AQMD will allow the use of the **dispersion factors** [X/Q in (ug/m$^{3)}$)/(gm/sec)] **from the tables** in this file. The tables are **for Boilers with an hourly rating between 2 MMBTU/hr to 75 MMBTU/hr and Internal Combustion Engines that are rated between 50 to 550 HP**. There tables are separated by the hours of operation of the engine or boiler (less than 12 hours a day and greater than 12 hours a day)

The selection of the engine or boiler size has to meet the criteria listed in the documentation provided for this program. The X/Q values are selected based on the closest receptor distances and the closest city to the source location of the emissions for the selected engine or boiler type.

Note: The Gas Company's Health Risk Assessment Program, Version 1.5, cannot be used to prepare a health risk assessment pursuant to these revised AQMD Risk Assessment Procedures, Version 7.0, as this program has not been updated to reflect the use of cancer potency values, daily breathing rates, multi-pathway adjustment factors for workers, and other changes from Version 6.0.

For guidance on the applicability or limitations of this alternative set of dispersion factors, contact Mohan Balagopalan, (909) 396 - 2704.

Step 9: Select Meteorological Correction Factor (MET)

Figure 1, at the end of the tables, provides the locations of meteorological stations in the air basin 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 ≤ 12 hr/day). See the table under Step 6 - Identify Tables for Dispersion Factor (X/Q) and Meteorological Correction Factor (MET).

Step 10: Identify Cancer Potency Factor (CP)

Using Table 8A, identify the cancer potency factor (CP) for the TAC.

What is a Cancer Potency Factor (CP)?

The cancer potency factor is a measure of the cancer potency of a carcinogen. It is the estimated probability that a person will contract cancer as a result of inhalation of a concentration of 1 milligram of the TAC per kilogram of body weight continuously over a period of 70 years.

The cancer potency 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 8A, 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 8A.

These factors allow permit units 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 or worker exposure situations. Note that there are separate MP factors for workers and residents (see Table 8A) since their potential routes of exposure varies. 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 Exposure Value Factor (EVF)

Using Table 9B, select the appropriate EVF.

What is Exposure Value Factor (EVF)?

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), for which a 40-year lifetime exposure is assumed. In addition to the 70- and 40-year exposure duration (ED) values described above, exposure values used to calculate cancer risk are exposure frequency (EF), which is the number of days per year of exposure, and the averaging time period in days over which exposure is averaged (AT). For EF, OEHHA recommends use of 350 days/year for residential exposure and 245 days/year for worker exposure. For AT, OEHHA recommends the use of 25,550 days (70 years x 365 days/year).

OEHHA recommends calculation of EVF using the equation:

$$EVF = (EF \times ED) / AT$$

For residential/sensitive receptors, EVF = (350 days/yr x 70 years) / 25,550 days = 0.96
For worker receptors, EVF = (245 days/yr x 40 years) / 25,550 days = 0.38

EVF values are summarized in Table 9B.

Only the EVF values in Table 9B should be used in a Tier 2 calculation. No further prorating of the published EVF values or consideration of other operating schedules is allowed.

If the residential or sensitive receptor is closer than the worker receptor, only the MICR for the residential or sensitive receptor need be calculated. (An equal or more distant worker receptor would have a lower MICR (because of the lower EVF) than a comparable residential or sensitive receptor.) Otherwise, 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.

Step 13: Select Daily Breathing Rate (DBR)

Using Table 9A, select the appropriate daily breathing rate value.

What are Daily Breathing Rate (DBR) Values?

Exposure to airborne chemicals occurs through inhalation and subsequent absorption into the body, potentially resulting in adverse health effects depending on toxicological properties of the chemical and concentration in air. The dose of a substance through inhalation is a function of the concentration of the substance and the amount of air inhaled. DBR values used in these procedures, expressed in liters per kilogram-day (L/kg-day), are recommended by OEHHA and were developed based on results from several breathing rate studies.

Step 14: Select Annual Concentration Adjustment Factor (AF_{ann})

Using Table 2C or 3C, select the appropriate annual concentration adjustment factor. Table 2C is used for exposures of 12 hours per day or less, while Table 3C is used for exposures of more than 12 hours per day.

AF_{ann} is calculated using the following equation:

AF_{ann} = (maximum number of hours of exposure per day / actual number of hours of exposure per day*) x (maximum number of days of operation per week / actual number of days of operation per week**)

For all residents, sensitive receptors, and workers at facilities operating continuously:

AF_{ann} = (24 hours of exposure per day / 24 hours per day) x (7 days of operation per week / 7 days per week) = 1

Assuming workers at a facility operating 8 hours per day, 5 days per week, AF_{ann} would be calculated as follows:

AF_{ann} = (24 hours of exposure per day / 8 hours per day) x (7 days of operation per week / 5 days per week) = 4.2

* If actual number of hours of exposure per day is ≤ 8, a value of 8 is to be used.
** If actual number of days of operation per week is ≤ 5, a value of 5 is to be used.

What is Annual Concentration Adjustment Factor (AF_{ann})?

AF_{ann} adjusts dispersion factors (X/Q), which are 24 hours per day and 7 days per week averages, to an average for the off-site worker exposure period (i.e., 8 hours per day and 5 days per week). This is necessary because the worker breathing rate of 149 l/kg-day is only applicable to the work-day and work-week exposure. It is assumed that the worker is only exposed while at work.

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 permit unit.

INSTRUCTIONS FOR CALCULATING CANCER BURDEN

The cancer burden is the estimated increase in the occurrence of cancer cases in a population 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 cancer burden only needs to be calculated if the MICR is greater than one (1) in one million.

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, 3A, 4A, and 5A.

- Define a zone of impact in the shape of a circle. The radius (r) of this circle is the distance between the permit unit 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 $3.14 \times r^2$.

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

  For areas where census data is available, it should be used. Where there is no census data, 7,000 persons/km^2 should be used for the areas with high population densities and 4,000 persons/km^2 should be used for areas with low population densities. Where the population densities are unknown, use 7,000 persons/km^2.

- Calculate cancer burden by multiplying the total population (residential and worker) 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, 3A, 4A, and 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 8A.

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 10A and 10B).

Detailed procedures for calculating total hazard index are provided in the 2003 OEHHA Guidance Manual. 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 use a meteorological correction factor (MET) or a multi-pathway adjustment factor (MP).

ACUTE HAZARD INDICES FOR COMPOUNDS 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 exposures.

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:

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

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 Tables 8B and 8C, based on the specified averaging times and source proximity to the nearest meteorological station. The acute hazard indices for these compounds are estimated using the following equation:

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

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. This exemption has never been used. Under this exemption, the HIC and/or HIA limit of 1.0 does not apply if the applicant substantiates to the satisfaction of AQMD staff that at all receptor locations and for every target organ system, the total chronic and acute HI levels resulting from emissions from the equipment 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 staff will consult with OEHHA staff regarding the request for the alternative HI level. If OEHHA staff 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 staff 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 staff 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 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:

Staff	E-mail address	Telephone number
Yi-Hui Huang	yhuang@aqmd.gov	(909) 396-3176
Tom Chico	tchico@aqmd.gov	(909) 396-3149

Tier 3 screening modeling should only be used for a permit unit with a single emission or release point. If there are multiple emission or release points, Tier 4 must be used. In addition, Tier 3 should only be beneficial for applications involving a combustion process since plume rise is more appropriately addressed with a dispersion model. (Tiers 1 and 2 do not address the dispersion effects from plume rise of buoyant plumes.)

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

- Air dispersion modeling expertise;
- An EPA-approved dispersion model program such as T-SCREEN or SCREEN3, which can be downloaded from www.epa.gov/scram001; and
- Additional equipment information such as stack gas temperature, stack gas exit velocity or flow rate, and stack inside diameter.

It should be noted that TSCREEN and SCREEN3 estimate peak one-hour concentrations for HIA calculations. These concentrations must be multiplied by 0.08 to estimate annual average concentrations for the MICR and HIC calculations.

In a Tier 3 approach, the Tier 2 equations for MICR, HIC, and HIA continue to be used except that a dispersion model is used to estimate each pollutant concentration. In addition, it is not appropriate to use the meteorological correction factor (i.e., MET) contained in the Tier 2 equations. Thus, the Tier 3 equations follows:

$$\mathbf{MICR = CP \times AveConc \times AF_{annual} \times DBR \times EVF \times 10^{-6} \times MP}$$

$$\mathbf{Total\ HIC_{target\ organ} = \Sigma\ \{[AveConc_{TAC} \times MP]/Chronic\ REL_{TAC}\}_{target\ organ}}$$

$$\mathbf{Total\ HIA_{target\ organ} = \Sigma\ \{[PeakConc_{TAC}]/Acute\ REL_{TAC}\}_{target\ organ}}$$

PeakConc is the peak one-hour pollutant concentration estimated by TSCREEN or SCREEN3 and AveConc is the annual average concentration or 0.08 times PeakConc. Refer to the section on Tier 2, Screening Risk Assessment for explanation of the other variables in the equations.

If the MICR, HIC, and HIA do not exceed the rule limits, then the equipment complies with Rule 1401 and no further analysis is required. If any risk value exceeds the rule limits, then proceed to Tier 4.

Tier 4: Detailed Risk Assessment

Tier 4 is a detailed risk assessment using ARB's Hotspots Analysis and Reporting Program (HARP). The HARP software and documentation can be obtained at http://www.arb.ca.gov/toxics/harp/harp.htm. The U.S. EPA air quality dispersion model called ISCST3 (Industrial Source Complex – Short Term, Version 3) is used by HARP for the exposure assessment. ISCST3 documentation is available at www.epa.gov/scram001. Meteorological data for use in HARP and ISCST3 can be downloaded at http://www.aqmd.gov/smog/metdata/MeteorologicalData.html.

Tier 4 is an option if neither Tier 2 nor Tier 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 either Tiers 2 or 3.

A detailed risk assessment should 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:

Staff	**E-mail address**	**Telephone number**
Yi-Hui Huang	yhuang@aqmd.gov	(909) 396-3176
Tom Chico	tchico@aqmd.gov	(909) 396-3149

Written guidance on preparing a detailed risk assessment is contained in an Office of Environmental Health Hazard Assessment document titled, "Air Toxics Hot Spots Program Risk Assessment Guidelines (August 2003)" which may be obtained at http://www.oehha.org/air/hot_spots/HRAguidefinal.html.

AQMD modeling staff has prepared supplemental risk assessment guidance which must be followed by all applicants submitting Tier 4 assessments. AQMD's supplemental guidance is available at http://www.aqmd.gov/prdas/AB2588/AB2588_B3.html.

EXAMPLE 1: MICR, CANCER BURDEN, HIA, & HIC CALCULATION

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. Some of the TACs are carcinogenic and some have chronic and acute non-cancer risks.

The application was deemed complete on July 30, 2005.
The nearest receptor distances:
Worker (Industrial) = 328 ft (100 meters)
Residential = 492 ft (150 meters)
Operating Schedule: 8 hr/day, 5 days/wk
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 list of TACs and their corresponding emission rates are for illustration purposes only. They may not reflect actual conditions.)

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 July 1, 2005 (i.e., Permit Application Package "L") are used.

Second, calculate MICR for those TACs that have Inhalation Cancer Potency Values from Table 8A. Table B below identifies the TACs and their corresponding inhalation cancer potency values for MICR calculations.

Table B

Toxic Air Contaminant (TAC)	**Inhalation Cancer Potency** (mg/kg-day)$^{-1}$
Cadmium	1.50×10^{1}
Hexavalent Chromium	5.10×10^{2}
Perchloroethylene	2.10×10^{-2}
Toluene-2,4-diisocyanate	3.90×10^{-2}
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 cancer potency value 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	√	√ (MP)	
Hexavalent chromium	√	√	
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 Tables 10A and 10B 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	NS	AL	KIDNEY	RESP
Cadmium			√	√
Hexavalent Chromium				√
Perchloroethylene		√	√	√
Toluene-2,4-diisocyanate				√
Xylene	√			√

NS: Nervous System
AL: Alimentary System (Liver)
KIDNEY: Kidneys
RESP: Respiratory System

Similarly, after reviewing Table 10B 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	NS	EYE	RESP
Perchloroethylene	√	√	√
Xylene		√	√

NS: 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 should be used.

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

For Tier 1, the equipment's TACs emissions (annual and/or maximum hourly) should be compared with the Screening Levels for the contaminant in Tables 1A or 1B as appropriate. Since this

example has multiple pollutants, the Pollutant Screening Index should be calculated for each pollutant per procedure specified on pages 6 and 7.

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. Use the PSLs for a distance of 100 meters.

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

TAC	Qyr_p	PSL_p	PSI_p
Cadmium	0.0189	0.0595	0.32
Hexavalent chromium	0.0175	0.00175	10.00
Perchloroethylene	2.628	42.5	0.06
Toluene-2,4-diisocyanate	78.84	18.1	4.36
Xylene	262.80	181,000	0.0014
		$\sum PSI_p =$	14.74

Calculate the Application Screening Index (ASI).

$$ASI_{cancer\ and/or\ chronic} = \Sigma\ PSI_p = 14.74$$

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. Use the PSLs for a distance of 100 meters.

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}	53.5	0.000007
Xylene	0.04	58.9	0.000679
		$\sum PSI_p =$	0.000686

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

CP, REL and MP values are taken from Table 8A in Permit Application Package "L".
(X/Q) values for cancer and chronic exposures are taken from Table 2A. 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.
Exposure values are taken from Table 9B.
MET = 0.86 for Pomona (closest to Ontario) - from Table 2B.

These values are summarized below:
(1) Worker:

TAC	CP $(mg/kg\text{-}d)^{-1}$	REL ug/m^3 Acute	REL ug/m^3 Chronic	X/Q (chronic & carcinogenic) $(ug/m^3)/(tons/yr)$	$(X/Q)_{hr}$ for acute $(ug/m^3)/(lbs/hr)$	MPw for MICR	MPw for HIC
Cadmium	1.50×10^{1}	n/a	2.00×10^{-2}	4.19	n/a	1	1.12
Hexavalent chromium	5.10×10^{2}	n/a	2.00×10^{-1}	4.19	n/a	1	1
Perchloro-ethylene	2.10×10^{-2}	20,000	35	4.19	295.2	1	1
Toluene-2,4-diisocyanate	3.90×10^{-2}	n/a	7.00×10^{-2}	4.19	n/a	1	1
Xylene	n/a	22,000	700	4.19	295.2	n/a	1

n/a - not applicable

(2) Resident: This example uses a 150m distance to the closest receptor. Using Tables 2A and 6, an interpolation between the downwind distance of 100 and 200m must be done to determine the carcinogenic, acute, and chronic X/Q.

TAC	CP $(mg/kg\text{-}d)^{-1}$	REL ug/m^3 Acute	REL ug/m^3 Chronic	X/Q (chronic & carcinogenic) $(ug/m^3)/(tons/yr)$	$(X/Q)_{hr}$ for acute $(ug/m^3)/(lbs/hr)$	MPr for MICR	MPr for HIC
Cadmium	1.50×10^{1}	n/a	2.00×10^{-2}	2.66	n/a	1	1.50
Hexavalent chromium	5.10×10^{2}	n/a	2.00×10^{-1}	2.66	n/a	1	1
Perchloro-ethylene	2.10×10^{-2}	20,000	35	2.66	202.4	1	1
Toluene-2,4-diisocyanate	3.90×10^{-2}	n/a	7.00×10^{-2}	2.66	n/a	1	1
Xylene	n/a	22,000	700	2.66	202.4	n/a	1

n/a - not applicable

MICR Calculation

$$MICR = \Sigma\,(CP \times Qyr \times (X/Q) \times AF_{ann} \times MET \times DBR \times EVF \times 10^{-6} \times MP)$$

(1) Worker:

TAC	CP	Qyr (tons/yr)	X/Q	AF_{ann}	MET	DBR	EVF	MP_w	MICR
Cadmium	1.50×10^{1}	9.46×10^{-6}	4.19	4.2	0.86	149	0.38	1	1.22×10^{-7}
Hexavalent Chromium	5.10×10^{2}	8.76×10^{-6}	4.19	4.2	0.86	149	0.38	1	3.83×10^{-6}
Perchloro-ethylene	2.10×10^{-2}	1.31×10^{-3}	4.19	4.2	0.86	149	0.38	1	2.36×10^{-8}
Toluene-2,4-diisocyanate	3.90×10^{-2}	3.94×10^{-2}	4.19	4.2	0.86	149	0.38	1	1.32×10^{-6}
Total									**5.29×10^{-6}**

(2) Resident:

TAC	CP	Qyr (tons/yr)	X/Q	AF_{ann}	MET	DBR	EVF	MPr	MICR
Cadmium	1.50×10^{1}	9.46×10^{-6}	2.66	1	0.86	302	0.96	1	9.41×10^{-8}
Hexavalent Chromium	5.10×10^{2}	8.76×10^{-6}	2.66	1	0.86	302	0.96	1	2.96×10^{-6}
Perchloro-ethylene	2.10×10^{-2}	1.31×10^{-3}	2.66	1	0.86	302	0.96	1	1.82×10^{-8}
Toluene-2,4-diisocyanate	3.90×10^{-2}	3.94×10^{-2}	2.66	1	0.86	302	0.96	1	1.02×10^{-6}
Total									**4.09×10^{-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 worker 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 worker receptor since the worker risk was determined to be higher than the residential risk. MICR for worker receptors was calculated to be **5.29×10^{-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.

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

$$F = (1 / 5.29 \times 10^{-6}) \times 1.0 \times 10^{-6}$$

$$F = 0.19$$

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,

New X/Q = 4.19 x 0.19

New X/Q = 0.80

Using Table 2A, the New X/Q lies between downwind distances of 200 to 300 m. Interpolating for the new downwind distance gives,

$$\text{New downwind distance} = \frac{[300\text{ m} - 200\text{ m}] \times [1.12 - 0.80]}{[1.12 - 0.50]} + 200\text{ m}$$

New downwind distance = 251.6 m = 0.2516 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,

$ZI = 3.14\ r^2$

$ZI = 3.14\ (0.2516\text{ km})^2$

$ZI = 0.20\text{ km}^2$

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

For areas where census data is available, it should be used. Where there is no census data, 7,000 persons/km^2 should be used for the areas with high population densities and 4,000 persons/km^2 should be used for areas with low population densities. Where the population densities are unknown, use 7,000 persons/km^2.

In this example we have no information on census data or population density, therefore,

Zone of Impact Population = ZI x Population Density

Zone of Impact Population = 0.20 km^2 x 7,000 persons/ km^2

Zone of Impact Population = 1,400 persons

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

Therefore,

$$CB = 1{,}400 \text{ persons} \times 5.29 \times 10^{-6}$$

CB = 0.0074

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 10B, 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 (150 m) is estimated using interpolation between the downwind distance of 100 and 200 m.
Resident X/Q (150 m) = 202.4 (ug/m^3)/(lbs/hr)
Worker X/Q (100 m) = 295.2 (ug/m^3)/(lbs/hr)

Perchloroethylene:
Affects nervous system, eye, and respiratory organs.

The Acute Hazard Index for Perchloroethylene is calculated as follows:

Worker: HIA = $[3.8 \times 10^{-4} \times 295.2] / 20{,}000$ **= 5.6×10^{-6}**
Nervous, eye, and respiratory systems: 5.6×10^{-6}

Resident: HIA = $[3.8 \times 10^{-4} \times 202.4] / 20{,}000$ **= 3.8×10^{-6}**
Nervous, eye, and respiratory systems: 3.8×10^{-6}

Xylene:
Affects eye and respiratory organs.

The Acute Hazard Index for Xylene is calculated as follows:

Worker: HIA = $[0.04 \times 295.2]/22{,}000$ **= 5.4×10^{-4}**
Eye and respiratory systems: 5.4×10^{-4}

Resident: HIA = $[0.04 \times 202.4]/22{,}000$ **= 3.7×10^{-4}**

Eye and respiratory systems: 3.7×10^{-4}

Chronic Hazard Index:

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

Based on Table 10A, 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:

Cadmium:
Affects kidneys and respiratory organs.

The residential chronic hazard index for cadmium is:

Resident: HIC = $[9.46 \times 10^{-6} \times 2.66 \times 0.86 \times 1.50] / [2.00 \times 10^{-2}]$ **= 1.62×10^{-3}**
Kidney and respiratory systems: 1.62×10^{-3}

Worker: HIC = $[9.46 \times 10^{-6} \times 4.19 \times 0.86 \times 1.12] / [2.00 \times 10^{-2}]$ **= 1.91×10^{-3}**
Kidney and respiratory systems: 1.91×10^{-3}

Hexavalent Chromium:
Affects respiratory organs.

The chronic hazard index for hexavalent chromium is:

Resident: HIC = $[8.76 \times 10^{-6} \times 2.66 \times 0.86 \times 1] / [2.00 \times 10^{-1}]$ **= 1.00×10^{-4}**
Respiratory system: 1.00×10^{-4}

Worker: HIC = $[8.76 \times 10^{-6} \times 4.19 \times 0.86 \times 1] / [2.00 \times 10^{-1}]$ **= 1.58×10^{-4}**
Respiratory system: 1.58×10^{-4}

Perchloroethylene:
Affects kidneys, alimentary system (liver), and respiratory organs.

The chronic hazard index for perchloroethylene is:

Resident: HIC = $[1.31 \times 10^{-3} \times 2.66 \times 0.86 \times 1]/35$ **= 8.56×10^{-5}**
Kidney, alimentary, and respiratory systems: 8.56×10^{-5}

Worker: HIC = $[1.31 \times 10^{-3} \times 4.19 \times 0.86 \times 1]/35$ **= 1.35×10^{-4}**
Kidney, alimentary, and respiratory systems: 1.35×10^{-4}

Toluene 2,4-diisocyanate
Affects respiratory organs.

The chronic hazard index for toluene 2,4-diisocyanate is:

Resident: HIC = [3.94 x 10^{-2} x 2.66 x 0.86 x 1] / [7.00 x 10^{-2}] **= 1.29**
Respiratory system: 1.29

Worker: HIC = [3.94 x 10^{-2} x 4.19 x 0.86 x 1] / [7.00 x 10^{-2}] **= 2.03**
Respiratory system: 2.03

Xylene
Affects nervous system and respiratory organs.

The chronic hazard index for xylene is:

Resident: HIC = [1.31 x 10^{-1} x 2.66 x 0.86 x 1] / [7.00 x 10^{2}] **= 4.28 x 10^{-4}**
Nervous and respiratory systems: 4.28 x 10^{-4}

Worker: HIC = [1.31 x 10^{-1} x 4.19 x 0.86 x 1] / [7.00 x 10^{2}] **= 6.74 x 10^{-4}**
Nervous and respiratory systems: 6.74 x 10^{-4}

In summary:

I. **MICR:**

Worker:

TAC	MICR
Cadmium	1.22×10^{-7}
Hexavalent Chromium	3.83×10^{-6}
Perchloroethylene	2.36×10^{-8}
Toluene-2,4-diisocyanate	1.32×10^{-6}
Xylene	n/a
Total	**5.29×10^{-6}**

Resident:

TAC	MICR
Cadmium	9.41×10^{-8}
Hexavalent Chromium	2.96×10^{-6}
Perchloroethylene	1.82×10^{-8}
Toluene-2,4-diisocyanate	1.02×10^{-6}
Xylene	n/a
Total	**4.09×10^{-6}**

II. **Cancer Burden:**

CB = 0.0074

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

(1) Worker:

TAC	HIA		
	NS	EYE	RESP
Perchloroethylene	5.6×10^{-6}	5.6×10^{-6}	5.6×10^{-6}
Xylene		5.4×10^{-4}	5.4×10^{-4}
Total	**5.6×10^{-6}**	**5.5×10^{-4}**	**5.5×10^{-4}**

(2) Resident:

TAC	HIA		
	NS	EYE	RESP
Perchloroethylene	3.8×10^{-6}	3.8×10^{-6}	3.8×10^{-6}
Xylene		3.7×10^{-4}	3.7×10^{-4}
Total	**3.8×10^{-6}**	**3.7×10^{-4}**	**3.7×10^{-4}**

By Target Organs for Chronic:

(1) Worker:

TAC	HIC			
	NS	KIDNEYS	AL	RESP
Cadmium		1.91×10^{-3}		1.91×10^{-3}
Hexavalent Chromium				1.58×10^{-4}
Perchloroethylene		1.35×10^{-4}	1.35×10^{-4}	1.35×10^{-4}
Toluene-2,4-diisocyanate				2.03
Xylene	6.74×10^{-4}			6.74×10^{-4}
Total	**6.74×10^{-4}**	**2.05×10^{-3}**	**1.35×10^{-4}**	**2.03**

(2) Resident:

TAC	HIC			
	NS	KIDNEYS	AL	RESP
Cadmium		1.62×10^{-3}		1.62×10^{-3}
Hexavalent Chromium				1.00×10^{-4}
Perchloroethylene		8.56×10^{-5}	8.56×10^{-5}	8.56×10^{-5}
Toluene-2,4-diisocyanate				1.29
Xylene	4.28×10^{-4}			4.28×10^{-4}
Total	**4.28×10^{-4}**	**1.71×10^{-3}**	**8.56×10^{-5}**	**1.29**

RESULT:
The spray booth in this example does not contain T-BACT, fails the Rule 1401 MICR limit, and would not be granted a permit. However, if the spray booth was equipped with T-BACT, it would pass the Rule 1401 MICR limit. Notwithstanding, the spray booth in this example also fails the Rule 1401 HIC limit and would not be granted a permit based on this criteria alone. A Tier 3 or 4 analysis should be conducted.

- ***MICRs for residential and commercial receptors exceed 1×10^{-6} (one in one million) but are below 10×10^{-6} (ten in one million).***
- ***Cancer burden is less than 0.5.***
- ***HIAs for residential and commercial receptors do not exceed 1.0 for each target organ.***
- ***HICs for residential and commercial receptors exceed 1.0 for respiratory organs.***

EXAMPLE 2: MICR, HIA, HIC, & CANCER BURDEN CALCULATION FOR PLATING OPERATIONS

A metal finishing shop operates a nickel plating operation. Prior to the actual plating process, component parts are first cleaned and/or etched. The cleaning is conducted in an electro-cleaner tank containing a sodium hydroxide (NaOH) solution. Parts requiring etching are immersed in a tank containing hydrochloric acid (HCl). Finally, the parts are placed in a plating tank containing a nickel solution where the nickel metal (Ni) is deposited on the parts.

The application was deemed complete on July 30, 2005.
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/yr = 1200 hrs/yr
Plant location: Azusa, CA

Note: Emissions from metal finishing operations can be determined from source test data or from emission factors and correlations, as appropriate. Operational data used in developing emission factors and correlations currently used by AQMD permitting engineers include the concentration of chemicals in the process tank, the quantity of ampere-hours applied to a tank, the plating efficiency, the tank temperature, parameters affecting air-sparging emissions, and control efficiencies for air pollution control equipment or other emissions reduction techniques that are employed.

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}

(The list of TACs and their corresponding emission rates are for illustration purposes only. They may not reflect actual conditions.)

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 July 1, 2005 are included in Permit Application Package "L" in the Attachments to this document.

Second, The MICR is calculated for those TACs that have appropriate Cancer Potency Values from Table 8A. Table B below identifies the TACs for MICR calculations.

Table B

Toxic Air Contaminant (TAC)	Cancer Potency Value	Chronic REL	Acute REL
Nickel	9.1×10^{-1}	5.0×10^{-2}	6.00
Sodium hydroxide	None	None	8.00
Hydrogen chloride	None	9.00	2.10×10^{3}

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

From Table 8A, 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 10A and 10B need to be reviewed to determine the target organs affected by these TACs due to chronic and/or acute toxicity.

Tables C and D below indicate the target organs affected by the TACs with chronic and acute toxicity, respectively. In the table, check marks (√) indicate the affected target organs.

Table C (Chronic Toxicity)

TAC	HEM	RESP
Nickel	√	√
Hydrogen chloride		√

HEM: Hematologic System
RESP: Respiratory System

Table D (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	0.981	0.23
Hydrogen Chloride	0.841	2330	3.6×10^{-4}
		$\sum PSI_p =$	0.23

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}	0.0214	1.00×10^{-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

CP, REL and MP values are taken from Table 8A in Permit Application Package "L".
(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.
Exposure values, daily breathing rate values and annual concentration adjustment factors are taken from Tables 9B, 9A, and 2C, respectively.

MET = 0.8 for Azusa - from Table 4B.

These values are summarized below:

(3) Worker: Using 100m receptor

TAC	CP $(mg/kg\text{-}d)^{-1}$	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_w for MICR	MP_w for HIC
Nickel	9.1×10^{-1}	6.00	5.00×10^{-2}	3.95	309	1	1
NaOH	n/a	8.00	n/a	n/a	309	n/a	n/a
HCl	n/a	2.1×10^3	9.00	3.95	309	n/a	1

n/a – not applicable

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

TAC	CP $(mg/kg\text{-}d)^{-1}$	REL (ug/m^3) Acute	REL (ug/m^3) Chronic	X/Q (chronic & carcinogenic) $(ug/m^3)/(tons/yr)$	$(X/Q)_{hr}$ for acute $(ug/m^3)/(lbs/hr)$	MPr for MICR	MPr for HIC
Nickel	9.1×10^{-1}	6.00	5.00×10^{-2}	0.17	24.1	1	1
NaOH	n/a	8.00	n/a	n/a	24.1	n/a	n/a
HCl	n/a	2.1×10^3	9.00	0.17	24.1	n/a	1

n/a – not applicable

MICR CALCULATION

$$MICR = \Sigma\,(CP \times Qyr \times (X/Q) \times AF_{ann} \times MET \times DBR \times EVF \times 10^{-6} \times MP)$$

(1) Worker:

TAC	CP	Qyr (tons/yr)	X/Q	AF_{ann}	MET	DBR	EVF	MP_w	MICR
Nickel	9.1×10^{-1}	1.14×10^{-4}	3.95	4.2	0.80	149	0.38	1	7.8×10^{-8}
Total									**7.8×10^{-8}**

(2) Resident:

TAC	CP	Qyr (tons/yr)	X/Q	AF_{ann}	MET	DBR	EVF	MPr	MICR
Nickel	9.1×10^{-1}	1.14×10^{-4}	0.17	1	0.80	302	0.96	1	4.09×10^{-9}
Total									**4.09×10^{-9}**

Please note that a comparison between the worker and residential cancer risks needs 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.

Cancer Burden Calculation

Cancer burden should always be calculated if the MICR exceeds 1 in a million, regardless of the type of receptor. For this example, cancer burden was not calculated because neither worker nor residential risk exceeded 1 in a million.

Hazard Index Calculations

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

Acute Hazard Index:

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

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

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

Nickel:
Affects immune and respiratory systems.

Note: The X/Q values in Table 7 are based upon the maximum hourly emission rates.

The Acute Hazard Index for Nickel is calculated as follows:

Worker: HIA = $(3.8 \times 10^{-4} \times 309) / 6$ = $\mathbf{2.0 \times 10^{-2}}$
Immune and respiratory systems: 2.0×10^{-2}

Resident: HIA = $(3.8 \times 10^{-4} \times 24.1) / 6$ = $\mathbf{1.5 \times 10^{-3}}$
Immune and respiratory systems: 1.5×10^{-3}

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

Note: The X/Q values in Table 7 are based upon the maximum hourly emission rates.

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

Worker: HIA = $(2.15 \times 10^{-6} \times 309) / 8$ = $\mathbf{8.3 \times 10^{-5}}$
Skin, eye, and respiratory systems: 8.3×10^{-5}

Resident: HIA = $(2.15 \times 10^{-6} \times 24.1) / 8$ = $\mathbf{6.5 \times 10^{-6}}$
Skin, eye, and respiratory systems: 6.5×10^{-6}

Hydrogen chloride:
Affects eye, and respiratory systems.

Note: The X/Q values in Table 7 are based upon the maximum hourly emission rates.

The Acute Hazard Index for hydrogen chloride is calculated as follows:

Worker: HIA = $(1.2 \times 10^{-4} \times 309) / 2100$ = $\mathbf{1.8 \times 10^{-5}}$
Eye and respiratory systems: 1.8×10^{-5}

Resident: HIA = $(1.2 \times 10^{-4} \times 24.1) / 2100$ = $\mathbf{1.4 \times 10^{-6}}$
Eye and respiratory systems: 1.4×10^{-6}

Chronic Hazard Index:

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

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

Nickel
Affects hematologic systems and respiratory organs.

The chronic hazard index for nickel is:

Resident: HIC = [1.14 x 10^{-4} x 0.17 x 0.80 x 1] / [5.00 x 10^{-2}] = **3.1 x 10^{-4}**
Hematologic and respiratory systems: 3.1 x 10^{-4}

Worker: HIC = [1.14 x 10^{-4} x 3.95 x 0.80 x 1] / [5.00 x 10^{-2}] = **7.2 x 10^{-3}**
Hematologic and respiratory systems: 7.2 x 10^{-3}

Hydrogen Chloride
Affects respiratory organs.

The chronic hazard index for hydrogen chloride is:

Resident: HIC = [4.20 x 10^{-4} x 0.17 x 0.80 x 1] / [9.00] = **6.3 x 10^{-6}**
Respiratory system: 6.3 x 10^{-6}

Worker: HIC = [4.20 x 10^{-4} x 3.95 x 0.80 x 1] / [9.00] = **1.5 x 10^{-4}**
Respiratory system: 1.5 x 10^{-4}

In summary:

I. **MICR:**

(1) Worker:

TAC	MICR
Nickel	7.8 x 10^{-8}

(2) Resident:

TAC	MICR
Nickel	4.09 x 10^{-9}

II. **Acute Hazard Index (HIA) and Chronic Hazard Index (HIC):**

By Target Organs for Acute:

(1) Worker:

TAC	HIA			
	SKIN	IMMUNE	EYE	RESP
Nickel		2.0×10^{-2}		2.0×10^{-2}
Sodium hydroxide	8.3×10^{-5}		8.3×10^{-5}	8.3×10^{-5}
Hydrogen chloride			1.8×10^{-5}	1.8×10^{-5}
Total	8.3×10^{-5}	2.0×10^{-2}	1.0×10^{-4}	2.0×10^{-2}

(2) Resident:

TAC	HIA			
	SKIN	IMMUNE	EYE	RESP
Nickel		1.5×10^{-3}		1.5×10^{-3}
Sodium hydroxide	6.5×10^{-6}		6.5×10^{-6}	6.5×10^{-6}
Hydrogen chloride			1.4×10^{-6}	1.4×10^{-6}
Total	6.5×10^{-6}	1.5×10^{-3}	7.9×10^{-6}	1.5×10^{-3}

By Target Organs for Chronic:

(1) Worker:

TAC	HIC	
	HEM	RESP
Nickel	7.2×10^{-3}	7.2×10^{-3}
Hydrogen chloride		1.5×10^{-4}
Total	$\mathbf{7.2 \times 10^{-3}}$	$\mathbf{7.4 \times 10^{-3}}$

(2) Resident:

TAC	HIC	
	HEM	RESP
Nickel	3.1×10^{-4}	3.1×10^{-4}
Hydrogen chloride		6.3×10^{-6}
Total	$\mathbf{3.1 \times 10^{-4}}$	$\mathbf{3.2 \times 10^{-4}}$

RESULT:
For this example, the evaluations indicate that MICR for residential and commercial, HIA, and HIC 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 3: HIA CALCULATION FOR COMPOUNDS WITH RELS AVERAGED OVER 4, 6, OR 7 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:*

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

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 July 30, 2005
The nearest receptor distances are:
Worker (Industrial) = 500 meters
Residential = 1000 meters
Operating Schedule: 8 hr /day, 1 day/wk
Stack height = 28 ft
Plant location: West Los Angeles, CA
The coating material contains lead chromate and EGEE.
The transfer efficiency is 65%.

Maximum annual coating sprayed: 25.0 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 lb of PbCrO4) x 0.05 = 0.008 = 0.8 wt%

The maximum yearly and hourly emissions are estimated as follows:

Lead:
Qyr (lb/yr) = 25 gal/yr x 10 lb/gal x 0.032 x (1 - 0.65) = 2.8
Qhr (lb/hr) = 0.5 gal/hr x 10 lb/gal x 0.032 x (1 - 0.65) = 0.056

Hexavalent Chromium:
Qyr (lb/yr) = 25 gal/yr x 10 lb/gal x 0.008 x (1 - 0.65) = 0.7
Qhr (lb/hr) = 0.5 gal/hr x 10 lb/gal x 0.008 x (1 - 0.65) = 0.014

EGEE:
Qyr (lb/yr) = 25 gal/yr x 10 lb/gal x 0.06 = 15
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	0.056	2.8	0.0014
Hexavalent chromium	0.014	0.7	0.00035
EGEE	0.3	15	0.0075

(The list of TACs and their corresponding emission rates are for illustration purposes only. They may not reflect actual conditions.)

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	7.40×10^{-9}
Hexavalent Chromium	7.64×10^{-6}
Total	$\mathbf{7.65 \times 10^{-6}}$

Resident:

TAC	MICR
Lead	3.57×10^{-9}
Hexavalent Chromium	2.59×10^{-6}
Total	$\mathbf{2.59 \times 10^{-6}}$

Cancer Burden:

CB = 0.20

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.

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:

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

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

$HIA = [(Q_{hr} \times (X/Q)_{hr}) / REL] \times AF$
Where,
AF is REL adjustment factor developed for compounds with REL averaged over 4, 6, or 7 hours and listed in Table 8B or 8C based on the source types (point or volume) and location of the source.

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

EGEE:
Affects Developmental and Reproductive Systems.
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.
Resident X/Q (1000 m) = 8.3 (ug/m^3)/(lbs/hr)
Worker X/Q (500 m) = 24.8 (ug/m^3)/(lbs/hr)

Note: The acute REL is taken from Table 8A.
Acute REL = 370 ug/m^3

The Acute Hazard Index for EGEE is calculated as follows:

Worker: HIA = [(0.3 x 24.8) / 370] x 0.83 **= 0.017**
Developmental and reproductive systems: 0.017

Resident: HIA = [(0.3 x 8.3) / 370] x 0.83 **= 0.006**
Developmental and reproductive systems: 0.006

Chronic Hazard Index:

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

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

Note: The X/Q values are taken from Table 2A.
Resident X/Q (1000 m) = 0.05 (ug/m^3)/(lbs/hr)
Worker X/Q (500 m) = 0.18 (ug/m^3)/(lbs/hr)

Note: The MET is taken from Table 2B.
MET = 1.00

Hexavalent Chromium
Affects respiratory organs.

Note: The MPs and chronic RELs are taken from Table 8A.
MPr = 1.00; MPw = 1.00
Chronic REL = 2.00 x 10^{-1} ug/m^3

The chronic hazard index for hexavalent chromium is:

Resident: HIC = [0.00035 x 0.05 x 1.00 x 1.00] / [2.00 x 10^{-1}] **= 8.75 x 10^{-5}**
Respiratory system: 8.75 x 10^{-5}

Worker: HIC = [0.00035 x 0.18 x 1.00 x 1.00] / [2.00 x 10^{-1}] **= 3.15 x 10^{-4}**
Respiratory system: 3.15 x 10^{-4}

Ethylene Glycol Ethyl Ether (EGEE)
Affects hematologic systems and reproductive organs.

Note: The MPs and chronic RELs are taken from Table 8A.
MPr = 1.00; MPw = 1.00
Chronic REL = 7.00 x 10^{1} ug/m^3

The chronic hazard index for EGEE is:

Resident: HIC = [0.0075 x 0.05 x 1.00 x 1.00] / [7.00 x 10^{1}] **= 5.36 x 10^{-6}**
Hematologic and reproductive systems: 5.36 x 10^{-6}

Worker: HIC = [0.0075 x 0.18 x 1.00 x 1.00] / [7.00 x 10^{1}] **= 1.93 x 10^{-5}**
Hematologic and reproductive systems: 1.93 x 10^{-5}

In summary:

Acute Hazard Index (HIA) and Chronic Hazard Index (HIC):

By Target Organs for Acute:

(1) Worker:

TAC	**HIA**	
	REPR	DEV
EGEE	0.017	0.017
Total	**0.017**	**0.017**

(2) Resident:

TAC	HIA	
	REPR	DEV
EGEE	0.006	0.006
Total	**0.006**	**0.006**

By Target Organs for Chronic:

(1) Worker:

TAC	HIC		
	RESP	HEM	REPR
Hexavalent Chromium	3.15×10^{-4}		
EGEE		1.93×10^{-5}	1.93×10^{-5}
Total	$\mathbf{3.15 \times 10^{-4}}$	$\mathbf{1.93 \times 10^{-5}}$	$\mathbf{1.93 \times 10^{-5}}$

(2) Resident:

TAC	HIC		
	RESP	HEM	REPR
Hexavalent Chromium	8.75×10^{-5}		
EGEE		5.36×10^{-6}	5.36×10^{-6}
Total	$\mathbf{8.75 \times 10^{-5}}$	$\mathbf{5.36 \times 10^{-6}}$	$\mathbf{5.36 \times 10^{-6}}$

RESULT:
The spray booth in this example does not contain T-BACT, fails the Rule 1401 MICR limit, and would not be granted a permit. However, if the spray booth was equipped with T-BACT, it would pass the Rule 1401 MICR limit and be granted a permit.

- ***MICRs for residential and commercial receptors exceed 1×10^{-6} (one in one million) but are below 10×10^{-6} (ten in one million).***
- ***Cancer burden is less than 0.5.***
- ***HIAs for residential and commercial receptors do not exceed 1.0 for each target organ.***
- ***HICs for residential and commercial receptors do not exceed 1.0 for each target organ.***

EXAMPLE 4: CONTEMPORANEOUS RISK REDUCTION

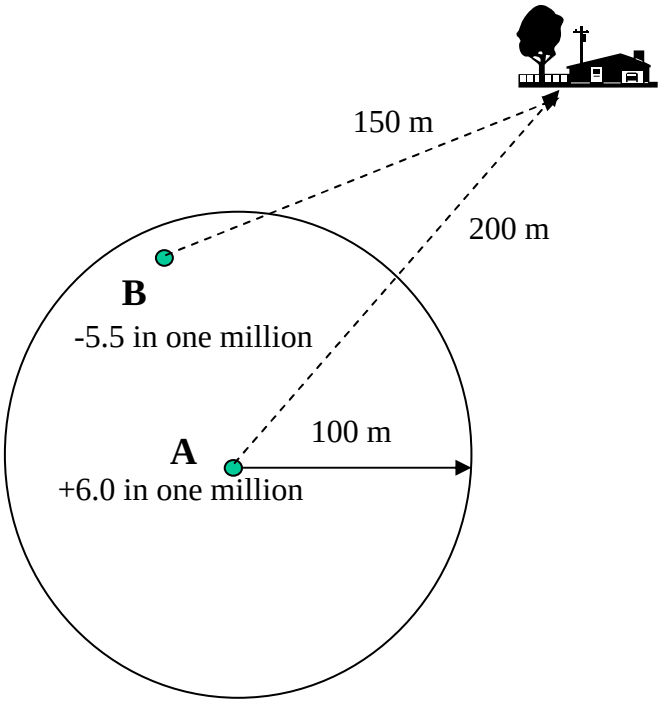
Rule 1401(g)(2)(A): The requirements of paragraph (d)(1) and (d)(4) shall not apply if the applicant demonstrates that a contemporaneous risk reduction resulting in a decrease in emissions will occur such that both of the following conditions are met:

(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. 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.

Receptor R1: The increased risk for Receptor R1 is the MICR for Unit A less the decrease in risk for Unit B.

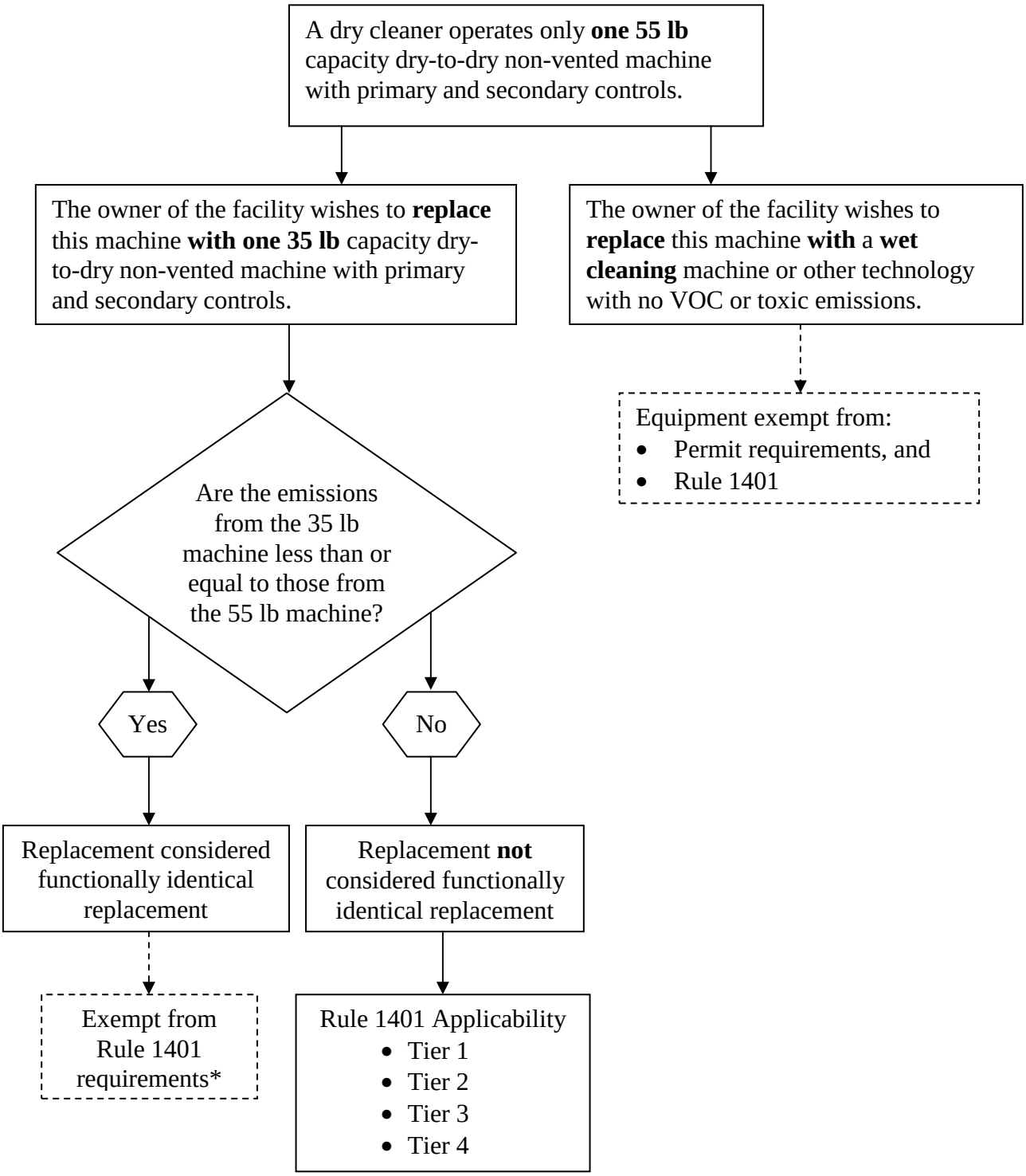
6.0 – 5.5 = **0.5 in one million**.

Note: This demonstaration is best achieved with a Tier 4 analysis (detailed air dispersion modeling) and must be performed for all possible receptors.

RESULT:

- ***Equipment was installed using T-BACT.***
- ***No receptor experiences an increase in risk greater than one in*** *one* ***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 5: FUNCTIONALLY IDENTICAL EQUIPMENT REPLACEMENT



* Rule 1421(d)(1)(F) allows for the functionally identical equipment replacement of **only one** machine. Please note that all perchloroethylene machines must comply with Rule 1402 as well.

BEST AVAILABLE CONTROL TECHNOLOGY FOR TOXICS

Best Available Control Technology for Toxics (T-BACT) is not required if the MICR is less than or equal to one in one million. If cancer risk is greater than one in one 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 10 in one million or less

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 10 in one million or less

T-BACT is acceptable

REFERENCES

Blaisdell, Robert, et. al. 2003. *Air Toxics Hot Spots Program Risk Assessment Guidelines: The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments.* California Environmental Protection Agency, Office of Environmental Health Hazard Assessment.

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

Maximum Individual Cancer Risk (MICR) Calculation Worksheet
Acute Hazard Index (HIA) Calculation Worksheet
Chronic Hazard Index (HIC) Calculation Worksheet

Maximum Individual Cancer Risk (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)	CP (Table 8A)	MP MICR (Table 8A)	
				Resident	Worker
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:**_____ m & **off-site worker receptor:** _____ m

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

Select **X/Q, MET, and AF_{ann} Tables** as follows (circle tables selected)

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

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

AF_{ann} value for nearest residential/sensitive receptor: 1.0 for nearest off-site worker receptor: _____

MET value _____

DBR value for nearest residential/sensitive receptor: 302 (Table 9A)

DBR value for nearest off-site worker receptor: 149 (Table 9A)

EVF value for nearest residential/sensitive receptor: 0.96 (Table 9B)

EVF value for nearest off-site worker receptor: 0.38 (Table 9B)

MICR CALCULATION

TACs	CP		Q_{tons}		X/Q		AF_{ann}		MET		DBR		EVF		10^{-6}		MP		MICR
1.		x		x		x		x		x		x		x	10^{-6}	x		=	
2.		x		x		x		x		x		x		x	10^{-6}	x		=	
3.		x		x		x		x		x		x		x	10^{-6}	x		=	
4.		x		x		x		x		x		x		x	10^{-6}	x		=	

MICR =_____

Acute Hazard Index (HIA) CALCULATION WORKSHEET

Target Organ: _____

Facility Name: _____

Facility Address: _____

Description of Equipment: _____

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: _____

Select **X/Q_{hr}** from Table 6 if Point Source or from Table 7 if Volume Source

Select **Acute REL** from Table 8A

Select **AF** from Table 8B if Point Source or from Table 8C if Volume Source

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.				

ACUTE HAZARD INDEX (HIA) CALCULATION:

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

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

Chronic Hazard Index (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 and MET Tables** as follows (circle tables selected)

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

Select **Chronic REL** and **MP Chronic** from Table 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 Factor Chronic (MP Chr)
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 staff 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 the Hotspots Analysis and Reporting Program (HARP), version 1.0 (build 21.09.03), a computer software package combining the tools of emission inventory database, facility prioritization, air dispersion modeling, and risk assessment analysis. Assumptions and parameters used to develop the MP factors are listed below:

Dispersion model options:

- Use Regulatory Default – No
- Rural or Urban – Urban
- Gradual Plume Rise – Yes
- Stack Top Downwash – Yes
- Buoyancy Induced Dispersion – Yes
- Calms Processing – No
- Emission rate = 1 pound per year

Risk assessment options:

- Deposition velocity – 0.02 m/sec
- Fraction of homegrown fruits and vegetables consumed – 5.2%
- For noncancer chronic risk estimates, the "Derived (OEHHA)" risk analysis method is used. In this approach, the two dominant (driving) exposure pathways use the high-end point-estimates of exposure, while the remaining exposure pathways use average point estimates.
- For cancer risk estimates, the "Derived (Adjusted)" risk analysis method is used. This method is identical to the "Derived (OEHHA)" method discussed above with one

exception. The "Derived (Adjusted)" method uses the breathing rate at the 80th percentile of exposure rather than the high-end point-estimate when the inhalation pathway is one of the dominant exposure pathways.

- The cancer risk estimates, including the Derived equations (both OEHHA and Adjustsed), are based on 70-year exposures.
- Pathways considered for residential exposure include inhalation, soil ingestion, dermal absorption, homegrown produce, and mother's milk.
- Pathways considered for worker exposure include inhalation, soil ingestion, and dermal absorption.
- The chronic multipathway factors (resident and worker) for the group listing of polychlorinated biphenyls (CAS number 1336-36-3) has been assigned those of its individual subspecies (18.08 and 10.27, respectively). (The group listing of PCBs does not include the Toxicity Equivalency Factors as developed by the World Health Organization 1997 and as adopted by the Office of Environmental Health Hazards Assessment in 2003.)

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 (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 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 cancer potency factors (CPc) and reference exposure levels (RELs) 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 CPs and RELs, 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 reagent blanks. Concerns were raised that in certain cases the concentration of TACs measured in reagent 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 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 AQMD staff. 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 AQMD staff.

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, AQMD staff 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 AQMD staff 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 AQMD staff 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 AQMD staff.

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

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 AQMD staff.

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 AQMD staff, facilities will be required to quantify the listed compounds through testing or other methods approved by AQMD staff 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, AQMD staff 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 AQMD staff, 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 Reagent Blanks

Reagent 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 AQMD staff, prior to the test or analyses, a determination as to the maximum allowable value for the blank.

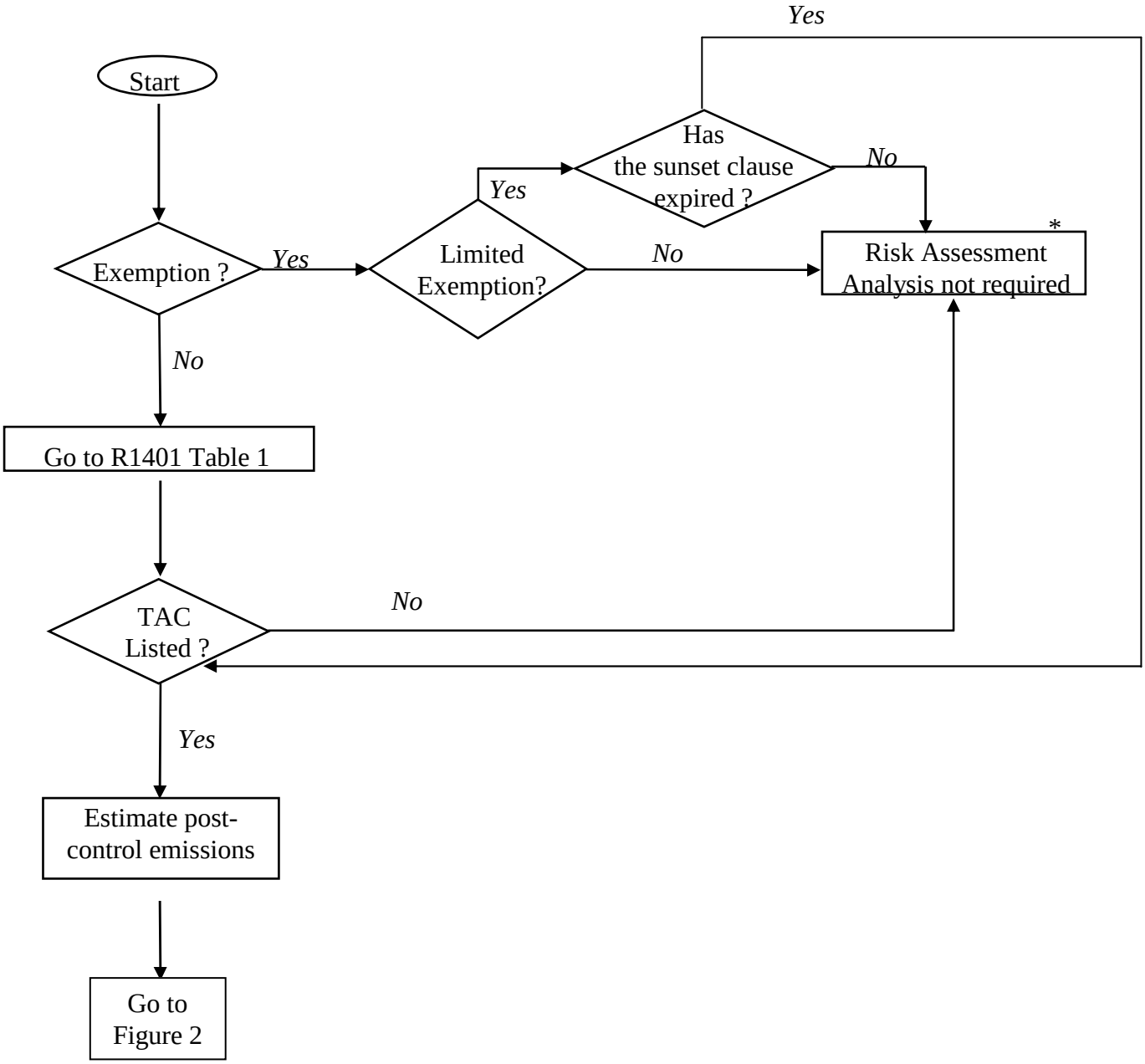
If the level of the TAC in the reagent blank is less than or equal to the maximum allowable blank, the reagent blank may be subtracted. The data must be reported with and without the correction. If the level of the TAC in the reagent blank is greater than the maximum allowable blank and the concentration of the sample is greater than 3 times the reagent blank value, then the maximum allowable reagent 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
Tier 1 - Screening Levels

Tier 1 involves comparing emissions or source specific units from a piece of equipment to Screening Levels

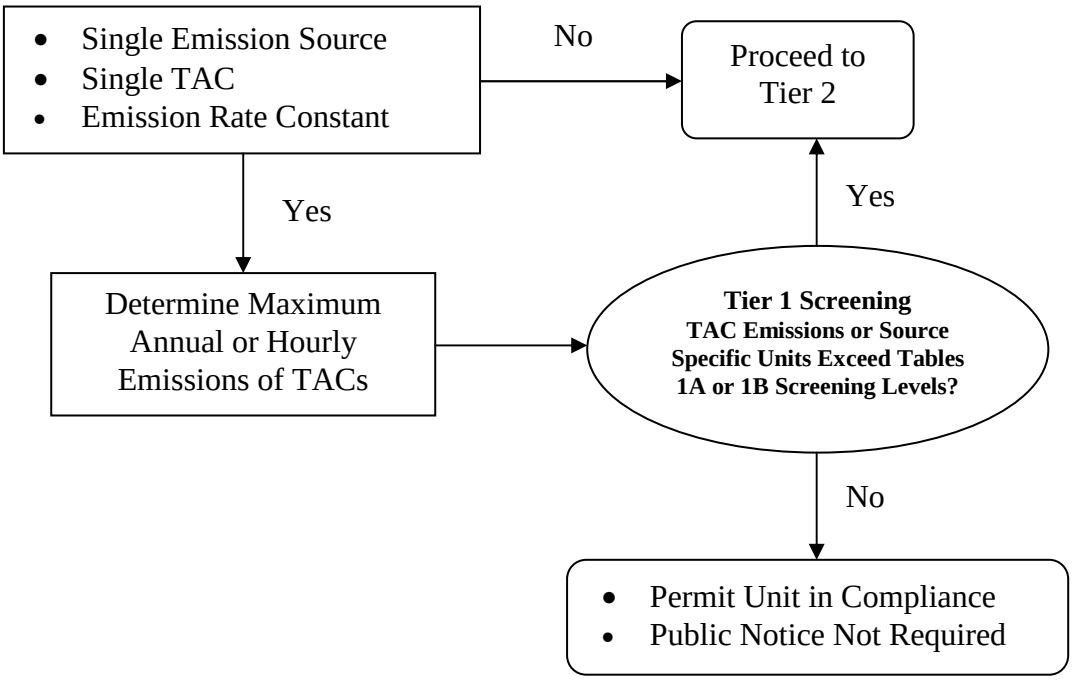
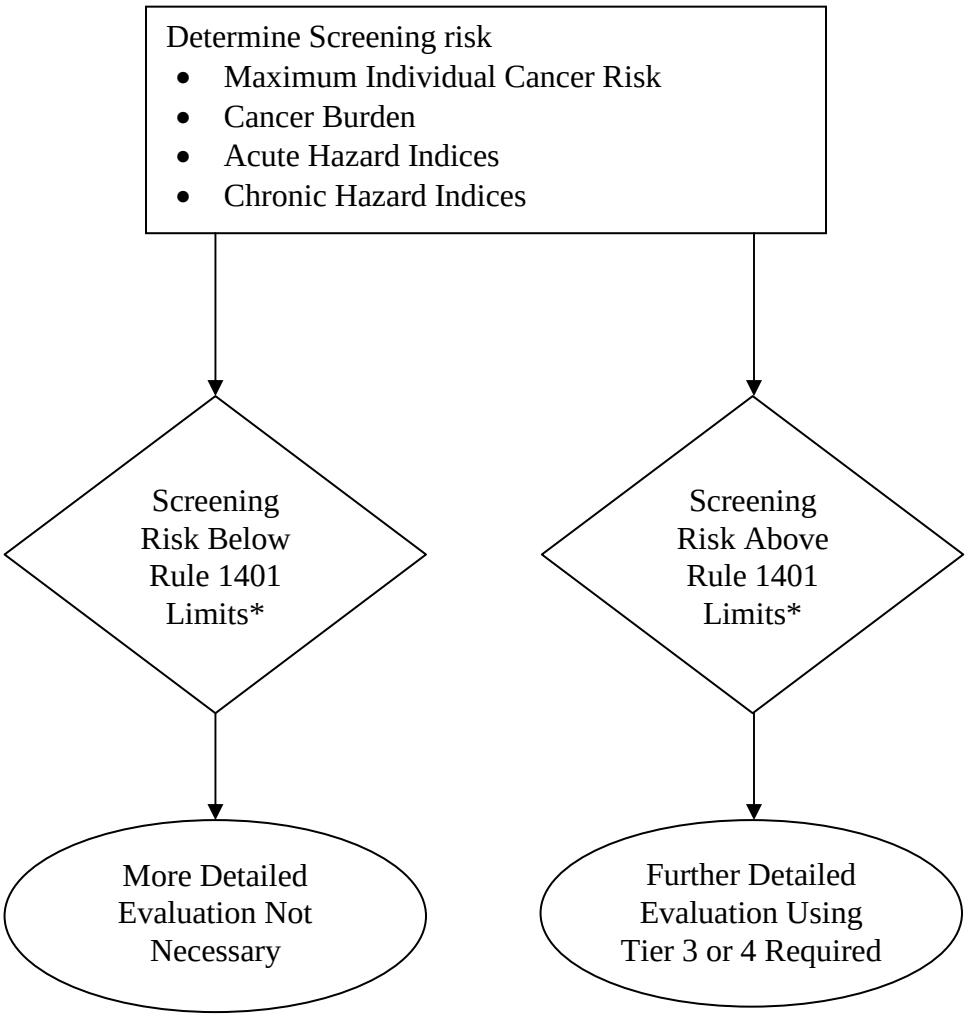


Figure 3A
Tier 2 - Screening Levels

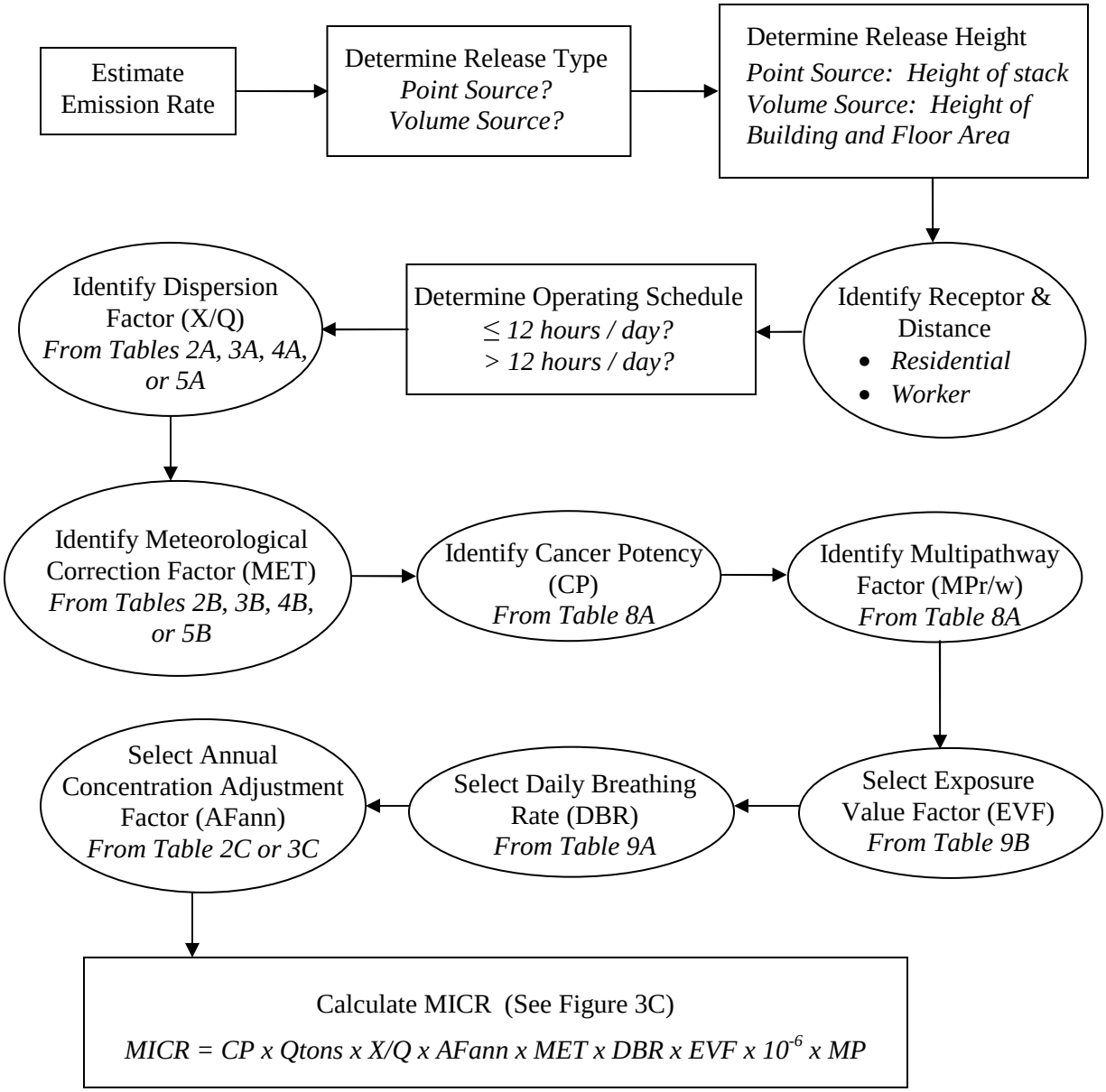
Tier 2 is a screening risk assessment, which includes procedures for determining level of risk from MICR, Cancer Burden, and Acute & Chronic Hazard Indices



* *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
Tier 2 - Maximum Individual Cancer Risk (MICR) Calculation



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

Figure 3C
Tier 2 - Maximum Individual Cancer Risk (MICR) Equation

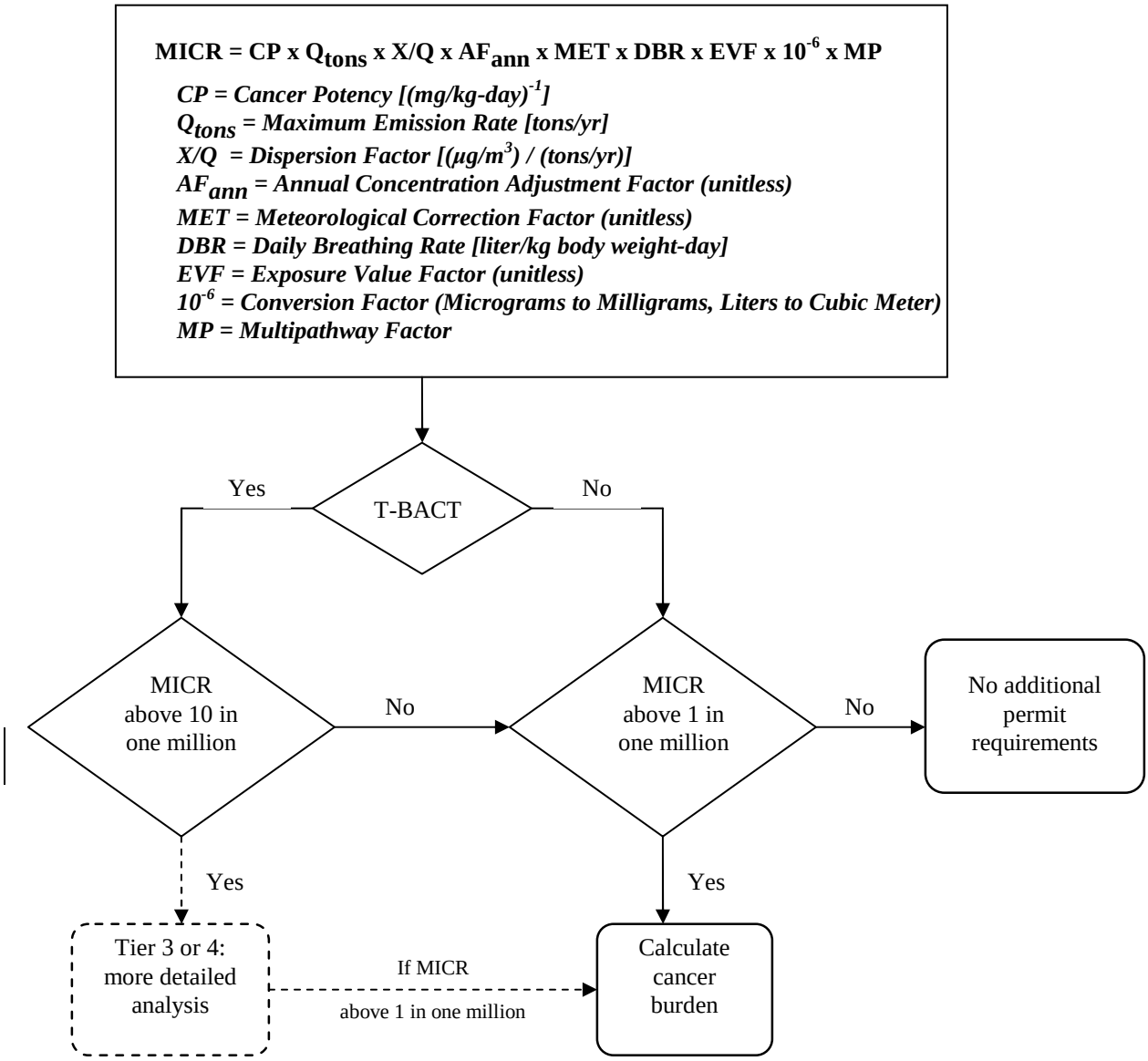


Figure 3D
Tier 2 - Dispersion Factor

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.

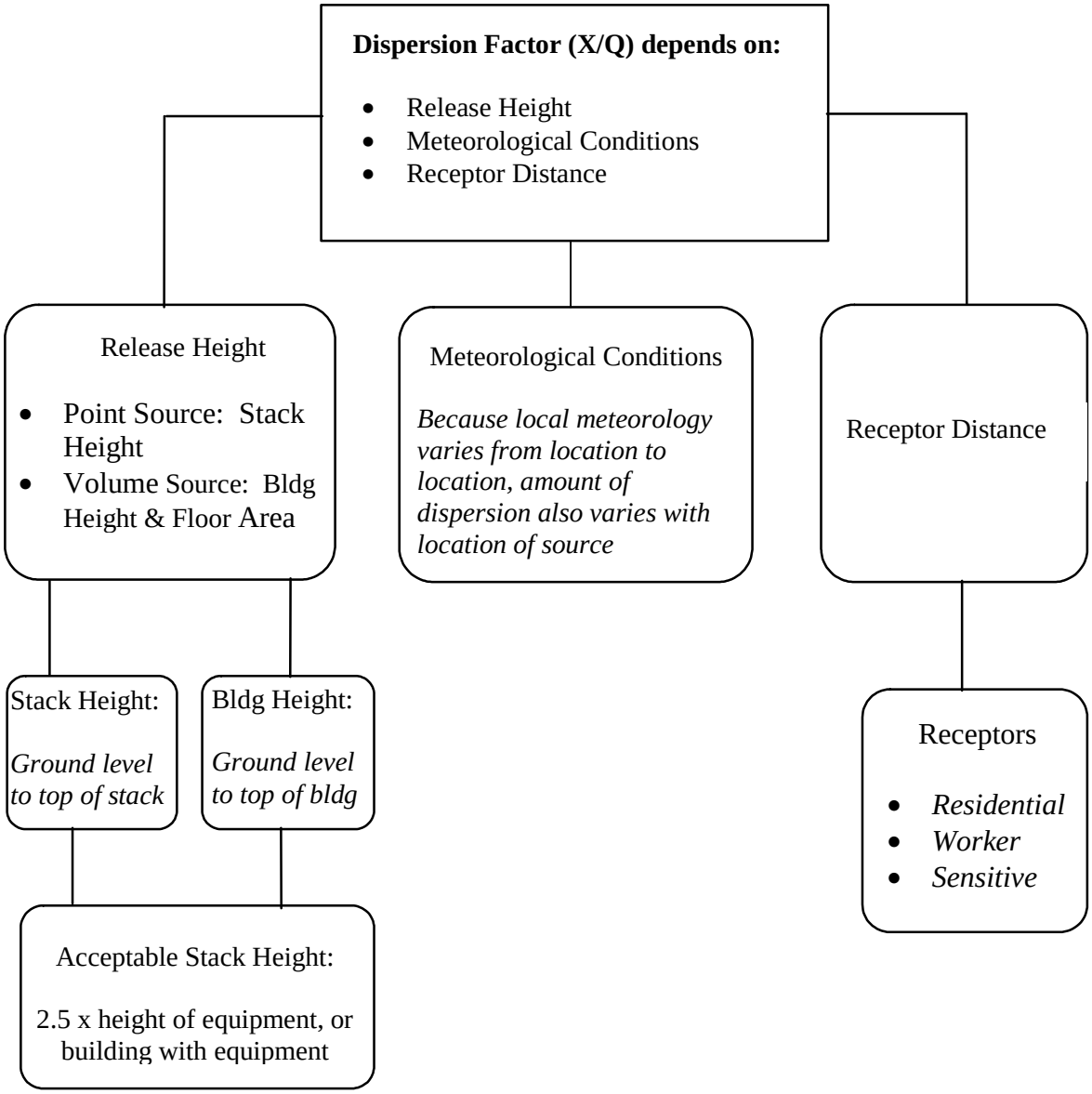


Figure 3E
Tier 2 - Cancer Potency Factor

Cancer Potency Factor (CP)

Cancer Potency Factor (CP)

- *Measure of the cancer potency of a carcinogen*

- *Estimated probability that a person will contract cancer due to inhalation of 1 milligram per kilogram of body weight of TAC continuously over period of 70 years*

Figure 3F
Tier 2 - Multi-pathway Adjustment Factor

Multi-pathway Adjustment Factor (MP)

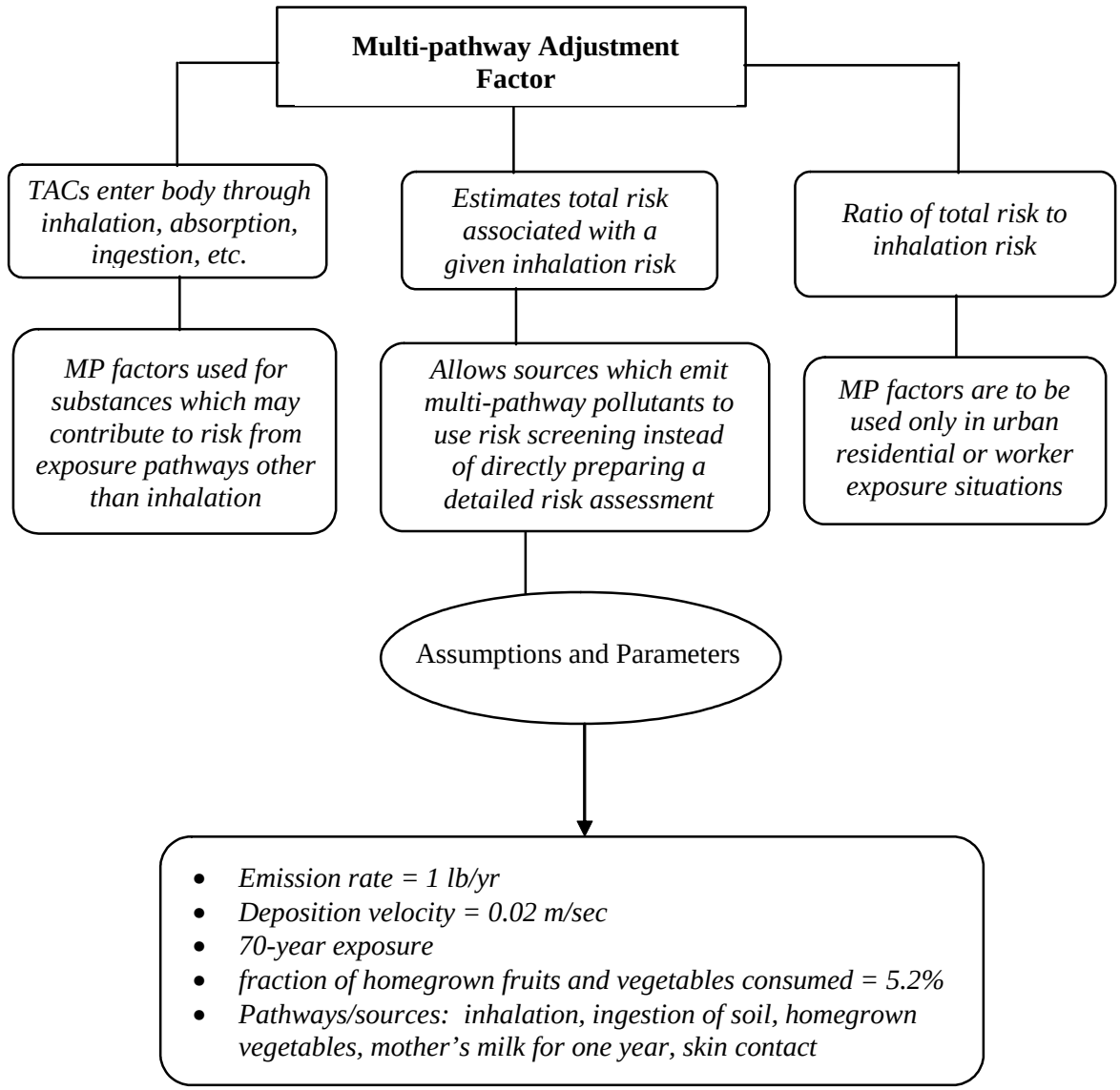


Figure 3G
Tier 2 - Exposure Value Factor

Exposure Value Factor (EVF)

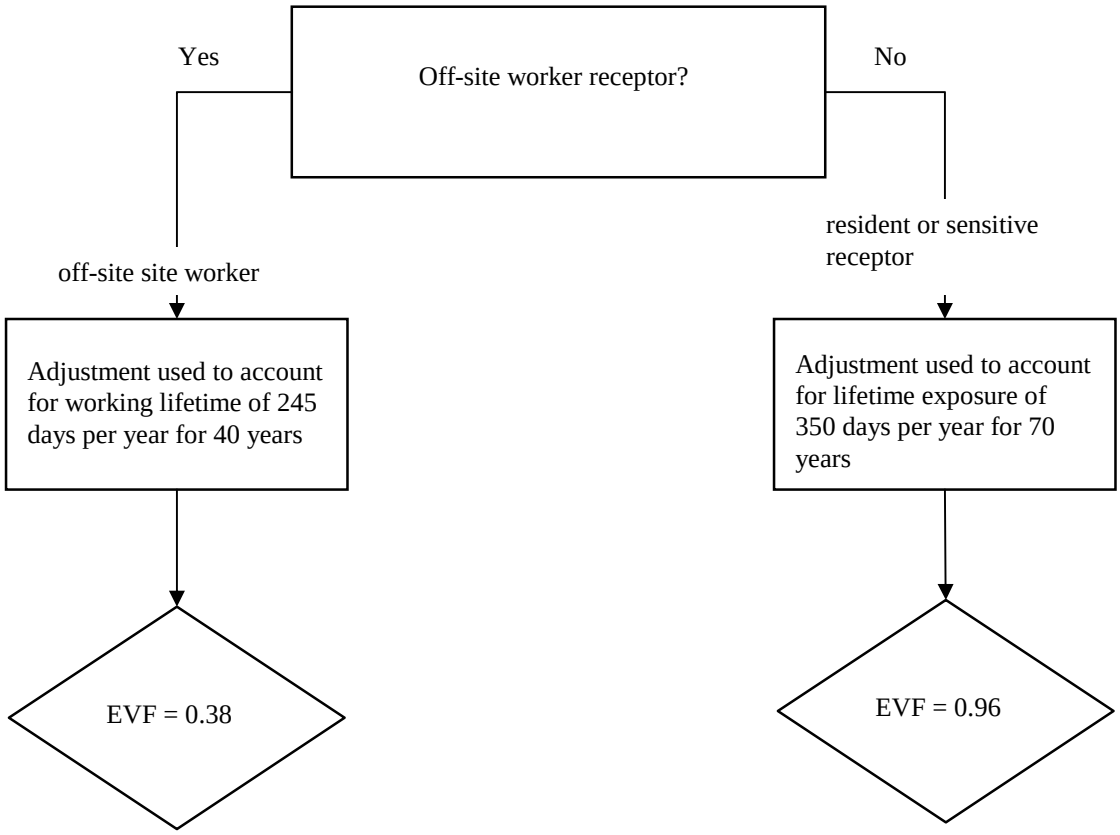


Figure 3H
Tier 2 - Daily Breathing Rate

Daily Breathing Rate (DBR)

Daily Breathing Rate (DBR)

- *Amount of air inhaled*
- *Used to determine the dose of a substance inhaled*

Figure 3I
Tier 2 - Annual Concentration Adjustment Factor

Annual Concentration Adjustment Factor (AF_{ann})

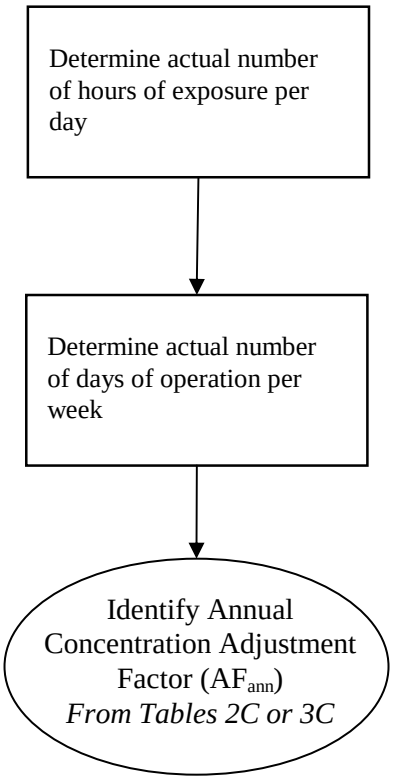


Figure 4
Cancer Burden

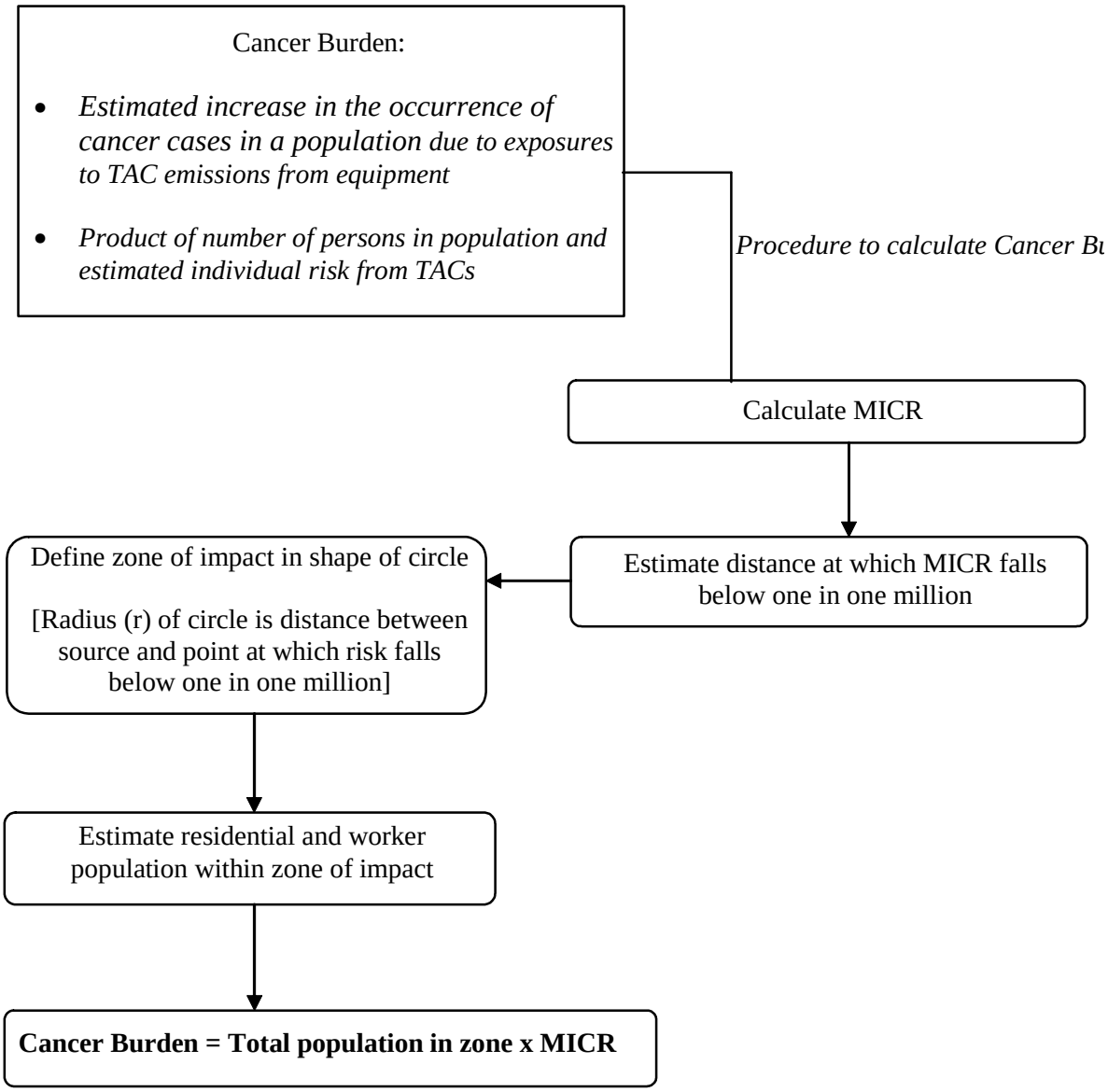
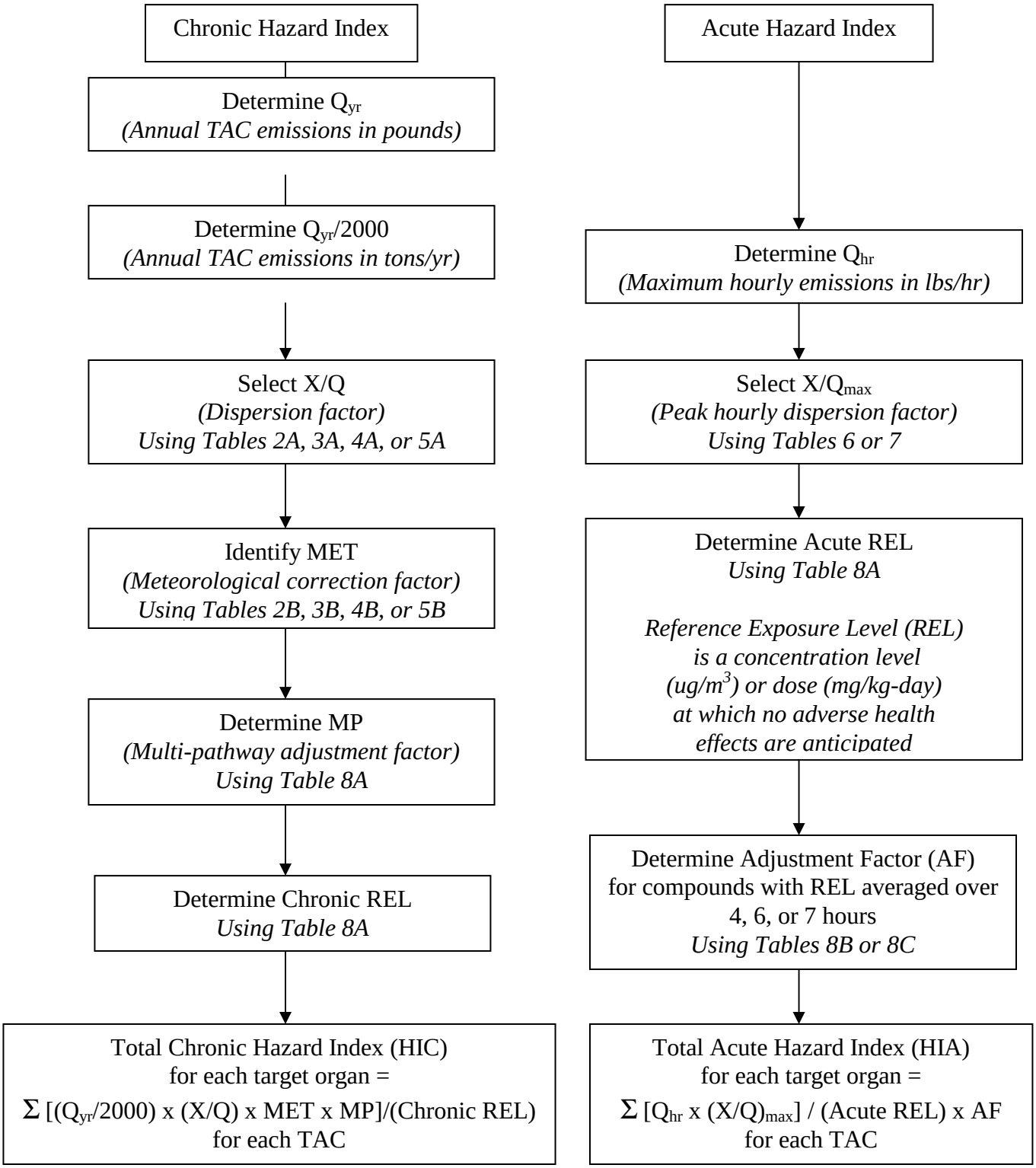


Figure 5
Chronic and Acute Hazard Index (HIC and HIA)



APPENDIX V

RULE 1401 EXEMPTION 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 permit unit that causes a reduction or no increase in the cancer burden, MICR or acute or chronic HI at any receptor location.

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

A permit unit replacing a functionally identical permit unit, provided there is no increase in maximum rating or increase in emissions of any toxic air contaminants. For replacement of dry cleaning permit units only, provided there is no increase in any toxic air contaminants.

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 that the equipment was installed prior to the Rule 219 amendment eliminating the exemption and a complete application for the permit is received within one (1) year after the Rule 219 amendment removing the exemption.

Rule 1401 (g)(1)(E): Modifications to Terminate Research Projects

Modifications restoring the previous permit conditions of a permit unit, provided that: the applicant demonstrates that the previous permit conditions were modified solely for the purpose of installing innovative control equipment as part of a demonstration or investigation designed to advance the state of the art with regard to controlling emissions of toxic air contaminants; the emission reductions achieved by the demonstration project are not used for permitting any equipment with emission increases under the contemporaneous emission reduction exemption as specified in paragraph (g)(2); the demonstration project is completed within two (2) years; and a complete application is submitted no later than two (2) years after the date of issuance of the permit which modified the conditions of the previous permit for the purpose of the demonstration or investigation.

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 permit units, provided that the risk increases due to emissions from the permit unit owned or operated by the applicant for which complete applications were submitted on or after July 10, 1998 will not exceed a MICR of 100 in one million (1.0×10^{-4}) or a total acute or chronic hazard index of five (5) 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)(1)(H): Gasoline Transfer and Dispensing Facilities (Expired)

For gasoline transfer and dispensing facilities, as defined in Rule 461 – Gasoline Transfer and Dispensing, the Executive Officer shall not, for the purposes of paragraphs (d)(1) through (d)(5), consider the risk contribution of methyl tert-butyl ether for any gasoline transfer and dispensing permit applications deemed complete on or before December 31, 2003. If the state of California extends the phase-out requirement for methyl tert-butyl ether as an oxygenate in gasoline, the limited time exemption shall be extended to that expiration date or December 31, 2004, whichever is sooner.

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

**(Note: Attachment L,
EFFECTIVE FOR APPLICATIONS DEEMED COMPLETE
ON OR AFTER July 1, 2005)**