General Characteristics		
1	**Abstract of Model Capabilities**	TSCREEN (A Model of Screening Toxic Air Pollutant Concentrations) is designed to analyze toxic emissions and their subsequent dispersion from one of many different types of possible releases. Four different transport/dispersion models are included to account for a variety of release configurations including point and area sources, neutrally buoyant and heavier-than-air, instantaneous and continuous. These models implement the procedures in the "Workbook of Screening Techniques for Assessing Impacts of Toxic Air Pollutants" (EPA-454/R-92-024).
2	**Sponsor and/or Developing Organization**	US EPA/US EPA, Research Triangle Park, NC
3	**Last Custodian/ Point of Contact**	The source code and executable programs for TSCREEN can be accessed on EPA's SCRAM Web Site at http://www.epa.gov/scram001/. (executable files are TSCREEN1-4.zip, 1.3 Mb, zipped; the source code file is TSCRCODE.zip, 418 Kb, and the code user's guide and documentation (workbooks) files are TSCREEND.zip, 40 Kb, and TSCRD1-4.zip, 2.1 Mb). Joe Touma U.S. Environmental Protection Agency, MD-14 Research Triangle Park, NC 27711 (919) 541-5381 E-mail: HYPERLINK mailto:touma.joe@epmail.epa.gov touma.joe@epmail.epa.gov
4	**Life-Cycle**	Developed by Pacific Environmental Services, Inc. under contract to EPA. Should be used in conjunction with the "Workbook of Screening Techniques for Assessing Impacts of Toxic Air Pollutants (Revised)." In the time since the study started, the SCREEN2 model within TSCREEN has been replaced by SCREEN3. However, that version was not used in this study.
5	**Model Description Summary**	SCREEN2 is a Gaussian dispersion model applicable to continuous releases of particulate matter and non-reactive, non-dense gases that are emitted from point, area, volume and flared sources. The SCREEN2 model implements the single source short-term procedures contained in the EPA screening procedures document. This includes providing estimated maximum ground-level concentrations and distances to the maximum based on a pre-selected range of meteorological conditions. In addition, SCREEN2 has the option of incorporating the effects of building downwash. There are four air toxins dispersion screening models imbedded in TSCREEN: SCREEN2, RVD, PUFF, and the Britter-McQuaid model. When TSCREEN is run a release scenario is defined by selecting input parameters, and TSCREEN automatically selects and executes the appropriate dispersion model for the scenario. Input and output can be saved. The RVD model provides short-term ambient concentration estimates for screening pollutant sources emitting denser-than-air gases and aerosols through vertically directed jet releases such as holes in pressurized containers. The model is based on empirical equations derived from wind tunnel tests and estimates the maximum ground level concentration at plume touchdown at up to 30 downwind receptor locations. The PUFF model is used where the release duration is finite but smaller than the travel time (i.e., an instantaneous release.) This model is based on the Gaussian instantaneous puff equation and is applicable for neutrally buoyant non-reactive toxic air releases. The Britter-McQuaid model is used for continuous and instantaneous release of denser-than-air gases from liquid spills.

6	**Application Limitation**	**Application Limitations** The program is designed as a screening tool. Releases must fit into one of 27 scenarios that are defined in the workbook. If input parameters are not consistent with the selected category, a new category may be suggested and the model starts over at the beginning of the input requests. Many types of scenarios are not addressed in TSCREEN, such as fires or explosions. Chemical database is limited. **Limiting Model Assumptions** Intended for use on small to mid-scale non-accidental releases. Toxic air contaminant is non-reactive and non-depositing and therefore not applicable for reactive gases and particle depositions. For two-phase flows, all released liquid is assumed to travel downwind as an aerosol with insignificant rain-out near the source. Denser-than-air contaminant behavior is a consequence of the initial contaminant density, the contaminant release rate and the ambient wind speed. Conditions resulting in worst case concentrations cannot be uniquely defined where meteorological conditions affect source estimates. Time-dependent emissions cannot be simulated; steady releases for a specified period are assumed. Ideal conditions for gas and liquid flows are assumed. Influence of obstructions and topography and releases not close to the ground is not included for denser-than-air calculations. Post-release thermodynamic behavior for denser-than-air releases is not accounted for.
7	**Strengths/ Limitations**	**Strengths:** Easy to use, fast to set up, little training necessary, fast calculation time, covers several source configurations. **Limitations:** Can only evaluate scenarios that match workbook. Performs only screening evaluations. User cannot define meteorological conditions since the model runs a range of conditions and reports the worst case. Some release conditions representative of release scenarios used in previous studies could not be modeled. Internal submodel selection is based on release configuration.
8	**Model References**	! Petersen, W., 1982: Estimating Concentrations Downwind from an Instantaneous Puff Release, EPA 600/3-82-078. U.S. Environmental Protection Agency, Research Triangle Park, NC. ! U.S. Environmental Protection Agency, 1989: User's Guide for RVD 2.0 — A Relief Valve Discharge Screening Model, EPA-450/4-88-024. U.S. Environmental Protection Agency, Research Triangle Park, NC. ! U.S. Environmental Protection Agency, 1992a: Workbook of Screening Techniques for Assessing Impacts of Toxic Air Pollutants (Revised), EPA-454/R-92-024. U.S. Environmental Protection Agency, Research Triangle Park, NC. ! U.S. Environmental Protection Agency, 1992b: Screening Procedures for Estimating the Air quality Impact of Stationary Sources (Revised), EPA-450/R-92-019. U.S. Environmental Protection Agency, Research Triangle Park, NC. ! Britter R.E. and J. McQuaid, 1989: Workbook on the Dispersion of Dense Gases, U.K. Health and Safety Executive Contract Research Report No. 17/1988. ! U.S. Environmental Protection Agency, 1990: User's Guide to TSCREEN, A Model for Screening Toxic Air Pollutant Concentrations, EPA-450/4-90-013. U.S. Environmental Protection Agency, Research Triangle Park, NC. ! U.S. Environmental Protection Agency, 1994: User's Guide to TSCREEN, A Model for Screening Toxic Air Pollutant Concentrations (Revised), EPA-450/B-94-023. U.S. Environmental Protection Agency, Research Triangle Park, N.C.
9	**Input Data/Parameter Requirements**	Release type (particulate, gaseous, liquid), source type (stack, vent, pipe leaks, pressurized liquid, low/high volatility, etc.). Depending on the release and source type, some of the following parameters are required: emission rate, exit velocity, release height, diameter at release point, release temperature, ambient temperature, building height and width, urban/rural classification, distances, flat or simple or complex terrain, elevated receptor heights, averaging time, flow rate, heat release rate, chemical parameters (boiling point, specific heat, molecular weight, latent heat of vaporization, liquid density).
10	**Output Summary**	Output includes input summary, maximum concentrations, distance to maximum, concentrations at selected locations and downwind plume parameters (height, sigma).
11	**Applications**	The code is in extensive use by State and local agencies throughout the United States.

12	**User-Friendliness**	! Run time keyboard entry into labeled locations on screen menus. ! Top-down prompting for input data. ! Self-explanatory (variable and units). ! A help system is included and is field-sensitive for data entry fields and menu items. ! An alternate source configuration is suggested when input parameters do not fit into one of the allowed scenarios.
13	**Hardware-Software Interface Constraints/ Requirements**	**Computer operating system:** MS-DOS **Computer platform:** Portable to MS-DOS platforms. When code is downloaded all of the FoxPro support is included. **Disk space requirements:** 1.500 KB of RAM, 2.2 MB disk space for files (including two runtime libraries that need 1.3 MB), and 3.25 MB for program. **Run execution time** (for a typical problem)**:** Time greatly reduced if computer has math-coprocessor. Run times averaged less than 5 seconds with a 60 MHz Petnium processor. **Programming language:** Uses all of the following: FoxPro, Microsoft C, v5.1, Microsoft FORTRAN, and BASIC. **Other computer peripheral information:**
14	**Operational Parameters**	**Identify whether the code has any error diagnostic messages to assist the user in troubleshooting operational problems:** If an error occurs while running TSCREEN an error window is displayed on the screen that contains the FoxPro error number, the procedure in which the error occurred and the line number at which the error occurred. If the error occurs while data are being entered the data will be saved and can be retrieved in the next run. The error information is also saved in a file named ERROR.OUT. An error message received during an RVD run was not explained.
15	**Surety Considerations**	**All quality assurance documentation:** While no specific quality assurance records are available, EPA contends that TSCREEN is an umbrella model that incorporates four well-known models that have experienced the test of time. Each of the four models has been verified by the original authors. **Benchmark runs:** Benchmark comparisons are not discussed in the documentation. Since the code is run for screening, it would be difficult to benchmark against other codes. Some limited comparisons have been made in this study. Basically, the model is considered to be conservative from the standpoint of dispersion. The conservatism of the source term is not as well established as that of dispersion, according to EPA. **Validation calculations:** **Verification with field experiments that has been performed with respect to this code:** No comparisons were presented in the documentation.
16	**Runtime Characteristics**	If all of the parameters are available in the correct units, the setup time is minimal and only limited by the typing speed of the user. All input is made during runtime (there are no predefined input files except for chemical data). The chemical data can be stored in the chemical database and retrieved during run input. Input from the previous run can be retrieved by selecting the file from the main menu and then editing as needed. Setup time is impacted by requests to try a different scenario after input of some of the parameters requested.

Specific Characteristics

Part A: Source Term Submodel Type

A1	**Source Term Algorithm?**	_✔_YES __NO

Part B: Dispersion Submodel Type

B1	**Gaussian**	**_✔_Straight-line plume __Segmented plume __ Statistical plume __ Statistical puff**

Part C: Transport Submodel Type

C2	**Deterministic**	Yes
C4	**Frame of Reference**	**_✔_ Eulerian __ Lagrangian __ Hybrid __ Eulerian-Lagrangian**

Part D: Fire Submodel Type (Not Applicable)

Part E: Energetic Events Submodel Type (Not Applicable)

Part F: Health Consequence Submodel Type		
F1	**For Chemical Consequence Assessment Models**	**Health effects: __ fatalities __ cancers __ latent cancers __ symptom onset** **Health criteria** **__ IDLH __ STEL __ TLV __ TWA** **__ ERPG __ TEEL __ AEGL __ WHO** **Zones with flammable limits: __ UFL __ LFL** **Blast overpressure regions:** **Fire radiant energy zones:** **Risk qualification:** **Concentration: ✔ single value __ time-history __ integrated dose** **Probits:**
Part G: Effects and Countermeasures Submodel Type (Not Available)		
Part H: Physical Features of Model		
H2	**Release Elevation**	**✔ ground __ roof**
H3	**Aerodynamic Effects from Buildings and Obstacles**	**✔ building wake ✔ cavity ✔ K-factors __ flow separation**
H6	**Mixing Layer**	**__ trapping __ lofting ✔ reflection __ penetration** **__ inversion breakup fumigation __ temporal variability**
H7	**Cloud Buoyancy**	**✔ neutral [passive] ✔ dense [negative] ✔ plume rise [positive]**
H11	**Resuspension**	**Yes**
Part I: Model Input Requirements		
I1	**Radio(chemical) and Weapon Release Parameters**	**Release rate: ✔ Continuous ✔ Time dependen__ Instantaneous** **Release container characteristics: ✔ vapor temperature** **✔ tank diameter ✔ tank height ✔ tank temperature ✔ tank pressure** **✔ nozzle diameter ✔ pipe length** **Jet release: __ initial size __ shape** **__ concentration profile at end of jet affected zone** **Release dimensions: ✔ point __ line ✔ area** **Release elevation: ✔ ground ✔ roof ✔ stack**
I2	**Meteorological Parameters**	**Wind speed and wind direction: __single point __ single tower/multiple point** **__ multiple towers** **Temperature: ✔ single point __ single tower/multiple point __ multiple towers** **See above.** **Dew point temperature: ✔ single point __ single tower/multiple point** **✔ multiple towers** **Precipitation: __ single point __ single tower/multiple point __ multiple towers** **See above.** **Turbulence typing parameters: __ temperature difference __ sigma theta** **__ sigma phi __ Monin-Obukhov length __ roughness length** **__ cloud cover __ incoming solar radiation __ user-specified** **Four dimensional meteorological fields from prognostic model: See above.**
Part J: Model Output Capabilities		
J3	**Concentration Versus Time Plots**	**Yes**
J4	**Tabular at Fixed Downwind Locations**	**Yes**
Part K: Model Usage Considerations (See Items 5 - 7.)		