		General Characteristics
1	**Abstract of Model Capabilities**	The SLAB model was developed to simulate the atmospheric transport and dispersion of dense gas releases from area sources. It has been enhanced to also simulate jet releases. Its solution is generalized to apply to neutral (passive) and buoyant gas releases. As its name implies, it assumes a similarity shape to cross-wind distributions of concentrations and other variables. It solves the one-dimensional (in downwind distance) equations of momentum, conservation of mass, species, and energy, and the equation of state. The model can be applied to continuous and instantaneous releases, and accounts for user-selected finite duration release times and the effects of averaging times. SLAB does not calculate source release rates, but can calculate the dispersion from liquid pool evaporation, horizontal and vertical jets at any height, and instantaneous volume sources.
2	**Sponsor and/or Developing Organization**	SLAB was developed in the 1980s by Lawrence Livermore National Laboratory (LLNL), with financial support from the Department of Energy (DOE). However, LLNL no longer provides technical support for the code, which is now distributed and supported by the EPA and by Bowman Environmental Engineering (see number 3 below).
3	**Last Custodian/ Point of Contact**	The source code and executable programs for SLAB can be accessed on EPA's SCRAM Web Site at http://www.epa.gov/scram001/. (executable file is slab.zip, 111Kb, zipped). An enhanced and user-supported commercial version of SLAB is available from: Bowman Environmental Engineering P.O. Box 29072 Dallas, TX 75229 (214) 233-5463.
4	**Life-Cycle**	SLAB grew out of some basic research carried out at LLNL in the early 1980s. This research was related to LLNL's responsibilities (as part of a DOE effort) to manage and carry out experiments with chemical releases at China Lake and at the Nevada Test Site. The SLAB computer code was first made available to the public in 1985, and dealt primarily with evaporative area sources. The U.S. Air Force and the American Petroleum Institute (API) supported enhancements in the late 1980s that were related to the addition of formulas to handle jet releases and to make the code generally more user friendly. SLAB is now available (free) on the EPA Bulletin Board, and a version with enhanced capabilities for inputs and outputs is available (at a cost) from a consultant (see number 3).
5	**Model Description Summary**	SLAB is one of the most widely used dense gas models in the public domain. Its developer, Dr. Donald Ermak, is recognized for creating a physically rational model that smoothly "transitions" from the dense gas to the passive gas regime, and for writing a clear and concise user's guide. SLAB is the easiest of the publicly available dense gas models to set up and begin using. SLAB does not calculate source emission rates. It assumes that all source input conditions have been determined externally. The model can treat evaporating pool sources, jet releases at any height, and instantaneous volume sources. SLAB produces outputs of chemical concentrations at various positions downwind and at specified heights above the ground. The plume or cloud is allowed to be denser-than-air, neutrally buoyant, or less dense than air. In-plume variables are assumed to have self-similar distributions in the cross-wind direction, thus simplifying the modeling system and permitting the basic equations to be solved in only one dimension (downwind distance). Thermodynamics effects are accounted for, including latent heat exchanges due to the condensation or evaporation of liquids. Effects of averaging time on the solutions are calculated.
6	**Application Limitation**	SLAB does not calculate source emission rates. While it handles jets, it does so in a simplified manner and does not calculate the details of the jet motions and thermodynamics. It is most applicable to dense gases, although its solution approaches known Gaussian plume solutions for neutral (passive) gases. It should not be used for strongly buoyant plumes.
7	**Strengths/ Limitations**	SLAB is recognized as the easiest-to-use dense gas model in the public domain. It agrees well with available field data. It does not calculate source emission rates.
8	**Model References**	Ermak, D.L., 1990, User's Manual for SLAB: An Atmospheric Dispersion Model for Denser-Than-Air Releases, ACRL-MA-105607, Lawrence Livermore National Laboratory, Livermore, CA 94550.

9	**Input Data/Parameter Requirements**	The public-domain version of the SLAB model requires one ASCII input file, and generates one ASCII output file. The input data include properties of the pollutant, source conditions (where source strengths must be known), meteorological conditions, maximum receptor downwind distance (the model will decide intermediate downwind distances internally), and up to four receptor heights of interest. To characterize the stability of the atmosphere, the user has the option of specifying either the traditional discrete stability class, or a continuous stability indicator known as the Monin-Obukhov length. The scope of this review exercise includes only public-domain models, as seen under number 3 above. A proprietary version of SLAB also exists but its characteristics have not been reviewed.
10	**Output Summary**	The output file generated by the SLAB model contains distributions with downwind distance of the maximum pollutant concentration, the time when the maximum concentration occurs, the time duration of the cloud, and the parameters that describe cloud geometry (width and depth).
11	**Applications**	SLAB has been applied thousands of times by hundreds of users to a wide range of scenarios. See number 19 for a reference for comparisons with numerous field experiments.
12	**User-Friendliness**	The public-domain version of the SLAB model has only a rudimentary command-line user interface. That is, the user has to manually prepare the input file using a text editor, and then execute the program by typing the name of the program. However, due to the limited number of input parameters required, the input file can be easily prepared.
13	**Hardware-Software Interface Constraints/ Requirements**	**Computer operating system:** The SLAB model (the public-domain version) runs in MS-DOS environment. **Computer platform:** **Disk space requirements:** It requires minimum disk space (a few megabytes). **Run execution time** (for a typical problem)**:** About 10 seconds on a Pentium PC for a typical scenario. **Programming language:** FORTRAN **Other computer peripheral information:** Can be easily ported to other computer platforms.
14	**Operational Parameters**	**Identify whether the code has any error diagnostic messages to assist the user in troubleshooting operational problems:** The model has limited error diagnostics to check the consistency of input parameters. Run-time error diagnostics are missing. However, the code appears to be very robust and rarely encounters any numerical problems. The model can be easily run in batch mode using DOS batch files.
15	**Surety Considerations**	**All quality assurance documentation:** It is not clear whether the SLAB code has been subject to formal procedures of quality assurance. However, as described in number 19 below, the code appears to be one of the best-performing dense gas models. An inspection of the source code shows that the SLAB model is well documented and concisely coded. **Benchmark runs:** **Validation** calculations: See Number 19 below. **Verification with field experiments that has been performed with respect to this code:** SLAB was included in the comprehensive model evaluation exercise reported by Hanna et al. (1993). The predictions of 14 models were compared with observations from 8 field experiments, including releases of LPG, LNG, Freon, ammonia, and HF. SLAB consistently performed near the top of the group of models, with minimal bias and scatter.
16	**Runtime Characteristics**	There is no initial setup time involved for the model. The user copies the model files to the hard disk on his computer, manually prepares an input file using a text editor, types “SLAB” to run the model, and an output file will be generated.

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**
B2	**Similarity**	**_✔_ Plume _✔_ Puff** Plume releases are modeled by the direct input of χ/Qs to the program by the user. Puff releases are modeled by requesting the program to calculate s or the user can directly input s.

B4	**Gradient Transport or K-Theory**	Vertical dispersion is parameterized by a pseudo gradient transport theory.
B6	**Box**	The cross-section of the plume or puff has an assumed similarity distribution, meaning that the plume or puff can be treated as a slab or box.
B9	**Multiple Capabilities**	Jet trajectories and dilution rates are parameterized using simple plume rise formulas and the Hoot-Meroney-Peterka formulas for dense gases.
Part C: Transport Submodel Type		
C1	**Prognostic**	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 (No Information Provided.)		
Part H: Physical Features of Model		
H2	**Release Elevation**	**_✔_ ground _✔_ roof**
H7	**Cloud Buoyancy**	**_✔_ neutral [passive] _✔_ dense [negative] _✔_ plume rise [positive]**
H8	**Cloud Liquid Droplet Formuation/ Aerosolization**	**The thermodynamic effects of aerosols are accounted for.**
Part I: Model Input Requirements		
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** **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:**
Pat J: Model Output Capabilities		
J1	**Hazard Zone**	**Can be calculated from concentration outputs.**
Part K: Model Usage Considerations (See Items 5 - 7.)		