General Characteristics		
1	**Abstract of Model Capabilities**	DEGADIS models the atmospheric dispersion of elevated or ground-level, area-source, denser-than-air gas (or aerosol) contaminants released with either negligible momentum, or as a jet from pressure relief valves, into an atmospheric boundary layer over flat, unobstructed terrain. DEGADIS models the dispersion processes which accompany the gravity-driven flow, contaminant entrainment into the atmospheric boundary layer, and subsequent downwind travel from the release. DEGADIS also accounts for ground reflection when the plume's lower boundary reaches the ground level.
2	**Sponsor and/or Developing Organization**	R.E. Lawson, Jr. U.S. Environmental Protection Agency Research Triangle Park, NC 27711 (919) 541-5368
3	**Last Custodian/ Point of Contact**	R.E. Lawson, Jr. U.S. Environmental Protection Agency Research Triangle Park, NC 27711 (919) 541-5368
4	**Life-Cycle**	DEGADIS Version 1.0 was developed for the USCG and GRI in 1985. It is an adaptation of the Shell HEGADAS model (Colenbrander, 1980; Colenbrander and Puttock, 1983). In 1988, Havens interfaced Ooms' jet model with DEGADIS (DEGADIS Version 2.0) to provide for the prediction of the trajectory and dilution of an elevated, denser-than-air contaminant (vertical) jet to ground contact, with the prediction of the ensuing ground-level dispersion by DEGADIS. In 1989, Spicer and Havens modified Ooms' jet model (DEGADIS Version 2.1) to provide for an elliptical plume cross-section with air entrainment consistent with the Pasquill-Gifford plume dispersion coefficient representation of atmospheric turbulent entrainment.
5	**Model Description Summary**	DEGADIS models the atmospheric dispersion of denser-than-air gas (or aerosol) contaminants released with negligible momentum or as a jet, into an atmospheric boundary layer over flat, unobstructed terrain. DEGADIS models the dispersion processes which accompany the gravity-driven flow, contaminant entrainment into the atmospheric boundary layer, and subsequent downwind travel from the release. DEGADIS also accounts for ground reflection when the plume's lower boundary reaches the ground level.
6	**Application Limitation**	DEGADIS has limited ability to address release scenarios in complex terrain. This limitation is significant since terrain features (i.e., valleys) influence the trajectory and ultimate transport of a dense gas release. ! DEGADIS prsently provides only for vertical releases. ! DEGADIS assumes an unobstructed atmospheric flow field. The jet/plume model assumes a logarithmic wind profile, and the ground-level, nonjet model assumes a power law wind profile which is consistent with the logarithmic wind profile. Application of the model should be limited to releases where the depth of the dispersing layer is much greater than the height of the surface roughness elements. ! For transient contaminant releases where the release duration is shorter than the averaging time associated with hazardous concentration levels (e.g., 10 minutes for a short-term exposure limit), DEGADIS does not provide for concentration time averaging in the wind direction.
7	**Strengths/ Limitations**	**Strengths:** Can address many types of dense gas releases; Able to address atmospheric dispersion of contaminant releases in the following fluid flow regimes: ! jet; ! buoyancy-dominated; ! stably-stratified; and, ! passive dispersion. Can account for a large spectrum of surface roughness elements. **Limitations:** Does not account for positive thermal buoyancy (i.e., plume rise); Unable to address complex meteorological flow phenomena (e.g., mountain-valley flows, seabreezes); does not account for aerodynamic effects of nearby buildings; does not account for dry or wet deposition effects; can only address pure chemical releases. Does not consider chemical mixtures or chemical transformations; is only a deterministic model and is unable to use prognostic data; and, see Applications Limitations section for additional items.
8	**Model References**	! Colenbrander, G.W., "A Mathematical Model for the Transient Behavior of Dense Vapor Clouds", 1980. ! Colenbrander, G.W., and J.S. Puttock, "Dense Gas Dispersion Behavior: Experimental Observations and Model Developments", 1983. ! Havens, J., and T.O. Spicer, "Development of an Atmospheric Dispersion Model for Heavier-than-Air-Gas Mixtures", 1985.

8	**Model References (Cont.)**	! Havens, J., "A Dispersion Model for Elevated Dense Gas Jet Chemical Releases", 1988. ! EPA-450/4-89-019, "DEGADIS User's Guide, 1989. ! T.O. Spicer, "Implementation of DEGADIS v2.1 on a Personal Computer", 1990.
9	**Input Data/Parameter Requirements**	Release type, release rate, release duration, source flux, initial density, initial temperature, averaging time, release Richardson number, wind speed at elevation, surface roughness, Pasquill stability class, Monin-Obukhov length, ambient temperature, ambient pressure, absolute humidity, surface temperature.
10	**Output Summary**	Tabular refelection of input data. ! Tabular calculated source parameters (time, gas radius, height, mole fraction, density, Richardson number, etc.). ! Tabular mole fraction, concentration, density, temperature, half width, sigma-y, sigma-z as a function of various downwind distances. The mass of the contaminant between the Upper Flammability Limit (UFL) and the Lower Flammability Limit (LFL), and the mass of contaminant above the LFL.
11	**Applications**	DEGADIS enjoys wide use in the public and private sector, as one of the dense gas dispersion models of choice. A stripped-down version of DEGADIS is contained in the popular ALOHA model.
12	**User-Friendliness**	DEGADIS is designed to be user friendly once the user becomes familiar with the physical principles of the model and the input-output details.
13	**Hardware-Software Interface Constraints/ Requirements**	DEGADIS runs in either a VAX or PC environment.
14	**Operational Parameters**	**Identify whether the code has any error diagnostic messages to assist the user in troubleshooting operational problems:** DEGADIS provides the user with various diagnostic messages to asist the user in determining the source of problems in running the model. In addition, a diagnostic procedure has been included in DEGADIS. A description of these diagnostic messages can be located in Appendix D of Reference 6. **Typical times are:** Once the user becomes familiar with the input structure and model physics, the setup time for running DEGADIS is relatively small.
15	**Surety Considerations**	**All quality assurance documentation:** EPA has an extensive quality assurance program to ensure that appropriate model upkeep is maintained since DEGADIS is on its SCRAM Bulletin Board. **Benchmark runs:** DEGADIS has compared well with other codes of its type, and with Gaussian models once downwind distances in the passive dispersion region are reached. **Validation calculations:** No Information Provided **Verification with field experiments that has been performed with respect to this code:** EPA has subjected DEGADIS to a large number of validation tests using the field experimental values of Goldfish, Maplin Sands, Thorney Island, and other locations. DEGADIS has performed well for a wide variety of release scenarios.

Specific Characteristics

Part A: Source Term Submodel Type (No Information Provided.)		
Part B: Dispersion Submodel Type		
B1	**Gaussian**	**✔ Straight-line plume __Segmented plume __ Statistical plume __ Statistical puff**
B9	**Multiple Capabilities**	DEGADIS has a unique secondary source blanket calculation that is used if the contaminant is not taken up directly by the atmosphere and dispersed downwind. The secondary source blanket is modeled as a time-varying right circular cylinder of air/contaminant mixture. DEGADIS treats four fluid flow regimes; jet, buoyancy dominated, stably stratified, and passive dispersion.
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 (No Information Provided.)		
Part H: Physical Features of Model		
H1	**Stability Classification Turbulence Typing**	**Pasquill-Gifford-Turner:** Yes **STAR:** **Irwin:** **Sigma theta:** **Richardson number:** Vertical dispersion only **Monin-Obukhov length:** Used for vertical/horizontal wind shear determinations **TKE-driven:** **Split sigma:**
H2	**Release Elevation**	_✔_ **ground** _✔_ **roof**
H6	**Mixing Layer**	__ **trapping** __ **lofting** _✔_ **reflection** __ **penetration** __ **inversion breakup fumigation** __ **temporal variability**
H7	**Cloud Buoyancy**	_✔_ **neutral [passive]** _✔_ **dense [negative]** __ **plume rise [positive]**
H13	**Temporally and Spatially Variant Mesoscale Processes**	**Urban heat island:** **Canopies:** **Complex terrain (land) effects:** __ **mountain-valley wind reversals** __ **anabatic winds** __ **katabaic winds** **Complex terrain (land-water) effects:** __ **seabreeze airflow trajectory reversals** __ **Thermally Induced Boundary Layer definition** __ **seabreeze fumigation** __ **landbreeze fumigation** **Thunderstorm outflow:** **Temporally variant winds:** Yes, up to 5 time steps **High velocity wind phenomena:** __ **tornado** __ **hurricane** __ **supercane** __ **microburst**
Part I: Model Input Requirements		
I1	**Radio(chemical) and Weapon Release Parameters**	**Release rate:** _✔_ **Continuous** _✔_ **Time dependent** _ **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 (Cont.)**	**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**
I2	**Meteorological Parameters**	**Precipitation: __ single point __ single tower/multiple point_ multiple towers** **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:**
Part J: Model Output Capabilities		
J4	**Tabular at Fixed Downwind Locations**	Yes
Part K: Model Usage Considerations		
K1	**Ease of Model Use**	Training required to run the model: 4 background (years of education) 3-6 months training time needed on the model to be able to exercise all model capabilities Training required to continue development of the model: 6+ background (years of education) 6-12 months training time needed on the model to be able to exercise all model capabilities
K3	**Ease of Use of Output, Evaluated as the Time Needed to Train a College Graduate in the Use of the Output**	DEGADIS is a very unforgiving model which occasionally has the capacity of giving different results for the same input parameter set. A DEGADIS user must be skilled in fluid dynamics, and the atmospheric sciences to navigate successfully. A college graduate that does not have these disciples within his/her expertise would require significant training.