DILUTION CALCULATIONS USING THE TLVs. The moderately toxic solvent products that can be addressed with dilution ventilation are those with relatively large TLVs. Below is the formula is for calculation the cubic feet per minute (cfm) exhaust/supply rate for a room in which a number of students are working at easels all using small amounts of a moderately toxic solvent at a known rate. The rate is expressed in the cubic feet per minute per pint (cfm/pt):

$$\text{cfm/pt} = \frac{403 \times 10^6 \times SG \times ER}{MW \times TLV}$$

403=volume of pt at STP
SG =specific gravity
ER =evaporation rate in pints/minute
MW =molecular weight
TLV=Threshold Limit Value

To convert the cfm/pt to the cfm needed to ventilated the room then is:

$$\text{Cubic feet/minute (cfm)} = \frac{\text{cfm/pt} \times \text{pts/hour} \times \text{No. of artists} \times K}{60 \text{ min/hr}}$$

The value of the constant, K, ranges from one to ten based on the efficacy of the ventilation system chosen, the toxicity of the solvent, its evaporation rate, the proximity of the solvent to the breathing zone, and other risk factors. In this case, the closeness to the work and the fact that the exposed population is students requires the highest K value of 10. Since TLVs are designed to protect most healthy adult employees (e.g. healthy teachers) and our population is students who are not employees and may not all be healthy, we need to use the highest value of 10 for these additional risk factors.

All sources of solvent vapors in the room must be considered which can include:

* the small open containers of solvent used by each painter;
* open containers in which brushes are soaking;
* turpentine washes & other solvent-intense painting methods;
* aerosol spray products, varnishes, and other materials;
* storage of used cleaning rags, paper towels, and newsprint;
* off-gassing from pallets, paintings in progress or stored (e.g. from previous classes);
* prevalence of accidental spills and splashes;
* sink areas or other brush cleaning stations;
* solvent dispensing areas;
* flammable storage cabinets and other storage units;
* student lockers if they are not monitored to ban solvent storage there; and
* any special practices observed (I have seem teachers cleaning large brushes by dipping them in solvent and beating them against easel legs!).

In my experience and having calculated these rates based on many classrooms and practices, it is common for an oil painter to use about an ounce (1/8th cup) of solvent an hour–as long as no excessive techniques such as solvent washes are used. The calculations for Gamsol are in section E of this report.

However, readers of this report need to understand that when these calculations are completed, the most energy-saving rates are those for chemicals with higher TLVs and lower evaporation rates. For example, the rate for solvents such as Gamsol® and Isopar L® with a TLV of 100 ppm and a moderate evaporation rate range around 190 to 200 cfm/student. This means that a room with 20 students in it doing traditional oil painting would require 3810 to 4000 cfm of air all exhausted 100% to the outside and replaced every minute!

This rate can be lowered if a displacement system is used by placing the supply at near head level and exhausting on the opposite side of the room at a similarly low level.

It is also important to know that the calculations clearly show that using turpentine with its very low TLV (20 ppm) and high evaporation rate results in a rate of 1290 cfm/student–an impossible rate to provide. And solvent washes, where several ounces of solvent are spread out on the canvas, cannot be done safely with any amount of dilution ventilation. This process should be done under local exhaust.