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April 22, 2013

**Mr. Jeffrey Flegg**
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**Our Ref.: ESSL-00026606**

**Subject: Final Report**
**Interpretation of Volatile Organic Compounds (VOC)**

Dear Sir,

We have received the laboratory report of EXOVA regarding the Volatile Organic Compounds emissions from the mattress sample and would like to present our interpretation of the laboratory results as follows.

## QUALITY OF THE LABORATORY TESTS

The emissions tests were performed in the AIHA accredited chemical laboratory of EXVOVA and followed the following protocols:

- ASTM D5116 « *Standard Guide for Small Scale Environmental Chamber Determinations of Organic Emissions (VOC)* ».
- ASTM D5197 Time weighted average sampling of formaldehyde.

Both tests are appropriate for the Green Guard Indoor Air Quality Product Certification of the Greenguard Organisation for OEM Materials, Surface Materials, Bedding, Seating Individual Case Goods, Tables, Workstation Components.

VOC and formaldehyde measurements were made following ASTM D6196 and ASTM D5197 which are in compliance with the requirements of the official « *Quebec Regulation respecting occupational health and safety* » (S-2.1, r.13).

## COMPARISON OF RESULTS WITH STANDARDS AND QUEBEC REGULATION

The results of different types of Volatile Organic Compounds (VOC) and of the Total Volatile Organic Compounds (TVOC) are compared with:

- The Greenguard Acceptable IAQ criteria.
- The standard for occupant comfort: ASHRAE standard 62.1-2010 *« Ventilation for Acceptable indoor air quality ».*
- The official Quebec governmental regulation for health concerns: « *Regulation respecting occupational health and safety* » (S-2.1, r.13). The Quebec regulation limits are almost the same as the TLV (Threshold Limit Values) used by different American organisations such as OSHA (« *Occupational Safety and Health Administration* »), ACGIH (« *American Conference of Governmental Industrial Hygienists* ») or NIOSH (« *National Institute for Occupational Safety and Health* »).
- And finally the exposure levels of the Office of Environmental Health Hazard Assessment of the State of California.

Table 1 shows the test results and the comparison with the Green Guard Acceptable IAQ criteria, ASHRAE Standard and Quebec regulation:

**TABLE 1: AIR CONCENTRATIONS OF VARIOUS CONTAMINANTS AND COMPARISON WITH COMFORT AND HEALTH LIMITS**

| CONTAMINANT | AIR CONCENTRATION | GREENGUARD ACCEPTABLE IAQ CRITERIA | COMFORT LIMIT BY ASHRAE STANDARD | HEALTH LIMIT BY QUEBEC REGULATION AND TLV |
|---|---|---|---|---|
| Formaldehyde | 15 ppb | 25 ppb | 200 ppb | 2 000 ppb |
| Styrene | Less than 2 µg/m³ | 35 µg/m³ | 21 300 µg/m³ | 213 000 µg/m³ |
| 4-Phenylcyclohexene | Less than 2 µg/m³ | 3 µg/m³ | 3.25 µg/m³ | No limit |
| Aldehydes | 15 ppb | 250 ppb | 250 ppb | No limit |
| **Total Volatile Organic Compounds** | **36 µg /m³** | **250 µg /m³** | **200 µg /m³** | **25 000 µg /m³** |

## COMPARISON OF FORMALDEHYDE RESULTS WITH THE CALIFORNIA OEHHA

Based on the emissions of one (1) queen size mattress (product name Classic Skinny) of an area of 4,54 $m^2$ in a room with a volume of 60 m³ and an air exchange of 0,23 air change per hour, the predicted concentration of formaldehyde after 168 hours is **6,4 µg /m³**

The California **Office of Environmental Health Hazard Assessment** (OEHHA) sets three (3) Reference Exposure Levels (RELs as on February 2012) for formaldehyde:

- **A = Acute = 55 µg /m³** (exposure averaging time is 1 hour) with the eyes as the target organ for sensory irritation.
- **8 = 8 hours = 9 µg /m³** (exposure averaging time is 8 hours) with the respiratory system as the target organ for respiratory problem.
- **C = Chronic = 9 µg /m³** (continuous exposures for up to a lifetime: the exposure metric used is the annual average exposure) with the respiratory system as the target organ for respiratory problem.

Since the predicted concentration of formaldehyde after 168 hours is **6,4 µg /m³**, this concentration is below all three (3) OEHHA Reference Exposure Levels of A (55 µg /m³), 8 (9 µg /m³) and C (9 µg /m³). Hence, there will not be any sensory irritation with the eyes, nor any respiratory problem for the user.

**CONCLUSION**

Based on the comparison as shown in table 1, we can interpret the results as follows:

- The air concentrations of different Volatile Organic Compounds are less than one thousandth of the health limits by the Quebec Regulation and by the US regulations.
- The air concentrations of different Volatile Organic Compounds are way below the comfort limits by the ASHRAE Standard.
- The air concentrations meet the Greenguard Acceptable Indoor Air Quality criteria.
- The predicted formaldehyde concentration after 168 hours is below all three reference levels (Acute, 8 hour and Chronic) of California's Office of Environmental Health Hazard Assessment.

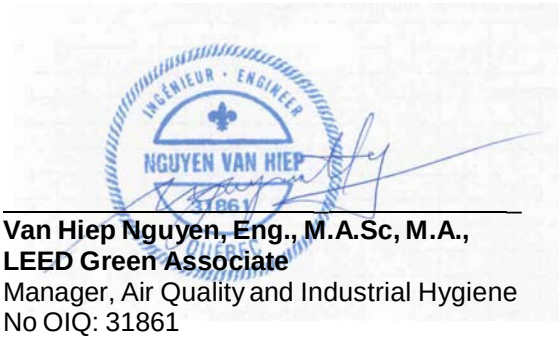
We can conclude that:

- ➢ The sample mattress Classic Skinny emits negligible amounts of Volatile Organic Compounds (VOC).
- ➢ There is no health risk with these negligible amounts of VOC.
- ➢ There is no risk of discomfort with these negligible amounts of VOC.
- ➢ There are no acute or chronic problems with the predicted low formaldehyde level.
- ➢ The VOC and formaldehyde levels can be characterized as background levels.

This report is written by the Professional Engineer and Industrial Hygienist, Mr. Van Hiep Nguyen, eng., M.A. Sc., M.A.

We hope everything is to your entire satisfaction and look forward to hearing from you.

Best regards,

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