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April 1, 2009

Associate Administrator for Hazardous Materials Safety  
Pipeline and Hazardous Materials Safety Administration  
ATTN: Special Permits, PHH-31  
U.S. Department of Transportation, East Building  
1200 New Jersey Ave, SE  
Washington, DC 20590-0001  
Fax (202) 366-3753, (202) 366-3308

PHMSA-2009-0143

RE: Mercotac, Inc. - Application for Special Permit

To whom it may concern,

Pursuant to 49 CFR § 107.105 and 107.113, Mercotac, Inc. is filing a standard application for a special permit seeking relief requested in this application on a continuing basis.

Applicant

The applicant is:

Mercotac, Inc.  
6195 Corte Del Cedro Suite 100  
Carlsbad, CA 92011  
Ph: (760) 431-7723  
Attention: David Brunet

Background

On May 21, 2007 Mercotac, Inc applied under 49CFR §106.95 to amend the hazardous materials shipping regulations 49CFR §173.162 for Gallium due to a new commercial application in electrical devices. This application was issued a Petition Number P-1500 and Docket Number PHMSA-2007-28486 and is still under review by the Pipeline and Hazardous Material Safety Administration. (A copy of our application to amend the hazardous materials shipping regulations is attached.) In our telephone conversations of December 2008 with Shane Kelly in the international office of PHMSA and Helen

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Ingraham we were told that they see "no reason not to deny the petition, but that this process takes several years". It was suggested we apply for a special permit. In the interim, use of this special permit will demonstrate shipping experience.

Since the previous application, Mercotac Inc., a small US manufacturer of rotating electrical connectors, has continued development of a replacement for Mercury in our products using a eutectic Gallium alloy, which is liquid at room temperature. The other metals in this alloy are not considered Hazardous Materials for shipping, unlike the Gallium. With the increasing regulation and bans of Mercury use, both abroad (Europe) and in the United States there is an increasing need by our customers for a replacement to Mercury. In many applications there is no economical substitute to our rotating connectors and the use of a Gallium alloy is the only practical solution. Simply put, without a substitute for Mercury they would not be able to sell their products in areas where Mercury is banned.

We have a customer who is upgrading their product to take advantage of this new alloy in order to continue sales into Europe, which will soon ban Mercury for their type of product. Mercotac Inc has a need to start shipping prototype Gallium-containing rotating connectors and then production connectors very shortly. We also have seen increasing inquiries from customers and potential customers who wish to sell products into states that have banned the sales of mercury-containing items. One area of many requests is in green energy. Electricity-producing windmills have a need for a rotating connection between the windmill head and the support tower so the cables don't twist up. We expect we will be transporting these new Gallium connectors to many other customers shortly.

A great impediment for the application of this Gallium alloy as a substitute for Mercury is the increased cost incurred to ship Gallium as a Hazardous Material because of the current packaging costs, documentation, and fees. Mercotac Inc believes these costs are a major deterrent to supplying a practical replacement for Mercury in our application. In certain cases the cost of the Hazardous Material shipping requirements and fees are several times the cost of the rotating connector. Mercotac Inc. further believes that scaled leakproof Gallium-containing manufactured articles can be shipped as safely as the Mercury ones. Mercury, because of its industrial and commercial uses, has had many exemptions granted to make transportation economical where the safety risk wasn't compromised. Gallium, because of past limited commercial use, has not had the need for these exemptions.

### **Description of Proposed Special Permit**

Mercotac Inc. seeks continuous relief from the following hazardous materials regulations when transporting "Gallium contained in a manufactured article" by vehicles on public highways:

- 49 CFR §173.162 (c) Non-bulk packaging requirements to the extent that manufactured article packaging exemptions are restricted to 100mg of Gallium per manufactured article and a total package quantity of Gallium not to exceed 1 gm.
- 49 CFR § 172.200 Shipping paper requirements to the extent that shipping papers are required for all modes of transportation and not limited to just air, which would be designated as an "A" in column 1 of the Hazardous Materials table at 49 CFR §172.101.

Mercotac Inc. further seeks continuous relief from the following hazardous materials regulations when transporting "Gallium contained in a manufactured article" by aircraft transportation:

- 49 CFR §173.162 (c) Non-bulk packaging requirements to the extent that manufactured articles packaging exemptions are restricted to 100mg of Gallium per manufactured article and a total package quantity of Gallium not to exceed 1 gm.

The proposed special permit would allow Mercotac Inc. to ship manufactured electrical articles containing gallium which are totally enclosed, leakproof, and in sealed metal or plastic units by both vehicle and aircraft without the non-bulk packaging requirements of 49 CFR §173.162 as long as they are packaged in strong outer packaging. Furthermore, the proposed special permit for shipment by vehicle would not require shipping papers as specified under 49 CFR § 172.101 (b)(2) and 49 CFR § 172.200 (b)(1) and would therefore be treated as if there was an "A" in column 1 of the table at 49 CFR §172.101.

#### **Basis for Proposed Special Permit**

The metals Gallium and Mercury, which are both listed as a Class 8 corrosive, have very similar corrosive properties. 49 CFR §173.137 assigns packing groups to Class 8 materials as to whether they either cause skin tissue destruction or exhibit a corrosion rate on steel or aluminum surfaces exceeding 6.25mm a year at a test temperature of 55°C (130°F). Gallium and Mercury do not cause skin tissue destruction. Gallium and Mercury are listed as Class 8 corrosives because they corrode aluminum. Furthermore Mercury is considered a toxic metal, unlike Gallium, which is non-toxic.

Manufactured articles containing Mercury, because of their widespread industrial uses and need for safe economical transport, have many exemptions for packaging as listed at 49 CFR §173.164. For example:

- 49 CFR §173.164 (c) (1) exempts manufactured electrical items from packaging requirements if they are leakproof and sealed metal or plastic units.
- 49 CFR §173.164 (c) (2) exempts manufactured electrical items containing up to 15 grams of Mercury from packaging requirements if they are installed in a machine so that impact damage would not likely cause leakage.
- 49 CFR §173.164 (e) exempts vehicle shipments containing less than a pound of Mercury from the packaging requirements of this subchapter.

Furthermore "Mercury contained in manufactured articles" are not subject to shipping papers requirements except by aircraft transportation:

- 49 CFR §172.101 Hazardous Materials table for "Mercury contained in a manufactured articles" is preceded in column 1 with an "A".
- 49 CFR §172.101 (b)(2) and §172.200 (b)(1) The letter "A" denotes a material that is subject to the requirements of this subchapter (*shipping papers*) only when offered or intended for transportation by aircraft.

As the volume of Mercury being shipped by aircraft increases, the packaging requirement becomes more stringent as a leak could cause major safety issues. For smaller Mercury shipping volumes it is permissible to ship Mercury in inner packaging made of earthenware, glass, or plastic each containing not more than 3.5KG of Mercury. These containers are then sealed in a bag and then packed with cushioning in another package, typically fiberboard (cardboard). Steel flasks are required at larger Mercury volumes up to 35KG. The flasks must be bagged and sealed and then packed in an outer packaging.

However, for manufactured articles, which are totally enclosed, leakproof, and in sealed metal or plastic units the packaging requirements are waived 49 CFR §173.164 (c) (1). The only requirement is that they are packaged in strong outer packaging. The logic behind this exemption is that Mercury leakage from these manufactured articles is impossible since they are in sealed leakproof units and constructed of robust materials. These articles tend to be very rugged and stronger than the outer packaging and not prone to damage that would cause leakage. Furthermore the amount of Mercury in each single manufactured electrical article tends to be quite small. The total weight of Mercury rarely exceeds 15 grams and typically is in the range of .1 to 5 grams. Although a shipment of manufactured electrical articles could contain a large amount of Mercury, leakage from the total shipment is an almost mathematical impossibility. This is due to the fact that the Mercury is sealed in a very redundant system (small amounts of Mercury sealed in many individual leakproof units). In the very improbable event that there was Mercury leakage from a sealed leakproof manufactured article, the amount would be too small to cause a corrosive safety issue and would furthermore be contained by the strong outer packaging.

### Justification for Proposed Special Permit

The level of safety contemplated by the special permit should equal the level of safety provided by the HMR.

Mercotac Inc. does not believe that their proposed use of non-specification packaging and the change to shipping paper requirements to aircraft transportation only would impact safety. The special permit would restrict the non-specification packaging to Gallium contained in manufactured articles, described as electrical items that are totally enclosed, leakproof, and in sealed metal or plastic units and would still require shipping papers for aircraft transportation.

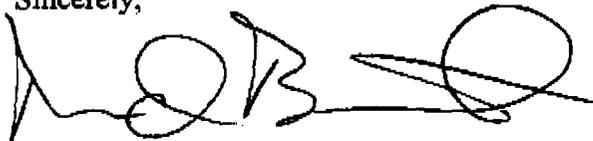
This would be the exact same relief provided for Manufactured articles containing Mercury at 49 CFR §173.164 (c) (1), 49 CFR §172.101 Hazardous Materials table, "Mercury contained in manufactured articles", column 1, A, as explained at 49 CFR §172.101 (b)(2) and §172.200 (b)(1)

The applicant is not aware of any increased risk to safety or property that may result if the proposed special permit is granted. To the extent that the proposed use of non- specification packaging might create such a risk, Mercotac Inc believes that these risks are addressed by the proposed limitations to Gallium contained in manufactured articles consisting of electrical items which are totally enclosed, leakproof, and in sealed metal or plastic units and are in themselves much stronger than the packaging which protects them. As referenced in our previous application, which is attached, there was a drop test conducted without packaging from 25 feet onto a hard asphalt surface with no evidence of leakage. Mercotac Inc. believes these risks are further addressed by the fact the Gallium is contained within a multiple redundant system (small amounts of Mercury sealed in many individual leakproof units) so that, in the extremely improbable event of leakage, the quantity of Gallium would be so small (one item) as not to cause a corrosive safety issue and would also be contained within the strong outer packaging. The first manufactured electrical items that would be transported under the proposed special permit would only contain 0.16 gm of Gallium each. Mercotac Inc believes future manufactured electrical items of larger design would never exceed 6 – 8 grams of Gallium per item.

Furthermore, "Mercury contained in manufactured articles", a metal with almost an exact corrosiveness profile against aluminum as Gallium, has been safely shipped in large quantities for many years under the same procedures as the proposed special permit. Mercotac Inc. is not aware of any incidents involving "Mercury contained in manufactured articles" that were shipped per 49 CFR §173.164 (c) (1) exemptions.

Mercotac Inc believes that the safety record pertaining to "Mercury contained in manufactured articles" that were shipped per 49 CFR §173.164 (c) (1), 49 CFR §172.101 Hazardous Materials table "Mercury contained in a manufactured articles", column 1, A, 49 CFR §172.101 (b)(2), and 49 CFR §172.200 (b)(1) exemptions more than thoroughly demonstrates that identical manufactured articles containing Gallium instead of Mercury would not increase property or safety risk.

Sincerely,



David Brunet  
Vice President



6195 Corte Del Cedro, Carlsbad California 92011  
Telephone (760) 431-7723 • Fax (760) 431-0905

**ATTACHMENT TO APPLICATION FOR SPECIAL PERMIT  
DATED APRIL 1, 2009**

**PETITION TO AMMEND HAZARDOUS  
MATERIAL REGULATAIONS FOR "GALLIUM"**

May 21, 2007

Office of Hazardous Materials Standards  
Pipeline and Hazardous Materials Safety Administration  
Attn: PHH-10  
US Department of Transportation  
400 7<sup>th</sup> Street, SW  
Washington, DC 20590-0001

RE: Petition to amend regulations for 49CFR Section 173.162 Gallium

Mercotac, Inc., a California corporation, is applying under 49CFR §106.95 to amend the hazardous materials shipping regulations 49CFR §173.162 for Gallium due to a new commercial application in electrical devices. The amendments requested are as follows:

- 1) To add the Hazardous material description "Gallium contained in manufactured articles" to the 49CFR §172.101 Hazardous Materials Table.
- 2) To restrict the application of 49CFR Subchapter C requirements for the new "Hazardous Materials Description" heading "Gallium contained in manufactured articles" to those materials offered or intended for transportation by aircraft. In the 49CFR §172.101 Hazardous Materials Table, Column 1 "Symbols" would be "A".
- 3) To add packaging exclusions in 49CFR §173.162 under a new subparagraph (d) for "Electrical devices that are totally enclosed, leak proof, and in sealed metal or plastic units". (The complete description below)

These changes were modeled after the requirement for "Mercury contained in manufactured articles" in the 49CFR §172.101 Hazardous Materials Table and 49CFR §173.164 "Mercury (metallic and articles containing mercury)" since the corrosive nature of Mercury is very similar to Gallium. These requested changes would not increase the risk either to safety or property.

**ABOVE ITEMS 1 & 2, PROPOSED NEW TABLE ENTRY 49CFR §172.101 TABLE**

Hazardous materials descriptions and proper shipping names (2)	Hazard class or Division (3)	Identification Numbers (4)	Pack- ing group (5)	Label(s) required (if not excepted) (6)	Special provisions (7)	(8) Packaging authorizations (173.***)			(9) Quantity limitations		(10) Vessel stowage requirements	
						Exceptions (8A)	Non-bulk packaging (8B)	Bulk packaging (8C)	Passenger aircraft or railcar (9A)	Cargo aircraft only (9B)	Vessel stowage (10A)	Other stowage provisions (10B)
Gallium	8	UN2803	III	CORROSIVE	T1, T33	None	162	240	20 Kg	20 Kg	B	48
Gallium contained in manufactured articles	8	UN2803	III	CORROSIVE	.....	None	162	None	None	None	B	48

**FOR REFERENCE EXISTING 49CFR §172.101 TABLE ENTRIES FOR MERCURY**

Hazardous materials descriptions and proper shipping names (2)	Hazard class or Division (3)	Identification Numbers (4)	Pack- ing group (5)	Label(s) required (if not excepted) (6)	Special provisions (7)	(8) Packaging authorizations (173.***)			(9) Quantity limitations		(10) Vessel stowage requirements	
						Exceptions (8A)	Non-bulk packaging (8B)	Bulk packaging (8C)	Passenger aircraft or railcar (9A)	Cargo aircraft only (9B)	Vessel stowage (10A)	Other stowage provisions (10B)
Mercury	8	UN2809	III	CORROSIVE	.....	164	164	240	35 Kg	35 Kg	B	40, 97
Mercury contained in manufactured articles	8	UN2809	III	CORROSIVE	.....	None	164	None	None	None	B	40, 97

**ABOVE ITEM 3, TEXT FOR PACKAGING EXCLUSIONS, 49CFR §173.162 "GALLIUM".**

Preferred addition for subchapter 49CFR §173.162 "Gallium" as subparagraph (d):

*(d) Manufactured articles or apparatuses of which Gallium is a component part of an electrical device, such as relays, switches, etc., are excepted from the specification packaging requirements of this subchapter if they are totally enclosed, leakproof, and in sealed metal or plastic units and packaged so that the quantity of Gallium per package does not exceed 1 lb (.454 kg).*

Alternate for subchapter 49CFR §173.162 with stricter product performance requirements:

*(d) Manufactured articles or apparatuses of which Gallium is a component part of an electrical device, such as relays, switches, etc., are excepted from the specification packaging requirements of this subchapter if they are totally enclosed, leakproof, and in sealed metal or plastic units and can withstand a drop from a height of 10 feet without any packaging onto a hard concrete surface with no Gallium leakage and where the quantity of Gallium per package does not to exceed 1 lb (.454 kg).*

## **SUPPORTING INFORMATION FOR THIS APPLICATION**

### **History of Mercotac Inc. and Mercury Use:**

Mercotac, Inc is a small US manufacturer of rotating electrical connectors, which are used almost exclusively in industrial equipment. These connectors are used in many applications, which require the transfer of electrical power, control signals or computer signals to and from a rotating shaft or member, which is not possible with wires due to the rotating motion. Some of the many applications are semiconductor manufacturing, underground video cameras, packaging machines, semiprecious and precious metal plating, rotary welding applications, automated assembly tables and systems, manufacturing automation, high-speed printing, lamination machines, etc. Mercury, which is an electrically conductive liquid metal, is used in the connectors manufactured by Mercotac, Inc. as the transferring link between the stationary and rotating parts. Mercury has a long history of use in the electrical fields such as relays and switches because of the unique property that it is the only pure metal that is liquid at room temperature and at the same time is an electrical conductor. Mercury is used because it makes a very compact rotating connector that is almost as good as a solid wire without loss of electrical power or degrading of electrical signals and offers at the same time an extremely long life. For many applications there is no suitable or economical replacement. There is an older technology known as a slip ring, which uses brushes sliding on a shaft to make the connection. This technology is not suitable for many modern applications due to the short rotational life, degradation of the electrical signals, which can cause problems with modern electronics, and the large size needed for electrical power.

### **Mercury Environmental Regulations:**

There is increasing governmental regulation against the use of Mercury due to environmental concerns. Mercury, when released into the environment is converted by bacteria into Methyl Mercury. Methyl Mercury is extremely toxic to living organisms, and is passed along in the food chain. These regulations attempt to limit Mercury's use so that it cannot accumulate in the environment. The European Union through the RoHS directive has a ban on Mercury in many applications. China is now proceeding with similar regulations. Many states in the US also are enacting bans. RoHS initiatives are being considered in Australia, Argentina, Mexico, Taiwan, and South Korea. With passing time there will be more governmental regulations banning Mercury. For many of Mercury's uses there are suitable replacements. Until now there has not been a suitable replacement for Mercury in our rotating connectors.

### **Mercury Replacement Research:**

Mercotac, Inc. has been conducting research upon a eutectic alloy as a replacement for Mercury. This alloy is comprised mainly of the metals Gallium and Indium with moderate amounts of tin, with trace amounts of other metals such as copper, bismuth, or zinc. Gallium at room temperature is a solid but when alloyed with other metals can be liquid at room temperature. Furthermore this alloy does not have the environmental problems of Mercury though it has Mercury's corrosive properties upon some metals. Although this alloy is an excellent conductor it is not a drop-in replacement for Mercury since it has physical properties that make it hard to use. There has not been much research on using this alloy as a replacement for Mercury in electrical items due to Gallium's cost, which is 10 to 15 times more expensive than Mercury. Further limiting Gallium's use is that this metal has been getting increasingly more expensive due to the demand in the manufacture of LCD flat panel displays and televisions. Mercotac has spent many years on research and has finally determined how to use this alloy as a replacement for Mercury in our rotating connectors.

**Existing Mercury Hazardous Shipping Regulations:**

The existing Hazardous Material shipping regulations for "Mercury" and "Mercury contained in manufactured articles" are included in 49CFR, parts 100 to 177. The Hazardous Materials Table is at 49CFR §172.101, with the non-bulk packaging exceptions for "Mercury" and "Mercury contained in manufactured articles" at 49CFR §173.164. For shipments by ground there are no packaging or reporting requirements for quantities less than a pound, at which point Mercury is regarded as a "Hazardous Substance" and requires reporting and packaging per packing group III performance level. For air shipments Mercury is considered a Class 8 corrosive and requires labeling, reporting, and packaging to packing group I or III. There are many exceptions to the packaging requirements listed at 49CFR §173.164 for "Mercury contained in manufactured articles". For electrical devices, such as relays and switches, there is an exception from the performance packaging requirements "if they are totally enclosed, leakproof and in sealed or plastic units".

**Existing Gallium Hazardous Shipping Regulations:**

The existing Hazardous Material shipping regulations for Gallium are included in 49CFR, parts 100 to 177. The Hazardous Materials Table, which includes Gallium, is at 49CFR §172.101. Unlike Mercury, there is no listing in the table for "Gallium contained in manufactured articles". Also the shipping treatment of Gallium is essentially the same for shipment either by ground, water or air shipment, with the only difference being the packing performance group required. There also are no packaging exceptions for Gallium except for very minute amounts (less than 100mg) in manufactured articles 49CFR §173.162 (c). The probable reason for not previously having a listing for "Gallium contained in manufactured articles", or packaging exceptions, or ground shipment labeling and packaging exclusions, is that there have not been commercial applications for this metal in manufactured articles. Unlike Mercury, Gallium even in large quantities is not considered a "Hazardous Substance" as listed in the 49CFR §172.101 Appendix A. In addition there are no health hazards associated with Gallium, but like Mercury it is a corrosive in the same manner to certain metals.

**Why are there Exemptions for "Mercury contained in manufactured articles"**

Mercury has many commercial uses both as a pure metal and for use in manufactured articles. As the commercial uses have expanded there has developed the need for shipment exclusions for manufactured articles, which because of their construction are safe and do not pose any hazard of leakage when shipped. The exemptions may take the form of reduced packaging requirements or labeling requirements. One such exemption for "Mercury contained in manufactured articles" is for items like relays and switches. They are excepted from packaging requirements for all modes of shipment if "they are totally enclosed, leakproof and in sealed metal or plastic units" because it is deemed leakage is not possible. Also for ground shipment of "Mercury contained in manufactured articles", there is no packaging or reporting requirements unless the package contains more than one pound of Mercury. Mercury over this quantity is deemed a "Hazardous Substance". Please note that for the above referenced items such as relays and switches these still would be excepted from the packaging requirements even if the package contained more than a pound of Mercury. In addition there is no labeling requirement for ground or water shipment.

**Ruggedness of Existing Mercotac Rotating Connectors:**

Mercotac connectors contain Mercury that is enclosed and sealed within a leak proof metal and plastic unit. Mercury leakage is virtually impossible even under extreme shipping conditions. Mercotac connectors have been dropped tested without any packaging from the height of 2 stories of approximately 25 Feet onto hard asphalt paving. While the connector was damaged and probably no longer useable there was no Mercury leakage. Any box type packaging dropped from this height would probably have been destroyed. Because of the Mercotac connector's sealed ruggedness there is no need of a packaging requirement since leakage of the hazardous material Mercury is not possible and therefore does not pose a hazard.

**Gallium Rotating Connectors are the same rugged construction:**

Mercotac's new Gallium Rotating Connectors are of the identical rugged construction as our Mercotac Mercury Rotating Connectors. The Gallium eutectic alloy is sealed within a leak proof metal and plastic unit, which makes Gallium leakage impossible even under extreme shipping conditions. They will survive the same drop test from 2 stories onto a hard asphalt surface without any leakage thus making the packaging inconsequential. The packaging would be present only to protect the connectors from cosmetic damage.

**New Hazardous Shipping Classification needed "Gallium contained in a manufactured article":**

Due to the new commercial industrial use of Gallium in a rotating connector, Mercotac, Inc is applying for a new Hazardous shipping classification "Gallium contained in manufactured articles". The UN identification number for Gallium contained in manufactured articles would remain unchanged at UN2803.

This need for a new classification is based upon the same reasoning as the two headings "Mercury" and "Mercury contained in manufactured articles". There is a need for a manufactured articles classification to differentiate them from bulk metal shipments. Mercotac Inc. believes that with the increasing regulation and prohibition of Mercury there will be more future commercial uses for Gallium as a replacement for Mercury, which would further require this new description.

**Justification of Packaging Exceptions for "Gallium contained in Manufactured articles":**

As previously stated above Mercotac Inc., is also applying for packaging exceptions for "Electrical devices such as relays, switches, etc. that contain Gallium and are totally enclosed, leakproof, and in plastic or metal units." In 49CFR §173.164 there is already packaging exclusions for exactly the same items that contain Mercury. This Mercury packaging exclusion was granted because these items were deemed safe to ship without performance packing due to the leakproof design. Since the adoption of this packaging exclusion sealed Mercury electrical items have been safely shipped without incident. The proposed addition to 49CFR §173.162 for the same items that contain Gallium instead of Mercury would also be safe since they are of the same leakproof rugged design, which makes leakage of Gallium not possible. The identical items that contain Gallium and also have the same safety profile should also be permitted the same requirements. Even though Gallium in quantity is not considered a "Hazardous Substance" per 49CFR §172.101 Appendix A, Mercotac Inc., considered it practical to limit the amount per package to a reasonable amount. From a safety issue towards personnel Gallium is not considered a toxic substance unlike Mercury, which is well-known for its toxicity and requires special treatment if released or spilled.

## Summary

There is an environmental need for new electrical products that contain Gallium as a replacement for Mercury. In order to introduce these new products to market there is a need for a reduction in the costs associated with shipping the Hazardous Material Gallium in electrical items. It has been established that Mercury-containing electrical devices such as relays and switches are safe to transport with lesser requirements since they are sealed against leakage. It has also been shown that Gallium electrical devices such as relays and switches are safe to transport since they are also sealed against leakage. The changes in the regulations requested are to bring Gallium's Hazardous Materials shipping regulations in line with the exemptions for the same items that contain Mercury since these items have the identical safety profile.

Sincerely,

David Brunet  
Vice President