

Issue Paper

Refrigerated Container (Reefer) Explosion

Background

On 18 October 2011, Maersk Line informed the World Shipping Council's Safe Transport of Containers Working Group that it had recently experienced three cases in which refrigeration units had exploded for no apparent reason. The explosions occurred on three separate occasions in 2011 in Itajai, Brazil and Cat Lai, Vietnam. Two men died in Vietnam and one in Brazil as a result of the explosions. CMA CGM also reported that explosion occurred in one of their refrigerated containers in Qingdao, China, in October.

US reefer technology provider Carrier Transicold has identified the port where the four reefer machines that experienced compressor ruptures received refrigeration system service work at Cat Lai in Vietnam. Maersk Line identified the malfunctioning containers underwent gas system repairs and maintenance at the same repair yard in Vietnam between 30 March 2011 and 25 April 2011.

Investigation into the causes of explosions

While the precise causes of the explosions are still under investigation, preliminary analysis appears to confirm suspicions that the cause of the explosions was contaminated gas in the cooling units. Peter Smidt-Nielsen, general director of Maersk in Vietnam, tells *beyondbrics*¹ that the situation is "very unusual" although he knows of one similar case in the 1980s and another one in the 1990s. Consultants Cambridge Refrigeration Technology, which is helping Maersk Line with its investigation, said material recovered from the exploded units had been analysed and evidence pointed to a counterfeit refrigerant being to blame for the explosions².

Carrier Transicold stated in their 8 November 2011 letter³ that "Independent lab analysis of one quarantined reefer container unit has definitively identified R40 as a contaminant." In its 16 November 2011 letter⁴, Daikin informed it had analyzed the contents of the gas which was extracted from a compressor and R40 was identified.

R-40, also called methyl chloride or chloromethane, is a hazardous chemical compound that is extremely flammable⁵. It was a widely used refrigerant, but its use has been discontinued due to its toxicity and flammability. The most important use of methyl chloride today is as a chemical intermediate in the

¹<http://blogs.ft.com/beyond-brics/2011/11/07/vietnams-exploding-reefers/#axzz1iTWsFCNI>

² Attachment 1

³ Attachment 2

⁴ Attachment 3

⁵ http://www.bocsds.com/uk/sds/special/methyl_chloride.pdf

production of silicone polymers. According to Neutronics Inc.'s R-40 alert⁶, R-40 reacts with aluminum and creates Trimethylaluminum which is a pyrophoric substance that will ignite spontaneously in air.

Summary of actions taken

Various actions have been undertaken by various stakeholders to address safety issue:

- Maersk Line had grounded 844 refrigerated containers that may contain contaminated coolant fluid, while CMA CGM has grounded 332 and Singapore-based-APL has grounded around 103 as a precaution measure.
- Maersk has also issued guidelines that any suspect boxes be cross-stuffed, the machinery unplugged and the containers be stored in an isolated position with the machinery facing away from people or traffic.
- Saigon New Port (SNP), operator of Cat Lai container terminal, had appointed one direct supplier of refrigerant “for all the items of M & R requiring the refrigerant serving for the reefer containers at SNP’s facilities”⁷.

Furthermore, fluorocarbon producers have warned customers to only purchase refrigerants from authorized suppliers. They are also adopting measures to address counterfeit refrigerants:

- Honeywell started using a new security measures to detect counterfeit refrigerants. The new anti-counterfeit technology allows for the identification of non-authentic products much faster and more easily than was previously possible.
- DuPont Refrigerants has initiated DuPont Brand Assurance Program. The Brand Assurance Program uses a proprietary DuPont technology which involves 3D holographic label.

The boiling point of R-40 is similar to that of R-134a, hence it is very difficult to detect R-40 when they are mixed in the refrigerant system. Various stakeholders are developing methods to check if R-40.

- Maersk Container Industry, in its 21 December 2011 Safety Notice, suggested the only practical method to ensure that R134a being added during service repairs is free from R-40 and any other chemical containing chlorine, is to use a flame halide detector to test each R-134a cylinder for any chlorine contamination. R-134a is fluorinated and does not change the blue color of the flame. A green flame indicates the presence of chlorine, eg. R- 22 will show a green flame because it contains chlorine.

⁶ <http://www.refrigerantid.com/R40.html>

⁷ <http://maritimeaccident.org/2011/11/exploding-reefers-the-vietnam-connection/>



- Neutronics’ R-40 alert also stated that “the ONLY acceptable readings on Neutronics Ultima ID DX or HV series refrigerant identifiers for a "virgin" R-134a cylinder are:

R-134a	100%
R-12	0%
R-22	0%
HC	0%
Air/Non	0%

- US-based Society of Automotive Engineers (SAE), in particular SAE’s, will be discussing the R-40 issue during the January 17, 2012 SAE Interior Climate Control Standards Committee meeting at MACS 2012 Convention in Las Vegas, Nevada.

Issues for National Ozone Unit:

HFC-134a is the widely adopted alternative refrigerants for refrigeration and air-conditioning equipment including domestic refrigerator, Mobile A/C systems, and reefers. There is evidence that R-40 has been supplied in 30lb. cylinders and marked as R-134a. R-40 and R-40 mixed with other refrigerants have been used by the refrigeration technicians to service, both stationary and MAC thinking it was the real R-134a. It is advisable for the National Ozone Unit to consider various measures to address the issue of counterfeit refrigerants to avoid widespread damage to RAC systems and negative opinions against ODS alternatives in the country.

- Coordinate with RAC equipment manufacturer (mobile A/C, domestic and refrigerator, compressor) to provide notice to their dealers.
- Coordinate with refrigerant importers/distributors to conduct random checking of refrigerants in the market and to provide notice to their customers.
- Inform Customs officials to be more vigilant on fake R134a gas and to use refrigerant identifiers to check for their purity level.
- Coordinate with refrigeration associations to provide notice to their members.
- Disseminate information to media, in particular those related to refrigeration and air-conditioning, to spread out the news among relevant stakeholders.

Attachment 1



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REFRIGERATION
TECHNOLOGY

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24 November 2011

Revised Information Regarding Counterfeit Refrigerant

There have been cases of reefer containers suffering explosions. Refrigerated container refrigeration units should contain polyolester oil and the refrigerant HFC-134a (1,1,1,2-Tetrafluoroethane) and should therefore be incapable of exploding.

Material recovered from the exploded units have been analysed by a laboratory and were found to be corroded by a chlorinated compound. A pyrophoric liquid (burns in contact with air) and traces of alumina (Al_2O_3) were also found at the sites.

From the above we can be reasonably certain that the pyrophoric liquid is trimethyl aluminium ($Al_2(CH_3)_6$), though it is not yet proven. The explanation is that the system has been contaminated with a counterfeit refrigerant containing methyl chloride (chloromethane, CH_3Cl); this has been proven by testing). This gas works as a refrigerant but reacts with the aluminium in the compressor probably forming trimethyl aluminium, which is a liquid at room temperature.

According to Wiley's Guide to Chemical Incompatibilities, trimethyl aluminium is an extremely reactive liquid, and will react violently with hydroxides; carbon dioxide, carbon tetrachloride, halon, halogens and halogenated hydrocarbons (e.g. refrigerants), oxides of nitrogen and many other substances.

The issues that need to be resolved are:

- How can this be prevented from occurring again?
- How can withdrawn units be checked for contamination?
- What is the procedure for making safe a contaminated reefer unit?

1. How can this be prevented from occurring again?

Refrigerant gas supplied to service depots needs to be from a certified source with a certificate of veracity of contents. Existing refrigerant gas held in stock can easily be checked using a standard halide lamp flame test. If this type of test is undertaken, it needs to be in a well-ventilated area in order that the degradation products of the refrigerants are safely removed, e.g. beneath a fume hood. It should be noted that no manufacture of either electronic refrigerant analysers or refrigeration leak detectors has so far been found that can identify a mixture of HFC-134a and methyl chloride as contaminated.

2. How can the withdrawn units be checked for contamination?

Withdrawn units will need to have their refrigerant gas checked, though the likelihood of identification of a problem unit may be increased by examination of the service records. According to Johnson Controls and Konika, the counterfeit refrigerant is a blend and therefore even if the methyl chloride and dichloromethane were consumed by reaction with aluminium, then the flame test would still detect the HCFC-22 and HCFC-141b. This can be lab verified once further samples have been analysed.

At present, no procedure has been agreed upon for the checking of existent gas within a reefer container.

3. What is the procedure for making safe a contaminated reefer unit?

Once a contaminated unit has been identified a procedure for making them safe needs to be identified. The problem is that trimethyl aluminium is a liquid and will be sitting in the crankcase of the compressor. Adding refrigerant or turning the machine on could cause an explosion.

There are several methods under investigation for the removal of trimethyl aluminium from within the reefer refrigeration circuit but as yet none has been agreed upon.

SUMMARY

It is now clear that the explosions are due to a counterfeit refrigerant containing chloromethane.

Looking forward, the following points need to be addressed:

- Existing refrigerant stock needs to be checked for contamination
- A refrigeration certification scheme needs to be put in place for future purchases
- A method for checking the withdrawn reefer units for contamination is required
- A safe method for compressor removal of contaminated units is to be identified

Source of Information:

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Attachment 2



TO: Equipment Owners – Carrier Container Refrigeration Units
Authorized Service Centers – Carrier Container Products

FROM: Michael Dormer
General Manager, Global Container Services
Container Products Group

RE: REEFER SAFETY UPDATE

DATE: November 8, 2011

In our continuing effort to share new information regarding R134a refrigerant contamination in certain reefer units as it becomes available, Carrier provides the following update to our customers and authorized service network partners:

- Independent lab analysis of one quarantined reefer container unit has definitively identified R40 (methyl chloride) as a contaminant. R40 is a hazardous refrigerant that should never be used in a refrigeration system.
- Currently, a test device capable of safely detecting R40 in contaminated reefer systems is not commercially available. Until one becomes available, Carrier reiterates the importance of our previous reefer quarantine recommendations (*see attached Safety Bulletins, 27-Oct-11 and 21-Oct-11*).
- Refrigerant identification tools for checking the purity of gas contained in R134a bottles are commercially available from a number of different suppliers. Carrier does not recommend the use of Flame Halide Detectors for checking the purity of gas contained in R134a refrigerant bottles.

We will continue to monitor the situation, and will share additional information as warranted.

CTR-SER11-008

Attachment 3



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November 16, 2011

RE: Suspected Refrigerant Contamination in Reefer Containers

Since middle of October 2011, when the compressor rupture cases were known to the industry, Daikin has been conducting investigations to discover the root cause. Daikin analyzed the contents of the gas which was extracted from a compressor and R40(methyl chloride) was identified. The refrigerant was charged at Cat Lai Terminal in Vietnam recently.

R40 is a hazardous refrigerant which should never be used in a R134a refrigeration system. Due to the fact that boiling point of R40 is similar to that of R134a, it is very difficult to detect whether they are mixed in the refrigerant system.

R40 reacts with aluminum and creates Trimethyl Aluminum, and Trimethyl Aluminum is flammable.

Like other machine manufacturers, Daikin uses aluminum in some compressor components.

Therefore, Daikin recommends you not to perform any work on reefers, which had recently any refrigerant system work done in Vietnam, regardless of warranty repair or not.

Daikin provides a list of reefer machines which had any refrigerant system service work done in Vietnam under warranty, since January, 2011.

Please contact your Daikin sales representative if the data for a longer period is required.

Daikin is also investigating to find how to detect R40 in a refrigeration system and other safety solutions. We will advise when the details are available.

Yours Sincerely,
Syouhei Tsutsumi
Vice president Reefer Business
Daikin Refrigeration Division

Updates, 20 April 2012: The following documents have been published in relation to the recent occurrences of ruptured compressors in some container refrigeration machinery. This is the information that has been released (that the UNEP-ROAP CAP is aware of) about these incidents. It is possible that other information has also been published:

- **Maersk Line Letter (released by the WSC): 18 October 2011**
- **Carrier Transicold: 21 October 2011**
- **Carrier Transicold: 27 October 2011**
- **Thermo King: 27 October 2011**
- **GEA Bock: September 2011**
- **Maersk Line update to WSC 28 October 2011**
- **Star Cool: 1 November 2011**
- **Lloyd's Register: 3 November 2011**
- **Carrier Transicold: 8 November 2011**
- **Daikin Industries: 9 November 2011**
- **Thermo King: 11 November 2011**
- **Daikin Industries: 16 November 2011**
- **Carrier Transicold (Refrigerant Quality Guidelines): 24 November 2011**
- **CRT: 6 December 2011**
- **Carrier Transicold (Testing of new R134a refrigerant supply): 16 December 2011**
- **Society of Automotive Engineers: 21 December 2011**
- **Star Cool: 21 December 2011**
- **MCI Safety Notice: 21 December 2011**
- **CRT Guide to Flame Testing: 16 January 2012**
- **Halide Torch Information: 16 January 2012**

October 18, 2011

Maersk Line has recently experienced incidents with 4 of our reefer containers, which potentially have a contaminated gas system. 3 of the reefer units have had explosions that have resulted in 3 fatalities.

From what we know at this stage a gas has been used in the cooling system, which potentially can cause damage when the container is on power. This is currently being investigated by our own technicians as well as the unit manufacturers and external specialists.

We have not been able to identify the exact cause of the incidents, but we have noted that the units involved have had a gas repair in Vietnam between late March and late April. While it is still too early to conclude, we suspect that during these repairs the gas system may have been contaminated and that this contamination could cause the issues we have seen. Should you have had repair or maintenance carried out in Vietnam in the same period, you may wish to take precautionary measures and technical investigations.

In order to curb the risk, we are in the process of grounding approximately 800 reefers while we conduct thorough technical investigations to determine the exact cause of the issue. The conclusions of these we will use to develop a repair method if needed for the units and then get the containers back in flow.

Once the containers have been grounded it is of the utmost importance that no repairs are attempted, parts cannot be removed, and they may not be plugged in until a thorough technical investigation has taken place. We further recommend that they are stored in an isolated place and if at all possible to store them with the units facing each other, thereby preventing unauthorized personnel in tampering with them.



TO: Authorized Service Centers – Carrier Container Products

FROM: Michael Dormer
General Manager, Global Container Services
Container Products Group

RE: URGENT SAFETY BULLETIN

DATE: October 21, 2011

We are contacting you regarding a recent potential safety issue that has come to our attention affecting several different brands of container refrigeration units.

To date, there have been four units that have experienced compressor ruptures with three fatalities, and one unit where the refrigerant reportedly spontaneously combusted when exposed to air. While no definitive cause of these incidents has been determined yet, Maersk, CMA/CGM, Hapag-Lloyd and others have identified at least 900 refrigeration units that they suspect may contain contaminated refrigerant and have quarantined those units. While not yet confirmed, it is our understanding at this time that the quarantined units may have received contaminated refrigerant during refrigeration system work performed in Vietnam since the beginning of 2011.

As part of the quarantine, Maersk has given instructions to stop all work on the suspect reefer units, unplug the reefers, and move them to an isolated place. The Maersk communication, which was released through the World Shipping Council, is included with this letter. We believe this is responsible and prudent guidance that you should follow.

Given the information available at this time, we recommend that you contact your reefer customers and request that they immediately implement a reefer quarantine policy that follows the Maersk guidelines for units that had refrigeration system work performed in Vietnam during 2011. We recommend that you do not perform any work on reefers until the reefer owner or lessee can provide you with service records verifying the reefer did not have any refrigeration system service work completed in Vietnam during 2011.

We will continue to monitor the situation and keep you informed of any developments as warranted. We want to work with you to provide accurate information and ensure safe operations at your company and across the industry.

If you receive inquiries from any of your customers that require Carrier support, we ask that you refer them directly to David Whyte, manager, service engineering for Carrier Transicold at +1-315-432-6411 or david.whyte@carrier.utc.com.



TO: Authorized Service Centers – Carrier Container Products

FROM: Michael Dormer
General Manager, Global Container Services
Container Products Group

RE: SAFETY UPDATE

DATE: October 27, 2011

In our continuing effort to share new information as it becomes available, Carrier wants to provide the following additional factual information to its service network:

- Since releasing the October 21 Safety Bulletin, it has come to our attention that there may be some confusion about who has experienced compressor ruptures linked to suspected contaminated refrigerants. It is important to note that compressor ruptures have occurred on various manufacturers' reefer machines.
- All four reefer machines that experienced compressor ruptures received refrigeration system service work in the Cat Lai port in Vietnam.
- Refrigeration system service work includes any work involving the refrigeration system. Examples include: adding refrigerant, repairing leaks, replacing a compressor, replacing a filter drier, etc.
- All reported reefer compressor ruptures have occurred during pre-trip inspection (PTI's), or while refrigeration system service work was being conducted. To date, we are not aware of any compressor ruptures occurring on reefers carrying cargo, either onboard a vessel or on land during transit.

We will continue to monitor the situation, and will share additional information as warranted.



Service Bulletin



SUBJECT: URGENT REFRIGERANT SAFETY BULLETIN

BULLETIN: C-095

DATE: October 27, 2011

We are contacting you regarding a recent potential safety issue that has come to our attention affecting several different brands of container reefer units. We attach a link to a World Cargo News article, published 26 October 2011, stating the facts known to date in the container industry. Additionally, we attach by kind permission of GEA Bock, a document from Bock Compressors, published today 27 October 2011, relating to their investigations on a similar issue.

This information may be supplemented in the coming days as more facts come to light.

As you have likely been made aware, recently there have been a number of very serious, albeit limited incidents of compressor ruptures. To date, there have been four container reefer units that have experienced compressor ruptures resulting in three fatalities, and one unit where the refrigerant reportedly spontaneously combusted when exposed to air. The companies directly involved in the ruptures are working diligently to evaluate the cause of these incidents.

From our preliminary investigation there appears to be one common factor: refrigerants involved were of poor quality, contaminated, or a hazardous substitute. As we await determination of root cause, we would advise you to only buy refrigerants and gases from a reputable source (see Bock bulletin).

We recommend that you do not perform any work on container reefers until the reefer owner or lessee can provide you with service records and information on the origin of the last refrigerant charge made on the unit. In case of suspect origin or no traceability, no work should be performed on this equipment.

We will continue to monitor the situation and keep you informed of any further developments as warranted.

<http://www.worldcargonews.com/htm/w20111026.937700.htm>

Attachment: GEA Bock Product Information bulletin

D	GB	F
<p>1. Kältemittelmischungen 2. Verdichter- und Ersatzteilkopien</p>	<p>1. Refrigerant imitations 2. Compressor and replacement parts copies</p>	<p>1. Fluides frigorigènes contrefaits 2. Copies de compresseurs et de pièces de rechange</p>
<p>1. Achtung! Gefährliche R134a Kältemittel-mischungen im Umlauf</p>	<p>1. Attention! Dangerous R134a refrigerant imitations in circulation!</p>	<p>1. Attention ! Des fluides frigorigènes R134a contrefaits dangereux sont actuellement en circulation !</p>
<p>Derzeit treten vermehrt Ausfälle von Verdichtern auf, die auf die Verwendung von gefälschtem Kältemittel zurückzuführen sind. Untersuchungen dieser Plagiate ergaben, dass die gefälschten Kältemittel, in diesem Fall als R134a deklariert, vorwiegend aus R22, R30, R40 und R142b bestanden.</p>	<p>An increasing number of compressor breakdowns have occurred recently due to refrigerant imitations. Investigations of these fakes show that the imitation refrigerants, in this case declared as R134a, consisted mainly of R22, R30, R40 and R142b.</p>	<p>Nous constatons actuellement une multiplication de pannes de compresseurs provoquées par l'utilisation de fluides frigorigènes contrefaits. Des examens de ces produits piégés ont révélé que les fluides frigorigènes contrefaits déclarés dans ce cas comme R134a sont en fait essentiellement composés de R22, R30, R40 et R142b.</p>
<p>Seit 1. Januar 2010 untersagt das Montreal-Protokoll die Verwendung von R22 in neuen Anlagen und verbietet ab 2015 die generelle Nutzung des Kältemittels. Die Halon-Verbotsverordnung untersagt weiterhin den Einsatz und Vertrieb von R142b.</p>	<p>The Montreal Protocol has prohibited the use of R22 in new systems since 1 January 2010 and will forbid the general use of this refrigerant starting in 2015. The Halon Prohibition Ordinance also prohibits the use and sale of R142b.</p>	<p>Depuis de 1er janvier 2010, le protocole de Montréal interdit l'utilisation de R22 dans les nouvelles installations et de manière générale l'utilisation de ce fluide frigorigène à partir de 2015. L'arrêté d'interdiction des halons interdit en outre l'utilisation et la vente de R142b.</p>
<p>Chlormethan (R40) wurde vor der Entwicklung der FCKW-Kältemittel als Kältemittel eingesetzt. In der Literatur sind Unfälle beschrieben, die auf die Reaktion von R40 mit Aluminium zurückzuführen sind. Demnach bilden sich bei dieser Reaktion hochentzündliche Gase, die bei Berührung mit Luft selbstentzündlich und explosiv sind. Das Aluminium wird nach genügend langer Zeit von dem Kältemittel vollständig aufgelöst. Dabei hemmt das Öl diesen starken Angriff nicht. Die in mobilen Kälteanlagen eingesetzten Aluminium-Verdichter werden durch Chlormethan angegriffen. Weiterhin reagieren Kunststoffmaterialien mit R40. Kältemittelschläuche können durch diese Kältemittel stark beschädigt werden. Das eingesetzte POE-Kältemaschinenöl wird durch die Reaktion mit R40 stark versetzt und in seine Ausgangsstoffe gespalten. Dabei entstehen Säuren und Alkohole.</p>	<p>Chloromethane (R40) was used as a refrigerant before CFC refrigerants were developed. Accidents resulting from the reaction of R40 with aluminium are described in the literature. This reaction is said to create highly inflammable gases which are self-igniting and explosive on contact with air. After sufficient time, the aluminium is completely dissolved by the refrigerant. The oil does not hinder this severe attack. The aluminium compressors used in mobile refrigerating plants are attacked by chloromethane. In addition, plastic materials react with R40. Refrigerant tubes can be strongly damaged by this refrigerant. The POE refrigerating-machine oil is strongly emulsified by the reaction with R40 and split into its component materials. Acids and alcohols result.</p>	<p>Le chlorométhane (R40) était utilisé comme fluide frigorigène avant le développement des fluides frigorigènes à hydrocarbures chlorofluorés. Dans la documentation, des accidents provoqués par la réaction de R40 avec l'aluminium sont décrits. Cette réaction forme en outre des gaz hautement inflammables, qui s'avèrent auto-inflammables et explosifs en cas de contact avec l'air. L'aluminium est intégralement dissout par le fluide frigorigène après une période prolongée. L'huile ne freine pas cette attaque intense. Les compresseurs en aluminium utilisés dans les installations frigorifiques mobiles sont attaqués par le chlorométhane. Les matières plastiques ont également une réaction avec le R40. Les tuyaux de fluide frigorigène peuvent donc être fortement endommagés par ce fluide frigorigène.</p>
<p>Desweiteren ist gestrecktes R134a im Umlauf, das R22 und teilweise auch Propan enthält. In „Heißländern“ treten dabei folgende Probleme auf:</p>	<p>Also in circulation is diluted R134a, which contains R22 and, at times, propane. This creates the following problems in „hot countries“:</p>	<p>Du R134a dilué et contenant du R22 ainsi que du propane est également en circulation. Dans les « pays chauds », les problèmes suivants apparaissent :</p>
<p>1.1 Die Temperatur/Druckkennlinien stimmen nicht miteinander überein. Durch die Beimischung von R22 ist die Drucklage gegenüber reinem R134a ca. 1-1,5 bar niedriger. Das heißt, im Stillstand der Anlage kann keine Aussage über die richtige Kältemittelfüllmenge gemacht werden. Ebenso ist die scheinbar vorhandene Sauggasüberhitzung von 7K nicht vorhanden, sondern der Verdichter fährt voll flüssig.</p>	<p>1.1 The temperature/pressure characteristics curves no longer agree. The addition of R22 reduces the pressure by about 1-1.5 bar compared to pure R134a. That means, when the system is at standstill, the correct refrigerant fill amount cannot be specified. Likewise, the apparent suction gas superheating of 7K is not real, but the compressor runs completely liquid.</p>	<p>1.1 Les courbes caractéristiques de température/pression ne correspondent plus. L'adjonction de R22 diminue la pression par rapport au R134a pur d'env. 1 à 1,5 bar. Cela signifie que lorsque l'installation est à l'arrêt, il est impossible d'évaluer la quantité de remplissage exacte en fluide frigorigène. De même, la surchauffe des gaz aspirés de 7K qui semble présente n'existe pas, mais le compresseur fonctionne entièrement sous forme liquide.</p>
<p>1.2 Durch die Beimischung von R22 wird das Öl nicht mehr aus dem System zum Verdichter zurück transportiert. Einige Verdichter fallen dann wegen Mangelschmierung aus.</p>	<p>1.2 Due to the addition of R22, the oil is no longer transported from the system back to the compressor. Some compressors will then break down due to a lack of lubrication.</p>	<p>1.2 Avec l'adjonction de R22, l'huile n'est plus renvoyée du système vers le compresseur. Certains compresseurs tombent alors en panne en raison d'une lubrification insuffisante.</p>
<p>1.3 Durch die Beimischung von Propan gibt es ein höheres Brandrisiko. Bei nicht ordnungsgemäßer Abspaugung des Kältemittels kann es zu Bränden kommen.</p>	<p>1.3 The addition of propane increases the fire risk. Fires may result if the refrigerant is not suctioned away properly.</p>	<p>1.3 Avec l'adjonction de R22, l'huile n'est plus renvoyée du système vers le compresseur. Certains compresseurs tombent alors en panne en raison d'une lubrification insuffisante.</p>

October 28, 2011

Following the information Maersk Line provided via World Shipping Council, we have been able to collect samples from the unit that exploded in Itajai as well as gas samples from containers we have grounded and that have had gas repairs done in Vietnam. We are awaiting outcome of laboratory tests to determine what may have caused the explosion and the contents of the grounded units.

The investigations so far indicate that explosions have indeed been caused by a contaminated refrigerant being injected into the cooling system. This is supported by traces of Chloride being found on samples from the reefer in Itajai. We further believe that incorrect repair processes and procedures would not be able to cause the explosions. Work on developing a safe repair method as well as a device to detect contaminated Freon is ongoing and will be shared as soon as it is ready.

Maersk Line has decided to switch off and ground all reefers having had a repair in Vietnam between February 1 and up to today as a precautionary measure.

To ensure the investigations continue to progress, it is critical that all lines that have experienced issues with their reefers make this information available for all, so the correct conclusions can be made.

Safety Notice to all Star Cool Service Providers

There have been several bulletins and reports from machinery manufacturers and shipping lines in relation to the unfortunate incidences of compressor ruptures, spontaneous combustion of refrigerant and system contamination.

The messages contained in these bulletins focus on the need to identify and quarantine suspect equipment, as well as ensuring that refrigerants are procured from genuine, reliable sources.

Maersk Container Industry supports these initiatives, particularly during the present situation where the cause and substance/s involved are yet to be determined.

Once the nature of the contaminant has been determined, it should then be possible to develop a safe procedure to test for the substance/s and if the system is contaminated, find a safe procedure for removal, system cleaning and to understand which components may have been affected.

We will update you with further information once it becomes available.

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Classification News

November 3, 2011 No. 31/2011

Safety alert: Explosion of refrigerated container compression units and recommendations for recharging

Applicability: Container ship operators and crew, container terminals and stevedores, road haulage firms, maintenance fitters and end users/lessors of refrigerated containers

There have recently been a number of incidents, some fatal, involving explosion of the compressor units fitted to refrigerated (reefer) containers.

The cause of the explosions is still under investigation but it appears that the servicing of the refrigeration system is a common factor in each case.

It has been reported to Lloyd's Register that refrigerant gas in refrigeration and air conditioning plants is being recharged or 'topped up' with different types of gas. This may have been a contributing factor to the explosions.

The international community is phasing-out the use of HCFC R-22 refrigerant. This refrigerant is becoming increasingly difficult and costly to obtain. As a result, it has been reported that some service contractors are mixing dissimilar refrigerants in air conditioning and/or refrigeration systems. This practice carries the following significant risks.

1. It may violate several European and national standards, and may be illegal in some countries.
2. The unknown composition of the resultant refrigerant mixture may change system performance unexpectedly.
3. Standard pressure gauges and pressure / temperature charts may no longer be used effectively, preventing effective servicing of the equipment.
4. The mixed refrigerant cannot be reclaimed and must be destroyed at considerable cost to the contractor or the equipment owner.
5. Compressor warranties may be invalidated.
6. Safety may be compromised since the Material Safety Data Sheet (MSDS) for the original refrigerant is no longer valid and does not exist for the mixed refrigerant blend of unknown composition.

Lloyd's Register recommendations

We recommend the following actions when recharging or 'topping up' refrigerant systems.

1. Never mix refrigerants of different types with different ASHRAE numbers in the same system.
2. Only 'top up' refrigerant in any installed system with refrigerant of the same type and ASHRAE number.
3. Clearly label all systems to prevent accidental mixing of different refrigerants.
4. If accidental mixing does occur, remove the entire refrigerant charge immediately and dispose of it properly, in accordance with relevant national laws.

The Maritime and Coastguard Agency (MCA) has also issued a [Marine Information Note](#) on the subject.



TO: Equipment Owners – Carrier Container Refrigeration Units
Authorized Service Centers – Carrier Container Products

FROM: Michael Dormer
General Manager, Global Container Services
Container Products Group

RE: REEFER SAFETY UPDATE

DATE: November 8, 2011

In our continuing effort to share new information regarding R134a refrigerant contamination in certain reefer units as it becomes available, Carrier provides the following update to our customers and authorized service network partners:

- Independent lab analysis of one quarantined reefer container unit has definitively identified R40 (methyl chloride) as a contaminant. R40 is a hazardous refrigerant that should never be used in a refrigeration system.
- Currently, a test device capable of safely detecting R40 in contaminated reefer systems is not commercially available. Until one becomes available, Carrier reiterates the importance of our previous reefer quarantine recommendations (*see attached Safety Bulletins, 27-Oct-11 and 21-Oct-11*).
- Refrigerant identification tools for checking the purity of gas contained in R134a bottles are commercially available from a number of different suppliers. Carrier does not recommend the use of Flame Halide Detectors for checking the purity of gas contained in R134a refrigerant bottles.

We will continue to monitor the situation, and will share additional information as warranted.

CTR-SER11-008



DAIKIN INDUSTRIES, LTD.
REFRIGERATION DIV.
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November 9, 2011

RE: Suspected Refrigerant Contamination in Reefer Containers

Since the issue of the communication in middle of October relating to the compressor ruptures, Daikin have been conducting investigations to discover the root cause. However, at this moment, we only have information which has come from various sources and as yet this information does not contain any fact to specify the root cause.

As a result Daikin does not know if these incidents were due to contaminated refrigerant, miss operation by local engineer or something else. Daikin has never experienced any compressor rupture of refrigeration units to date.

According to one news source, "Refrigerant gas from Daikin unit is said to have spontaneously combusted when exposed to air". This is not correct. According to our re-confirmation, the combustion was not spontaneous. The refrigerant from a Daikin machine will never "spontaneously combust when exposed to air" as long as genuine R134a gas and the recommended lubricant oil is used.

For reference, Daikin have collected refrigerant from a "suspect" container and are analyzing to establish the actual content.

According to the communication the containers which had compressor ruptures have a history of being repaired in Vietnam. Daikin have issued lists of containers which have had warranty repairs in Vietnam to their respective customers. If any customer has not received a list you should contact your local Daikin sales or service staff.

Daikin will provide further updates by safety bulletin when information becomes available.

Yours Sincerely,
Syouhei Tsutsumi
Vice president Reefer Business
Daikin Refrigeration Division



Service Bulletin



SUBJECT: REFRIGERANT SAFETY BULLETIN

BULLETIN: C095-1

DATE: November 11, 2011

The industry is still researching for the best way to handle units that might have contaminated R134a refrigerant.

Based on what is known as of today, Thermo King's recommendations are as follows:

1. Make sure you are getting quality refrigerant from reputable sources and you have traceability of that refrigerant. You should consider requesting that your refrigerant supplier verify the quality of refrigerant being purchased.
2. As the industry is still determining best practices in how to detect and handle the contaminated refrigerant, we recommend not using a halide torch (flame) to test the quality of the refrigerant.
3. Consider using refrigerant identification tools (manufactured and sold by third party companies) available for verifying the purity of the refrigerant in a bottle.
4. Quarantine any refrigeration unit that may have contaminated refrigerant already installed. To our knowledge, currently there is no method developed to test a refrigeration unit that may have contaminated refrigerant already installed.
5. Work only on refrigeration systems where the service records of that unit can be provided. You should review the service records before performing any such repairs.

Take note that the use of the R134a refrigerant is not limited to reefer containers, and, in some regions, may have been used in truck and trailer units.

Finally, please take note that Thermo King Container units CSR, MAGNUM AND MAGNUM PLUS are manufactured with R-404A. To our knowledge the potential refrigerant safety issues reported recently have been linked to units manufactured with R-134a. That being said, as the industry and Thermo King continues to learn more about this developing issue, Thermo King recommends that you exercise a heightened degree of caution when handling any refrigeration units.

As more information becomes available, we will keep you updated.



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November 16, 2011

RE: Suspected Refrigerant Contamination in Reefer Containers

Since middle of October 2011, when the compressor rupture cases were known to the industry, Daikin has been conducting investigations to discover the root cause. Daikin analyzed the contents of the gas which was extracted from a compressor and R40(methyl chloride) was identified. The refrigerant was charged at Cat Lai Terminal in Vietnam recently.

R40 is a hazardous refrigerant which should never be used in a R134a refrigeration system. Due to the fact that boiling point of R40 is similar to that of R134a, it is very difficult to detect whether they are mixed in the refrigerant system.

R40 reacts with aluminum and creates Trimethyl Aluminum, and Trimethyl Aluminum is flammable. Like other machine manufacturers, Daikin uses aluminum in some compressor components.

Therefore, Daikin recommends you not to perform any work on reefers, which had recently any refrigerant system work done in Vietnam, regardless of warranty repair or not.

Daikin provides a list of reefer machines which had any refrigerant system service work done in Vietnam under warranty, since January, 2011. Please contact your Daikin sales representative if the data for a longer period is required.

Daikin is also investigating to find how to detect R40 in a refrigeration system and other safety solutions. We will advise when the details are available.

Yours Sincerely,
Syouhei Tsutsumi
Vice president Reefer Business
Daikin Refrigeration Division



Container Products

CTR-SER11-009 11-24-11

Subject: Refrigerant Quality Guidelines

Given the recent global concerns over refrigerant contamination in the reefer service industry, it is important that every Carrier Authorized Service Center take steps to ensure the quality of refrigerant used in your business. Since 1993, Carrier has exclusively produced R134a reefers. The only refrigerant acceptable for servicing these machines is R134a.

To assist in your efforts to assure refrigerant quality to your customers, Carrier recommends the following guidelines:

- Use only internationally known refrigerant brands purchased from reputable sources.
- Request a certificate of origin or chemical analysis documentation from your refrigerant supplier for each purchase or delivery. AHRI Standard 700 is a good reference for refrigerant purity specifications. If your supplier is unable to provide this type of information, consider changing suppliers.
- Visually inspect every refrigerant package for misspelled words, unusual logos or other obvious changes from previous deliveries. Do not accept disposable cylinders that are not in their original, sealed cardboard box.
- Visually inspect every gas cylinder for any changes in shape, color or fittings on the bottle, as these rarely change for refrigerant sourced from major manufacturers.
- Consider purchasing a refrigerant identification tool, and implement processes to test each new refrigerant cylinder when it is delivered by your supplier.
- Be cautious of refrigerant offered for sale at prices well below normal market price. Counterfeit refrigerant is frequently offered at a significant discount.
- Consider using exchange refillable cylinders from direct gas suppliers, which typically have shorter supply chains and easier traceability. (Note that refillable cylinders are required by F-gas rules within the EU).
- Consider implementing a record retention system which includes the following:
 - A gas cylinder numbering or identification system.
 - Delivery logs that track refrigerant source and authenticity by cylinder number.
 - Technician logs that track the amount of refrigerant used from each numbered cylinder on every unit (container ID).
- Store refrigerant in a secure location.

As always, be sure to follow refrigerant manufacturers' recommendations and applicable local regulations for gas handling, charging, recovery, recycling, etc.

Service Engineering / Container Products

PLEASE CIRCULATE COPIES OF THIS BULLETIN TO ALL OF YOUR SERVICE AND MANAGEMENT PERSONNEL AS SOON AS POSSIBLE

6th December 2011

Guide to Flame Testing R-134a for Chlorine Contamination

Flame Halide Detector

The method is to check a small quantity of gas from each of the refrigerant bottles in stock using the described Flame Halide Detector. At present no other method has been found that will satisfactorily find mixtures of gases containing chlorinated products.

This test will detect if there are chlorine contaminants in the refrigerant, sensitivity 300ppm (parts per million). R-134a is fluorinated and does not change the colour of the flame. A green flame indicates the presence of chlorine. R-22, for example, will show a green flame. Halide detectors were commonly used by service engineers for more than twenty years but became largely obsolete when chlorine-free refrigerants, (like R-134a), were introduced.



To familiarise yourselves with this, try a test using a bottle of R-22. This link shows what you should expect: <http://www.youtube.com/watch?v=jHJU6UYM6Ug>

Any refrigerant bottles marked R-134a that show a green flame should be quarantined and NOT USED.

It is recommended that the contents be sent to a laboratory for analysis.



Container Products

CTR-SER11-012 12-16-2011

Testing of NEW R134a refrigerant supply

This bulletin is intended as a further update to the industry to describe available options and devices for testing the quality of refrigerant in new R134a refrigerant gas cylinders.

Consideration was given to devices that would identify contaminated refrigerant comprised of varying blends of R12, R22, R40 and R134a. Three different device types have been identified that can be used to test gas phase refrigerant from new R134a refrigerant cylinders. Each device has limitations and concerns as shown in the table below, but each has the ability to detect contaminated refrigerant. None of these devices can directly confirm the presence of R40, which may have played a role in recent compressor ruptures.

Carrier does not endorse or recommend any specific device, method of testing or particular supplier, but is providing the basic information on each device type to enable users to make a decision on what is best for their operations based on their own evaluation.

THE INFORMATION BELOW IS APPLICABLE ONLY FOR TESTING NEW R134a REFRIGERANT GAS CYLINDERS.

Device	Identifies Refrigerant	Ease of use	Refrigerant release	Sensitivity	Concerns
Electronic Refrigerant Analyzer ^{1,2}	R22, R134a, R12 and Hydrocarbons	Simple	De minimis	10%	Low sensitivity
Portable VOC ³ device ⁴	Read out ppm of VOC's which include R40	Complex	Uncontrolled	1ppm	Over sensitive and may give false positive. F-gas regulation
Halide Leak detector ⁵	Qualitative detection of Chlorine compounds (CFC, HCFC, R40)	Simple	Uncontrolled	300-600ppm	Combustion gas concern F-gas regulation

- Devices are available from a number of suppliers including:
 - Neutronics – Ultima ID (Model #'s RI-2004HV and RI-2004HVP)
 - Bacharach – PurChek (Model #'s 2100-8001 and 2100-8002)
- The Neutronics Mini ID R134a, Neutronics Ultima ID Pro and Bacharach PurChek Pro are not suitable for this use.
- VOC, Volatile Organic Compounds
- Devices are available from a number suppliers, including the MiniRAE with 11.7eV lamp from RAE systems
- The US EPA does not advocate the testing of refrigerant leaks using halide leak detectors

PLEASE CIRCULATE COPIES OF THIS BULLETIN TO ALL OF YOUR SERVICE AND MANAGEMENT PERSONNEL AS SOON AS POSSIBLE

Committee Correspondence

December 21, 2011

To: SAE ICCSC members

From: Ward Atkinson Bill Hill

Subject: R-40 Refrigerant Issues

As noted in recent activities there is evidence that R-40 has been supplied in 30# cylinders and marked as R-134a. R-40 and R-40 with other refrigerants have been used to service, both stationary and Mobile A/C systems in various parts of the world. At the present time we do not have any indication that cylinders containing R-40 are in the North American marketplace. However, with this extensive indication worldwide there may well be the potential of the refrigerant appearing in the North American marketplace.

R-40 is extremely toxic, flammable and highly reactive when exposed to aluminum. In some cases R-40 may react with aluminum to form a third, highly unstable compound that can react violently with air.

With its potential in any MAC system worldwide we are attempting to provide some guidelines should the R-40 refrigerant cylinders or a contaminated system be encountered.

Since this refrigerant can damage MAC systems and service equipment it may be advisable that vehicle and service equipment manufacturers provide notice to their dealers.

The R-40 issue will be discussed during the January SAE ICCSC meeting.

In order to address this issue there has been some work done on how to determine if a container contains this refrigerant. (See included press release)

Current thoughts are to establish information regarding this refrigerant for both the commercial and mobile sectors. This issue was discussed during the 21 December Standard 700 Subcommittee (AHRI) meeting.

- Establish the ability to identify cylinder contents
- Establish a safe method on how to determine if the system contains R-40
- Establish how to remove the refrigerant from a system
 - What type of equipment
 - How to dispose of it
- Damage to systems that contain aluminum
 - Potential of early failures plate fin evaporators
 - Requires complete MAC refrigerant system component replacement
- Exposure issues
 - Technician servicing MAC Systems
 - Vehicle occupant toxic exposure when the refrigerant is installed into a system that has a leaking evaporator



R134a Refrigerant Cylinder testing

21 December 2011

Guide to testing R-134a cylinder contents for Chlorine Contamination

Flame Halide Detector

The following method is to check a small quantity of gas from each of the refrigerant cylinders in stock using the described Flame Halide Detector. At present no other method has been found that will satisfactorily find mixtures of gases containing chlorinated products.

This test will detect if there are chlorine contaminants in the refrigerant, sensitivity 300ppm (parts per million). HFC-134a is fluorinated and does not change the colour of the flame. A green flame indicates the presence of chlorine. Eg. R-22 will show a green flame because it contains chlorine. Halide detectors were commonly used by service engineers for more than twenty years but became obsolete when chlorine free refrigerants, (like R134a), were introduced.



To familiarise yourselves with this; try a test using a bottle of R-22. The below link shows what you should expect; <http://www.youtube.com/watch?v=jHJU6UYM6Ug>

Any refrigerant bottles marked as HFC-R134a that show a green flame should be quarantined and NOT USED.

Please notify service@starcool.dk for further advice if such a result is found.

STAR  COOL

Safety Notice to all Star Cool Service Providers

As more information has become available in relation to the issue of counterfeit and contaminated refrigerant, we would like to provide the following update and recommendations.

It is now widely concluded that contamination of refrigeration systems has been as a result of the addition of a counterfeit refrigerant using a blend of chemicals including R40 (methyl chloride). The methyl chloride will react with aluminium to form trimethylaluminium (TMA), a pyrophoric substance. All hermetic and semi-hermetic compressors use aluminium in their internal construction and are therefore exposed to risk if contaminated with R40.

Work continues in an effort to develop a safe and accurate method of testing suspect machines for both R40 and TMA presence, but until such a test is available we continue to recommend quarantine of any units suspected to be contaminated.

To prevent further occurrences of unit contamination and the associated hazards, it is extremely important that all stocks of R134a are verified as containing no R40, and that all purchases of R134a are verified and certified to be from reliable and genuine sources.

While there are several electronic refrigerant analyzers on the market which are designed to verify the purity of R134a, the manufacturers confirm that none of the analyzers commercially available today are able to detect R40 and may report contaminated refrigerant as pure. These electronic analyzers cannot be relied upon or provide any safety in relation to the integrity of the refrigerant.

The only practical method to ensure that R134a being added during service repairs is free from R40 and any other chemical containing chlorine, is to use a halide lamp to test each cylinder. This procedure has been distributed to certain repair vendors by Maersk Line, but we now include the bulletin distribution to our Service Providers and customers.

12th January 2012

Guide to Flame Testing R-134a for Chlorine Contamination

Flame Halide Detector

The method is to check a small quantity of gas from each of the refrigerant bottles in stock using the described Flame Halide Detector. At present no other method has been found that will satisfactorily find mixtures of gases containing chlorinated products.

This test will detect if there are chlorine contaminants in the refrigerant, sensitivity 300ppm (parts per million). R-134a is fluorinated and does not change the colour of the flame. A green flame indicates the presence of chlorine. R-22, for example, will show a green flame. Halide detectors were commonly used by service engineers for more than twenty years but became largely obsolete when chlorine-free refrigerants, (like R-134a), were introduced.



To familiarise yourselves with this, try a test using a bottle of R-22. This link shows what you should expect: <http://www.youtube.com/watch?v=jHJU6UYM6Ug>

Any refrigerant bottles marked R-134a that show a green flame should be quarantined and NOT USED.

It is recommended that the contents be sent to a laboratory for analysis.



16 December 2011

Halide Torch Information.

Torches fueled by alcohol, propane, acetylene and other fuels burn with an almost colorless flame. **A flame will continue to be almost colorless if a copper strip is placed in the flow of the flame. With the copper sitting in the flame, as soon as small amount of chlorinated refrigerant is brought into contact with the heated copper it will cause the flame to change to a green color.** These chlorine based refrigerants include R-12, R-22, R-500, R-502,R40 etc.) This principle is used in halide torches to detect leaks in refrigeration systems using these types of refrigerants.

The use of a halide leak detector is the most positive method of detecting chlorine based refrigerants. Such a detector consists essentially of a torch burner, a copper reactor plate, and a rubber exploring hose.

Refrigerant gas suspected of containing chlorine is drawn through the hose into the torch burner of the detector. Here the air passes over the copper reactor plate, which is heated by the flame of the torch. If there is a minute trace of chlorine present in the refrigerant, the colour of the torch flame changes from blue (neutral), to green as the chlorine containing refrigerant makes contact with the reactor plate. The shade of green depends upon the amount of chlorine in the refrigerant; a pale green colour indicates a small concentration and a darker green colour, a heavier concentration.

Please note a standard blowtorch/lamp cannot be used, as the copper reaction plate is required.

For more detailed instructions please refer to CRT and Maersk Line, Technical Bulletin R134a gas testing Rev 5.

Events and some taken actions:

- Counterfeit Refrigerants/Contaminated Reefer Machinery 4th COA Reefer Forum Antwerp, Wednesday 28 March 2012. The 4th COA Forum on Counterfeit Refrigerant Gases and Contaminated Refrigeration Machinery took place in Antwerp on Wednesday 28 March 2012. Morning classroom sessions were followed by demonstrations of testing procedures in the afternoon.
- Counterfeit Refrigerants/Contaminated Machinery 3rd COA(Container Owners Association) Reefer Forum Singapore: 9 February 2012. The COA organised a Forum in Singapore on Thursday 9 February 2012, aimed at updating the industry with regard to systems for testing refrigerant gas canisters and samples of refrigerants from reefer machinery.
- Counterfeit Refrigerants/Contaminated Machinery 2nd COA Reefer Forum: London, 19 December 2011. The Container Owners Association and the TT Club organised an industry Forum on Monday 19 December, bringing together container owners, refrigeration machinery manufacturers and relevant experts to debate ways to resolve the exploding reefer machinery issue
- 10th Containers Owners Association members meeting will be held in Seoul, Korea. 12-13 June 2012. with special session on Refrigeration Machinery Status on Contaminated Refrigeration Issues
- Heatcraft Australia has issued a recall of certain models of a Kirby brand packaged refrigeration unit supplied within Australia and suspected of being charged with the potentially dangerous counterfeit R134a refrigerant. HEATCRAFT Australia has confirmed that the “flammable and poisonous” counterfeit refrigerant responsible for the recall of certain models of Kirby packaged refrigeration units in Australia does have methyl chloride (R40) as one of its constituents. It has also been confirmed that the suspect units were manufactured and charged with the refrigerant at its own factory in China.

Some news from UNEP and World Customs Organization and Countries Customs stations:

- UNEP Compliance Assistance Programme (CAP) in Bangkok has contacted Environment Programme of World Customs Organization about this issue and the

issue paper(earlier version) has been sent to all members of World Customs Organization for their awareness and any necessary action at the borders.

- CAP has been in contact with counterfeiting and piracy at the WCO's Counterfeiting and Piracy Group to raise this important issue in their working group. Also a representative of UNEP OzonAction office in Paris will participate in coming WCO's counterfeiting and piracy group meeting, on 2 – 3 May 2012 at the WCO in Brussels.
- The issue paper has been sent to all the National Ozone Officers in the region countries in Asia and the Pacific to take any possible and necessary action at their national levels.
- UNEP CAP in Bangkok has been in contact with The Customs Capacity Building Working Group who is working to support the other Working Groups (Customs Procedures and Trade Facilitation Working Group and Customs Enforcement and Compliance Working Group) to raise counterfeiting issues in their training and capacity building programmes in their member countries.
- Customs Services at the Greater Port in Saint Petersburg succeeded to seize more than 19 metric tons of ozone-depleting substances (ODS) in February 2012. The cylinders originated from China and were shipped by sea transport via Gdansk in Poland to Saint Petersburg in the Russian Federation. They were mis-declared as hydrofluorocarbon R134a which is not controlled by the Montreal Protocol. But actually the shipment contained 3320 kg of R12, 2490 kg of R113, 4980 kg of R141b as well of 8300 kg of a mixture of R22 and the toxic R40. The import of these chemicals into the Russian Federation is either banned or requires an import license. The investigations are still ongoing.

(Updated on 30 April 2012)