

These flashes summarise key safety matters and incidents, allowing wider dissemination of lessons learned from them. The information below has been provided in good faith by members and should be reviewed individually by recipients, who will determine its relevance to their own operations.

The effectiveness of the IMCA safety flash system depends on receiving reports from members in order to pass on information and avoid repeat incidents. Please consider adding the IMCA secretariat ([imca@imca-int.com](mailto:imca@imca-int.com)) to your internal distribution list for safety alerts and/or manually submitting information on specific incidents you consider may be relevant. All information will be anonymised or sanitised, as appropriate.

A number of other organisations issue safety flashes and similar documents which may be of interest to IMCA members. Where these are particularly relevant, these may be summarised or highlighted here. Links to known relevant websites are provided at [www.imca-int.com/links](http://www.imca-int.com/links). Additional links should be submitted to [webmaster@imca-int.com](mailto:webmaster@imca-int.com)

## Incidents during Heliox Gas Transfer

This safety flash is concerned with some recent incidents involving heliox gas transfers using Williams & James compressors.

There are three incidents reported in this safety flash – the Safety Alert issued by the Department of Minerals and Energy of Western Australia was also included in IMCA Safety Flash 03/00.

### I Gas Transfer during Project Mobilisation

Approximately one hour into the gas transfer operation from a quad (48 pack) of 20% oxygen / 80% helium to storage tubes via a large (D1247) Williams & James compressor an explosion occurred, causing extensive damage to the compressor and its associated high pressure pipework.

Analysis of both the quads and storage tubes indicated that the oxygen level was 21%. Analysis of the damaged pipe found that oil was present – the investigation did not enable any firm conclusion as to the cause of the explosion to be drawn.

The incident investigation could not reach a definitive cause of the incident but identified one or a combination of the following as possible contributing factors:

- ◆ Incorrect assembly of certain compressor components in particular the piston ring unit which could have caused oil to be dragged from the injection point up the cylinder wall into the pressurised area of the cylinder.
- ◆ Excess oil in the cylinder head would have reduced the clearance between the piston and cylinder head. This could have resulted in compression ignition of the oil, this would then have travelled along the discharge pipe from the third stage head to the cooler as the pipework would all have been coated in oil.
- ◆ From previous investigations it was noted that the compressor was ‘oily’ and oil had been seen in the first desiccator stage of the filter system which could indicate that the third stage was over oiling.
- ◆ The compressor safety shut down system incorporates a high gas discharge temperature switch, which did not operate in time to avoid an explosion.
- ◆ Possible incorrect or not the most satisfactory filter medium in use, allowing oil vapours/ residue to accumulate and not be satisfactorily removed.
- ◆ Carbonisation of lubricating oils on valve plates and intercoolers by high operating temperature.

The company involved implemented the following recommendations:

1. Review compressor maintenance routines;
2. Use Anderol 500 oil instead of the recommended Shell Corena P100;
3. Fitting of coalescer type oil separator to the discharge to remove as much oil droplet/vapour prior to entering long delivery pipeline runs and filter elements;
4. Filtration must not include activated carbon;
5. Dual use of a compressor for dual air and heliox mixes is not recommended;
6. Compressor model D1247 is not suitable for air compression;

7. Oxygen level for compression to be limited to a maximum of 20%.

## **2 Incident during Restart of Compressor**

The attached memo from Halliburton sets out the findings to date and the interim actions recommended following an incident in May 2000.

## **3 Gas Transfer during Demobilisation**

Attached is a safety alert issued by the Department of Minerals and Energy, Western Australia, concerning an explosion which occurred during heliox transfer using a Williams & James compressor.



## Memorandum

**Date:** 21 July 2000

**To:** Dive Supt, Dive Tech, Chief Engineer, Vessel Master/OIM, D Downing, P Harrold

**cc:** D Martin; M Fitzgerald; P Alexander; P Ratcliffe; S Williams; D Tilley; Project Managers; P Somner; K Coutts; M O'Meara, B Simpson, IMCA

**From:** Alan Forsyth

**Subject:** William & James Compressors

**Status:** JT00031

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The purpose of this memo is to present the findings to date and to confirm the implementation of the interim actions recommended following the incident on 8.5.00 in light of a recent incident overseas. The explosion in a Williams and James Gas 977 Transfer Compressor on 8.5.00 occurred during the re-start of the compressor to continue gas transfer operations after a short shut down to change over between storage banks.

The unit had been used for transfer of 13.3% Oxygen in Helium, immediately prior to a changeover to 20% Oxygen in Helium. During the restart for the new gas mixture an explosion occurred within the compressor discharge system. This resulted in pipework ruptures within the final stage cooler, the discharge piping and significant damage to the filter/coalescer element.

The damage associated with the incident has been established as follows:

- Third stage cooling tubes – rupture – resulting in the failure of the cooling jacket seal and loss of cooling water.
- Third stage cooling tubes – stress indication without rupture.
- ½” delivery line failure – between pipe clamp and filter coalescer unit, at the pipe bends.
- ½” delivery line “ballooned”.
- Heavy damage to both the filter cartridge and insert with signs of combustion.
- Rupture of filter unit ½” discharge line at the swage fitting. Flame damage to the purification filter, probably from the rupture of the filter/coalescer discharge pipe.

In addition to the incident damage, inspection of the compressor revealed the following:

- 1<sup>st</sup> stage bores show signs of wear and were considered to be passing oil.
- Heavy carbon deposits on 2<sup>nd</sup> and 3<sup>rd</sup> stage discharge valves and ports.
- Liquid separator contained sediment and “tar” like deposits, possibly preventing draining.

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## Memorandum

Following review by the supplier and manufacturer, the company issued an internal statement of interim actions as follows:

1. Inspection of the filter/coalescer units for oil carry over and element condition.
2. Inspection of the 2<sup>nd</sup> and 3<sup>rd</sup> stage valves for wear and/or carbon build-up.
3. Cool down period of 60 minutes between operations.
4. Monitoring of CO levels within dive gas is carried out following gas transfer.
5. Inspection of the liquid separator and down loading valves should be carried out to ensure the systems are free of blockage and functioning properly.
6. Oil injection on the second and third stages for machines operating with Heliox or Air mixtures is not recommended by the manufacturer, advise where fitted.
7. Filtration systems should be checked to ensure that activated charcoal has not been used in the filtrate.

The above actions have been advised previously, please confirm their implementation and continued application. In addition, these actions are not exclusive to the 977 series of machines and the company considers these actions to be applicable to all W&J HP gas compressors.

**Please acknowledge receipt and compliance with the above to Jean Thomson, Halliburton Subsea Safety Department, by return.**

Regards

Alan Forsyth  
HS&E Manager

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# SAFETY ALERT

## Incident on a DSV During Heliox Gas-Transfer

A serious incident occurred on a diving support vessel (DSV), on Saturday, 15 July 2000. The vessel was demobilising from diving works on the North West Shelf of Australia when a loud bang was heard and felt throughout the ship.

A LST (life support technician) sustained severe traumatic injuries to his right hand, which it is understood was nearly severed at the wrist. This occurred due to a 'shrapnel' fragment hitting the LST, following a catastrophic failure of a pressurised diving gas transfer system.

At the time of the incident a Williams & James gas transfer compressor (Model K975) was pumping a heliox (20% oxygen in helium) gas mixture between storage tubes. The output pressure was reportedly about 19 MPa (190 bar). It is not clear at this time what caused the failure.

There was considerable damage to the third stage cooling system of the compressor, the outlet pipe and associated filters downstream of the compressor. A cast iron filter housing ruptured violently causing the above injury and damaging control pipe work, bulkheads and other diving system equipment.

The subject equipment has been removed and quarantined pending a detailed engineering investigation. Further interviews and other investigative work are planned for the immediate future to identify the causes of the incident. It is understood that several similar incidents have occurred around the world.

### Recommendation

Until further information is available it is recommended that William & James gas transfer systems should not be used in Western Australia, unless the Operator can demonstrate that the risks have been assessed and are acceptable. Owners and operators of William & James compressors are advised to contact the manufacturer (Hamworthy Belliss & Morcom Ltd), for information with regard to installation, maintenance and operation of the system and ancillary equipment (eg. filters). Further details will be made available when known.

All pressurised systems present some hazards. It is recommended that high-pressure gas transfer systems should be located and contained so that the hazards to personnel and or equipment are minimised.

### Contacts

Hamworthy Belliss & Morcom Ltd Tel: +44-1452-528431 Fax: +44-1452-381232

R J Craddock  
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20 July 2000



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