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Report No. 3
SAFETY INSPECTION OF R 600a CHARGING STATION

Project: MOGANSHAN
Isobutane-Charging Plants

Plant Location: Moganshan Electric Appliances Co.,
( Zhongke Life Science & Technology Co.,Ltd)
No. 88 Zhiyuan Road Wukang Town
Deqing County / Zhejiang Province
P.R. China

Plants: Isobutane-Charging Plants for the production
of refrigerators (Project/Step 1)
Workshop 2 and 4

Engineering and
Manufacturer of the
Plants:
1. A'GRAMKOW, Denmark
2. Moganshan, Company, P.R. China

Check-type: Plant inspection in Moganshan

UNIDO-project MP/CPR/99/166
TÜV-Order-No.: 11 057
TÜV-Experts: Dipl.-Ing. K-J Richardt, TÜV BB-ULM, Dep. NDD
Dipl.-Ing. (FH) E. Mack, TÜV BB-ULM, Dep. NEG
Dipl.-Ing. (FH) A.. Lips, TÜV BB-ULM, Dep. NEG
Company Group TÜV Süddeutschland

Dates:
- September 27th, 2002 - plant check on site
- October 12th, 2002 - Report
- December 10th, 2002 - inspection of pend
ing points on site

Participants on location:
- Mr. Lee Wai Peng
- Mr. Albert Zhang
- Mr. Jukka Ye
- Mr. Qian Dong Da
- Mr. Wang Shouguo
A'Gramkow
INFICON
INFICON
Moganshan
Moganshan

Report is sent to:
- Dr. Grof
- Mr. Soerensen
UNIDO
A'Gramkow
TABLE OF CONTENTS

1. Preliminary remark ........................................................................................................... 3
2. Checking principles ........................................................................................................... 4
   2.1 Applicable regulations ................................................................................................. 4
   2.2 Applicable documentation ......................................................................................... 5
3. Check extent ..................................................................................................................... 6
   3.1 In general .................................................................................................................. 6
   3.2 Plant-specific check included .................................................................................... 6
   3.3 Not part of the TÜV-check ....................................................................................... 6
4. Short description of the HC-plants .................................................................................. 7
   4.1 HC-storing / HC-providing and supply-area .............................................................. 7
   4.2 HC-charging stations ............................................................................................... 8
   4.3 Repair place for refrigerators with HC workshop 4 ................................................ 9
5. Inspection ........................................................................................................................ 10
6. Deficiencies and required measures .............................................................................. 17
   6.1 HC-providing / HC-supply-area .............................................................................. 17
   6.2 HC-charging station – workshop 2 .......................................................................... 20
   6.3 HC charging / repair station – workshop 2 ............................................................... 21
   6.4 HC-charging station – workshop 4 .......................................................................... 22
   6.5 HC-repair place – workshop 4 .............................................................................. 22
   6.6 Further measures .................................................................................................... 23
7. Summary .......................................................................................................................... 24
   7.1 Handling of the deficiencies and measures .............................................................. 24
   7.2 Some other regulations ............................................................................................. 24
8 Conclusion / Result of the inspection / tests ................................................................. 25
1. Preliminary remark

The MOGANSHAN company is going to use Isobutane as cooling agent for the production of refrigerators.

As Isobutane is a flammable liquid gas safety technical measures against a possible fire- and explosion danger have to be regarded and realized when this gas is used.

UNIDO engaged TÜV Süddeutschland, branch Ulm, to carry out a safety technical evaluation and check of the Isobutane Charging Plants at the Moganshan Company.

The whole TÜV-check of the Isobutane Charging Plants has been carried out divided into the following partial checks:

- 1st Partial Check:
  - Safety technical evaluation of the draft documentation of the Isobutane Charging Station made by A'Gramkow.
  - The result of this evaluation is contained in the „Report No 1, Safety Technical Plant Pre-inspection“, File No.: UNI/AGR-PRC/01/01, date July 17th, 2001.

- 2nd Partial Check:
  - Coordination and fixing of solutions of problems with A'Gramkow, which have been assessed in the 1st partial check.

- 3rd Partial Check:
  - TÜV-check, which has been carried out on location, it contained all the Isobutane (HC)-Charging-Plants consisting of HC-Supply and HC-Charging Stations, safety-technical evaluation of the plant-peripherals and evaluation of safety relevant aspects of organizational matters.
  - Other technical equipment not being of any safety-relevance to the HC-plants are not part of this check.
  - The result is contained in the „Report No 2, Report of a Safety Technical Plant Inspection“, File No.: UNI/AGR/Mog-PRC/02/02, date 22 October, 2002

- 4th Final Check
  - The deficiencies mentioned in Report File No.: UNI/AGR/Mog-PRC/02/02, have been checked during a visit in Moganshan again. The missing informations related the plant were discussed during a visit on A'Gramkow workshop in March 2003.

The TÜV-report at hand is only valid specifically for the mentioned HC-plants at MOGANSHAN company related to Project No. 1. The extensions of i-Butane step 2 have not been on site complete and were not part of this check. The existing parts as repair station in workshop 4 has been monitored too and are mentioned in this report.
2. Checking principles

2.1 Applicable regulations

- EG directive 94/9/EG (Atex 100 a)
- EN 1127-1 Explosion protection, Fundamentals and Methods
- European Pressure Vessel Directive
- Electrotechnical regulations: International: IEC / European: EN / National: DIN VDE e.g.
  IEC 60073, IEC 439-1/A2, IEC 204-1, IEC 1210-2, EN 50054, EN 50054, EN 50013,
  EN 50020, EN 50081, EN 60529, pr. EN 1050, DIN VDE 0165, EN 349, EN 418, EN
  294, EN 954-1
- Fundamental safety aspects to be considered for measurement and control equipment: - Germany: DIN V 19250
- Safety requirements for automated manufacturing systems: Germany VDI 2854
- Personal protection regulations / accidents prevention
  European: EN...EC / Germany: UVV/ZH, e.g.
  VBG 1, VBG 5, VBG 20, VBG 21, VBG 61, ZH 1/220, ZH 1/255, ZH 1/8, ZH 1/10, ZH
  1/134, ZH 1/455
- Technical regulations for combustible liquids and for gases: Germany TRF / TRG e.g.
  TRF 1996 / TRG 280
- Technical regulations for ventilators in ex-zones: Ex-proof / spark-proof for ventilators:
  Germany VDMA 23169 Part 1
- Homologation of technical plant and equipment - European: conformity certificates
  (e.g. PTB, Cesi)
- EN 378, Refrigerating systems and heat pumps, Safety and environmental requirements
- EG machine directive (89/392/EWG, revised edition 91/368/EEC)
- IEC 79-10/EN 60079-10/VDE 0165 Part 101: Electrical apparatus for explosive gas
  atmospheres - classification of hazardous areas
- IEC/EN/DIN VDE Standards: especially DIN 31000 / VDE 1000, DIN VDE 0116, DIN
  57 165 / VDE 0165, EN DIN 50014 / VDE 0170/0171.
2.2 Applicable documentation

Basis for the report at hand was following documentation, which were available on site.

- P-I diagram Max 95 F-1,
- P-I diagram RSS HC supply,
- Electrical diagram of Max 95 F-1,
- Electrical diagram of SAFE 5, drawing number
- Electrical diagram of R 600 supply pump, drawing number
- Specifications which were related to above mentioned plants
3. Check extent

3.1 In general

The TÜV-check, that has been carried out, contains the checking and evaluation of the safety-relevant requirements for securing the safety-measurements against fire- and explosion danger of Moganshan project step 1.

Those are in detail:

- Pressure-, -technical and electrotechnic checks and measurements on the plants for HC-supply and HC-charging.
- Check and evaluation of general safety technical measures on the plants for HC-supply and HC-charging.
- Check and evaluation of the safety relevant surrounding of HC-supply and HC-charging.
- Evaluation of safety-relevant organizational measures.
- The check of all safety-relevant aspects in accordance with the requirement of the „Report No 1, Safety Technical Plant Pre-inspection“, File No.: UNI/AGR-PRC/01/01, date July 17th, 2001.

3.2 Plant-specific check included

Following plants, respectively plant-sections are part of this TÜV-check:

- isobutane supply station including room for 3 x 100 cylinders i-Butane and room with A’Gramkow supply station.
- isobutane charging station on refrigerator line in workshop 2
- isobutane charging station on refrigerator line in workshop 4
- repair place for refrigerators with isobutene in workshop 4 – is part of Moganshan Iso-butane Project 2

3.3 Not part of the TÜV-check

Following checks and evaluations are not part of this TÜV-check:

- the refrigerators in regard of suitability for Isobutane
4. Short description of the HC-plants

4.1 HC-storing- / HC-providing and supply-area

a) General:

A storage room for i-Butane is presently not available. There is only a providing room which contains 2 cylinders – connected to the supply station and additional one cylinder as spare.

In the next room the A’Gramkow supply station is situated.

The complete supply station is located in separate rooms separated from the workshop.

Both rooms are ventilated. The room with the cylinders is equipped with a gas sensor as well as the pump station.

The Isobutane-supply of the HC-charging stations is starting at the pump-station via a rigid pipe.

b) Data of the technical equipment of providing and supply area:

- HC-pump-station:
  
  Producer: A’Gramkow  
  Series no.: 182 000 46 – 82 702  
  Manufactured: 08.05.2002  
  Refrigerant supply: R 600a  
  Working pressure: 19 bar,  
  Design pressure: 21 bar  
  Electrical control panel: AX2

- HC-cylinders:
  
  Producer: Chinese standard type  
  Volume: max 100 Kg  
  Design pressure: 15,6 bar
4.2 HC-charging stations

a) General

On the refrigerator lines workshop 2 and workshop 4 there are each one HC-charging stations, produced by A'Gramkow.

The cooling-circuits of the refrigerators are evacuated by this charging station and filled with Isobutane.

After the HC-charging process the cooling circuits will be closed by an ultrasonic-system.

The HC-charging station and the HC-charging place are equipped with a technical ventilation system and an automatic gas-detector-system.

On the HC-charging station of both lines a 10 litre accumulator with bubble is installed after the transmission pipe.

b) Dates of the HC-charging station workshop 2 and 4:

- HC-charging station Workshop 2
  Producer: A'Gramkow, Type max 95 F-1  
  Serial-No 17 200 216 – 82 703  
  Manufactured 08.05.2002  
  Supply R 600a  
  Supply pressure 16 bar  
  Design pressure 25 bar

- HC-charging station Workshop 4
  Producer: A'Gramkow, Type max 95 F-1  
  Serial-No 17 200 214 – 82 703  
  Manufactured 08.05.2002  
  Supply R 600a  
  Supply pressure 16 bar  
  Design pressure 25 bar
4.3 Repair place for refrigerators with HC workshop 4

The repair place isn't contained in the UNIDO isobutene project No 1. But the mosts parts were installed and therefore TÜV has monitored the existing parts.

The repair place is installed in the same way as the filling stations. It is equipped with a ventilation system as well as with a gas sensor and additional with a explosion proof vacuum pump.

Dates of the HC-charging station at repair place workshop 4:

<table>
<thead>
<tr>
<th>HC-charging station</th>
<th>Workshop 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producer:</td>
<td>A'Gramkow, Type max 95 F-1</td>
</tr>
<tr>
<td>Serial-No</td>
<td>17 200 215 – 82 703</td>
</tr>
<tr>
<td>Manufactured</td>
<td>08.05.2002</td>
</tr>
<tr>
<td>Supply</td>
<td>R 600a</td>
</tr>
<tr>
<td>Supply pressure</td>
<td>16 bar</td>
</tr>
<tr>
<td>Design pressure</td>
<td>25 bar</td>
</tr>
</tbody>
</table>
### 5. Inspection

#### - Measurements and function tests -

<table>
<thead>
<tr>
<th>Plant-components/ Measurement / Function test</th>
<th>Result of measurement</th>
<th>Function conforming to safety strategy</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>1 HC-Providing room</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Automatic shut down valves after cylinders</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Valves connected to all safety panels of all workshops</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Measurement</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- electrical resistance of the floor</td>
<td>&lt; 10 kOhm</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>- ground resistance / lightning protection</td>
<td>&lt; 0.8 Ohm</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>- resistance of grounding/ potential equalisation</td>
<td>&lt; 0.3 Ohm</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>- effectiveness of ventilation (test fog)</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>d. Fire protected room/fire fighting system</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. HC-supply-Station</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Function-coupling with safety monitoring panel</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>b. Remote panel</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>c. Emergency push button</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>d. HC Unit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Pressure difference switch / Monitoring of ventilation system</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>- Series function of Solenoid valves</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Plant-components/Measurement / Function test</td>
<td>Result of measurement</td>
<td>Function conforming to safety strategy</td>
<td>Remarks</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>-----------------------</td>
<td>----------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Emergency push button</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Safety relief valve</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Monitoring of compressed air</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Monitoring of ventilation before fan</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Safety relief valve in pipe</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Measurement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>electrical resistance of the floor</td>
<td>≤ 10 kOhm</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>ground resistance / Lightning protection</td>
<td>0,8 Ohm</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>resistance of grounding/ potential equalisation</td>
<td>general ≤ 0,3 ohm</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>electrostatic conductivity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>effectiveness of ventilation (test fog)</td>
<td>o.K.</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Ventilation:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>air speed before fan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed ( V_1 ) 8,8 m/s</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Speed ( V_2 ) 13,0 m/s</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Gas monitoring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pre-alarm (15% LEL)</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>alarm (35 % LEL)</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Fault</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HC-charging area
- line workshop?

<table>
<thead>
<tr>
<th>Plant-components/ Measurement / Function test</th>
<th>Result of measurement</th>
<th>Function conforming to safety strategy</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>3. Line workshop 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Ventilation of Accumulator</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>b. safety relief valve between accumulator and valve charging station</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>c. Emergency push button</td>
<td></td>
<td>x</td>
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</tr>
<tr>
<td>d. Gas monitoring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- pre-alarm (15% LEL)</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>- alarm (35 % LEL)</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>- fault</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>e. max 95 F-1 unit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Different pressure switch / Monitoring of suction</td>
<td>20 Pa</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>- Emergency push button</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>- Safety relief valve</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>- Monitoring of compressed air</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>- Switch for monitoring of pre-filled cooling circuit</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>- Grounding charging gun</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>f. Safe 5+</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>- UPS / backup supply</td>
<td></td>
<td>x</td>
<td></td>
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<tr>
<td>- Overvoltage protection</td>
<td></td>
<td>x</td>
<td></td>
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<tr>
<td>- Overcurrent protection</td>
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<td>x</td>
<td></td>
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<tr>
<td>g. Ventilation system</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- effectiveness of ventilation (test fog)</td>
<td></td>
<td>x</td>
<td></td>
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<tr>
<td>- fan in antispark execution</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>- monitoring of suction before fan</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Plant-components / Measurement / Function test</td>
<td>Result of measurement</td>
<td>Function conforming to safety strategy</td>
<td>Remarks</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-----------------------</td>
<td>----------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>- air speed</td>
<td></td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>- Speed $V_1$</td>
<td>7.7 m/s</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>- Speed $V_2$</td>
<td>10.3 m/s</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>- Function coupling ventilation to supply station</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h. Measurement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- electrical resistance of the floor</td>
<td>$\leq 10$ k ohm</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>- electrical resistance of general grounding / potential equalization</td>
<td>general: $\leq 0.3$ ohm partly: $&gt;0.3$ ohm</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>- electrostatic conductivity</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>i. Remote panel</td>
<td></td>
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</tr>
<tr>
<td>4. HC-charging area-Line workshop 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Ventilation of Accumulator</td>
<td></td>
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<td>b. safety relief valve between accumulator and valve charging station</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>c. Emergency push button</td>
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<td>x</td>
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</tr>
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<td>- pre-alarm (15% LEL)</td>
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<td></td>
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<td>e. max 95 F-1 unit</td>
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<td>x</td>
</tr>
<tr>
<td>- Emergency push button</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Plant-components/ Measurement / Function test</td>
<td>Result of measurement</td>
<td>Function conforming to safety strategy</td>
<td>Remarks</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-----------------------</td>
<td>---------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>- Safety relief valve</td>
<td></td>
<td>x</td>
<td></td>
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<tr>
<td>- Monitoring of compressed air</td>
<td></td>
<td>x</td>
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<tr>
<td>- Switch for monitoring of pre-filled cooling circuit</td>
<td>&gt; 2 M Ohm</td>
<td>x</td>
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<tr>
<td>- Grounding charging gun</td>
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<tr>
<td>f. Safe 5+</td>
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<tr>
<td>- UPS / backup supply</td>
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<td>x</td>
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<tr>
<td>- Overvoltage protection</td>
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<td>- Overcurrent protection</td>
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<td>g. Ventilation system</td>
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<tr>
<td>- effectiveness of ventilation (test fog)</td>
<td></td>
<td>x</td>
<td></td>
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<tr>
<td>- fan in antispark execution</td>
<td></td>
<td>x</td>
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<tr>
<td>- monitoring of suction before fan</td>
<td></td>
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</tr>
<tr>
<td>- air speed</td>
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<tr>
<td>• Speed $V_1$</td>
<td>6.4 m/s</td>
<td>x</td>
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<tr>
<td>• Speed $V_2$</td>
<td>9.9 m/s</td>
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<td>- Function coupling ventilation to supply station</td>
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<td>h. Measurement</td>
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<tr>
<td>- electrical resistance of the floor</td>
<td>≤ 10 k ohm</td>
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<tr>
<td>- electrical resistance of grounding /potential equalization</td>
<td>general: ≤ 0.3 ohm</td>
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<td></td>
<td>partly: &gt;0.3 ohm</td>
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<td></td>
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<tr>
<td>i. Remote panel</td>
<td></td>
<td></td>
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<td>j.</td>
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<td>Result of measurement</td>
<td>Function conforming to safety strategy</td>
<td>Remarks</td>
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5. **HC-repair area-Workshop 4**

   a. Ventilation of Accumulator
   b. Safety relief valve between accumulator and valve charging station
   c. Emergency push button
   d. Gas monitoring
      - pre-alarm (15% LEL)
      - alarm (35 % LEL)
      - fault
   e. max 95 F-1 unit
      - Different pressure switch / Monitoring of suction 20 Pa
      - Emergency push button
      - Safety relief valve
      - Monitoring of compressed air
      - Switch for monitoring of pre-filled cooling circuit
      - Grounding charging gun 0,1 MOhm
   f. Safe 5+
      - UPS / backup supply
      - Overvoltage protection
      - Overcurrent protection
   g. Ventilation system
      - effectiveness of ventilation (test fog)
<table>
<thead>
<tr>
<th>Plant-components/Measurement / Function test</th>
<th>Result of measurement</th>
<th>Function conforming to safety strategy</th>
<th>Remarks</th>
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<td>x</td>
<td></td>
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<tr>
<td>- electrical resistance of grounding /potential equalization</td>
<td>general: ≤ 0,3 ohm</td>
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<td>- electrostatic conductivity</td>
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<td>- grounding of forceps to empty the cooling circuit</td>
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<td></td>
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<tr>
<td>i. Remote panel</td>
<td></td>
<td></td>
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<tr>
<td>j. Trivac D16B - Ex</td>
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<td>- Flame arrestors</td>
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<td>- Grounding with refrigerators</td>
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<td>- Overcurrent protection with EEx-e Motor</td>
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</table>
6. Deficiencies and required measures

6.1 HC-providing / HC-supply-area

6.1.1 HC-providing room

a) Remark
   A separate room to store i-Butane cylinders is presently not available.
   This will be necessary in the future.

b) The gas sensor must be fixed and protected against mechanical
   stress in a good way.

c) The gas sensor must be calibrated e.g. by Dräger.

d) A sufficient handle to close the i-butane cylinders must be installed.

e) Fire protection
   The room is not fire protected as an F 90 room as mentioned in the
   protocol of pre-inspection.
   Possible solution:
   A water sprinkler system will be installed as done in the Cannon/Bono
   plant.

f) Heating system of room
   Presently there is no heating system available. In the future a water
   heated system will be used.

   g) The flexible steel pipe connected on the i-butane cylinder will be ex-
      changed (renewed) yearly.

h) The door of the room has to be modified as a self closing door.

i) The position of the i-butane cylinder must be in a way that the flexible
   steel pipe is not cracked.

j) Documentation
   Actual documentation is needed.
Documentation must be updated

k) Automatic valves in the outgoing pipes of i-butane cylinders: The type plates with the technical data are missing.

6.1.2 HC-supply room

a) The dumper in the ventilation channel must be bridged with a ground wire

b) Documentation of fan is missing

c) Flexible pipes / hoses

  Some flexible pipes are electrostatically high chargeable and therefore not suitable. An exchange of these pipes is necessary. This affected following pipes / hoses:

  - relief pipe after supply system
  - relief pipe of safety relief valve pipe
  - ventilation hose between supply station and ventilation channel

d) Butane pipe to the workshop:

  1. The pipe must be supported additionally behind supply station over the street (angle and support)

  2. Butane pipe

     The record about the carried out pressure test and the vacuum test must be submitted.

  3. Remark

     If the pipe is as long as in Moganshan it is sufficient to install additional an automatic shut off valve to close the pipe and reduce the amount of Butane in case of an emergency situation. This valve must be mounted before the i-butane pipe entered the workshop.

  4. The pipe must be marked with the correct colour and arrow (in Moganshan: red/black) in sufficient distances (usually 2 m)

  5. A'Gramkow will name the maximum distances of supports of the pipe in relation of the diameter

  6. Along the i-butane pipe between supply area and workshops about each 20 m a connection of the pipe to the earth system is necessary.

e) The gas sensor in the HC-supply unit must be fixed.

f) HC-supply unit: The set point of the difference pressure switch for

<table>
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<td>must be</td>
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</table>
8 Conclusion / Result of the inspection / tests

The HC charging and discharging stations and the HC-supply system at Moganshan were evaluated by the undersigned experts for observance of fire and explosion protection measures.

Measurements/tests in the supply and charging/discharging stations of A'Gramkow with the Safe 5+ safety supervision system were carried out by the undersigned experts on the premises of Moganshan.

Based on the visual inspections and functional tests carried out, the experts come to the conclusion that from a safety point of view the protective measures implemented for the avoidance of fire and explosion hazards reflect the state of the art.

The HC-supply/charging/discharging system as described and illustrated in the documentation meets the requirements of the applicable technical regulations.

The TÜV Süddeutschland BB-Ulm has issued a certificate for the inspected Isobutane-Charging Plant.

The Certificate with the No. TÜV-BB-UL 11 057 will expire on December 2005 or if the plant will not be run according to the regulations.

The experts

signed  
signed  
signed

E. Mack  
K.-J. Richardt  
A. Lips
7. Summary

7.1 Handling of the deficiencies and measures

a. The detected deficiencies and required measures mentioned in chapter 6 were solved by either A'Gramkow and Moganshan.

b. The deficiencies of Report No 2, Report of a Safety Technical Plant Inspection*, File No.: UNI/AGR/Mog-PRC/02/02, date 22 October, 2002 were checked on 10 December 2002 again.

c. The TÜV experts can issue the certificate after the successful inspection on site.

7.2 Some other regulations

a. Validity of this report.
   The carried out TÜV-inspection is valid till 30th December 2005.

b. Information under the safety point of view:
   During the validity of this TÜV inspection the supervision by the experts will be realised as follow:
   - In case of special incidents and especially accidents (e.g. fire, explosion, human accident) the signed experts must be informed immediately.
   - The experts can receive the yearly safety record of the internal competent people (CP's) of MOGANSHAN.

c. Special request:
   The experts can visit the factory at any time e.g. on a request of UNIDO.
6.6. Further measures

6.6.1 TÜV report UNI/AGR/-PRC/01/01 must be taken into account

6.6.2 Power emergency supply

In connection with the TÜV inspection of the pentane foaming plants in Moganshan company solutions for a new electricity back up systems were decided.

The safety relevant equipments of the i-butane plants must be connected to this new system.

6.6.3 Safety related education

The education of the Moganshan-technicians and responsible persons related to the safety aspects by use of isobutene is still missing.

The education must be carried out and recorded.

6.6.4 Refrigerators / Cooling circuits

Remark

The technical evaluation of the refrigerators / cooling circuits which are foreseen for use of i-butane are not part of this TÜV inspection.

6.6.5 Safety related instructions

Instructions for operating and maintenance of the i-butane plants are still missing.

<table>
<thead>
<tr>
<th>Responsible</th>
<th>A Gramkow</th>
<th>Moganshan</th>
</tr>
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<tbody>
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Has not been part of the TÜV inspection

6.4 **HC-charging station – workshop 4**

6.4.1 General
All the points mentioned for workshop 2 Chapter 6.2.1 till 6.2.4 are valid too.

6.4.2. Additional
a) The function coupling from 35% LEL alarm and the ventilation alarm to the HC-supply unit isn’t realized.

6.5 **HC-repair place – workshop 4**

Remark: This part belongs to step 2, but the existing part has been monitored during the inspection on site.

6.5.1 General
All the points mentioned for workshop 2 Chapter 6.2.1 till 6.2.4 are valid too.

6.5.2. Additional
a) The pit (contains motor) at the right side of repair place must be cleaned and connected with the ventilation system
b) Channel before accumulator must be filled with sand that no gas can go inside
c) Motor for explosion proof pump:
The power supply is not equipped with a correct over current protection
The 40 A -fuse must be exchanged for a 16A-fuse and an automatic motor protection device with 2 A maximum must be installed.
d) The flexible plastic hose, connected to the evacuation pump, isn’t under the electrostatic point of view not suitable.
e) Charging gun: the grounding resistance to the front part of the gun is too high (measured 0.5 M ohm).
"Caution! i-Butane charging place" must be hanged up.

j) Fire extinguisher:
   A fire extinguisher must be positioned near the HC charging place

6.2.2 Max 95-F

   a) The gas sensor within the max 95 must be fixed
   b) The set point of pressure switch must be marked
   c) Charging gun
      The front part of the gun is not grounded (resistance to high, measured 20 M ohm)
      A'Gramkow must investigate this problem in general too!

6.2.3 Safe 5+

   a) There is no signal to an remote panel.
      A'Gramkow has the safe 5+ equipped with the needed contact
   b) The UPS for supply the SAFE 5+ has to be installed yet.
   c) The power supply for SAFE 5+ must be connected to the back up generator.
   d) A lamp in the surrounding of SAFE 5+ must be connected also to the back up generator.
   e) The cables which are used for connections of the gas sensors are blue now. Blue cables in connection with explosion technical state of affairs are only allowed for EEx-i circuits. The relevant circuits area not EEx-i circuits. This must be taken into account by future plants.

6.2.4 Ventilation system

   a. Control panel:
      The measures described in chap. 6.1.2 are valid also here.
   b. Difference pressure switch in the exhaust channel. The measure described in chap. 6.1.2 is valid also here.
   c. Lightning protector:
      The measure described in chap. 6.1.2 is valid also here.

6.3 HC charging / repair station – workshop 2

Remark:

This part is foreseen in step two of the project and has not been installed.
monitoring the ventilation must be marked.

g) Remark:
The supply of compressed air is presently temporary made via a cylinder. According to the plan of A‘Gramkow /Moganshan the final solution will be the connection to the central compressor air supply.

h) Ventilation system of HC-providing room and HC-supply room

1. Control panel:
   - The switches and push buttons which are mounted in the panel door must be secured against operating by not authorized persons. This can be realized with a lockable covering (2nd door made by glass) over the operating switches.
   - A sign with a text similar like this: Caution – safety devices; use of operating switches is only allowed by authorized persons; switch over from automatic position to manual position means the safety system is not in order.
   - The supply cable of control panel must be connected to the back up generator.

2. Difference pressure switch in the exhaust channel:
The connecting cable of the pressure switch is connected to the EEx-i barrier in the SAFE 5 unit. The use of a blue cable or EEx-i markings on this cable with distances of approx. 2 m is necessary.

3. The exhaust channel over the roof must be integrated in the lightning protection system (connection to earth system).

i) HC-supply area

1. i-Butane emergency push button:
   An emergency push button with the same functions as the 35 % LEL alarm must be installed in the HC-supply area. The design of this emergency push button should have the same design as the pentane emergency push buttons (yellow housing with glass).
   This emergency push button must be marked with “i-butane emergency”.

2. Fire extinguisher
   A fire extinguisher must be positioned in the HC-supply area.

3. Supply of the pneumatic-valves is presently temporary realized by N2-cylinders. A supply from the central compressed air station is foreseen.
6.2 HC-charging station – workshop 2

6.2.1 HC charging place

a) The gas sensor with is presently inside of the ventilation system will be removed under the cylinder accumulator (big amount of l-Butane, a lot of connections)

b) Area of accumulator will be improved:
   - enclosure around accumulator will be installed
   - enclosure will be included in ventilation system
   - enclosure will be equipped with the gas sensor

c) The Butane alarm push bottom will be installed and will get the same function as gas alarm 35%.

d) Following flexible pipes are not suitable:
   - relief pipe
   - pipe from max 95 to ventilation system

e) Ventilation channel behind max 95 must be fixed

f) Area with l-Butane
   - Will be equipped with a fence
   - Will be marked with: dangerous area

g) Documentation
   Drawing 172-12034 A – 00 date: 27-06-2001 must be updated
   - Safety relief valve before automatic valve in ingoing pipe max 95 must be introduced
   - P1 is not availbl
The installation is fine!

h) Surrounding of HC charging station:
   1. In the 5.00 surrounding of HC-charging station the electrical installation must be improved so that IEC-standards are fulfilled (e.g. exist following deficiencies: switches without cover, terminal boxes without cover).
   2. The lamp over the charging place must be exchanged for a lamp with protection degree IP 54-
   3. The switch for start und stop of the conveying belt must be exchanged for an explosion proofed switch.

i) Identification of hazard area:
   Over the HC charging place a warning plate with a text like this:
CERTIFICATE

No.: TÜV- BB-UL 11057

This is to certify that

Subject: R 600a - Supply and Charging Line Max 95 F-1 and Safety Supervision System Safe 5+

Producer: A'Gramkow, Denmark

Operator: Moganshan Electric Appliances Zhongke Life Science & Technology Zhejiang, P.R.China

meets the requirements of the TÜV Süddeutschland BB-ULM. It was installed according to the relevant International Standards. The R 600a evacuation and refrigerant charging system has been submitted to an audit to verify compliance with the state of the art. The system was audited finally in the period from 9th to 10th December 2003.

This Certification is based on Report No. 3 Safety Inspection of R 600a Charging Station UNIDO - MP/CPR/99/166 - R600a TÜV BB-ULM-Ri/Ma/Li File No.: UNII/ACR/MOG-PRC/01/03

This Certification is valid until December 2005

Ulm, 30th March 2003
TÜV Süddeutschland experts

K-J. Richardt E. Mack

TÜV Süddeutschland Bau und Betrieb GmbH Geschäftsstelle Ulm Benzstrasse 17 D-89079 Ulm Tel. +49 (731) 49 15-2 30 Fax +49 (731) 49 15-3 60 e-mail: Karl-Josef.Richardt@tuev-sued.de