



**Operating Instructions**  
Pressure Reducers  
for pure gases in cylinders

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## Operating Instructions

### Pressure reducers for cylinders used with Pure gases and Specialty Gases

Pressure reducers	Pressure reducers with T purge system
HBS - HBS.V	DIM
HBD.S	DIM T purge
HD300 , HD-CO	DIM GLC T Purge
LH	HD.S-T Purge
AHL	HBSI
BS-A, BS-GL, BS.V-GL	HBD.S
DLM, DLM-BA, DLM-FOOD	HBD.S- T purge
DHP	BD.S-GLC
HEPAL12 - FOOD	

#### Warning

To preserve the quality of our product throughout its usage in the best safety conditions, please read this manual carefully and strictly follow the instructions that it contains. Non-compliance with these instructions or modification of the product may result in serious accidents or bodily injuries. Air Liquide shall not be held responsible in case of non-approved usage of the product.

Air Liquide reserves the right to make all necessary modifications to the specifications described hereafter without notice.



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# 1. FIELD OF USAGE AND CHARACTERISTICS

## 1.1 Functions

The pressure regulators are used:

- to reduce a high-pressure conditioned gas (200 or 300 bar at 15°C) in cylinder
- to regulate and maintain stability of outlet pressure.
- to preserve the gas purity.

The regulators are designed for implementation of pure gases and mixtures with purity < N60 thus ALPHAGAZ™ 1 and 2.

⚠ These regulators should not be used as shut-off valves

## 1.2 Technical characteristics

Operating temperature: - 20°C to + 50°C.

Leakage rate (Internal/External):  $\leq 3 \times 10^{-7}$  mbar.l/ s helium.

## 1.3 Flow Rate curve

Each regulator model has a flow curve, which can be found on its product sheet.

To determine which regulator is suitable for the pressure and flow requirement, the user should refer to this flow curve using the method below.

A flow curve is presented in the form below with the following definitions from the ISO 2503 Standard:

P1: inlet pressure

P2: outlet regulated pressure

Q1: nominal flowrate with a pressure loss of 10%.

Qmax: maximum flowrate

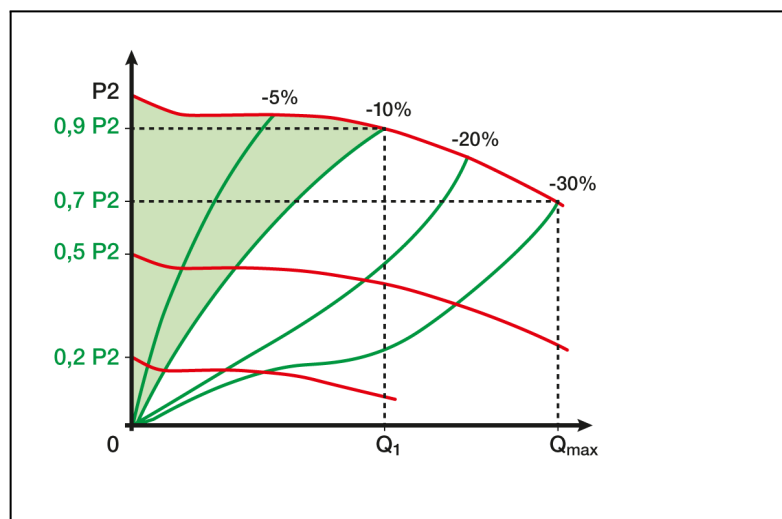
The optimal operating zone of the regulator will be in the green area in the figure

If the operating point is outside this zone, the reducer will not be able to operate correctly.

If a 30% downstream pressure drop is acceptable to the user, then the operating area can be extended to an area approximately forming a triangle, with a line connecting zero to the -30% point (like the line joining the point -10%).

NB: the prior operating condition is that:  $P1 \geq 2 \times P2 + 1$  bar

Take this condition into account when emptying the bottle.



## 1.4 Gas compatibility table

**IMPERATIVE** : check the gas compatibility of this equipment by referring to the "Gas Compatibility Table" in APPENDIX.

⚠ The regulators are delivered with the high pressure fitting corresponding to the compatible gas, according to the standards for bottle valves in force in the country: NEVER DISASSEMBLE this fitting.

## 2. AIR LIQUIDE COMMITMENTS

### 2.1 Conformity

AIR LIQUIDE certifies that the equipment is manufactured, tested and controlled, in accordance with state of the art and AIR LIQUIDE rules.

It is the responsibility of the end user to ensure that such equipment is installed and used in accordance with the current regulations.

#### **Directive 2014/68/EC: Pressurized equipment (PED)**

Technical requirements of Article 4§3 indicates that Pressure equipment and assemblies below or equal to the limits set out in points (a), (b) and (c) of paragraph 1 and in paragraph 2 respectively shall be designed and manufactured in accordance with the sound engineering practice of a Member State in order to ensure safe use.

Without prejudice to other applicable Union harmonisation legislation providing for its affixing, such equipment or assemblies shall not bear the CE marking referred to in Article 18.

By design, these equipment may integrate pressure relief valves or burst disks. In this case, those ones shall neither be CE marked according to paragraph 2 of annex II.

In all other cases, pressure relief valves and burst disks shall be CE marked.

#### **Directive 2014/34/UE ATEX :**

The equipment is not in the scope defined in points a), b) et c) of the article of the ATEX Directive ; consequently, they shall not bear the CE marking.

The equipment is not capable of causing an explosion through their own potential sources of ignition: then, they can be installed in ATEX zone 1 or 2, as far as respecting up to date regulations, rules, operating instructions, in accordance with the sound engineering practice are followed during installation and use.

Reminder: it belongs to the end user to define the ATEX zone.

### **REACH regulation (EC) n°1907/2006 :**

The pressure reducers are made of brass parts, essentially the body, which is a copper alloy with a lead content between 1% and 4% w/w.

As requested by art.33 of REACH Regulation (Registration, Evaluation and Authorisation of Chemicals) and with reference to current list of SVHC (substances of very high concern) available on ECHA website, we inform that lead may be present in a concentration above 0,1% w/w in our products made of brass.

Lead inclusion in the SVHC list in June 2018 does not modify the use conditions described in operating instructions.

Lead will not be released to the surrounding environment or the gas used during normal use.

After product end of life, the pressure reducers must be scrapped by an authorized metal recycler.

### **FOOD regulation (EC) n°1935/2004**

The AL equipment enhancing the term "FOOD" in their designation are specifically designed for use with food gases used for food and beverage applications. They are compliant with Regulation EC 1935/2004 which requires that packaging and articles intended to be in contact with foodstuffs are to be manufactured in compliance with good manufacturing practices and standard operating procedures.

Thus, under normal or foreseeable conditions of use, , no transfer of contaminants, eg, metal elements, to food in quantities that could endanger human health, modify food composition or deteriorate organoleptic characteristics is expected.

Nethertheless, the end-user must check the compliance with an eventual national regulation.

Articles for food usage has a Food logo marking.

For traceability purposes, the batch number is written on each article and AL can perform a batch recall, as requested by its Quality management system.



## **2.2 Cleaning**

Each equipment is subject to a grease removal and a high quality cleaning to preserve the purity of gas in the equipment as well as for use with oxygen for compatible equipment.

A suitable packaging protects the equipment against exterior pollutants during storage and transport.

Take care to avoid polluting the equipment during installation.

## **2.3 Inspections**

Equipment is inspected and has undergone a certified helium leak test prior to packing and dispatch.

## **2.4 Warranty**

The warranty period for equipment supplied by AIR LIQUIDE is one year, covering faulty material or workmanship during manufacture. The warranty does not cover packing and return transport

costs.

Excluded from warranty: seals and relief valves. These components are submitted to a natural wear.


Warranty is not valid on deterioration resulting from incorrect or improper use, use of spare parts which are not recommended by AIR LIQUIDE or from the none respect of this operating instruction.

For more information, refer to the general sales conditions of AIR LIQUIDE.

## 3. ASSEMBLY-ACTIVATION

### 3.1 Safety

First of all, it is ESSENTIAL to read and respect the safety instructions described in the document "General Safety Instructions" delivered with the product.

 NEVER dismantle a component of the regulator in the High Pressure part, especially the cylinder inlet fitting.

### 3.2 Precautions before assembly

After opening the packaging, check that the equipment is not damaged and that the contents correspond to the accompanying delivery notes.

- During assembly, it is important to take extreme care to ensure cleanliness and avoid contamination.
- The regulators are designed to be directly mounted on high pressure gas cylinders. Ensure that the gas cylinders are installed on a smooth and level surface and that the cylinders are attached to their racks. This will prevent the risk of falling.
- To install the equipment, select a ventilated area, protected from the effects of bad weather.

### 3.3 Assembly

#### 3.3.1 Cylinder set up

- Check that the high-pressure inlet connection is compatible with the cylinder valve connection. It must be clean and in perfect state.
- Screw in the fitting nut all the way:
  - hand tightening in case of fitting with overmolded or knurled nut with O-ring seal
  - Fitting by wrench in case of other fitting types.

In case of combustible gases, the fitting must be generally tightened counter-clockwise. (Circular mark on the nut).

#### 3.3.2 Pipe work set up

Outlet fitting (5) assembly on the regulator outlet port:

- Make sure that the supplied outlet fitting matches the application.
- Put in place the seal.
- Screw the outlet fitting on the regulator outlet port (tighten to 35 Nm with a wrench).
- Connect the pipe network and strongly fix it to avoid risks of flapping.

Collect of relief valve:

- Original mounted pressure relief valve are collectable (except the AHL regulator). During the setup of the equipment, it is recommended to connect the relief valve to an event (compression fitting 6mm) in the following cases:
  - Risk of anoxia (restricted space) with neutral gases,
  - Risk of explosion (restricted space) with hydrogen,

### 3.3.3 Tee purge with corrosive and toxic gases

Tee purge systems are implemented on specific reducers DIM or HBD.S for use with corrosive gases or toxic gases.

Functions of tee purge system :

- ★ allow the operator to handle safely the reducer during the cylinder change.
- ★ maintain the quality of the gas during the use,
- ★ increase the lifetime of the reducers by reducing corrosive damages on materials.

To increase the lifetime of the equipment, an installation with corrosive gases shall :

1- be free of any trace of moisture ( $H_2O$  content < 5 ppm) ; it means purge operation must be done before each use of corrosive gas and after each cylinder change.

NB: the cylinder and associated materials must be stored for at least 12 hours in their place of use before use for the following reason: hot air contains a lot of water vapor and when the equipment is colder than the air environment, water will condense on metal surfaces.

2- Perfectly gastight ( $1$  to  $3 \times 10^{-7}$  atm.cm<sup>3</sup>/s helium), that means a very high care on the installation .

Main corrosive gases used: HF, SO<sub>2</sub>, NH<sub>3</sub>, HBr, Cl<sub>2</sub>, HCl, SiH<sub>2</sub>Cl<sub>2</sub>, BCl<sub>3</sub>, SiF<sub>4</sub>, BF<sub>3</sub>, F<sub>2</sub>, NO<sub>2</sub>.

Purge gas to be used: nitrogen, argon very dry ( $H_2O$  content < 5 ppm).

It is highly recommended to install the cylinder+pressure reducer in a safety gas cabinet for the very high toxic gases.

#### **Tee purge use :**

The tee purge is connected to the high pressure chamber of the reducer to allow a sweeping of the internal parts and downstream line with an pure inert gas. The corrosive and/or toxic gas is removed either by a long flowing or by several pressurizing/depressurizing cycles.

#### **Tee pure mounting :**

The tee purge is fitted with a valve to open the inert gas flow and the check-valve to avoid the reactive gas to flow back to the inert gas cylinder.

→ always check the gas compatibility with the materials inside the equipment wetted by reactive gas.

#### **Recommendation for the upstream protection of the pipe network :**

- Install a shut-off valve on the pipe upstream of the point of use.
- Install a relief valve suited to the application on the pipe (besides the relief valve integrated to the pressure reducer).
- The equipment relief valve is not designed to protect the application.
- The application owner is responsible for the safety relief valve (CE marked) to be installed for its application protection.
- If flow adjustment is needed, install a metering valve.

### 3.3.4 Cycles de compression/détente

The corrosive and/or toxic gas is purged either by a steady flow or by several pressure/depressurizing cycles.

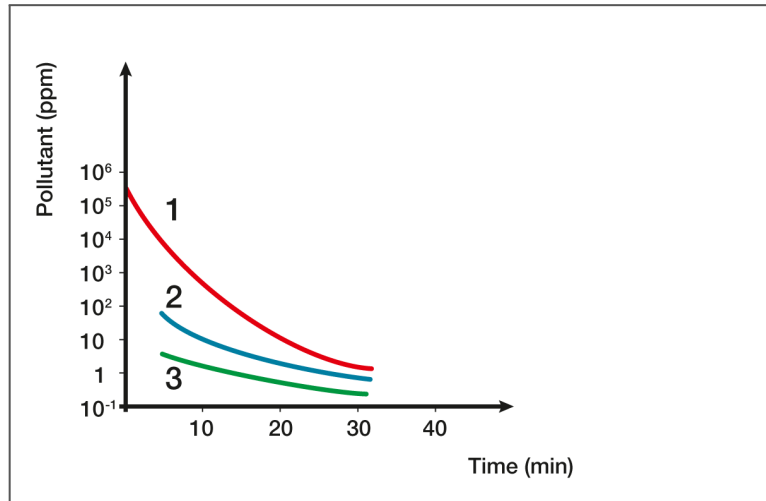
For greater efficiency, a vacuum can be used occasionally.

The curve below shows the three purge methods:

**1:** purge by dilution with continuous flushing with dry inert gas (< 2ppm H<sub>2</sub>O).

**2:** cycles pressurizing-depressurizing.

**3:** cycles pressurizing - depressurizing and vacuum



At a minimum, 6 compression-depressurizing cycles must be carried out.

This number of cycles can be increased in the case of corrosive gases likely to combine with traces of water, which corrodes the metals and greatly reduces the life of the equipment.

#### Mounting the Tee purge :

The Tee purge system is fitted with a valve to open the flow of inert gas and a check-valve to prevent reactive gas from flowing back into the inert gas cylinder.

→ Always check gas compatibility with equipment materials in contact with reactive gas.

### 3.4 Assembly of a compression fitting

Check dimensions and respect material compatibility between connection and pipe: Connection and pipe must always be made from the same material, example: Stainless steel connection for stainless steel pipe <Rockwell hardness B90 (exception : brass connection with copper pipe).

Connector pre-assembled by hand

- After cutting, deburring and blowing on the tube (use preferably a tube cutter), pre-assemble the nut and the ferrules, following the order and the direction indicated in the figure.
- Introduce the tube inside the connector up to the stop limit on the body.
- Clamp the nut completely by hand
- Complete the clamping using a wrench by turning the nut a 1-1/4 turn.

### 3.5 Activation

Even if the tightness of each regulator is tested in a factory, it is necessary to ensure there is no leakage on the connections made during the assembly. Before carrying out this check, make sure that the downstream circuit is closed (towards the application).

Never stand directly in front of the cylinder valve outlet while opening it.

#### 3.5.1 Checking of leakage on the upstream circuit

- Check that the regulator handwheel is loose (counterclockwise)
- Open the cylinder valve
- Verify that the value indicated on the high pressure gauge does not vary over a sufficiently long period
- If necessary, check the leakage on the upstream circuit (Inlet fitting and gauge) by using an AIR LIQUIDE leaks detector.

##### In case of leakage:

- Close the cylinder valve.
- Purge the regulator
- Check the seal and, if necessary, change it.
- Retighten the inlet connection. In case of compression fitting, make sure that the tube is fully inserted in the fitting. Check the ferrules, if necessary, change them.
- Retighten the compression fitting nut.

#### 3.5.2 Checking of leakage on the downstream circuit

- Make sure that the valve on the outlet circuit is closed.
- Open the cylinder valve.
- Turn the handwheel clockwise to read the pressure on the outlet pressure gauge.
- Verify that the value indicated on the high pressure gauge does not vary over a sufficiently long period.
- If necessary, check the leakage on the downstream circuit (outlet fitting and gauge) by using an AIR LIQUIDE leaks detector.

**In case of leakage:**

- Close the cylinder valve.
- Purge the regulator.
- Turn the handwheel counterclockwise.
- Make sure that the tube is fully inserted in the fitting.
- Check the ferrules, if necessary, change them.
- Retighten the compression fitting nut.

 Always turn valves GRADUALLY. NEVER retighten a fitting under gas pressure.

## 4. USAGE

### 4.1 Use

Verify that the regulator handwheel is loose (counterclockwise) and the valve upstream circuit is closed.

- Open the cylinder valve
- Read the pressure on the high pressure gauge.
- Turn the handwheel clockwise until you start feeling resistance. Then continue until you reach the required working pressure.
- Now the regulator is ready to regulate the working pressure.
- Read the outlet pressure on the low pressure gauge.
- Open the outlet valve.
- Adjust the outlet pressure if necessary.
- To stop the gas flow, close the cylinder valve or the valve upstream of the regulator.

### 4.2 After use

When the regulator is no longer used.

- Close the cylinder valve.
- Lower the pressure by the outlet.
- Loosen the handwheel (3) of the regulator.
- Close the upstream valve of the regulator.
- **Dismantle the regulator and store it safely from dust and moisture.**

## 5. MAINTENANCE

### 5.1 Troubleshooting

Default	Cause	Remedy
Mounting impossible	Connections cannot be mount	Verify the compatibility of gases, inlet and outlet
	Damaged connections	Replace the regulator
Insufficient flow rate	Cross section of passage limited by a valve	Open the valve
	Insufficiently filled or empty cylinder	Change the cylinder
	Valve not operating	Change the cylinder
	Under-dimensional equipment	Contact Air Liquide
	Downstream device not operational	Change the device
Gas leak	Tightness default	Close the cylinder valve and replace the safety valve
Gas comes out of the relief valve	Leakage at the poppet or damaged relief valve	
Rise of the outlet pressure	Leakage at the poppet	
Unstable outlet pressure or frosting	Working temperature too low	Close the cylinder valve. Bring back the equipment temperature above 0 °C
	Gas used is (Ar), carbon dioxide (CO <sub>2</sub> ) or nitrous oxide (N <sub>2</sub> O)	Use a heater at the inlet
	Flow rate to high	Respect the max. flow rate of the regulator. Limit the flow by a valve or a calibrated orifice
Vibrations	low rate to high	Limit the flow by a valve or a calibrated orifice
	Presence of valve with quick opening on the downstream pipe	

## 5.2 Maintenance

Even though the equipment is reliable, it must be checked periodically. Since this task requires some precautions, it must be done exclusively by a qualified technician.

The periodicity of this verification depends essentially on the usage of the equipment (intensive, moderate, occasional). We recommend to replace it every 5 years.

In case of operating accident (insufficient output, leakage, opening of the relief valve or accidental damage) : replace the equipment.

**Defective reassembly may cause bursting, malfunctioning and/or an increasing output pressure, which is dangerous for your safety.**

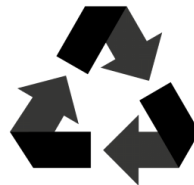
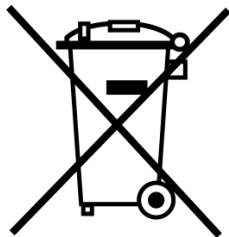
## 5.3 Disposal and recycling

At the end of the equipment's useful life or when it is impossible to repair it, it is essential to respect the local regulations for recycling / disposal of our equipment

To prevent reuse, these products must be unsuitable for use.

In accordance with EU Directive 2018/851 on waste, the owner of the equipment ensures that when recovery is not carried out in accordance with article 10, the waste will be subjected to safe disposal operations that comply with the provisions of article 13 on the protection of human health and the environment.

The licensee must take steps to promote high quality recycling and, to this end, must establish separate waste collections when technically, environmentally and economically feasible and adequate to meet the quality standards required by the relevant recycling sectors.



## 6. APPENDIX: Gas compatibility tables

Y : yes, compatible

N : not compatible

### 6.1 Chromed-brass HP Reducers

Reducer	P max	N <sub>2</sub>	CO <sub>2</sub>	CO	Air*	O <sub>2</sub>	N <sub>2</sub> O	H <sub>2</sub>	C <sub>2</sub> H <sub>2</sub>	C <sub>3</sub> H <sub>8</sub>	C <sub>3</sub> H <sub>6</sub>	C <sub>2</sub> H <sub>4</sub>	CH <sub>4</sub>
HBS	200 bar	Y	Y	N	Y	Y	Y	Y	N	N	N	N	N
HBS-V	200 bar	N	N	N	N	N	N	N	N	Y	Y	Y	Y
HD300	200 bar	Y	Y	N	Y	Y	Y	Y	N	N	N	N	N
LH	200 bar	Y	Y	N	Y	Y	Y	Y	N	N	N	N	N
AHL	200 bar	Y	Y	N	Y	Y	Y	Y	N	N	N	N	N
DLM*	200 bar	Y	Y	N	Y	Y	Y	Y	N	N	N	N	N
DHP	200 bar	Y	N	N	Y	N	N	N	N	N	N	N	N

\* DLM-BA shall be used only for **breathable air** applications.

### 6.2 Brass HP Reducers for carbon monoxide

Reducer	P max	N <sub>2</sub>	CO <sub>2</sub>	CO	Air*	O <sub>2</sub>	N <sub>2</sub> O	H <sub>2</sub>	C <sub>2</sub> H <sub>2</sub>	C <sub>3</sub> H <sub>8</sub>	C <sub>3</sub> H <sub>6</sub>	C <sub>2</sub> H <sub>4</sub>	CH <sub>4</sub>
HD CO	200 bar	N	N	Y	N	N	N	N	N	N	N	N	N

### 6.3 Chrome-Brass LP Reducers used for liquified product or low pressure gas

Reducer	P max	CO <sub>2</sub>	C <sub>3</sub> H <sub>6</sub>	C <sub>3</sub> H <sub>8</sub>	C <sub>2</sub> H <sub>4</sub>	C <sub>2</sub> H <sub>2</sub>	Corrosive liquid	Low pressure mixed gas
BS-A	25 bar	N	N	N	N	Y	N	N
BS-GL	25 bar	Y	N	N	N	N	N	Y*
BS.V-GL	50 bar	N	Y	Y	Y	N	N	Y*

Y\*: check the pressure of the mixed gas cylinder and all components compatibility

## 6.4 SS HP Reducers

Stainless steel material for HP fitting and reducer body.

Reducer	N <sub>2</sub>	CO <sub>2</sub>	CO	Air *	O <sub>2</sub>	N <sub>2</sub> O	H <sub>2</sub>	C <sub>2</sub> H <sub>2</sub>	C <sub>3</sub> H <sub>8</sub>	C <sub>3</sub> H <sub>6</sub>	C <sub>2</sub> H <sub>4</sub>	CH <sub>4</sub>
HBSI	Y	Y	Y	Y	N	N	Y	N	N	N	N	N
DIM- DIM T Purge	Y	N	N	Y	N	N	Y	N	N	N	N	Y
HD.S - HD.S T Purge	Y	N	N	Y	N	N	Y	N	N	N	Y	Y
HBD.S - HBD.S- T purge	Y	N	N	Y	N	N	Y	N	N	N	Y	Y

\*

Air: compressed air not breathable

In case of use with corrosive gas, check the compatibility between the equipment and the gas used.

## 6.5 SS reducers for corrosive liquified gases or low pressure mixed gas

Stainless steel material for HP fitting and reducer body.

Reducer	P max	C <sub>3</sub> H <sub>8</sub>	C <sub>3</sub> H <sub>6</sub>	C <sub>2</sub> H <sub>4</sub>	CH <sub>4</sub>	Corrosive liquid	Low pressure mixed gas
DIM-GLC	25 bar	Y	Y	Y	Y	Y*	Y*
	70 bar	Y	Y	Y	Y	Y*	Y*
BD.S-GLC	27 bar	Y	Y	N	N	Y*	Y*

Y\*: check the pressure of the mixed gas cylinder and seals compatibility with Air Liquide

\*\*BD.S can be used with ammonia (NH<sub>3</sub>)

For others corrosive liquified gas, make a request to Air Liquide.

## 6.6 HEPAL12 FOOD

Reducer HEPAL12 FOOD is only used for food gas range ALIGAL™.

Models	P <sub>1</sub> max	P <sub>2</sub> max	N <sub>2</sub> /Ar	CO <sub>2</sub>	CO	Air *	B.A	O <sub>2</sub>	N <sub>2</sub> O	H <sub>2</sub>	C <sub>2</sub> H <sub>2</sub>	C <sub>3</sub> H <sub>8</sub> (10 bar)	C <sub>3</sub> H <sub>6</sub> (10 bar)	C <sub>2</sub> H <sub>4</sub> (70 bar)	CH <sub>4</sub> (200 bar)
HEPAL12 FOOD 200-8-15	200	8	Y	Y	N	N	N	N	N	N	N	N	N	N	N
HEPAL12 FOOD 200-16-25	200	16	Y	Y	N	N	N	N	N	N	N	N	N	N	N

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