

LPG as a Refrigerant (R290, R600, R600a, R1270)

LPG can be used also as a refrigerant; in which case it is found mostly under the code names:

R290 - PROPANE - C₃H₈, High Purity propane
R600 - n-BUTANE - C₄H₁₀
R600a - ISOBUTANE (2-Methylpropane) - C₄H₁₀
R1270 - PROPYLENE (Propene) - C₃H₆

This is a very special case of use of LPG and is covered by specific standards.

The use of hydrocarbon (HC) refrigerants, mostly R600a and R290 for replacements for HCFC's and HFC's continues around the globe. R600a and R290 have ozone depletion potential (ODP) factors of zero (0.0) and a fraction of the global warming potential of those refrigerants they are intended to replace. Both have acceptable toxicity levels; however, both being LPG, are flammable and are only allowed for use in appliances which fulfil the requirements laid down in the latest revision of EN/IEC 60335-2-24 (To cover potential risk originated from the use of flammable refrigerants). Consequently, R600a and R290 are only allowed to be used in household appliances designed for this refrigerant and fulfil the above-mentioned standard. R600a and R290 are heavier than air and the concentration will always be highest at the floor. R600a must only be stored and transported in approved containers and must be handled according to existing guidelines.

Conversions from refrigerants R12 or R134a to R600a is not permitted, as the refrigerators are not approved for operation with flammable refrigerants, and the electrical safety has not been tested according to existing standards. The same applies to conversions from R22, R502 or R134a to R290

LPG destined for normal fuel applications and even when it is of technical grade 95 % purity, is not sufficient for hermetic refrigeration. Water, sulphur and reactive compounds contents must be on a lower level than guaranteed for those products. Technical grade 99.5 %, also called 2.5, is the one most widely used.

The specifications of R 600a and R 290 according to DIN 8960 - 1998 are as follows

	Specification	Unit
Refrigerant content ¹	≥ 99.5	% by mass
Organic impurities ²	≤ 0.5	% by mass
1,3-Butadiene ³	≤ 5	ppm by mass
Normal Hexane	≤ 50	ppm by mass
Benzene ⁴	≤ 1	ppm per substance
Sulphur	≤ 2	ppm by mass
Temperature glide of evap.	≤ 0.5	K (at 5 to 97 % destill.)
Non condensable gases	≤ 1.5	% vol. of vapour phase
Water ⁵	≤ 25	ppm by mass
Acid content	≤ 0.02	mg KOH/g Neutralization
Evaporation residue	≤ 50	ppm by mass
Particles/solids	no	Visual check

Notes:

1) This content is not explicitly stated in DIN 8960. Only the impurities are listed and limited. The main content is the rest up to 100 %.

From thermodynamic calculation an isomer content of R 600 normal Butane up to 5 % in R 600a isobutane is not critical and still does not exceed the temperature glide criteria and has only very low impact on pressure, less than 0.2 K temperature at evaporation.

2) From compressor point of view content up to approx. 1 % of butane in R 290 or 1 % of propane in R 600a is acceptable.

3) This is a maximum value for every single substance of the multiple unsaturated hydrocarbons.

4) This is a maximum value for every single aromatic compound.

5) This is a preliminary value, to be reviewed with growing experience