CONNECTING EXPERTS.

CHILLVENTA eSPECIAL

Refrigeration | AC & Ventilation | Heat Pumps

13.–15.10.2020

NÜRNBERG MESSE

A2L
READY

PRODUCT SOLUTIONS FOR A2L REFRIGERANTS

BITZER Kühlmaschinenbau GmbH // Julian Karbiner

AGENDA

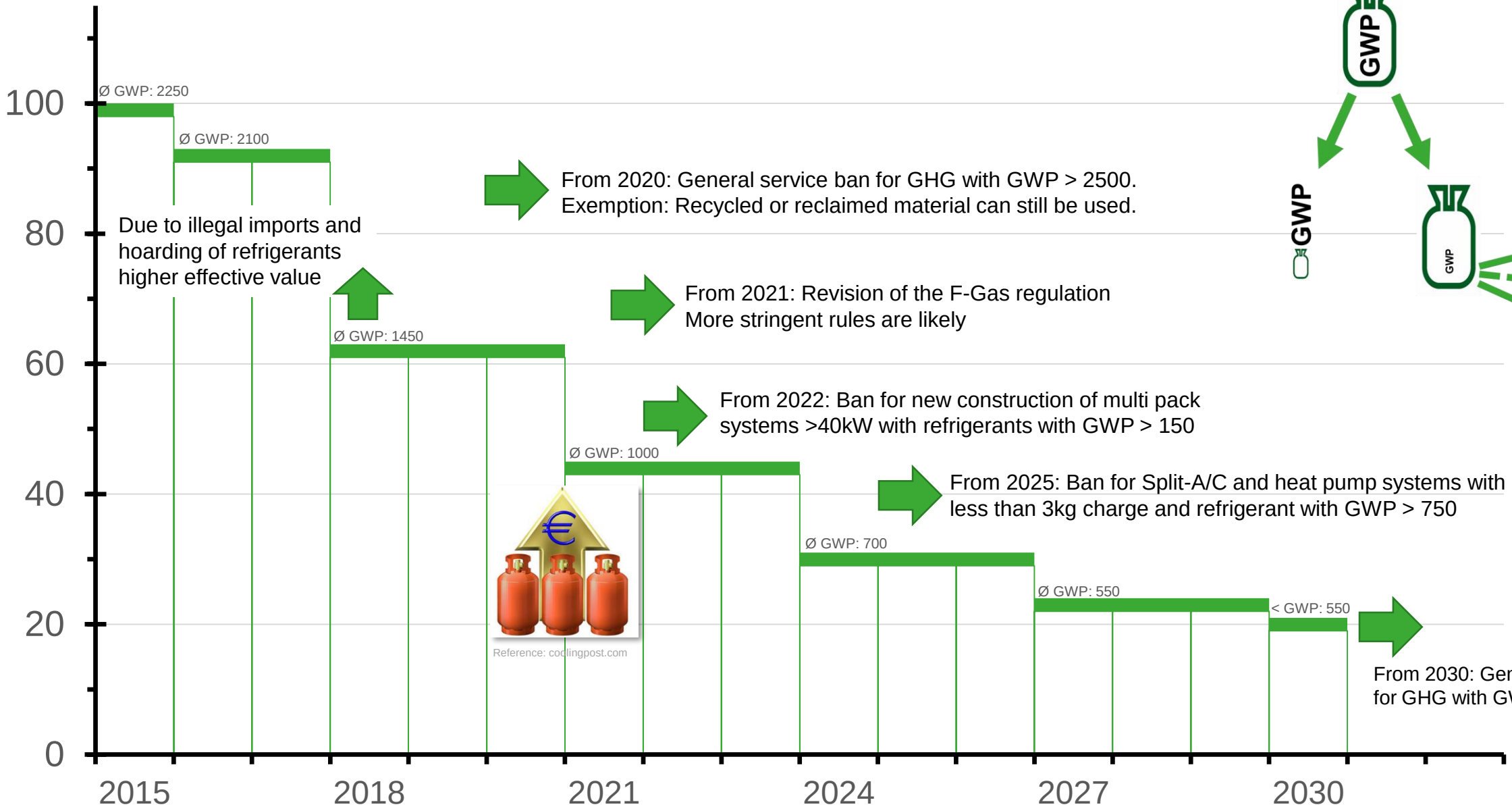
// Introduction

- Refrigerant situation
- Basic requirements for A2L refrigeration

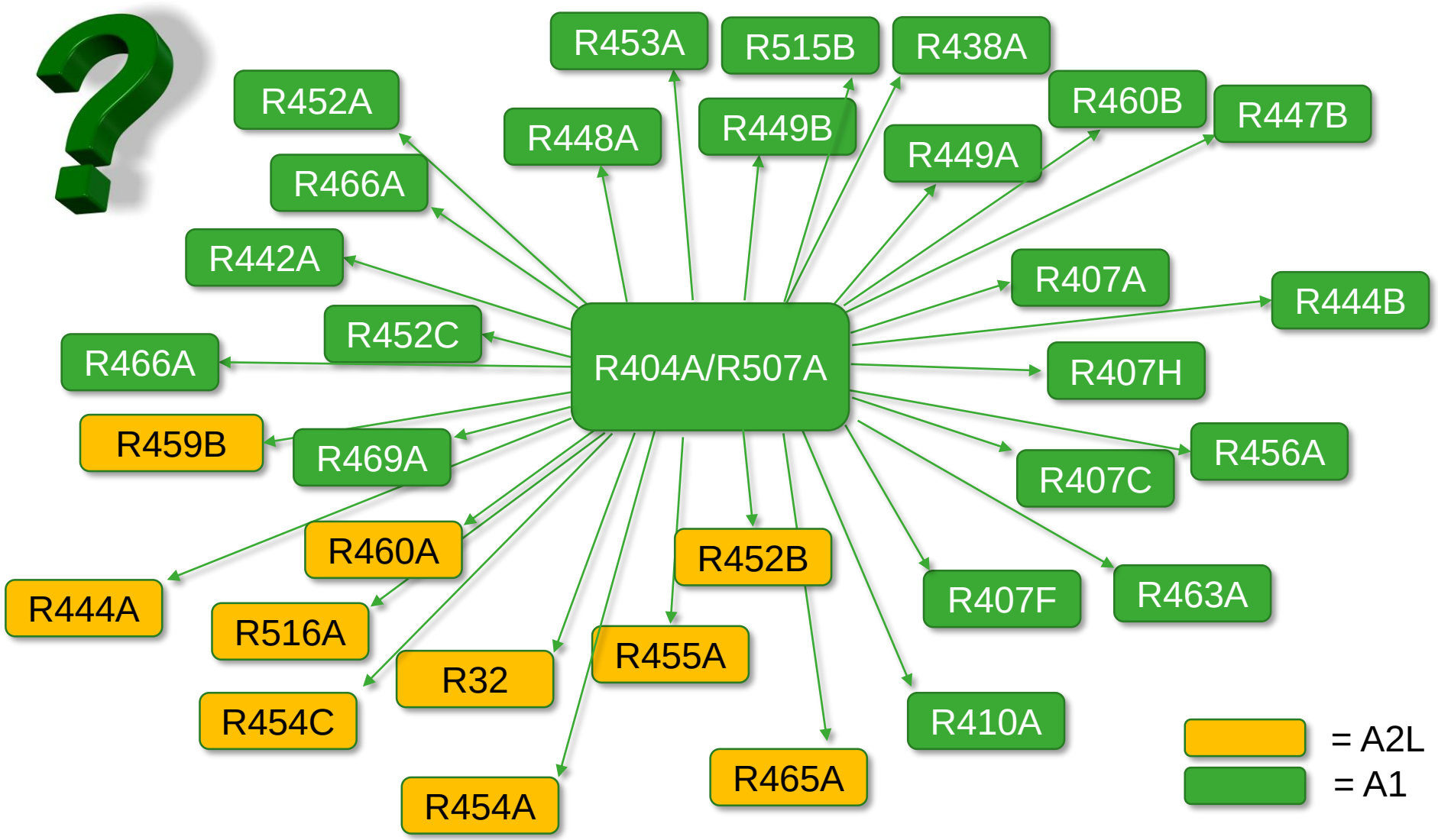
// BITZER solutions for A2L refrigerants

- Semi-hermetic compressors
- Hermetic (Scroll) compressors
- Pressure vessels and heat exchanger

REFRIGERANT SITUATION



REFRIGERANT SITUATION



REFRIGERANT SITUATION

R404A	R143a/125/134a	3922 (3940)	A1
R507A	R143a/125	3985 (3990)	A1
R407A	R32/125/134a	2107 (1920)	A1
R407F	R32/125/134a	1825 (1670)	A1
R422A	R125/134a/600a	3143 (2850)	A1

R404A/R507A GWP 3922/3985	**R448A**	Honeywell	R32/125/1234yf/1234ze(E)/134a	1387 (1273)	A1
	R449A	Chemours	R32/125/1234yf/134a	1397 (1282)	A1
	R449B④	Arkema	R32/125/1234yf/134a	1412 (1296)	A1
	R460B	Mexichem	R32/125/1234ze(E)/134a	1352 (1242)	A1
	R452A	Chemours	R32/125/1234yf	2140 (1945)	A1
	R452C④	Arkema	R32/125/1234yf	2220 (2019)	A1
	R460A	Mexichem	R32/125/1234ze(E)/134a	2103 (1911)	A1
(R22/R407C)	**R454A**	Chemours Daikin Chemical	R32/1234yf	239 (238)	A2L
	R454C②	Chemours	R32/1234yf	148 (146)	A2L
	R455A	Honeywell	R32/1234yf/CO_2	148 (146)	A2L
	–	Arkema	R32/1234yf/152a	251 (251)	A2L
	R457A②	Arkema	R32/1234yf/152a	139 (139)	A2L
	R459B②	Mexichem	R32/1234yf/1234ze(E)	144 (143)	A2L

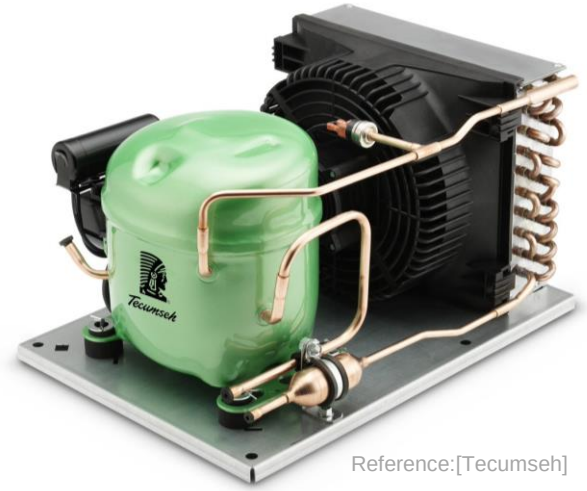
- R32 is used to substitute R143a (GWP: 675 vs. 4470)
- R125 is still used to suppress flammability → for GWP < 150: R125 not applicable anymore
- HFOs replace R134a and have a larger total share
  - Diverging boiling pressures → increased temperature glide

BASIC REQUIREMENTS FOR A2L REFRIGERATION

// In General:

– Refrigeration systems, that contain refrigerants of the safety category A2/A2L or A3 , must be designed „permanent technical sealed“.

Permanent technical sealed system



Reference:[Tecumseh]

~~No~~ permanent technical sealed system

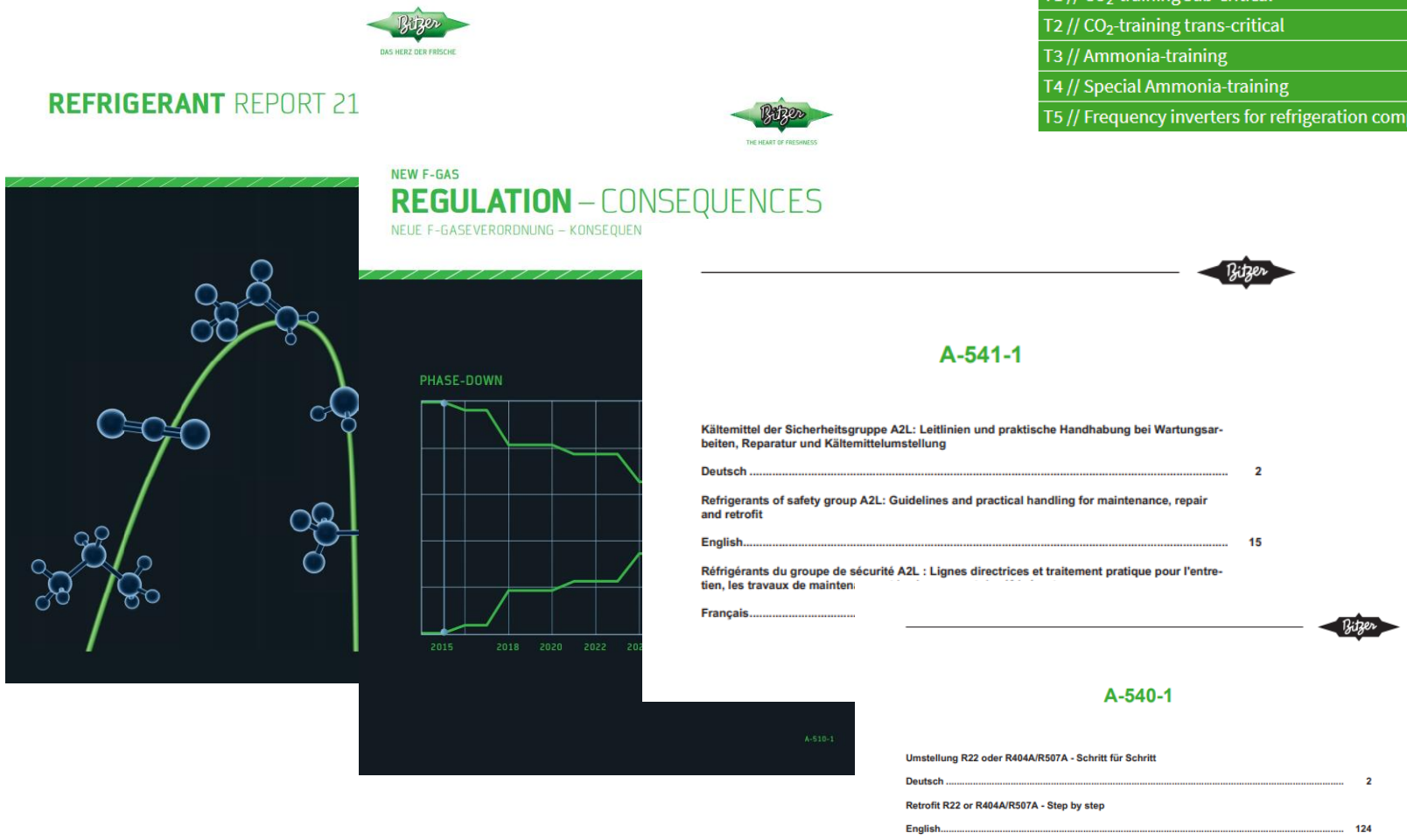
2.4.3.2 Auf Dauer technisch dichte Anlagenteile

(1) Bei Anlagenteilen, die auf Dauer technisch dicht sind, sind keine Freisetzungen zu erwarten.
(2) Anlagenteile gelten als auf Dauer technisch dicht, wenn
sie so ausgeführt sind, dass sie aufgrund ihrer Konstruktion technisch dicht bleiben
oder ihre technische Dichtheit durch Wartung und Überwachung ständig gewährleistet wird.

[TRBS 2152-2]

BASIC REQUIREMENTS FOR A2L REFRIGERATION

// Supportive documents and trainings by BITZER:



LEGEND TO OVERVIEW

T1 // CO_2-training sub-critical	T6 // Compact screw compressor with integrated VSD
T2 // CO_2-training trans-critical	T7 // Training on practical application of A2L refrigerants
T3 // Ammonia-training	T8 // Hydrocarbons-training
T4 // Special Ammonia-training	T9 // Training ROADSTAR compressor for bus air-conditioning
T5 // Frequency inverters for refrigeration compressors	

BASIC REQUIREMENTS FOR A2L REFRIGERATION

// 2014/68/EU PED Pressure vessels need to fulfill **PED**

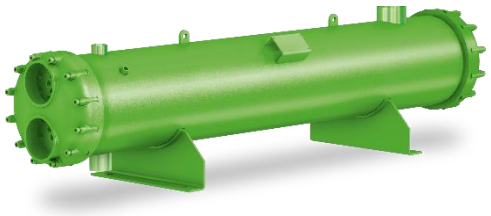
/ **Components** of a refrigeration system:

Vessels, Valves
Piping
Safety accessories
Assemblies

→ Approval according to the PED
Pressure Equipment Directive 2014/68/EU

European Commission

Oil separators and
Liquid Receivers



Evaporators and
Condensers

Ref.: Parker

Safety devices, e.g.
Pressure Relief Valve

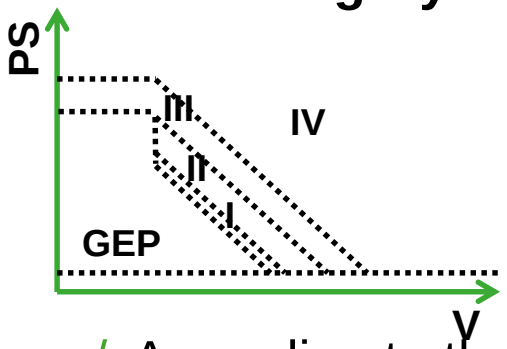
Suction, **Discharge** and **Liquid** Lines

BASIC REQUIREMENTS FOR A2L REFRIGERATION

// 2014/68/EU PED 2 **Fluid Groups** are defined:

- Group **1** = **dangerous** substances (e.g. R290; R1234yf but **not** R1234ze)
- Group **2** = all other substances (e.g. R134a)

PED **Category Classification Charts**



Increasing **Level of Hazard**

- Good Engineering Practice (**GEP**)
- Category **I**
- Category **II**
- Category **III**
- Category **IV**

/ According to the EN 378 / ASHRAE 34, **refrigerants are classified**:

Safety Groups

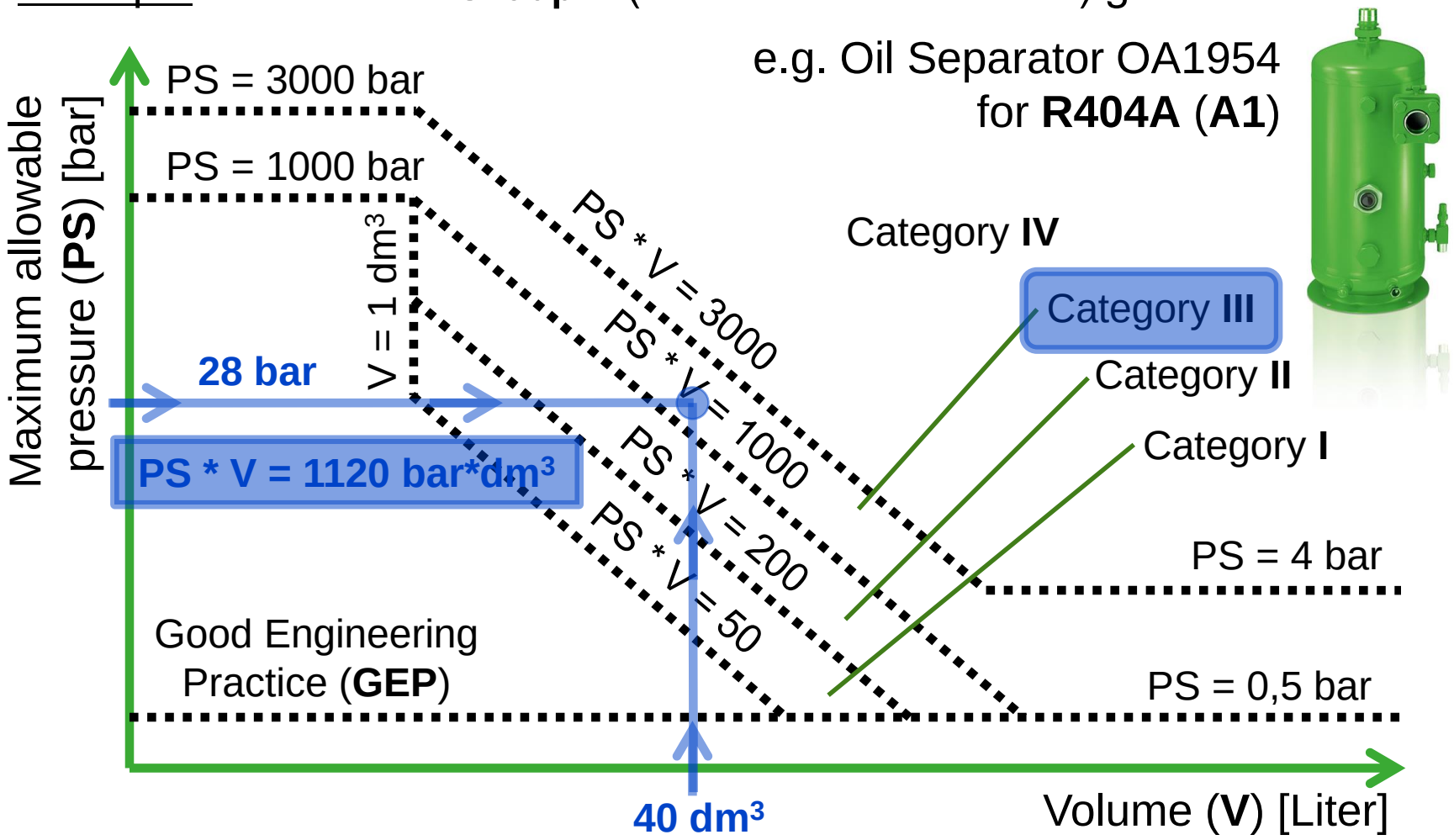
A1	B1
A2	B2
A3	B3

- Non-flammable and non-toxic refrigerants = **Fluid Group 2**
- Toxic refrigerants = **Fluid Group 1**
- Flammable refrigerants = **Fluid Group 1**
- Flammable and toxic refrigerants = **Fluid Group 1**

BASIC REQUIREMENTS FOR A2L REFRIGERATION

// 2014/68/EU PED

Example: Vessels for **Group 2** (= all other substances) gases



BASIC REQUIREMENTS FOR A2L REFRIGERATION

// 2014/68/EU PED

Example: Vessels for **Group 1** (= **dangerous** substances) gases

e.g. Oil Separator OA1954
for **R454C / R455A** (**A2L**)

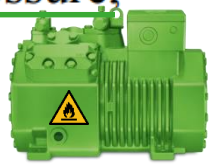
BASIC A2L REFRIGERATION MAIN TOPICS – PED

// 2014/68/EU PED Semi-hermetic compressors are **excluded from the PED**

/ According to **Article 1, Paragraph 3.10**:

1. Article 1.3.10 excludes pressurized equipment comprising casings or machinery from the scope of the PED

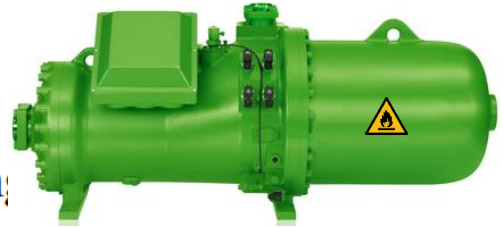
a) if this equipment is primarily dimensioned for loads other than pressure, i.e. for which pressure is not the significant design factor



and

b) if it is primarily designed to move or rotate or fulfil other functions than pressure containment.

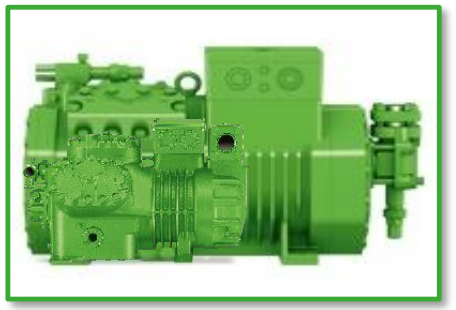
2. Such equipment may include



- engines including turbines and internal combustion en

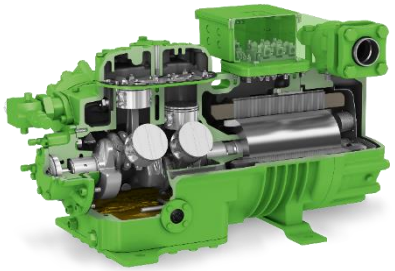
- steam engines, gas/steam turbines, turbo-generators, compressors, pumps, actuating devices and curing moulds for tyres.

BITZER SOLUTIONS FOR A2L REFRIGERANTS



// Semi-hermetic reciprocating compressors
  – All BITZER semi-hermetic reciprocating compressors can be operated with mildly flammable refrigerants (A2L) as well as flammable refrierants (A3 → P-Version available)

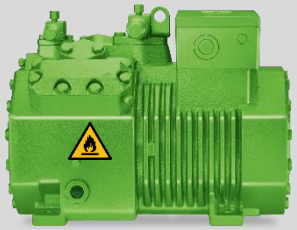
RECIPROCATING COMPRESSORS
INTELLIGENT PRODUCTS
FREQUENCY INVERTER
HFO READY
PROPANE



IQ MODUL

Information
When using a flammable refrigerant:
Affix the warning sign “Warning: flammable materials” (W021 according to ISO7010) well visibly to the compressor. An adhesive label showing this warning sign is enclosed with the Operating Instructions.

ECOLINE SERIES FOR SYNTH. REF.



Displacements:	27 + 19 Tandem
Design:	2-, 4-, 6-, 8-Cylinders 7 Housing sizes
Types:	2KES … 8FE
Refrigerants:	HFO & Blends, HFC, HCFC
Motor:	Motor Version 1, 2, 3

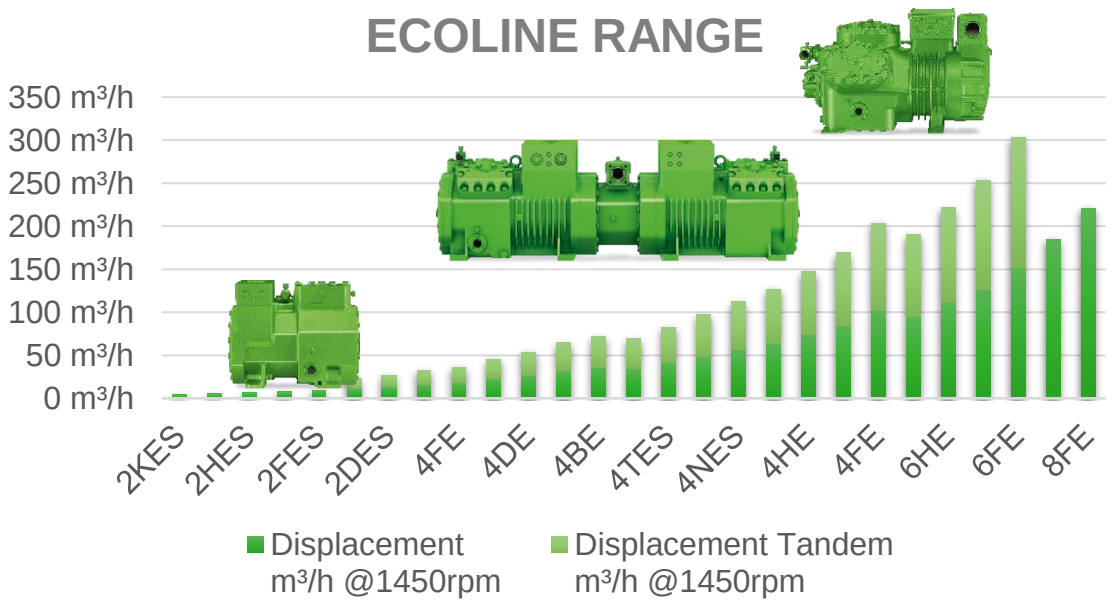
ECOLINE P SERIES FOR HYDROCARBON

Displacements:	27
Design:	2-, 4-, 6-, 8-Cylinders 7 Housing sizes
Types:	2KESP … 8FEP
Refrigerants:	Hydrocarbons
Motor:	Motor Version 1, 2

BITZER SOLUTIONS FOR A2L REFRIGERANTS

// Semi-hermetic reciprocating compressors

– All BITZER semi-hermetic reciprocating compressors can be operated with mildly flammable refrigerants (A2L) as well as flammable refrierants (A3 → P-Version available)



7.2 Reciprocating compressors

Since introduction of the ECOLINE range for amongst others R404A in the beginning of 2013, the elastomer gaskets of the reciprocating compressors of BITZER are suitable as stated above.

The gaskets used in the reciprocating compressors before are considered a low risk only.

Elastomer gaskets are used at the oil pump, the oil sight glass and on open type compressors also at the shaft seal.

On semi hermetic compressors without oil pump, elastomer gaskets are used only at the oil sight glass.

On compressors manufactured before 2010, a change of the gaskets is recommended. If the gasket surface is opened during maintenance, an exchange is recommended.

On open type compressors a preventive change of the shaft seal is recommended to reduce the risk of loss of new refrigerant.

BITZER SOLUTIONS FOR A2L REFRIGERANTS

// Semi-hermetic screw compressors

– All BITZER semi-hermetic screw compressors can be operated with mildly flammable refrigerants (A2L) as well as flammable refrierants (A3 → Adapted P-Version available for compact screw compressors)

7.1 Compatibility

BITZER has tested the currently used elastomer gaskets of the compressors for the application with R404A, R507A, R134a also for application with unsaturated hydrofluorocarbons (HFO) like R1234yf and R1234ze(E). This covers also the blends containing these, like R448A, R449A, R450A and R513A.

7.3 Screw compressors

BITZER screw compressors contain more elastomer gaskets. The currently used gaskets are suitable as stated above.

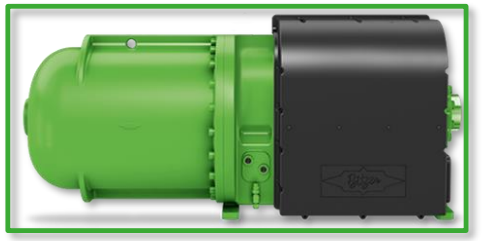
On compressors manufactured before 2010, a change of the gaskets is recommended. If the gasket surface is opened during maintenance, an exchange is recommended.

Information

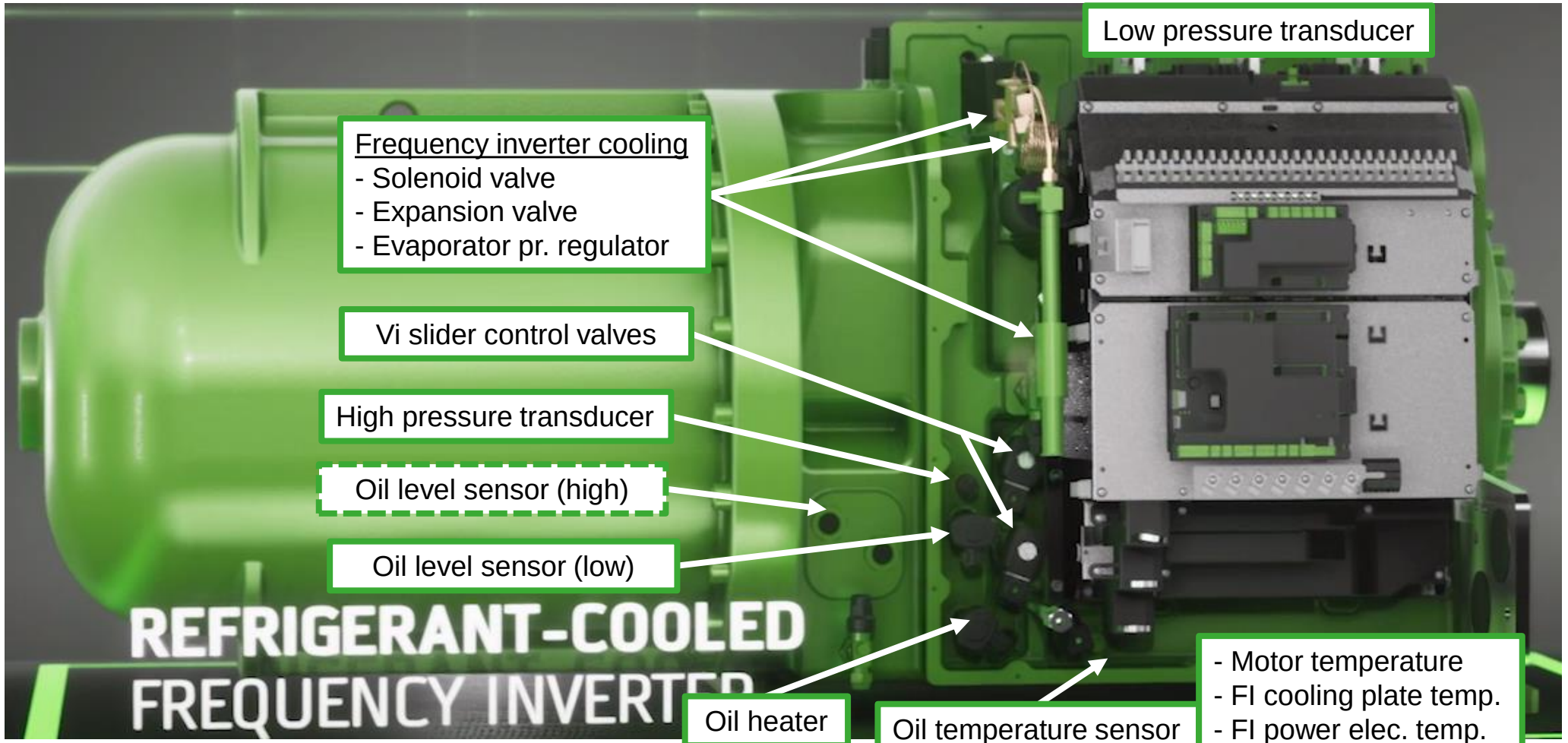
When using a flammable refrigerant:
Affix the warning sign “Warning: flammable materials” (W021 according to ISO7010) well visibly to the compressor. An adhesive label showing this warning sign is enclosed with the Operating Instructions.

Refrigerant burning in the terminal box may only happen if several very rare errors occur at the same time. The probability of this event occurring is extremely low. When suspecting burnt refrigerant in the terminal box, wait at least 30 minutes before opening it. According to the present knowledge, this is the time needed for the toxic combustion products to be degraded. It is necessary to use appropriate, acid-resistant gloves. Do not touch moist residues, but let them dry, because they may contain dissolved toxic substances. Never inhale evaporation products. Let the concerned parts be cleaned by trained staff or, if the parts are corroded, dispose of them properly.

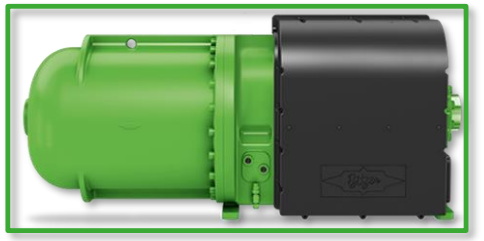
BITZER SOLUTIONS FOR A2L REFRIGERANTS



// Semi-hermetic screw compressors with integrated VSD

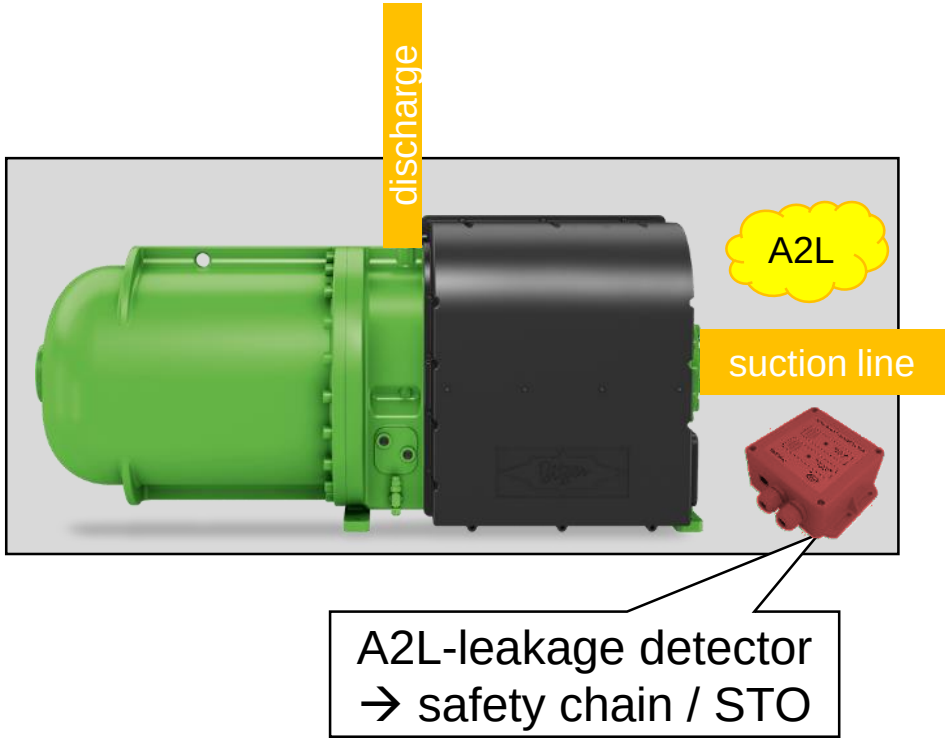


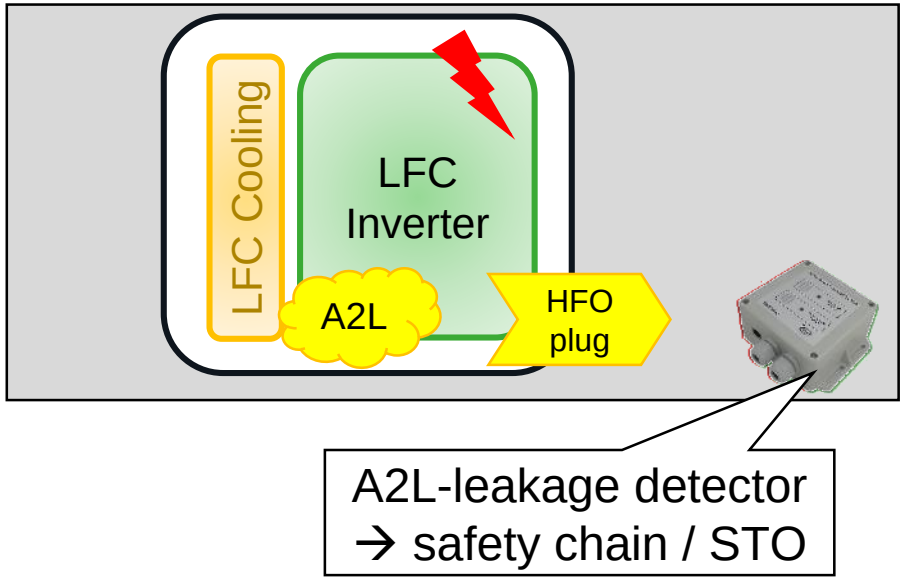
BITZER SOLUTIONS FOR A2L REFRIGERANTS



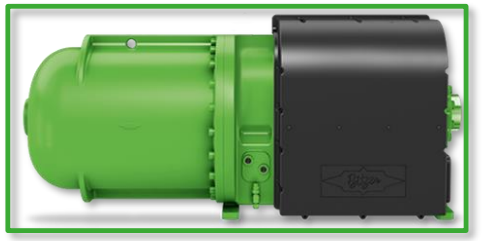
// Semi-hermetic screw compressors with integrated VSD

- Also the BITZER CSVH and CSVW compressor series with integrated frequency inverter is A2L ready
- The compressor is adapted with a „HFO-Plug“ that enables the unimpeded flow of potential leaking refrigerant out of the inverter housing



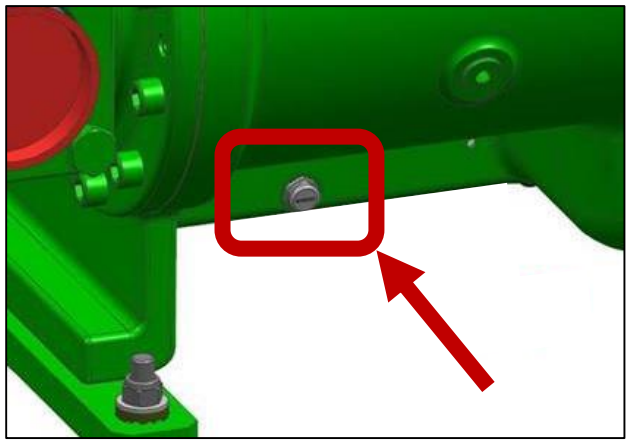


BITZER SOLUTIONS FOR A2L REFRIGERANTS

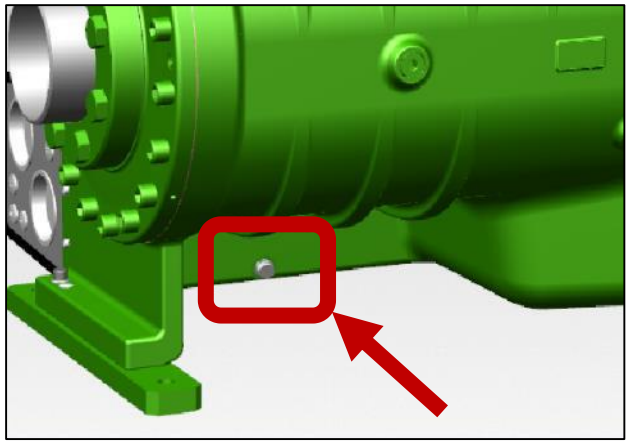


// Serial implementation since S/N 1094202099 for all CSV compressors

CSV.2

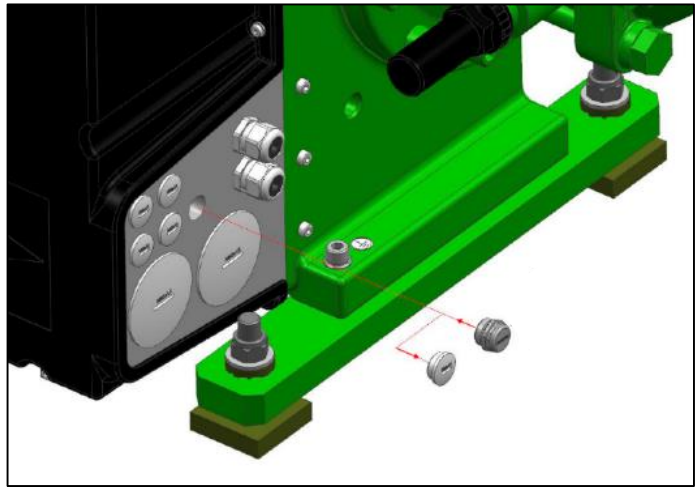


CSV.3

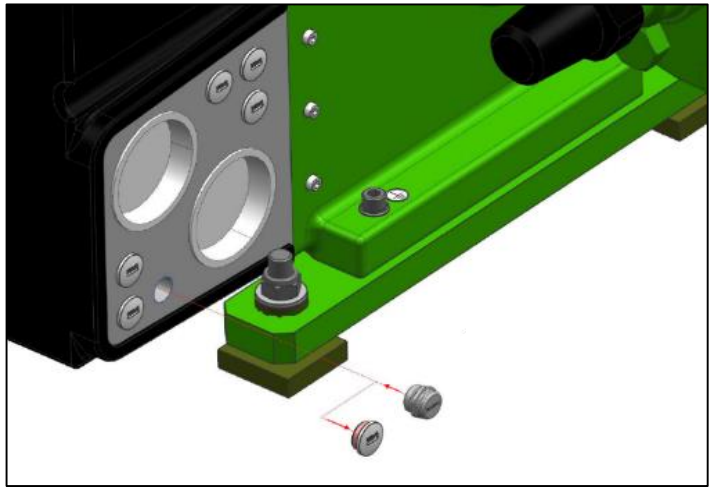


// Possible retro-fit for S/N before 1094202099 ; additional HFO-plug for on-site assembly

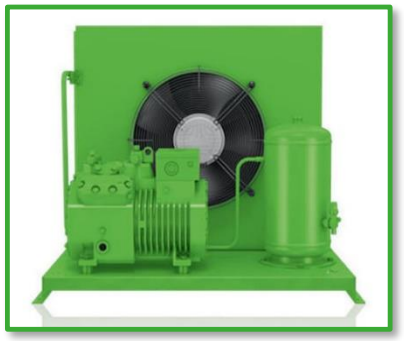
CSV.2



CSV.3



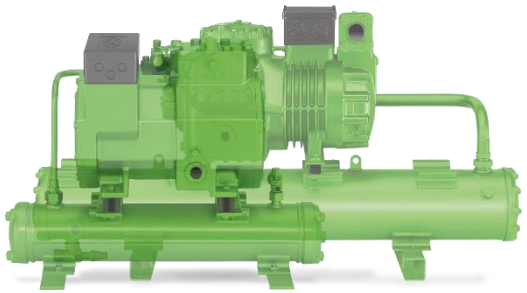
BITZER SOLUTIONS FOR A2L REFRIGERANTS



// BITZER condensing units

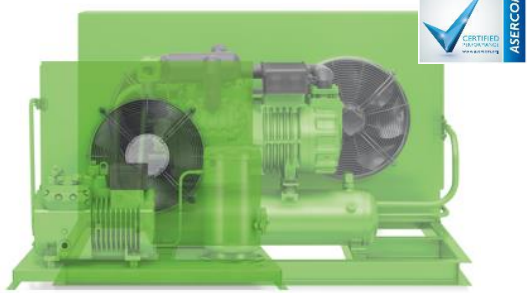
- The BITZER K-, LHE- and LHL- (ECOLITE) Series can be operated with mildly flammable refrigerants (A2L)
- Due to the high number of the refrigerants, please use the BITZER selection Software, to verify the ECODESIGN conformity with the selected refrigerant

K - Series



- ✓ Fixed Speed
- ✓ ECOLINE compressor
- ✓ Sea water version available
- ✓ HFO Ready
- ✓ Various accessories
  - VARISTEP ; Oil separator ; check valve etc…

LH(E) - Series



- ✓ ECOLINE with VARISTEP
- ✓ EU Ecodesign conform
- ✓ HFO Ready
  - R449A; R448A; R513A; R450A etc…
  - R1234ze/yf ; R454C; R455A etc…
- ✓ Asercom certified
- ✓ Various accessories

LHL - Series

- ✓ ECOLINE with VARISTEP
- ✓ EU Ecodesign conform
- ✓ HFO Ready
  - R449A; R448A; R513A; R450A etc…
  - R1234ze/yf ; R454C; R455A
- ✓ Asercom certified
- ✓ A2L certificate (TÜV Nord approved)

BITZER SOLUTIONS FOR A2L REFRIGERANTS

// Refrigerants Group A1 only
// SW version 1.7
// Nearly no claims from the field

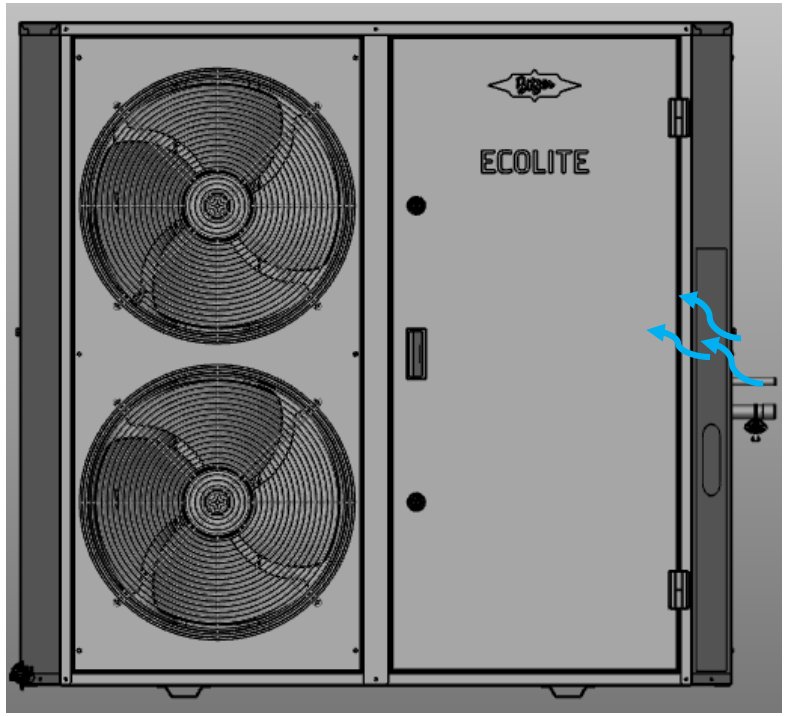
1.0 to 2.0

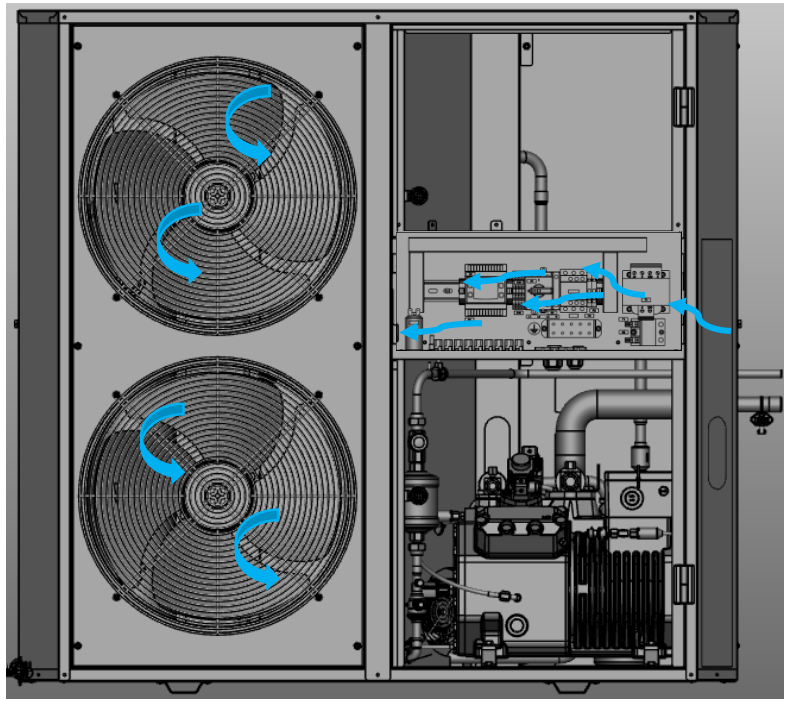
// Refrigerants Group A1 and **A2L**
// New SW version 2.1 with new functions
// Small design changes for A2L approval and even more service friendliness

BITZER SOLUTIONS FOR A2L REFRIGERANTS

// General: t_{amb}> 25°C → the condenser fan(s) are switched on a few seconds before the compressor starts.

// When refrigerant group A2L → the condenser fans are always pre-started before the compressor (regardless of t_{amb}) for approx. 30 s to ventilate the machine room and the electrical cabinet.





BITZER SOLUTIONS FOR A2L REFRIGERANTS

// For refrigeration projects with A2L refrigerants, the A2L Certificate is necessary

// This certificate can be ordered directly with the unit or also later, when the ECOLITE is already on-site to release the A2L refrigerants

A2L refrigerant needed?

Contact

Order certificate

Receive

Declaration of Release for Use with Flammable Refrigerants A2L

The ECOLITE condensing unit listed below is released by the manufacturer for use with the flammable refrigerants of safety class A2L according to ISO817, selectable in the controller and listed in the Operating Instructions.

Manufacturer: BITZER Kühlmaschinenbau GmbH, Peter-Schaufler-Platz 1, 71065 Sindelfingen, Germany

Condensing unit: LHL5E/4CES-6Y

ensured by the operator resp. end user via sufficient ventilation or cut out via a gas sensor or other reliable measures.

The pressure equipment installed in the condensing unit is applicable and categorized for flammable gases according to EU Pressure Equipment Directive 2014/68/EU fluid group 1.

Applied standards: EN12100, EN 378-2

BITZER Kühlmaschinenbau GmbH

ppa. CTO R. Große-Kracht

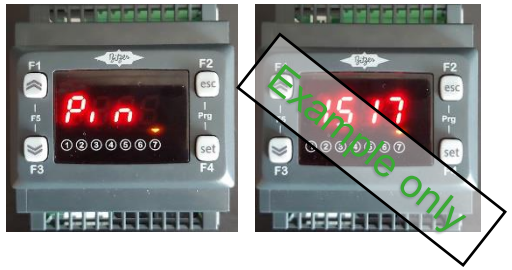
BITZER Kühlmaschinenbau GmbH // Peter-Schaufler-Platz 1 // 71065 Sindelfingen // Germany
Tel +49 7031 932-0 // Fax +49 7031 932-147 // bitzer@bitzer.de // www.bitzer.de

KC-ECOLITE_A2L-20

Subject to change! 03.2020

A2L certificate
+
four digit code

Release



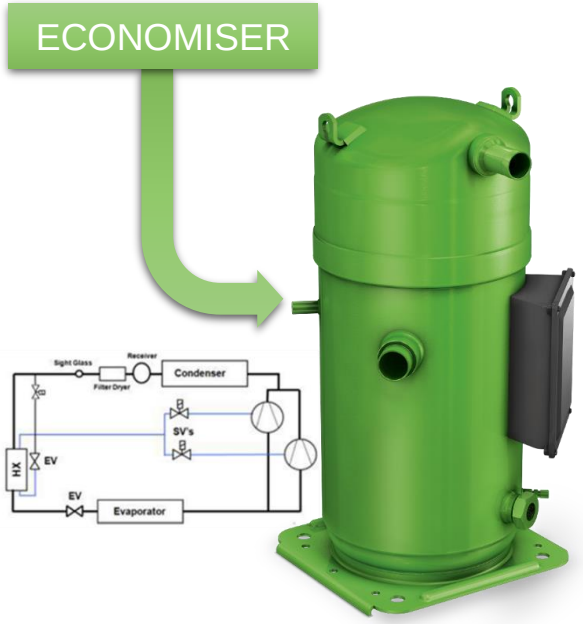
Type	Safety group	Fluid group
R-1234yf	A2L	1
R-1234ze(E)	A2L	2
R-454C	A2L	1
R-455A	A2L	1

BITZER SOLUTIONS FOR A2L REFRIGERANTS

// BITZER ORBIT Scroll compressors are released for use with A1 & A2L refrigerants
// A dedicated Version is available for A2L refrigerants due to special non destructive testing requirements and quality management (PED category II to III)

// **ORBIT (GSD)**
// R410A, R454B, R452B, R32
// Chiller and reversible heat-pump

// **ORBIT+ (GSU)**
// R410A, R454B, R452B, R32
// High efficiency LSPM Motor



// **ORBIT FIT (GED)**
// R410A, R454B, R452B, R32
// Dedicated heat-pump and MT chiller

BITZER SOLUTIONS FOR A2L REFRIGERANTS

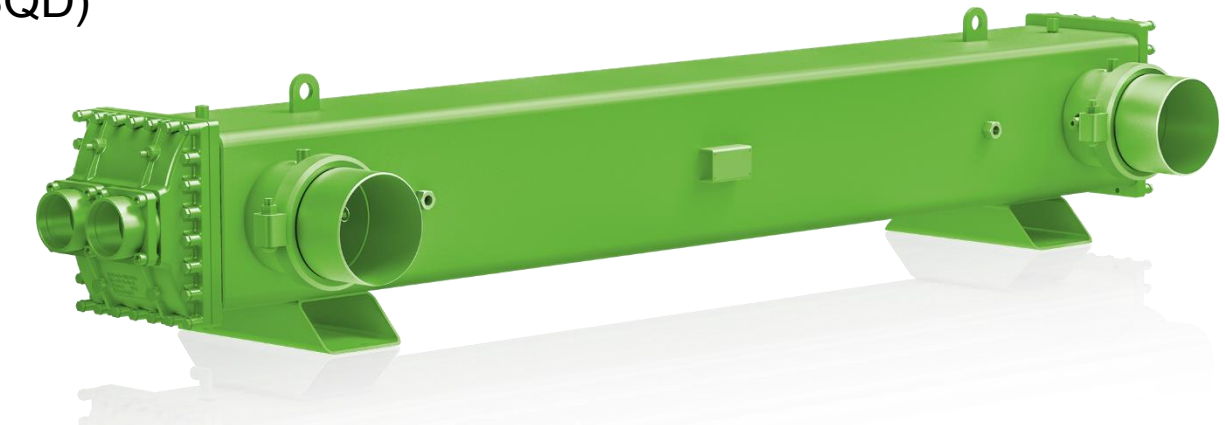
// The complete BITZER portfolio of Heat Exchangers and Pressure Vessels is released for use with A2L refrigerants

// This is valid for both A2L refrigerants classified in refrigerant Group 1 and 2 according to PED directive 2014/68/UE as all the heat exchangers and pressure vessels are approved for use with Group 1+2 fluids

// The safety measures which are recommended to be used when designing and assembling a system operating with an A2L refrigerant (risk assessment etc.) must me observed, but no specific measure is connected to the heat exchanger / pressure vessel

// Available product portfolio includes:

- Water-cooled condensers (series K, K..B, CXP, CXPM, CRF, CRM, McDEW)
- Dry-expansion evaporators (series DH, PC, DM, SQD)
- Flooded evaporators (series FEV)
- Oil coolers (series OW)
- Oil separators (series OA, OAF)
- Liquid receivers (series F, FS, F..K, F..G)



DAS HERZ DER FRISCHE

Thank you for your attention.

CONNECTING EXPERTS.