

Chillventa Specialist Forums 2024

Chillventa Fachforen 2024

**CONNECTING
EXPERTS.**





Fluor & Energy
Materials

koura

Koura's Low GWP Refrigerants

- Solutions ranging from comfort cooling to ultra-low temperature refrigeration

Sarah Kim

08.10.24

What Makes Us Unique

- 01 World's largest fluorspar producer¹ vertically integrated into high-value, high-growth applications with a secure “mine to market” approach.
- 02 Owner's mindset to **optimizing and investing in current portfolio**.
- 03 Investing in **low carbon footprint** refrigerants and medical propellants to massively reduce greenhouse gas emissions for our customers.
- 04 Enabling the world's rapid transition to **sustainable energy** with fluorinated energy materials.

1. Mordor Intelligence fluorspar market report 2023





Fluor & Energy
Materials

Retrofit Solutions



Klea® 456A

Low GWP R-134a replacement

- Non-flammable
- 50% GWP reduction vs R-134a

Qualified by 20+ brands of AC charging equipment in EU

Successfully servicing R-134a vehicles

Applications:



MAC
(aftermarket)



Cold chain



Chillers



Heating



Klea® 456A

Properties

Composition R-32/134a/1234ze(E) (6/45/49%)

Property	Units	R-134a	R-456A
ASHRAE 34 Classification		A1	A1
EU GWP ₁₀₀		1430	685
Relative COP*		100%	99.6%
Relative Volumetric Capacity*		100%	102.3%
Typical Temperature Glide*	K	0	1.5
Liquid Density (20°C)	kg/m ³	1225	1182
Bubble Point	°C	-26.1	-30.8
Saturated Vapor Pressure (20°C)	kPa	572	555

*Thermodynamic cycle calculation conditions: Single-stage, isentropic efficiency 65%, volumetric efficiency 100%, 0.2 bar pressure drop
Mean evap T = 10°C, Mean cond T = 40°C, Subcool = 5K, SH = 5K

Klea® 456A



50%
Lower GWP**



Non
flammable



cooling
capacity boost



Ease of use
Drop in

**Klea 456A v R-134a
(685 vs. 1430)



Fluor & Energy
Materials

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Klea[®] Edge[™] 444A

Drop in R-1234yf replacement

- Mildly flammable (A2L)
- Faster pulldown rate

Commercially available, Type approved

Qualified by 3 brands of AC charging equipment in EU (others in progress)



Applications:



MAC
aftermarket & OE



Cold chain



Chillers



Heating

Klea® Edge™ 444A

Properties

Composition R-32/152a/1234ze(E) (12/5/83%)

Property	Units	R-1234yf	R-444A
ASHRAE 34 Classification		A2L	A2L
EU GWP ₁₀₀		0.5	88
Relative COP*		100%	105%
Relative Volumetric Capacity*		100%	112%
Typical Temperature Glide*	K	0	5.4
Liquid Density (20°C)	kg/m ³	1110	1140
Bubble Point	°C	-29.5	-30
Saturated Vapor Pressure (20°C)	kPa	592	712

*Thermodynamic cycle calculation conditions: Single-stage, isentropic efficiency 65%, volumetric efficiency 100%, 0.2 bar pressure drop
Mean evap T = 10°C, Mean cond T = 40°C, Subcool = 5K, SH = 5K

Klea® Edge™
444A



Faster pulldown
rate



Higher COP



>10% cooling
capacity boost



Ease of use
Drop in

Klea® 456A & Klea® Edge™ 444A

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Market Driven Easy Adoption

Approved by major recovery, recycling and recharging (RRR) service trolley manufacturers



Klea® 473A

Solution for ultra low temperature refrigeration

- Non-flammable
- 85% GWP reduction vs R-23 (14,800)

RAC Cooling Industry Awards 2022 winner for “Refrigeration Innovation of the year: Technology”



Applications:



High value
cold chain



Pharmaceutical



Test chambers



Medical



Klea® 473A

Properties

Composition R-744/1132a/23/125 (60/20/10/10%)

Property	Units	R-23	R-473A
ASHRAE 34 Classification		A1	A1
EU GWP ₁₀₀		14800	1831
Relative COP*		100%	98%
Relative Volumetric Capacity*		100%	120%
Temperature Glide*	K	0	2.5
Critical Temperature	°C	26.1	29.2
Isentropic Index (Cp/Cv) (@ 0°C and 300 kPa)		1.24	1.26
Liquid Density (0°C)	kg/m ³	1035	895
Bubble Pressure (@-60°C)	kPa	312	420
Bubble Pressure (@-20°C)	kPa	1395	1790

*Thermodynamic cycle calculation conditions: Single-stage, isentropic efficiency 65%, volumetric efficiency 100%, zero pressure drop
Mean evap T = -70°C, Mean cond T = -20°C, Subcool = 5K, SH = 5K

Klea® 473A



+85%
Lower GWP**



Non
flammable



-75°C
effective

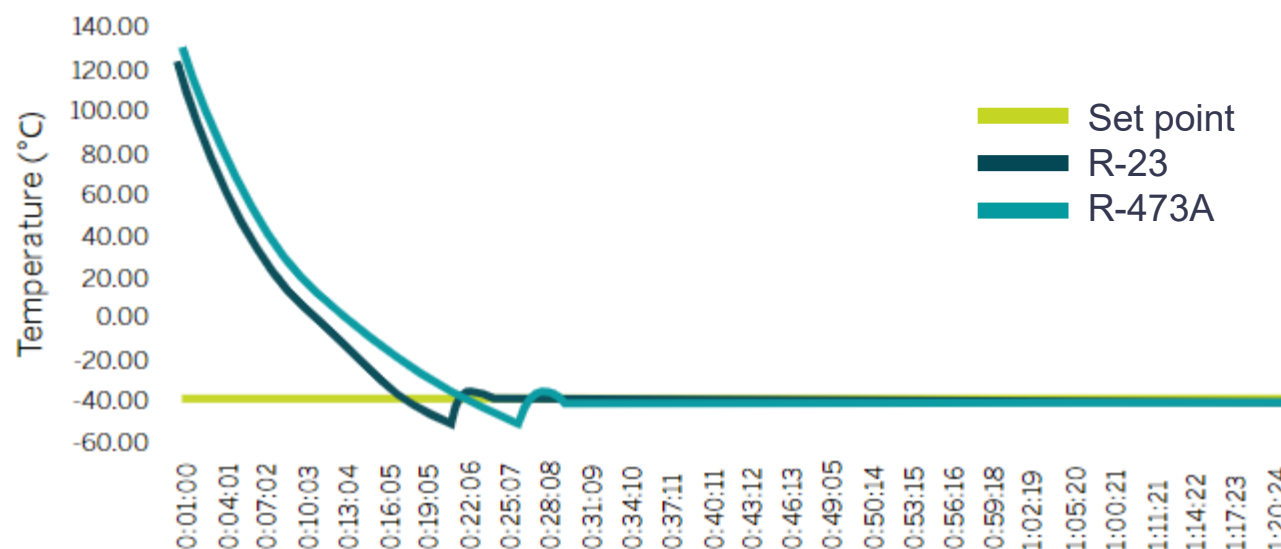


Ease of use
Drop in

**Klea 473A v R-23 (14,800 GWP)
and R-508 (13,396 GWP)

Environmental Chamber Case Study – SJJ System Services Ltd

R-23 vs R-473A Cooling From +130°C & -40°C



Drop-in test results with same refrigerant charge showed comparable performance vs R-23
Original POE 32 oil was used without any issues for 8 months+ operation



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New Systems Solutions



Klea[®] Edge[™] 485A

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Fig. CO₂ equator for cooling

Demonstrated efficiency improvement vs CO₂ up to 25%

- Viable option in warmer climates

Non PFAS under ECHA definition

Non-flammable for handling

Applications:



Cold chain



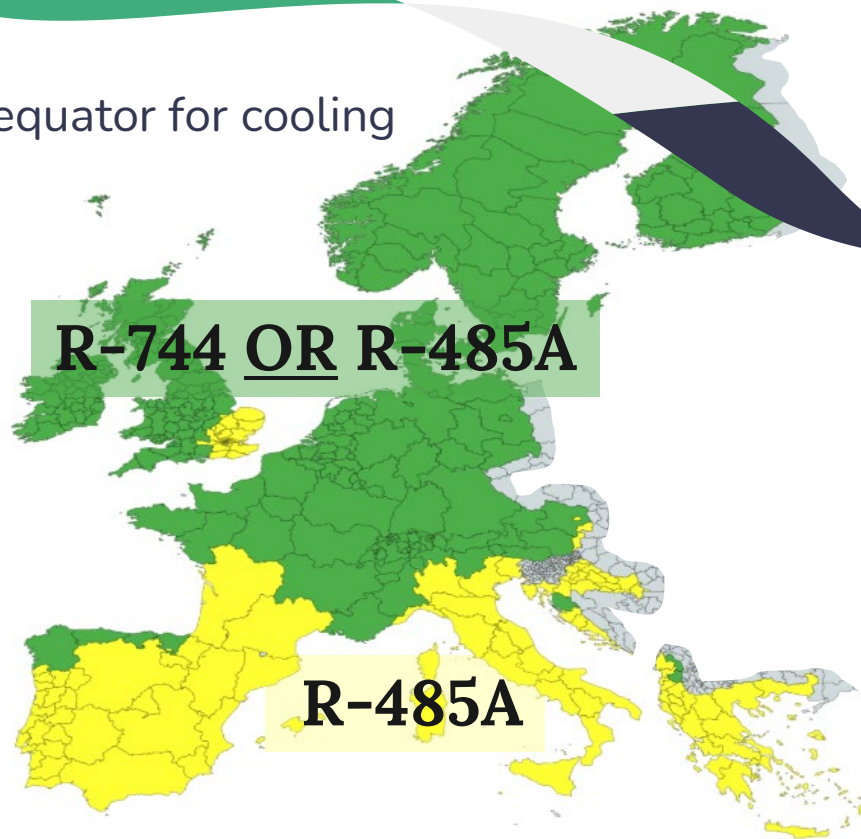
Heating



AC



MAC

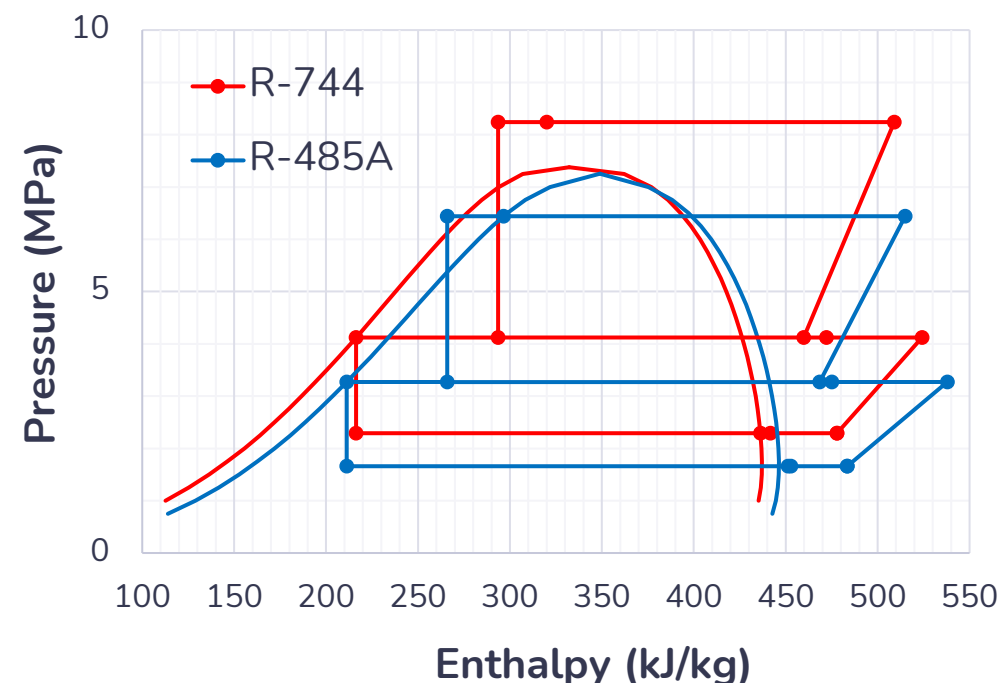


Thermodynamic Properties

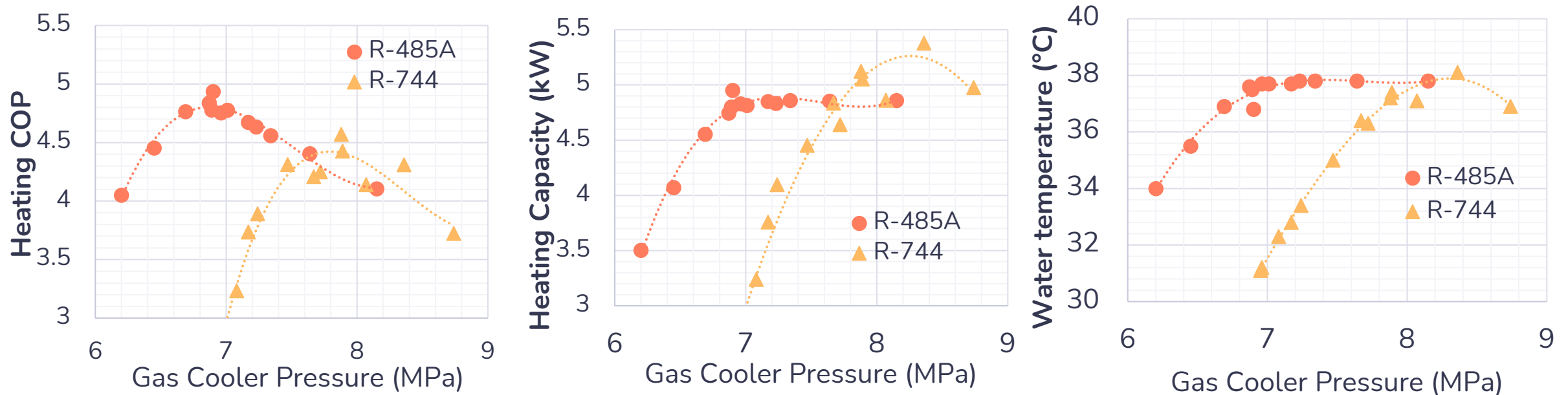
Composition R-744/1132a/32 (69/10/21%)

Property	Units	R-744	R-485A
EU GWP ₁₀₀		1	142
Safety class (ASHRAE/ISO)		A1	A1/A2L
Molecular mass	g/mol	44.0	47.0
Critical temperature	°C	31.0	41.2
Critical pressure	kPa	7377	7170
Liquid density (0°C)	kg/m ³	927	935
Bubble pressure (-40°C)	kPa	1004	842
Bubble pressure (0°C)	kPa	3485	2875
Isentropic index (C_p/C_v) (saturated at 0°C)	---	2.14	1.89
Latent heat at 0°C	kJ/kg	231	231
Evaporator Glide (2800kPa)	K	0	~5

Split Pressure Cycle Evaporator -15°C, ambient air 32°C



Drop-in Assessment in R-744 heat pump water heater



Soft optimization was carried out to independently control water flow, compressor speed, evaporator air-flow and gas cooler pressure

9% maximum COP increase was observed at **20% lower operating pressure** vs R-744

Composition R-1132a/32/152a/1234ze(E) (12/18/14/56%)

Klea® Edge™ 492A

Lower flammability vs R-290

- 5x higher LFL
- Comparable performance
- Utilize same system components

Opportunity to exploit glide (ATW or WTW)

- +10%~22% COP gain possible

Applications:



EV



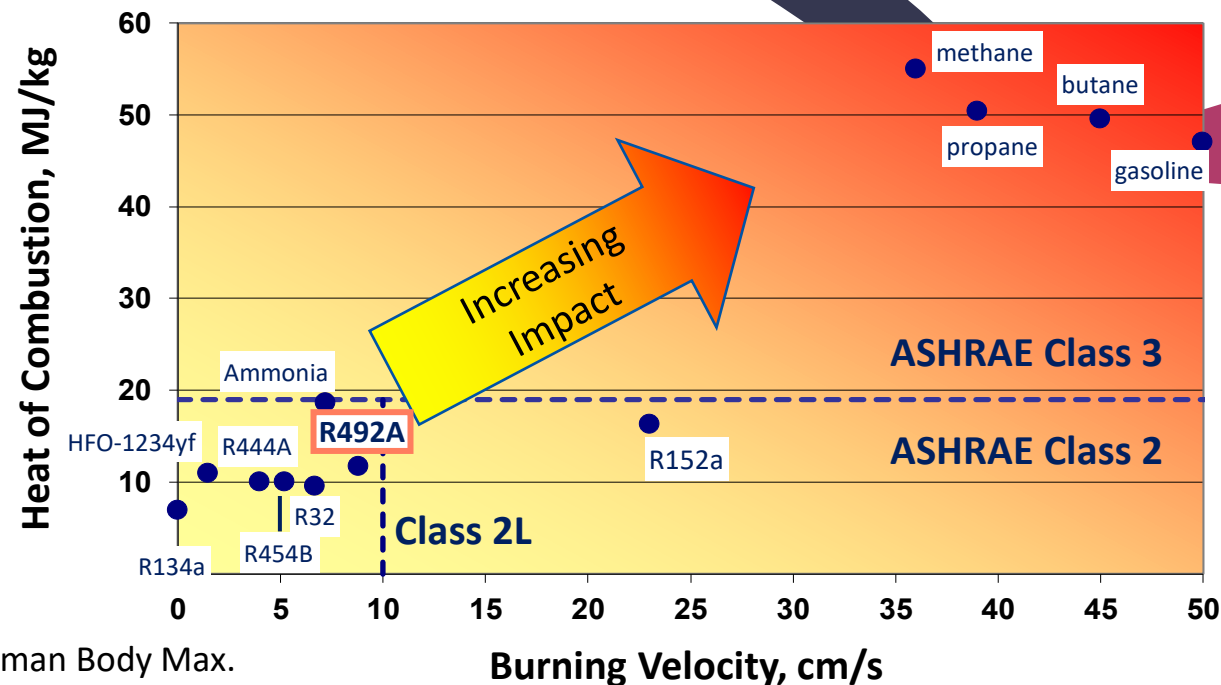
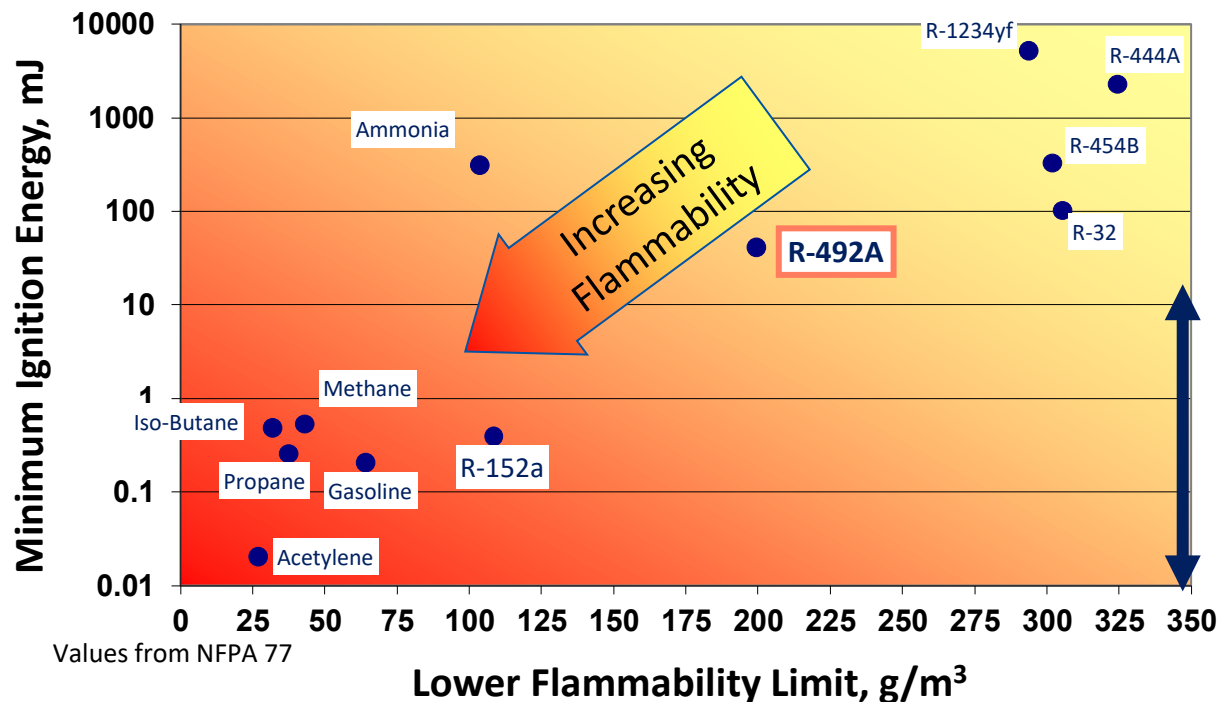
Chillers



Heating

Property	Units	R-290	R-492A
EU GWP ₁₀₀		3	140
Flammability (ASHRAE/ISO classification)		A3	A2L/A2
Molecular Mass	g/mol	44.1	80.9
(Avg) saturation temperature	°C	-42.1	-45.5
(Avg) saturation pressure (0°C)	kPa	474	565
Liquid density (0°C)	kg/m ³	529	1106
Typical T _{evap} glide (with zero pressure drop)	K	0	8-10

Flammability Characteristics



Human Body Max.
< 22.5 mJ
NPFA 77, 5.5.5.2

Brush Discharge
< 10 mJ
NFPA 77, Fig 5.5.1

Koura Next Generation Refrigerants

A low carbon footprint offering for every application



Thank you

sarah.kim@orbis.com

Visit us at Booth 9-429

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