

# Carbon Dioxide Air Conditioning and Heat Pump System for the FCHV-4

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## Introduction

(Background)  
Concern of Global Warming Effect

Refrigerant	G.W.P.	Flammability
HFC-134a	1300	○
<b>Carbon Dioxide (CO<sub>2</sub>)</b>	<b>1</b>	○
Hydro Carbon (HC)	8	×



## Air Conditioning System for the Fuel Cell Hybrid Vehicle

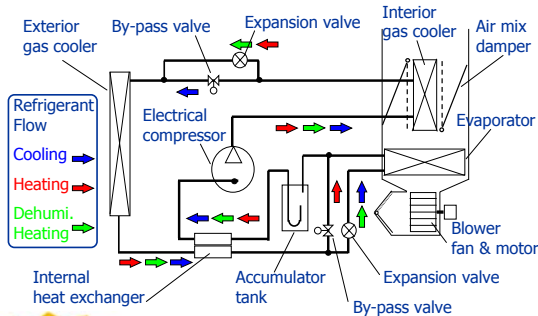
(Heat source of the vehicle)  
FC-Hybrid Vehicle << I.C.E. Vehicle



System is operated as  
Not only Air Conditioner  
But also Heat Pump



## Outline of the CO<sub>2</sub> System

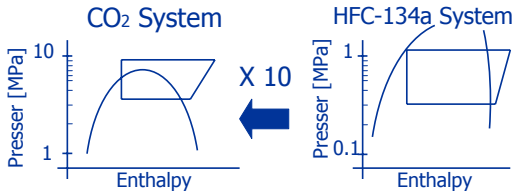


## Component Specification

Refrigerant Component	CO <sub>2</sub> (for FCHV)	HFC-134a (for EV)
Compressor	Electric <b>4.6cc/rev</b>	Electric 25cc/rev
Exterior Gas Cooler	712x422x24 mm	710x398x16 mm
Interior Gas Cooler	204x152x24 mm	179x126x38 mm
Evaporator	264x258x58 mm	226x220x90 mm
Internal Heat Exchanger	<b>156x68 mm</b>	Not installed



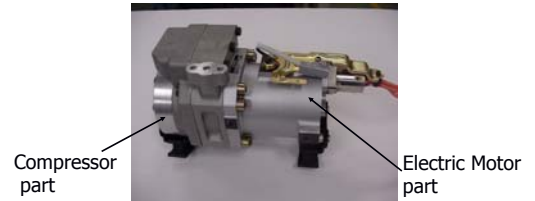
## Developed components for CO<sub>2</sub> System



Components should be against high pressure over 10MPa



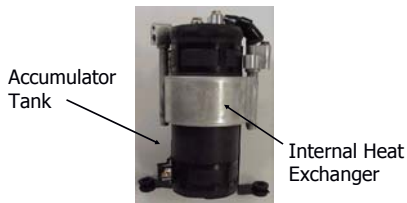
## Hermetic Electric Compressor



Gas-tight shaft seal is not necessary (by adopting hermetic construction)



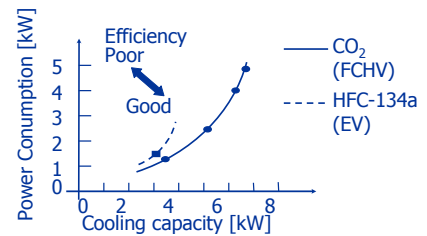
## Accumulator Tank with a I.H.E.



Integration is achieved by wrapping Internal Heat Exchanger around Accumulator Tank



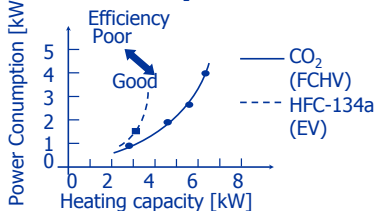
## Cooling Performance of the CO<sub>2</sub> System



Efficiency of the CO<sub>2</sub> is more excellent



## Heating Performance of the CO<sub>2</sub> System



Maximum heating capacity is 5 kW @ -20 C  
Efficiency of the CO<sub>2</sub> is more excellent



## Summary

- CO<sub>2</sub> A/C and Heat Pump system has been developed for F.C. Hybrid Vehicle
- The efficiency of developed system is more excellent than that of HFC-134a system

## Future Plan

- Confirming the Suitability of CO<sub>2</sub> system by actual road tests in California, Japan

