NISSAN

NISSAN NORTH AMERICA, INC.
One Nissan Way
Franklin, TN 37067

August 28, 2019

Mr. Linc Wehrly
Light Duty Vehicle Center
Compliance Division
Office of Transportation and Air Quality
U.S. Environmental Protection Agency
2000 Traverwood Drive
Ann Arbor, MI 48105

Subject: Application for Off-Cycle GHG Credits for DENSO A/C Compressor Incorporating Variable Crankcase Suction Valve Technology

Dear Mr. Wehrly,

Pursuant to the provisions of 40 C.F.R. § 86-1869(12)(d), Nissan requests Agency approval of an off-cycle greenhouse gas (GHG) credit of 1.1 gram/mile CO_2 for 2017 and subsequent model year vehicles equipped with a DENSO SAS air conditioner compressor incorporating variable crankcase suction valve (VCSV) technology and optimized suction and discharge valve technology. This GHG credit request and credit value parallels General Motors' assessment, testing and request, which was reviewed and accepted by the Agency and published for public comment[1]. The requested credit was approved in September 2015[2].

Materials and information required in 40 CFR 86.1869-12(d) (e.g. background, technology description, off-cycle applicability) which EPA accepted for General Motors use of the DENSO SAS compressor is also incorporated by reference into this document. That material may be found at https://www.epa.gov/vehicle-and-engine-certification/general-motors-gm-compliance-materials-light-duty-greenhouse-gas . Nissan-specific information required in 40 CFR 86.1869-12(e) e.g. test results, model installation information and credit calculations are shown in Appendix 4 of Attachment 1. A statement of the in-use durability of this component is also provided.

Nissan's comparative baseline technology used to establish this 1.1 gram/mile CO_2 credit value is the DENSO SBH compressor. DENSO SBH compressor and DENSO SBU compressor (used by General Motors for baseline determination) have equivalent performance for purposes of baseline determination. The DENSO SAS compressor achieves an additional 1.1 gram/mile CO_2 benefit by the incorporation of variable crankcase suction valve (VCSV) technology and improved suction valve and discharge valve structures to minimize suction and discharge pressure losses.

We respectfully request that the Agency accept that its previous recognition of an equivalent alternative demonstration program for this compressor used by other manufacturers satisfies the pre-approval requirements contained in 40 CFR 86.1869-12(d).

This application covers 2017 and subsequent model year vehicles models equipped with a DENSO SAS air conditioning compressor incorporating variable crankcase suction valve (VCSV) technology and optimized suction and discharge valve technology. In the future Nissan may use this improved air conditioning compressor in additional models. At that time, we will apply for off-cycle greenhouse gas (GHG) credits for those models (see the statement in Appendix 4 of Attachment 1).

If you have any questions or comments, please contact Mr. Shota Horiguchi of Nissan Technical Center North America at (248)488-4654, e-mail: Shota.Horiguchi@nissan-usa.com.

Best Regards,

Keiichi Kitahara
Director, Regulatory Compliance
Nissan North America, Inc.

1. At 80 FR 31598 June 3, 2015
2. "EPA Decision Document: Off-cycle Credits for Fiat Chrysler Automobiles, Ford Motor Company and General Motors" EPA-420-R-15-014, September 2015

Attachment (one – GHG credit application)

(Redacted) cc:
Maurice Hicks, NHTSA
Otto Matheke, NHTSA

Attachment 1: Request for Off-Cycle GHG Credits for DENSO Mobile Air Conditioner Compressor Incorporating Variable Crankcase Suction Valve Technology

Executive Summary: Nissan requests Agency approval of an off-cycle greenhouse gas (GHG) credit of 1.1 gram/mile CO_2 for 2017 and subsequent model year vehicles equipped with a DENSO SAS air conditioning compressor incorporating variable crankcase suction valve (VCSV) technology and optimized suction and discharge valve technology. To support this approach, the DENSO SBH compressor was used for baseline comparison values in the tests described in Appendix 3 of Attachment 1.

This submission contains the results of Nissan's and DENSO's testing program. Those results are to generate an approved GHG credit through the review and approval process in 40CFR 86.1869-12 (e)(2). This includes:

(i) A detailed description of the off-cycle technology and how it functions to reduce CO_2 emissions under conditions not represented on the FTP and HFET.
(ii) A list of the model(s) which will be equipped with the technology
(iii) A description of the test vehicles selected by Nissan
(iv) All testing and/or simulation data required under 40CFR 86.1869-12 (c) or (d) as applicable "...plus any other data the manufacturer has considered in the analysis"

<u>Background</u>

The U.S. Environmental Protection Agency (EPA) and the U.S. Department of Transportation's National Highway Traffic Safety Administration (NHTSA) have issued rules to reduce greenhouse gas (GHG) emissions and improve fleet average fuel economy. Under the Clean Air Act EPA established national GHG standards. Separately under the Energy Policy and Conservation Act and the Energy Independence and Security Act NHTSA established Manufacturers' Average Fuel Economy (CAFE) standards.

EPA provides Mobile Air Conditioner (MAC) credits for air conditioner compressors that feature externally controlled variable displacement (EVDC) to reduce cabin air reheat under moderate ambient condition. The DENSO SBH compressor used for baseline testing in this application includes the EVDC feature. Variable displacement compressors represent a significant efficiency improvement over the fixed displacement compressors that were in common use when the mobile-source-related greenhouse gas rules were originally developed. In addition to EVDC the DENSO SAS air conditioning compressor adopts variable crankcase suction valve (VCSV) and optimized suction and discharge valve technology to further advance greenhouse gas reduction. This application requests additional GHG credits for the incremental improvement attributable to the DENSO SAS air conditioning compressor incorporating VCSV technology and optimized suction and discharge valve technology.

In 40 CFR 86.1869-12(c) and (d) EPA established 2 alternate pathways for manufacturers to generate GHG credits for technologies whose real-world CO_2-reducing contributions are not adequately captured by the 2-cycle test (used to determine manufacturer compliance with fleet-average GHG standards). Since 2-cycle testing is conducted with air conditioning switched off, the 2-cycle test is insensitive to A/C system improvements. This makes any A/C system improvement a candidate for "off-cycle" evaluation. The Agency created these two additional mechanisms to encourage manufacturers to adopt technologies that produce real-world CO_2 reductions. These two pathways for generating off-cycle credits are:

- **Using EPA's 5-cycle test procedure (which includes a greater range of operating conditions than the 2-cycle test procedure):** If the 5-cycle test is able to adequately capture a given technology's CO_2-reduction contribution a vehicle manufacturer may apply for GHG credit using this option. The manufacturer's application will contain 5-cycle test data generated by the manufacturer. After EPA review and approval, EPA can authorize a GHG credit. If the 5-cycle test procedure is insufficient to characterize the emission reduction attributable to an off-cycle technology the manufacturer may request EPA approval of an "alternative demonstration program". However, even the 5-cycle test undervalues the real-world CO_2 reductions produced by VCSV technology and optimized suction and discharge valve technology.
- **Using an "alternative demonstration program":** For technologies that are not adequately characterized by either 2-cycle or 5-cycle testing, the vehicle manufacturer can develop an alternative methodology to measure CO_2-reduction contribution (see 40 CFR 86.1869-12(d)(1)(i)-(iv)). The alternative methodology itself is subject to Agency and public review and comment. DENSO has cooperated with the Agency and several other vehicle manufacturers to create a pattern demonstration program, which the Agency accepted and which Nissan proposes to use here.

Nissan requests approval of an "alternative demonstration program" under 40 CFR 86.1869-12(d). Nissan requests that the Agency deems that the pre-approval provisions of 40 CFR 86.1869-12(d)(i-iii) have already been met through the Agency's previous reviews and approvals for the DENSO SAS air conditioning compressor for other manufacturers[1] (see https://www.epa.gov/ vehicle-and-engine-certification/general-motors-gm-compliance-materials-light-duty-greenhouse-gas). Nissan's model type information required under 40 CFR 86.1869-12(d)(iv) is provided in Appendix 4 of Attachment 1under claim of business confidentiality.

Description of the off-cycle technology and how it functions to reduce CO_2 emissions

DENSO SAS air conditioning compressors incorporate variable crankcase suction valve technology and optimized suction valve and discharge valve technology. These features reduce internal refrigerant flow necessary throughout the range of displacements used by the compressor during its normal use and operation. The variable crankcase suction valve technology allows larger refrigerant mass flow under high-demand conditions and also allows reduced refrigerant mass flow under lower-demand operating conditions. The ability to vary refrigerant mass flow reduces overall energy consumption of the A/C system. This is the basis for the Agency's previous approval[1] of off-cycle credits for this compressor.

These energy consumption improvements produce real-world CO_2 reductions are not adequately captured by in the 2-cycle or 5-cycle dynamometer testing regimes.

The baseline DENSO compressor used in this analysis is the SBH type. The improved version used for this application is designated SAS. The internal structure of both compressors is fundamentally the same DENSO SAS. Efficiency improvements include:

1. Changes to the internal valve structure to optimize suction and discharge pressure losses, and
2. Addition of a variable crankcase suction valve (VCSV) to optimize suction/discharge pressure loss (quick start-up under full liquid condition).

See Appendix 1 of Attachment 1for additional descriptive material.

1. "EPA Decision Document: Off-cycle Credits for Fiat Chrysler Automobiles, Ford Motor Company and General Motors" EPA-420-R-15-014, September 2015.

List of the models equipped with DENSO SAS technology

Please see Appendix 4 of Attachment 1

Bench Test Methodology (SAE J2765)

The DENSO SAS compressor was evaluated using procedures contained in the SAE standard J2765. That standard was developed and is used to evaluate average U.S. system efficiency (as part of the SAE IMAC Cooperative Research Program). SAE J2765 specifies a series of 40 bench tests at various compressor speeds. The results of these bench tests characterize a system's coefficient of performance. Twenty five of these forty bench test values are used as input values into the Lifecycle Climate Change Performance model. That model was jointly developed by EPA, SAE, General Motors and the Japanese Automobile Manufacturers Association (and subsequently adopted as SAE standard J2766). The selected 25 bench tests represent a broad cross-section of operating conditions, climate conditions, and A/C system operating modes.

Bench test data (SAE J2765)

See Appendix 1 of Attachment 1

Vehicle-based validation test method (AC 17)

Although the accurate benefit can be established by bench testing as above, we also did on-vehicle testing to confirm the GHG benefit. Vehicle testing used AC17 procedure which more closely simulates average U.S. air conditioner operating conditions. AC17 has already been used for demonstration of off-cycle credit of Crankcase Valve technology.

The credit-generating DENSO SAS compressor is installed on 2018MY Nissan Rogue Sport. Rogue Sport was selected for AC17 validation testing because it is by far the higher selling model and will have the greatest impact on the earned CO_2 credit. We consider Rogue Sport to be representative of benefits attributable to the DENSO SAS compressor.

See Appendix 2 of Attachment 1for additional descriptive material.

Validation vehicle test data (AC17)

See Appendix 3 of Attachment 1

Credit Determination

See Appendix 4 of Attachment 1

Durability Statement

DENSO SAS A/C compressors installed in Nissan and Infiniti models meet all of Nissan's and DENSO's internal durability test requirements. Based upon those tests the DENSO SAS compressors described herein are validated to perform over the full useful life of the vehicle on which they are installed without deterioration of the GHG benefits attributable to the VCSV technology described above.

Conclusion

Based upon:

1. Meeting the alternate demonstration methodology requirements contained in 40 CFR 86.1869-12(d), and
2. The bench-test data presented herein, and
3. The validation vehicle test data presented herein, and
4. The Life-cycle Climate Change Performance calculation presented herein

under the provisions of 40CFR 86.1869-12 Nissan respectfully requests Agency approval of an off-cycle greenhouse gas credit of 1.1 gram/mile CO_2 for 2017 and subsequent model year vehicles equipped with a DENSO SAS air conditioning compressor incorporating variable crankcase suction valve (VCSV) technology and optimized suction and discharge valve technology.

This 1.1 gram/mile CO_2 credit has been estimated to represent the fuel savings that can be expected from VSCV technology in real-world use in U.S. national average climate conditions. A list of applicable models, model years and sales volumes are submitted (in Appendix 4 of Attachment 1) under a claim of business confidentiality.

Appendices:

1. DENSO Presentation to EPA April 2013 updated July 2016
2. AC17 test condition
3. AC17 test results
4. Off-cycle Benefit by Vehicle Model and Fleetwide Benefit Calculation (Business Confidential)

Indirect CO_2 Credit for DENSO SAS Compressor

April 5, 2013

DENSO International America, Inc.

Updated July 14, 2016

DENSO

Agenda

- DENSO Corporation
- Background / Objective
- SAS Efficiency Improvement Mechanism
- Off-cycle Engineering Analysis Method
- Testing Details
- Test Results
- LCCP Results
- Conclusions

DENSO

DENSO Corporation

- **Established: Dec. 16, 1949**
- **Capital: US$2.3 billion**
- **Net Sales: US$38.4 billion**
- **Net Income: US$1,086.5 million**
- **Employees: 126,000 in 35 countries**

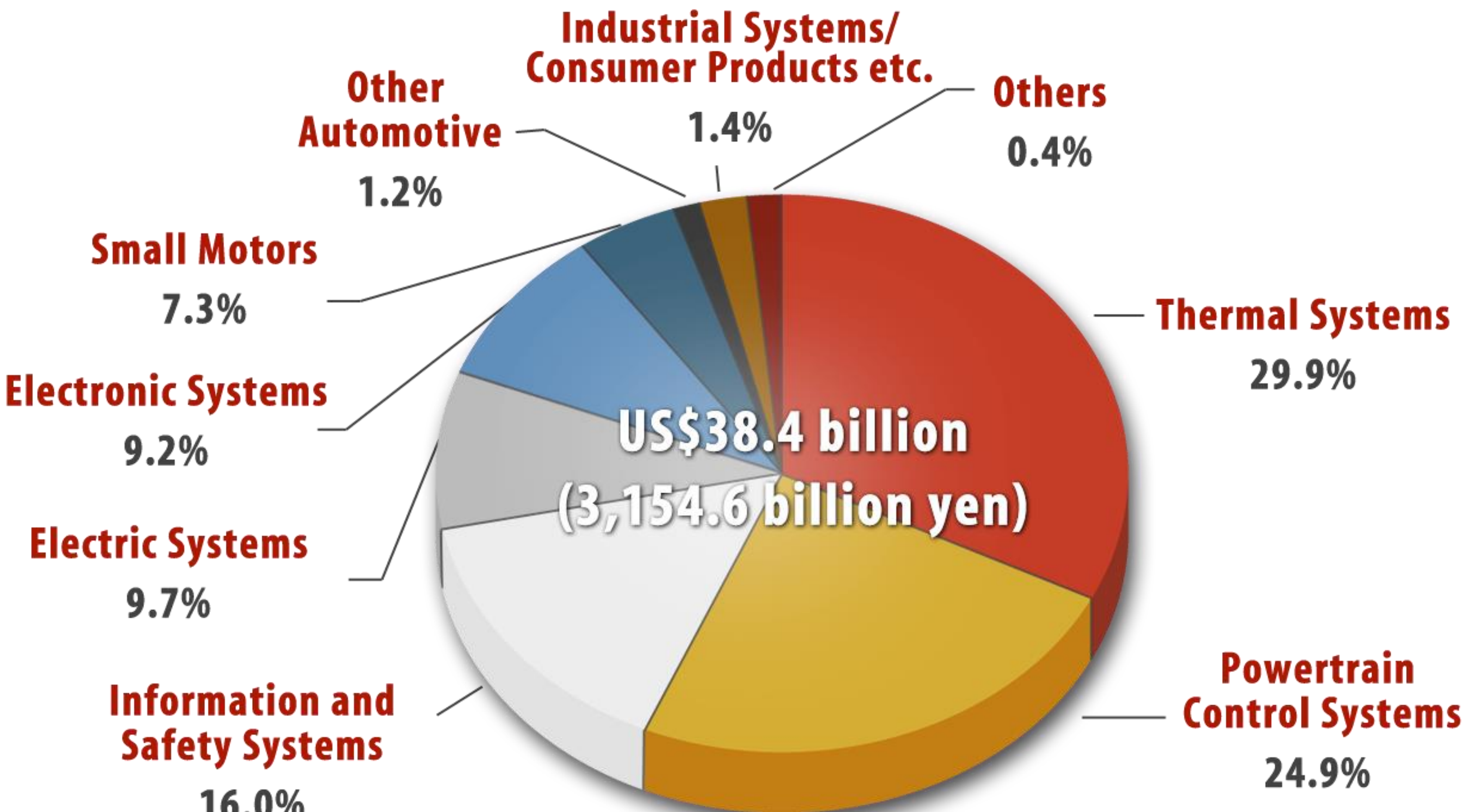
Data are consolidated base

- As of March 31, 2012
- U.S. dollar amounts have been translated from Japanese yen for convenience only at the rate of 82.19 yen= US$1

DENSO

Sales by Business Groups

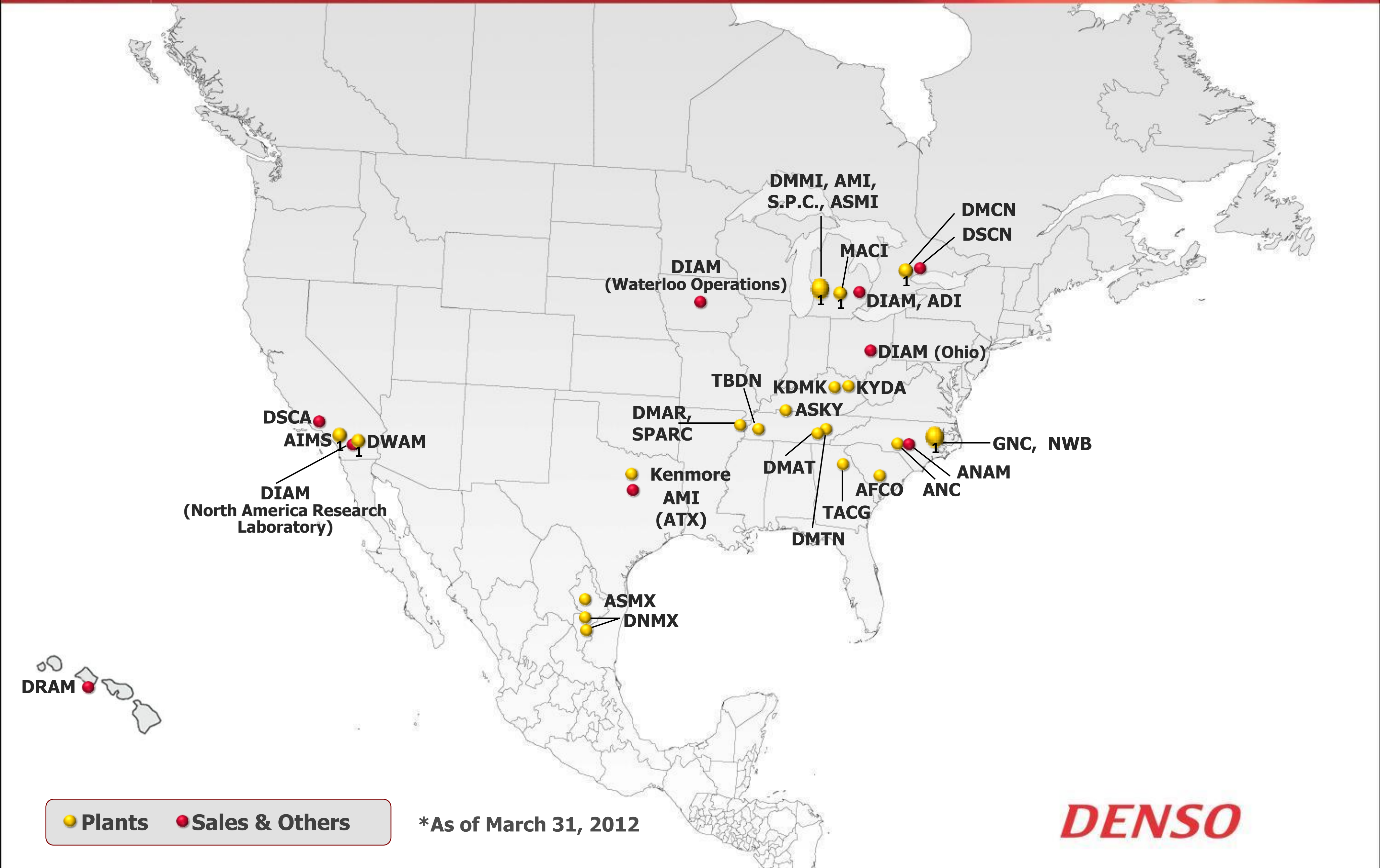
Consolidated Base



*For fiscal year ended March 31, 2012

DENSO

DENSO Operations in North America



*As of March 31, 2012

DENSO

Background / Objective

Federal fuel economy tests do not include A/C usage, but A/C usage generates CO_2 and reductions to these emissions benefit the environment.

DENSO's new SAS external variable displacement compressor (EVDC) improves energy consumption compared to current generation technology. Therefore, we feel SAS compressor should qualify for CO_2 off cycle credits.

Objective: Perform an engineering analysis to quantify the amount of indirect CO_2 credit that the SAS compressor should receive. Use this information to support customer applications to the EPA for credit.

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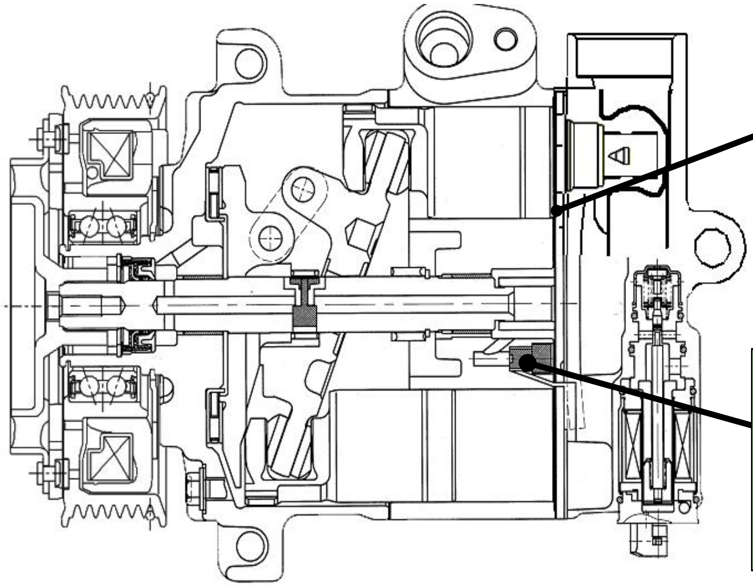
SAS Efficiency Improvement Mechanism

The new SAS compressor has two efficiency improvements over the existing SBU/SBH (referred to collectively as SB*) compressor: optimized suction and discharge valves and a CS valve.



<Efficiency>
Change the structure of valve to optimize suction and discharge pressure loss.

<Efficiency at Variable Condition>
Crankcase Suction Valve (CS valve)
(*optimize suction/ discharge pressure loss*)
(quick start-up under full liquid condition)

Clutch less version (called SES) is available and has same internal design.

The optimized valves reduce suction and discharge pressure loss within the compressor, increasing efficiency.

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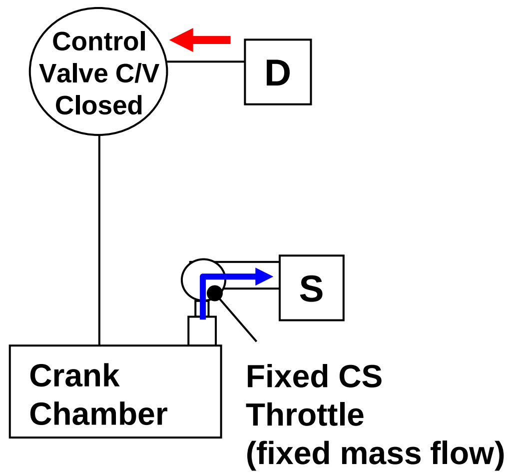
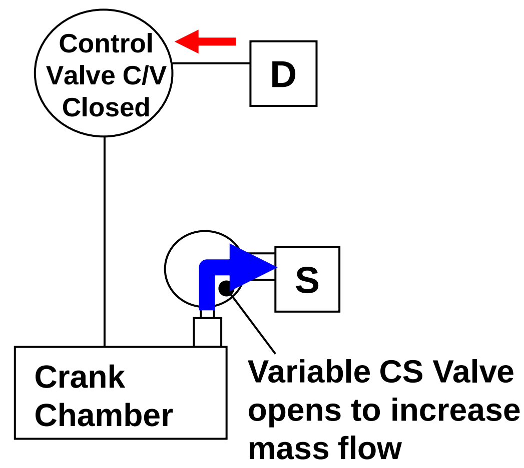
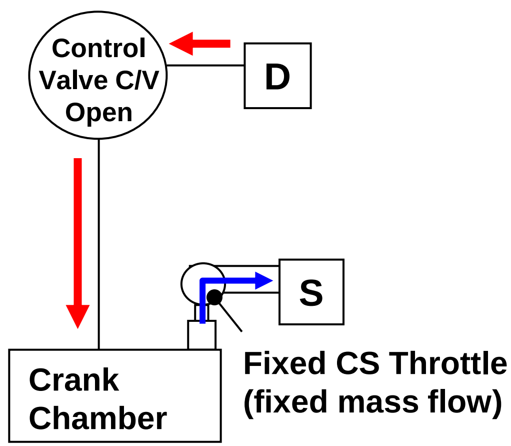
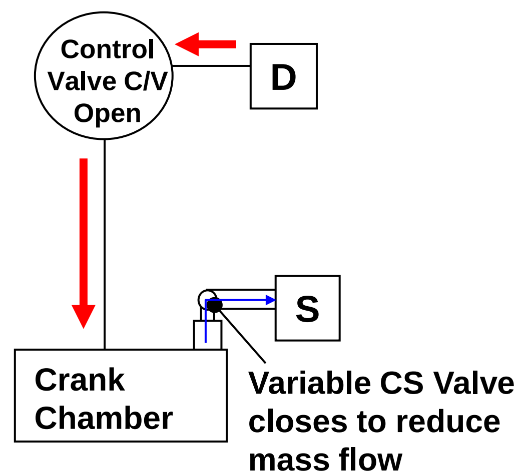
SAS & SES Efficiency Improvement Mechanism

Condition	Current Design (SBU/SBH)	New Technology (SAS)	Benefit of Variable CS Valve
Max Capacity and Compressor Start-up			Large opening allows a large mass flow. This allows for a stable max capacity condition and for the compressor to achieve max capacity more quickly at compressor start-up.
Variable (Mid) Capacity			Small opening results in a reduction of contol gas flow through the crank chamber, thus reducing internal compressor losses and **increasing efficiency** at variable condition.

The CS valve increases efficiency of the SAS compressor at mid displacement.

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A/C Indirect CO_2 Credits

For A/C there are three CO_2 credit types available which can be used to meet the fleet average CO_2 emissions requirements:

Leakage credits for low refrigerant leakage rate or low GWP refrigerant.

Menu credits for improving system efficiency.

Off-cycle credits for advanced technology not on the menu. The technology must reduce emissions levels compared to current technology.

DENSO will do testing to show SAS/SES compressor may get off-cycle credits.

DENSO

Off-cycle Engineering Analysis Method

Bench Testing Per SAE J2765 for Each Compressor → Analysis Using LCCP Model (CO_2 Emission Per City) → Calculate US Average CO_2 For Each Compressor

http://www.epa.gov/cppd/mac/compare.htm

LCCP is an existing method to estimate CO_2 impact of MAC systems. It was developed by EPA, GM, SAE, and JAMA.

LCCP analysis can be used as an acceptable engineering analysis method for determining the off-cycle CO_2 emissions impact for SAS compressor.

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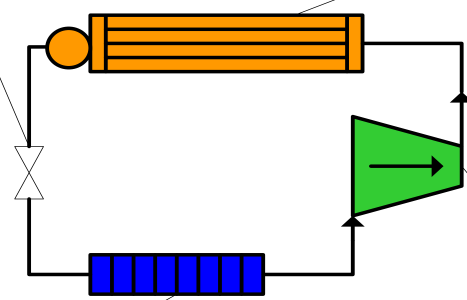
Test Bench System

Thermal Expansion Valve
-Set Point = 2.1kPa @ 0°C (1.0ton)
- Slope = 0.7 bar

Condenser
- W600mm x H422.4mm x D16mm
- Fin Height = 5.5 mm
- Tube Thickness = 1.0mm
- Fin pitch ~ 3.15mm
- Configuration: 1 Pass + Sub-cool (55-11)
- Integrated Receiver / Dryer



Evaporator
-W306.5mm x H201mm x D38mm
- Fin Height = 5 mm
- 4 pass : 22-23-23-22
- Tube Thickness = 1.7 mm

Compressor 6SBU14 & 6SAS14
- Pulley Ratio = 2.15
- Oil Amount = 100 g
- Refrigerant Charge:
R-134a: 650 grams

All components were common during testing of the 6SB*14 and 6SAS14 compressors.

Test Conditions (J2765)

Test Name	Simulated Ambient Temp. [C]	Compressor Speed [RPM]	Cond Air In Temp [C]	Cond Face Velocity [m/s]	Evap Air In Temp [C]	Evap Humidity [%]	Air Mass Flow [kg/min]	Air Flow Volume [m3/h]	Air Flow Volume [CFM]	Simulated Air Selection	Evap Air Out Target Temp [C]
I60	45	900	60	1.5	35	25	9.0	475	280	Recirc	3
I45	45	900	45	1.5	35	25	9.0	475	280	Recirc	3
L45	45	1800	45	2.0	35	25	9.0	475	280	Recirc	3
M45	45	2500	45	3.0	35	25	9.0	475	280	Recirc	3
H45	45	4000	45	4.0	35	25	9.0	475	280	Recirc	3
I50a	35	900	50	1.5	35	40	9.0	477	281	OSA	3
I35a	35	900	35	1.5	35	40	9.0	477	281	OSA	3
L35a	35	1800	35	2.0	35	40	9.0	477	281	OSA	3
M35a	35	2500	35	3.0	35	40	9.0	477	281	OSA	3
H35a	35	4000	35	4.0	35	40	9.0	477	281	OSA	3
I40a	25	900	40	1.5	25	80	6.5	337	198	OSA	3/10
I25a	25	900	25	1.5	25	80	6.5	337	198	OSA	3/10
L25a	25	1800	25	2.0	25	80	6.5	337	198	OSA	3/10
M25a	25	2500	25	3.0	25	80	6.5	337	198	OSA	3/10
H25a	25	4000	25	4.0	25	80	6.5	337	198	OSA	3/10
I40c	25	900	40	1.5	25	50	6.5	334	197	OSA	3/10
I25c	25	900	25	1.5	25	50	6.5	334	197	OSA	3/10
L25c	25	1800	25	2.0	25	50	6.5	334	197	OSA	3/10
M25c	25	2500	25	3.0	25	50	6.5	334	197	OSA	3/10
H25c	25	4000	25	4.0	25	50	6.5	334	197	OSA	3/10
I30	15	900	30	1.5	15	80	6.5	322	190	OSA	3/10
I15	15	900	15	1.5	15	80	6.5	322	190	OSA	3/10
L15	15	1800	15	2.0	15	80	6.5	322	190	OSA	3/10
M15	15	2500	15	3.0	15	80	6.5	322	190	OSA	3/10
H15	15	4000	15	4.0	15	80	6.5	322	190	OSA	3/10

All conditions were run for each compressor

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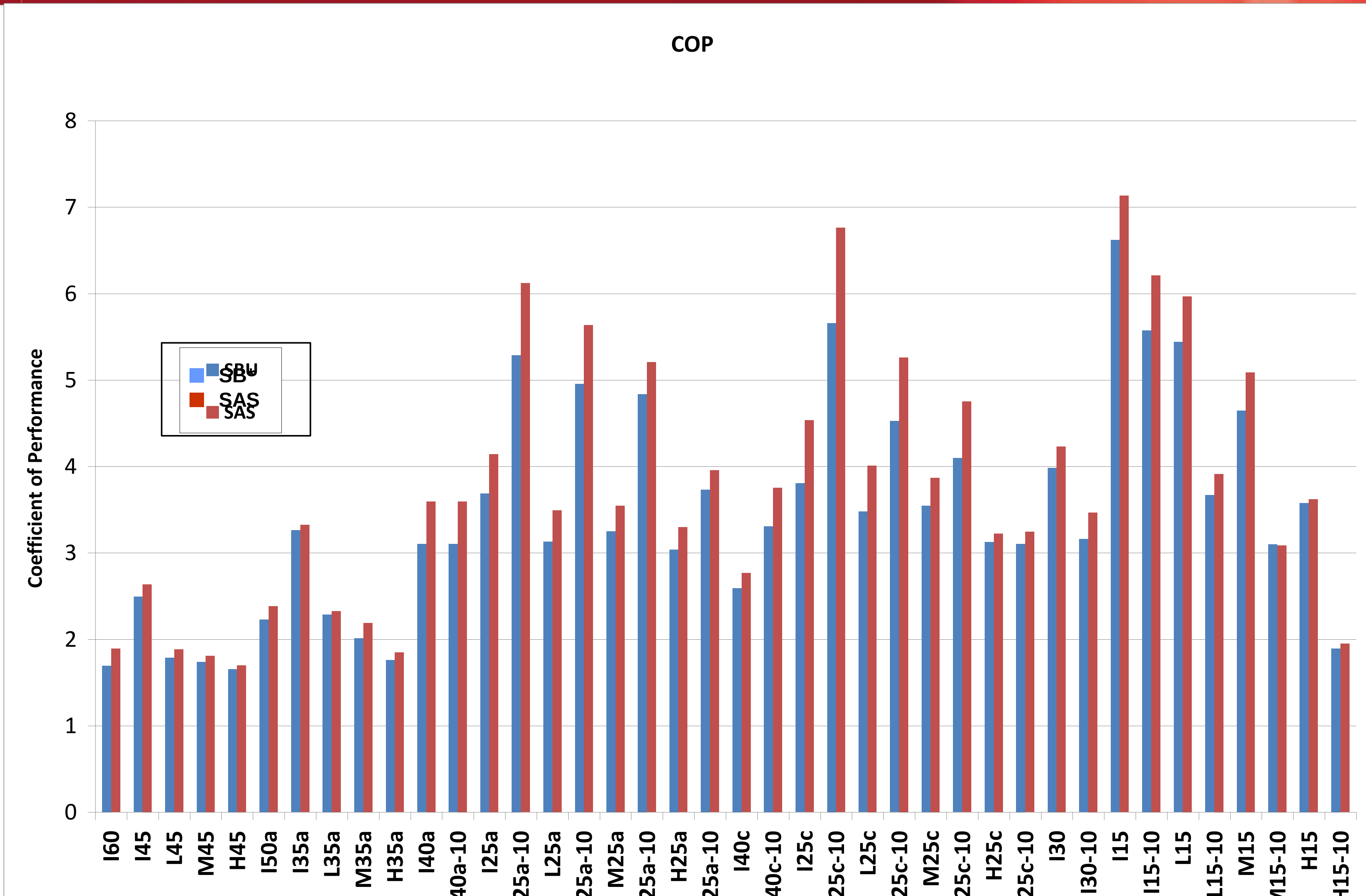
Test Results



COP for SAS is higher at middle ambient (as expected due to CS valve)

These values were entered into the LCCP model.

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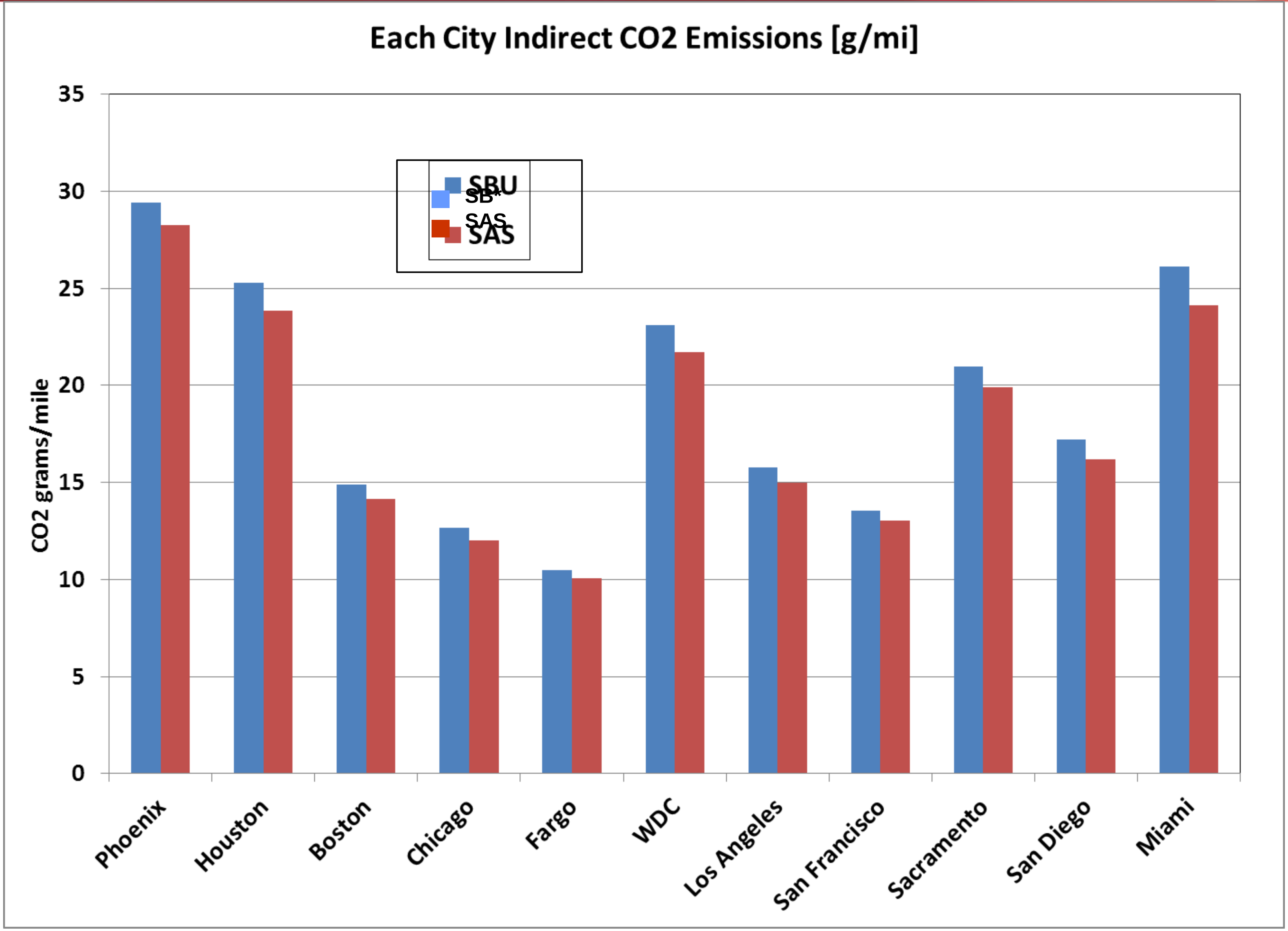
LCCP Results (per city)



Indirect CO_2 emissions for each US city.

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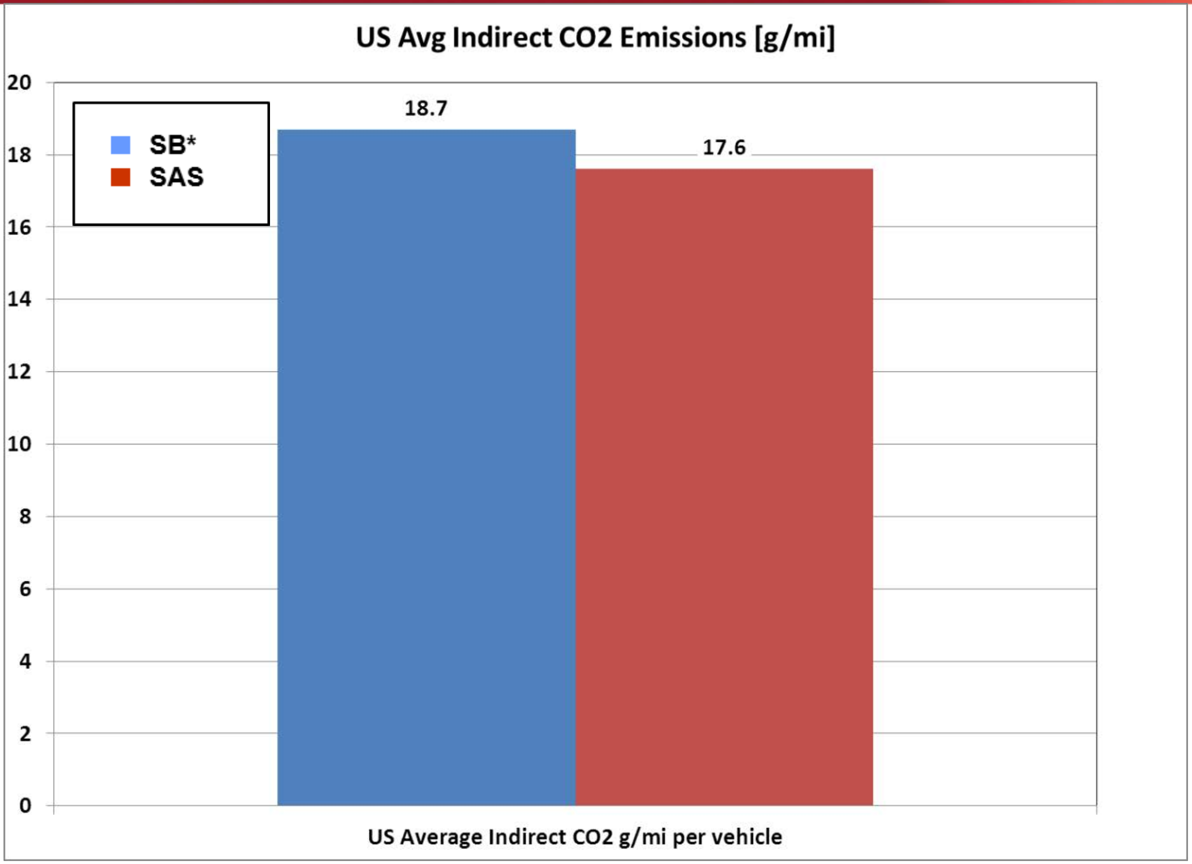
LCCP Results (US Average)



Average US Vehicle Indirect CO_2 Emissions	
SB* compressor	18.7 g/mi
SAS compressor	17.6 g/mi
Benefit of SAS compressor	**1.1 g/mi**

Off-cycle CO_2 credit of 1.1g/mi should be requested for the SAS compressor.

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Conclusion

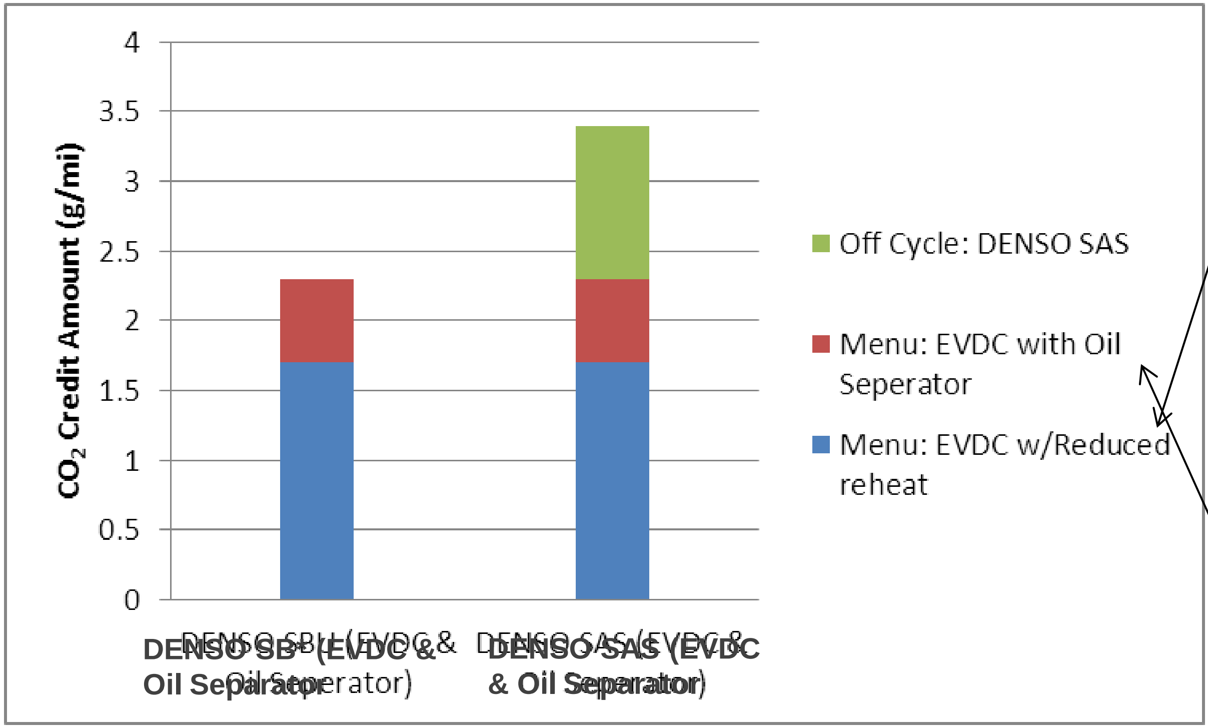

Table III.C.1-2 Efficiency-Improving A/C Technologies and Credits

Technology Description	Estimated Reduction in A/C CO_2 Emissions	A/C Efficiency Credit (g/mi CO_2)
Reduced reheat, with externally-controlled, variable-displacement compressor	30%	1.7
Reduced reheat, with externally-controlled, fixed-displacement or pneumatic variable-displacement compressor	20%	1.1
Default to recirculated air with closed-loop control of the air supply (sensor feedback to control interior air quality) whenever the ambient temperature is 75 °F or higher (although deviations from this temperature are allowed if accompanied by an engineering analysis)	30%	1.7
Default to recirculated air with open-loop control air supply (no sensor feedback) whenever the ambient temperature 75 °F or higher lower temperatures are allowed)	20%	1.1
Blower motor controls which limit wasted electrical energy (e.g., pulse width modulated power controller)	15%	0.9
Internal heat exchanger	20%	1.1
Improved condensers and/or evaporators (with system analysis on the component(s) indicating a COP improvement greater than 10%, when compared to previous industry standard designs)	20%	1.1
Oil Separator (with engineering analysis demonstrating effectiveness relative to the baseline design)	10%	0.6

We believe the total benefit for SAS or SES compressor should be 3.4 g/mi credit (Menu Credits + Off Cycle)

Based on 2012-2016 Regulation

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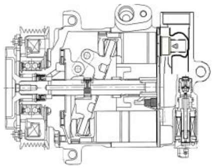
Conclusion



- SAS/SES Compressor Off Cycle (1.1 g/mi)
  - OEM A
    - C Segment 6SAS14
    - SUV 7SAS17
  - OEM B
    - C Segment 6SAS14
    - Mini Van 7SAS18
  - OEM C
    - C Segment 6SES14
  - OEM D
    - C Segment, CD Segment, SUV, Pick up 7SAS17
    - SUV 7SAS18

Our assumption is this data supporting the 1.1 g/mi credit can be applied to any vehicle using SAS or SES compressor.

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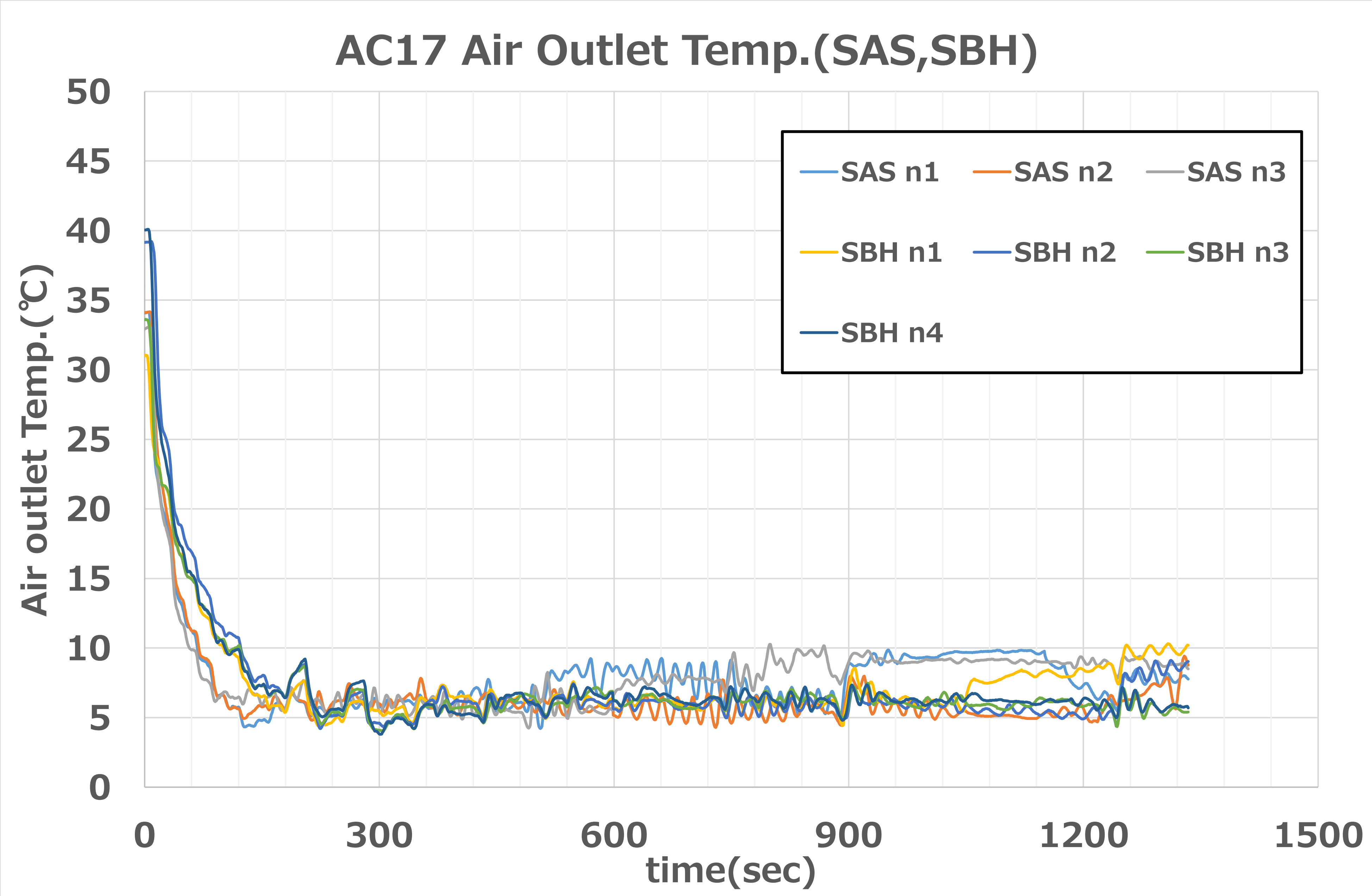
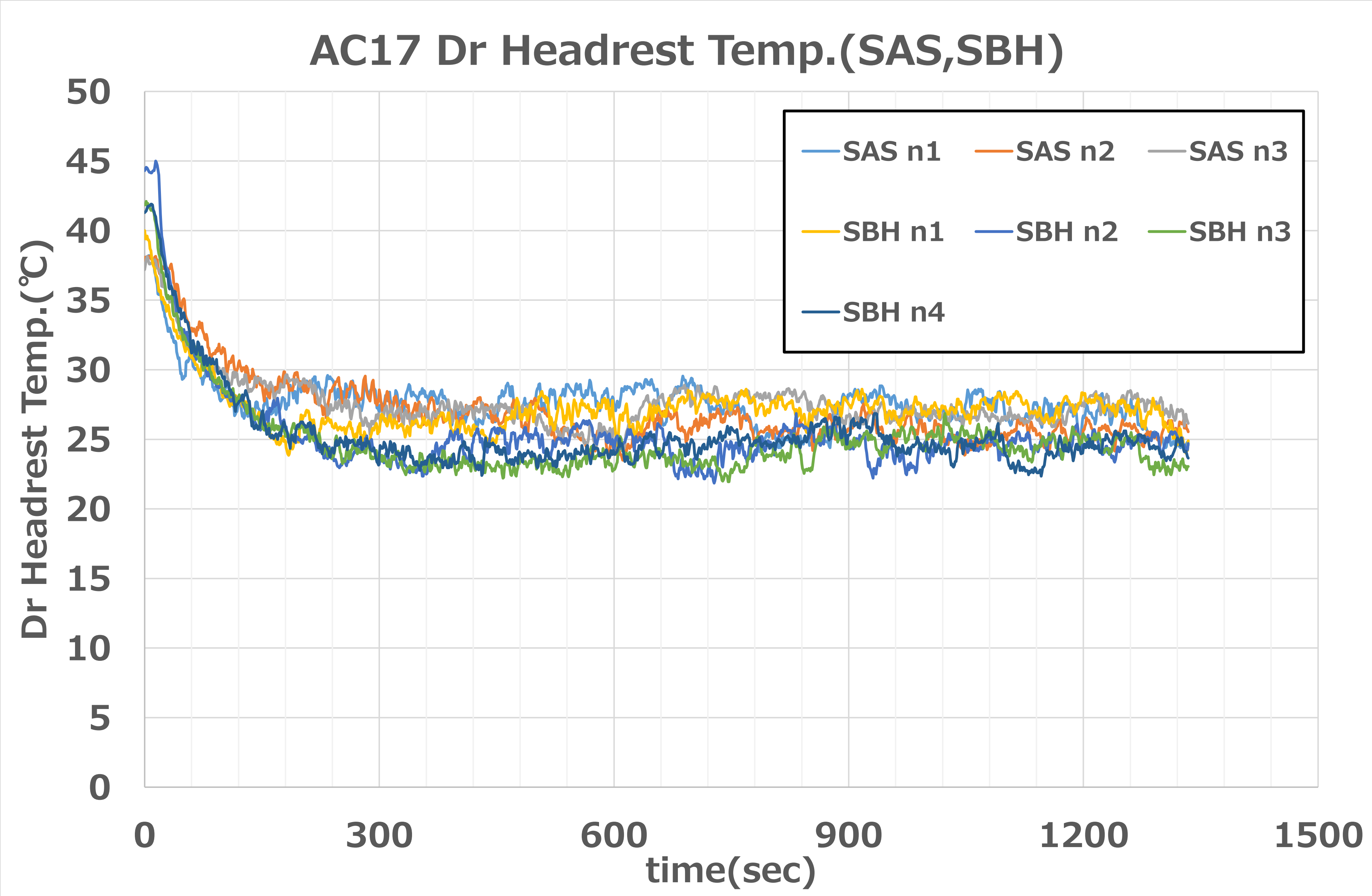
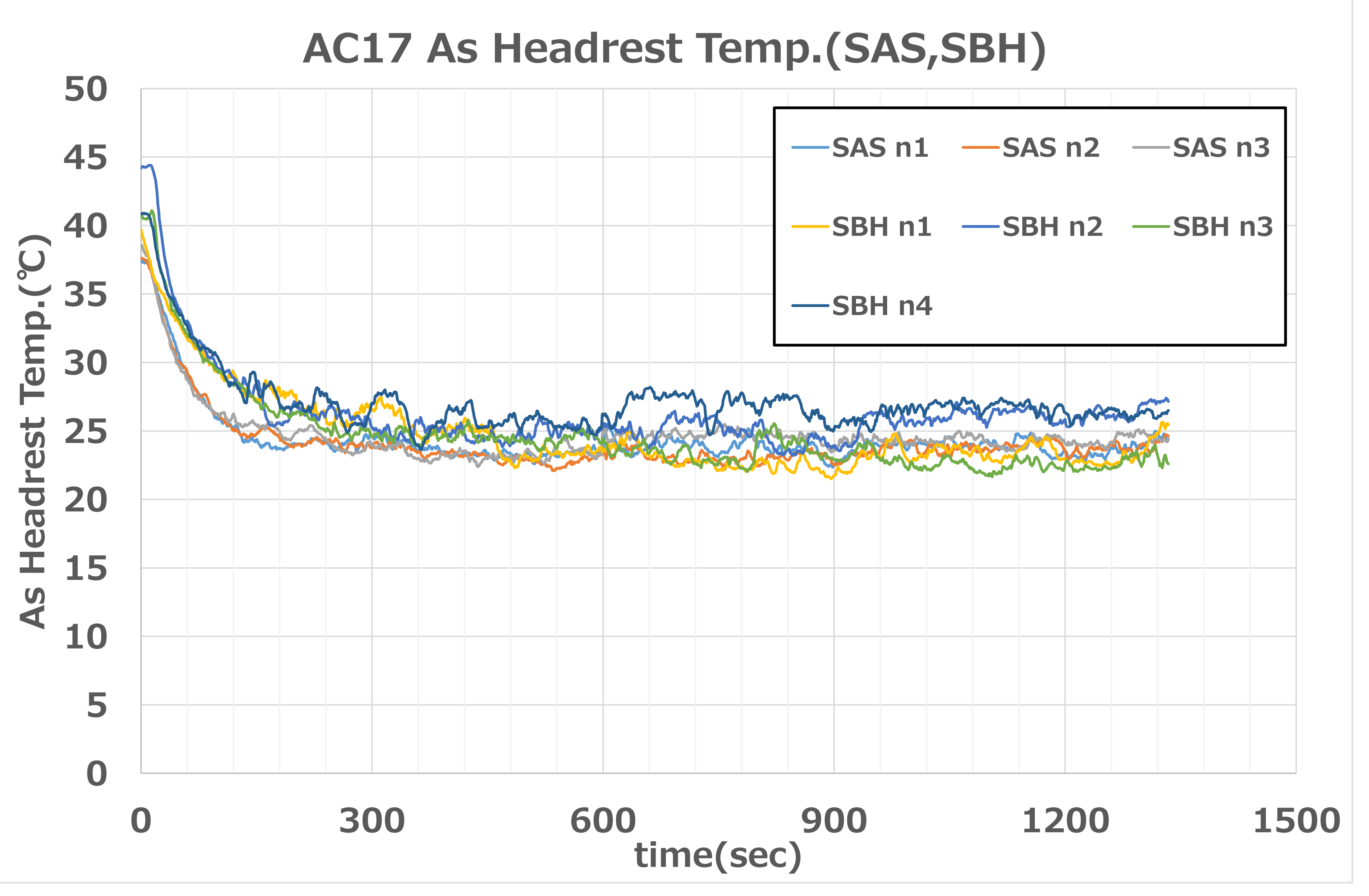
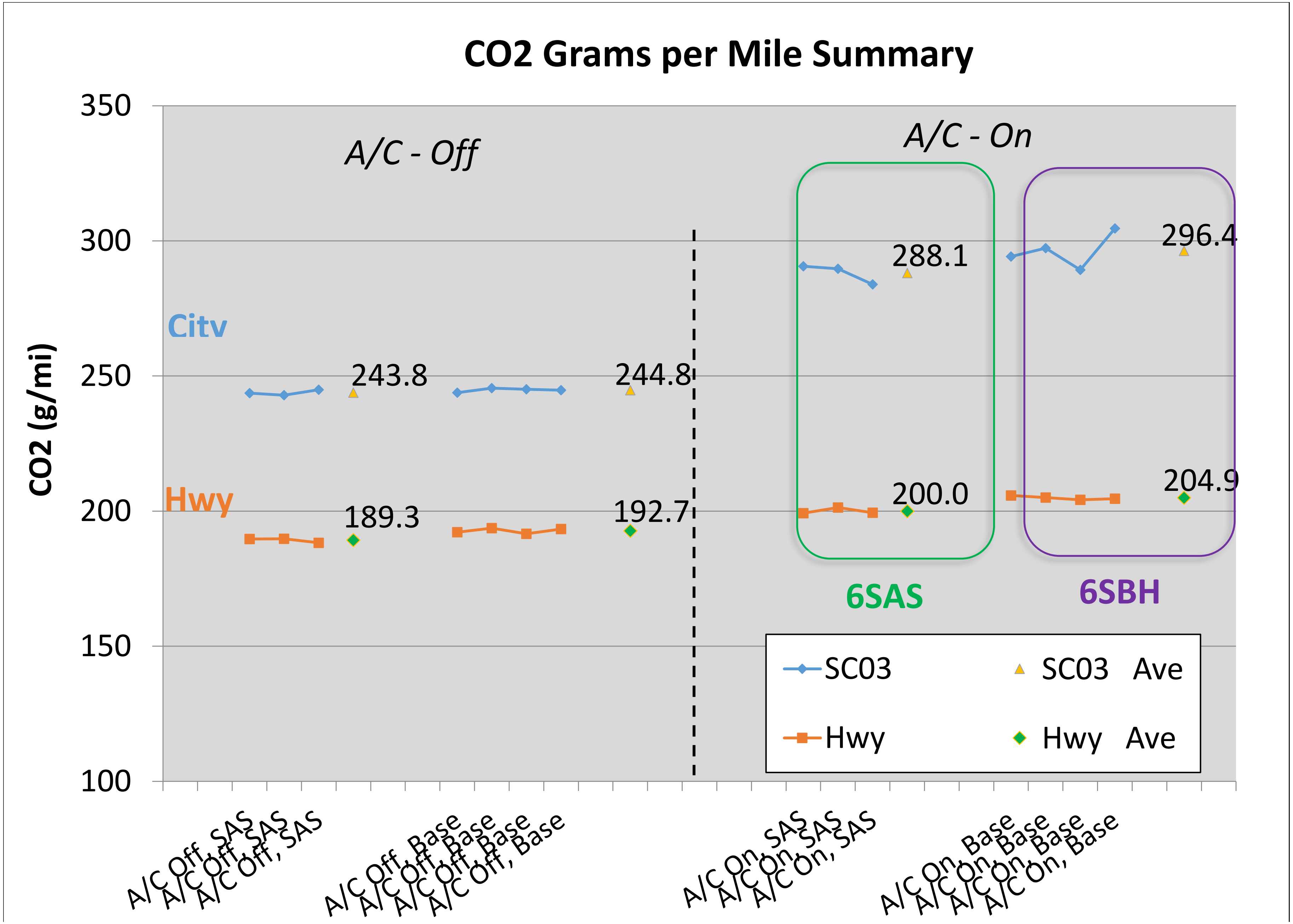
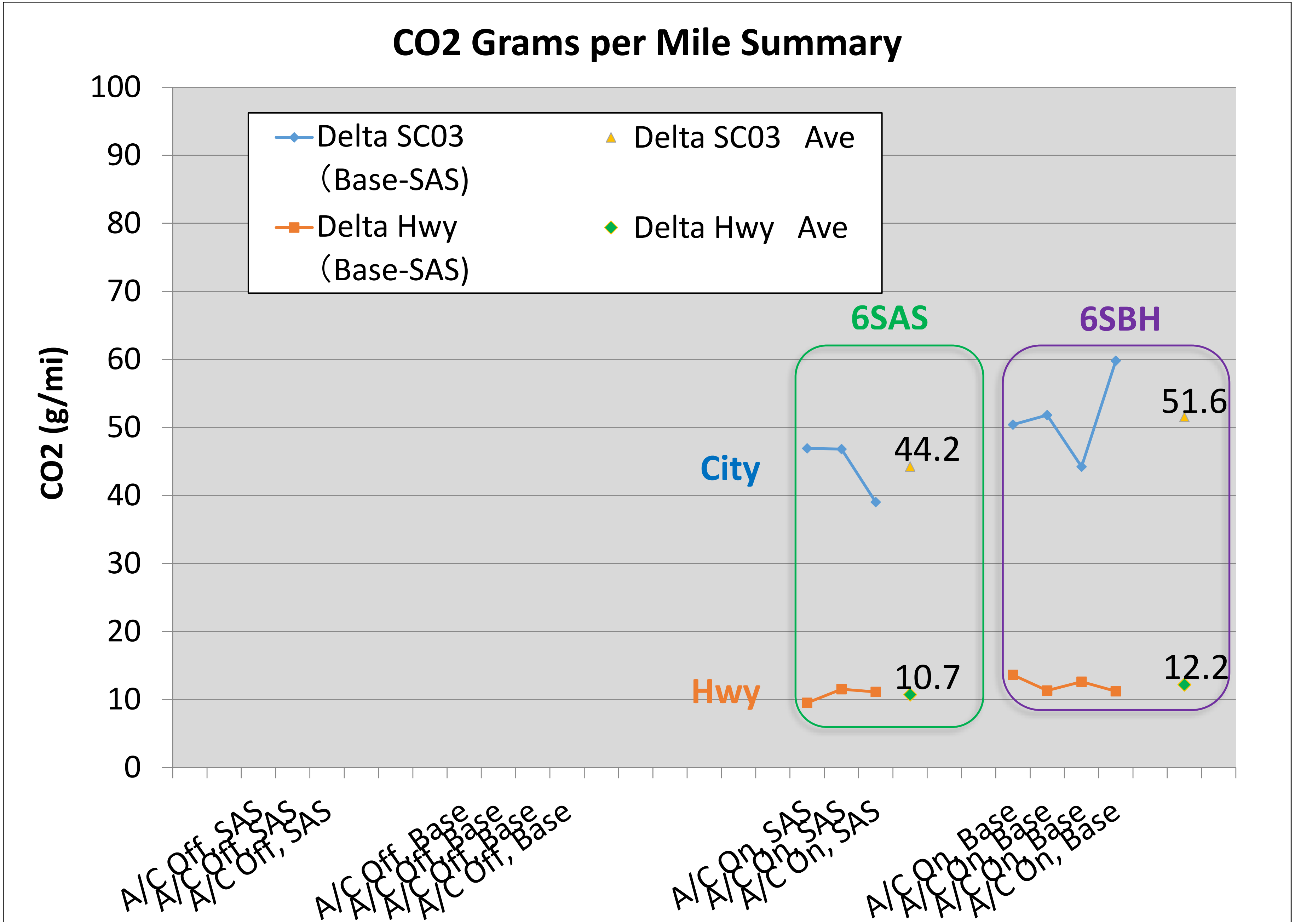

AC17 Air Outlet Temp.(SAS,SBH)
Air outlet Temp.(℃)
50
45
40
35
30
25
20
15
10
5
0
0
300
600
900
1200
1500
time(sec)
SAS n1
SAS n2
SAS n3
SBH n1
SBH n2
SBH n3
SBH n4


AC17 Dr Headrest Temp.(SAS,SBH)
Dr Headrest Temp.(℃)
50
45
40
35
30
25
20
15
10
5
0
0
300
600
900
1200
1500
time(sec)
SAS n1
SAS n2
SAS n3
SBH n1
SBH n2
SBH n3
SBH n4



AC17 As Headrest Temp.(SAS,SBH)
As Headrest Temp.(℃)
50
45
40
35
30
25
20
15
10
5
0
0
300
600
900
1200
1500
time(sec)
SAS n1
SAS n2
SAS n3
SBH n1
SBH n2
SBH n3
SBH n4


CO2 Grams per Mile Summary
CO2 (g/mi)
350
300
250
200
150
100
A/C - Off
A/C - On
City
Hwy
243.8
244.8
189.3
192.7
288.1
296.4
200.0
204.9
6SAS
6SBH
SC03
SC03 Ave
Hwy
Hwy Ave
A/C Off, SAS
A/C Off, SAS
A/C Off, SAS
A/C Off, Base
A/C Off, Base
A/C Off, Base
A/C Off, Base
A/C On, SAS
A/C On, SAS
A/C On, SAS
A/C On, Base
A/C On, Base
A/C On, Base
A/C On, Base



CO2 Grams per Mile Summary
CO2 (g/mi)
100
90
80
70
60
50
40
30
20
10
0
Delta SC03 (Base-SAS)
Delta SC03 Ave
Delta Hwy (Base-SAS)
Delta Hwy Ave
6SAS
6SBH
City
Hwy
44.2
51.6
10.7
12.2
A/C Off, SAS
A/C Off, SAS
A/C Off, SAS
A/C Off, Base
A/C Off, Base
A/C Off, Base
A/C Off, Base
A/C On, SAS
A/C On, SAS
A/C On, SAS
A/C On, Base
A/C On, Base
A/C On, Base
A/C On, Base

		AC	CO2 (g/mile)	CO2 difference (g/mile)	Average CO2 difference(g/mile)	Average CO2 difference(g/mile)
6SBH#1	SC03	ON	294.2	50.4	51.6	31.9
	HWY		205.8	13.6	12.2	
	SC03	OFF	243.8	–	–	–
	HWY		192.2	–	–	–
6SBH#2	SC03	ON	297.3	51.8	–	–
	HWY		205.0	11.3	–	–
	SC03	OFF	245.5	–	–	–
	HWY		193.7	–	–	–
6SBH#3	SC03	ON	289.3	44.2	–	–
	HWY		204.2	12.6	–	–
	SC03	OFF	245.1	–	–	–
	HWY		191.6	–	–	–
6SBH#4	SC03	ON	304.6	59.8	–	–
	HWY		204.6	11.2	–	–
	SC03	OFF	244.8	–	–	–
	HWY		193.4	–	–	–
6SAS#1	SC03	ON	290.6	46.9	44.2	27.5
	HWY		199.2	9.5	10.7	
	SC03	OFF	243.7	–	–	–
	HWY		189.7	–	–	–
6SAS#2	SC03	ON	289.7	46.8	–	–
	HWY		201.3	11.5	–	–
	SC03	OFF	242.9	–	–	–
	HWY		189.8	–	–	–
6SAS#3	SC03	ON	283.9	39.0	–	–
	HWY		199.4	11.1	–	–
	SC03	OFF	244.9	–	–	–
	HWY		188.3	–	–	–
CO2 reduction(g/mile) ※credit value			–	–	–	4.4

<Summary – AC17 CO2 >

Grams Co2 per mile	SC03	HWY	Combined
SAS(3tests)	44.2	10.7	27.5
SBH(4tests)	51.6	12.2	31.9
Differential(Credit)			4.4