Visit Report (SANDEN TECH DAY @ PACCAR DAF)

Issuer	Armin Tavanaianfar	**Issuing Date**	22.11.2022
Distribution List	SDAC – SIE Team Members		
Place of Visit	DAF HQs in Eindhoven – The Netherlands		
Date of Visit	16.11.2022		
Participants	DAF Core Engineering Team: René Nevels (Lead Engineer Vehicle Definition - Thermal Management), Guus Obelink (HVAC System Owner), Yassir Lahrichi (ICS PWT PD - AC Compressor), Gokhan Cebici (EV PWT PD – AC Compressor), Ozgun Hoeke (PD Air Compressors), Ignacio Medina Arboleya & Onur Sagaltici (PD Cab Interior Electronics Displays) DAF PUR Vistors & Participants: Jos Smetsers (Paccar Europe Purchasing Board Member), Sjef Cornelissen (DAF PUR Director), Marcel Bloemen (PUR Unit Commodity Manager), Otto Heerschap (DAF PUR Commodity Manager), Ricardo Kroek (DAF PUR Buyer & DAF coordinator of Sanden Tech Day), Gerben Liebregts (DAF PUR Commodity Manager Aircompressors), Mariska Boerenkamp (DAF PUR Manager Displays) Sanden Team: Waldemar Carl Meissner, Jose Miguel Dias, Georges Khoury, Markus Heidemann, H.U. Clauswitz, Armin Tavanaianfar		

PURPOSE OF THIS VISIT

Promote Sanden Advanced Engineering Projects & ECs, Develop New Business on top of today's mass production HVAC System!

Promoted Units: MC: SD7V16, EC: 24V, 48V, 800V (R744/R1234yf), Expanders: Mechanical & Electrical, HVAC: CF HVAC System, ITMS/ECH, Display Mock Up

OUTCOME

The Tech Day is a major success for Sanden, which resulted in agreements to follow up with DAF PD on the NBD subjects. DAF PUR announced to share Rfl's for Integrated Parking Cooling, Sanden 800V 60cc EC and a potential BC to introduce SD7V16 to DAF Europe!

DETAILS

<u>800V 60cc Electric AC Compressor:</u>

DAF BEV vehicle is equipped with 2 Mahle 800V ECs. One is designated to Cab Cooling, the other one is mounted in the battery cooling pack. Max cooling performance stated, 16KW each. The Sanden 800V 60cc EC, which max cooling performance is 18KW, impressed the DAF Team besides the overall performance data, shared. Sanden explained that by the "Booster" function, the max cooling performance can be increased (higher RPM), possibly meeting the TRS value of 21KW peak.

SOP Sanden: Q2/2025.

<u>48V 33cc AC Compressor:</u>

48V Hybrid Diesel Vehicle Project has not been reconfirmed by DAF, however DAF is working on a Plug in Hybrid Vehicle, which for the purpose of Cab- and Battery Thermal Management most likely requires a High Voltage EC.

24V 15Cc Electric AC Compressor:

Today, DAF assembles a Dirna - Bergstrom IPC System, using an Electric Scroll Compressor.

An additional Control Unit is part of the E-system. DAF and its customers may not be happy with the performance (nor cost). Target must be to use the Sanden 24V EC and to integrate some functionalities in the HVAC System CCU. DAF shared relevant engineering data with Sanden TCE, i.e. LIN LDF files, CAN speed alignment, next to come is Look Up Table. Sanden to consider the 24V EC to be painted at the DAF assy plant.

SD7V16 HDT Mechanical Compressor:

Sanden mentioned an expected cost leverage level to DAF PUR, in the event that the SD7V16 is sourced for the MY27 engine line up – in line with Paccar N.A. sourcing of SD7V16 MY24. Engineering explained that the variable compressor is justified for implementation at DAF if emission reduction, even by a small contributor to it, can be proven.

E- Aircompressor:

Sanden presented its current milestone plan and the technical concepts of consideration. DAF is interested in an oil-/maintenance free compressor. The parties agree that the piston type compressor does not fulfil the BEV NVH requirements and share the view of the lower efficiency rate in comparison to Scroll or Turbine Type Aircompressors. DAF confirmed its' Air Flow Rate of 700L/min and Max Pressure of 15 Bar.

DAF requires the Sanden validation plan for its compressor, and information about the chosen compressor design concept. DAF understands the Sanden request for the DAF TRS, however explained that the supplier for the current BEV is sourced. But, DAF reviews the possibility to supply technical data to support Sanden early development phase. A true next implementation opportunity for Sanden in general is possible, but its timing currently unclear.

ECH:

Sanden presented its ECH sample and its' performance to DAF. The narrow design of the Sanden unit has been remarked. DAF explained that for Cab Heating 9Kw are required at peak / max. Heat up phase with a coolant flow of 20 l/min. For battery heating the demand is 7.5Kw x 5 and managed by a solution integrated in the battery.

DAF stated that its Low Voltage range is 24V – High Voltage Range 400V – 650 V, since not all required components are available with 800V, yet. Currently, their board net voltage is 24V.

Expanders:

DAF PD explained that for years, vast effort in WHR Systems research and development was spent. However, this technology was overran by the ambitious CO2 emission reduction legislation 2025 & 2030, which made DAF to go battery electric, first. DAF PD stated, that by this fact, system efficiency losses as well as for the cost of the WHR system, the project has been halted for Diesel ICS. The Hydrogen engine is the next potential project to bring the WHR system back to DAF. DAF PD was impressed by Sanden knowledge about WHR Systems and its expander technology, especially by the high efficiency level of its scroll type expander.

Displays:

The Sanden Hisense Display Demonstrator raised a lot of attention at the DAF PD community.

During the Tech Day, several discussions took place aside the presentations. Exchange took place with the DAF Component Leader and with Purchasing, which then participated during the entire scheduled presentation. PUR and PD are interested to understand the cost of the presented technology, patent situation, presented micro LED sample timing. DAF understood and appreciated the Hisense/Sanden Tier I position intention.

ITMS:

There was recognition that Sanden are currently not at the level of supporting HDT TMS, as the focus is on passenger vehicle. A later discussion with DAF Thermal Engineering revealed that there might be interest in TMS going forward, the capacity question was answered with 35kW of cooling capacity required for 800V quick charge. The refrigerant discussion was held quite openly and it became apparent that DAF are currently not really working beyond R1234yf. The conclusion from the exchange is that DAF are currently seeing the cab climate as an attachment that is orchestrated separately from the truck TMS. Integration likely will take place but will require Sanden to show components & system ideas, suitable for HDT application (not research).

ACTIONS

800V 60cc AC Compressor:

Share latest project milestone plan and performance data with DAF PUR. (ATR CW47)

DAF PUR announced that Sanden receives the RfI until end of CW 48. Chase PUR for submission in time (ATR CW48).

Explain the Booster function & resulting additional KWs cooling performance. (JMD CW47/48)

48V 33cc AC compressor:

DAF PD/PUR and Sanden PE/Sales to follow up. (JMD & ATR CW05)

24V 15cc AC Integrated Parking Cooling:

RfI already received. RfI reply due date: 25.11.2022 (HUC & ATR CW47)

SD7V16 HDT Mechanical AC Compressor:

DAF PUR requires the potential cost saving overview, resulting out of a combined SD7V16 sourcing for the MY24 & MY27 engine line up. (ATR CW48)

DAF PD intends to run their own simulations and requires on HVAC system level the corresponding TXV Valve definition. (TCE WCM CW48)

DAF PD requires ASAP a SD7V16 sample. To provide OTP MY24 samples in March/April 2023 is too late. Sanden to find another solution. (PE JMD CW48)

Sanden must clarify with DAF how the tests to verify fuel consumption difference will be conducted. By testing on real truck, it is very difficult to compare the difference between fixed and variable compressor. On Truck level, the saving is approx. 0.3% due to the low Compressor fuel consumption level (0.3% of the total consumption). A potential measurement mistake could be higher than such value.

ECH:

Sanden to request the DAF ECH TRS for its' studies. (ATR CW49)

Expander:

Sanden NBD to follow up with René Nevels and his PD team. (GKY CW 02)

Displays:

A mutual signed off NDA is in place. Sanden received the TRS for the rear mirror Displays and Cluster Instruments. Hisense/Sanden to study the TRS. If required a clarifying Tech Rev Meeting to be organised. If not, kick off the Display calculation for a follow up meeting with DAF PUR.

Event Photos:


1. R&D Activities Performed for Direct/Indirect HPS
Sanden's current THS system developments
Step 2.0
Step 3.0
Customized
Standard
Sanden Developing and Industrializing Two Basic System Concepts


Reliability under low lubrication conditions