

Overview of Systems under Evaluation in SAE Alternate Refrigerant Cooperative Research Program

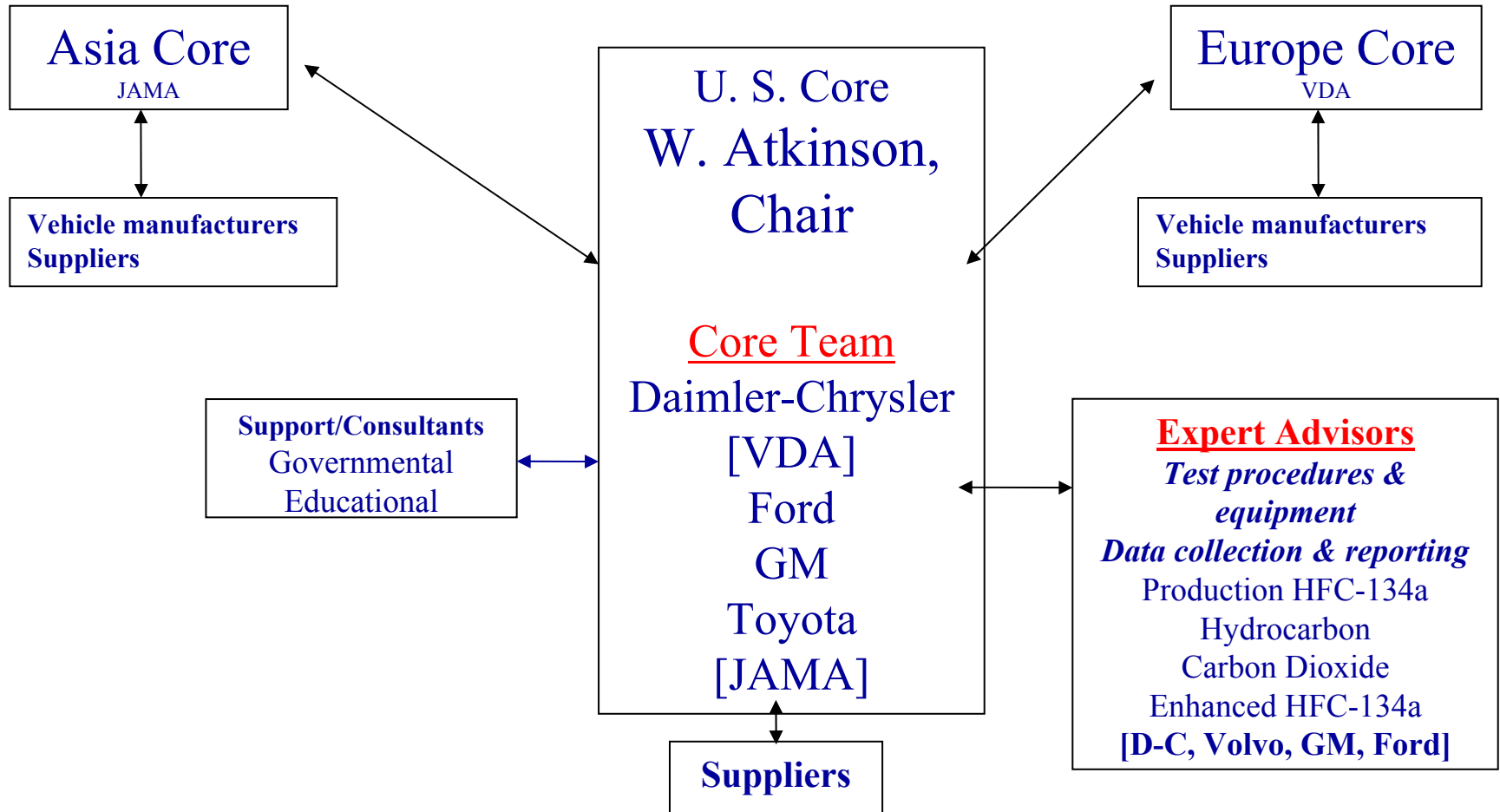
Bill Hill
General Motors



Alternate Refrigerant Cooperative Research Project (ARCRP)

- SAE and the Alternate Refrigerant Cooperative Research Team would like to express our gratitude to suppliers who provided components for test!
 - Source of components will not be discussed
 - Components were chosen at the discretion of the Expert team

Program Overview



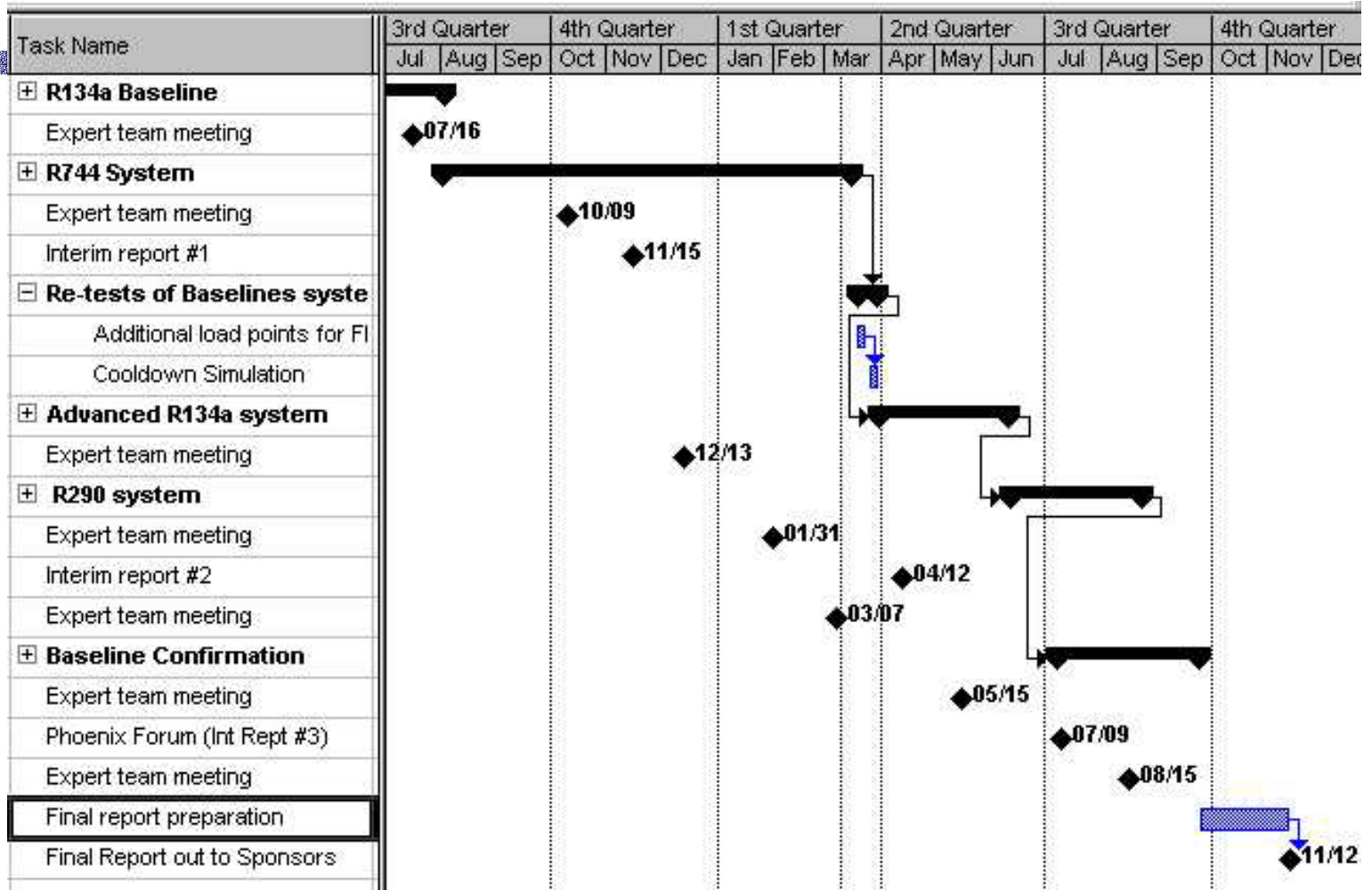
Project History

- Concept July 2000
- Funded 2001
- 25 Partners
 - Most major OEM's and suppliers are represented
- Expert Team makes regular reports to the Core Team
 - Interim Report #1 Nov., 2001
 - Interim Report #2 Mar., 2002
 - Interim Report #3 Aug., 2002

Alternate Refrigerant Cooperative Research Project (ARCRP)

- University of Illinois (U of I) chosen to perform the testing
 - Research Quality Test lab
 - Selected after careful review of available labs by Expert Team

Project Timing Chart

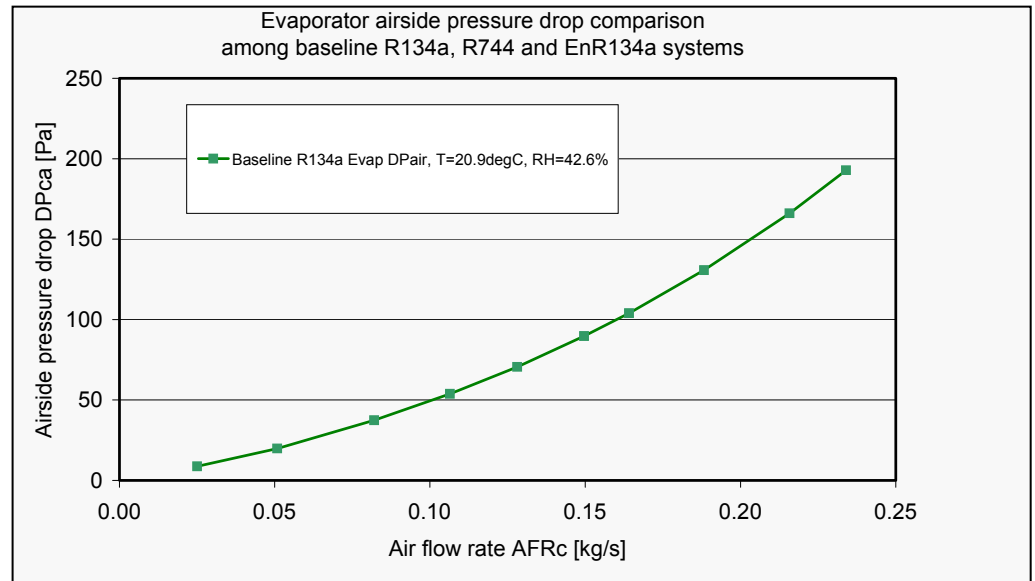


System component selection guidelines

■ Target component sizes

- Airside pressure drop of the baseline heat exchangers was used as a target

Component	Target
Condenser	D < 20 mm Face area < 318,000 mm ²
Evaporator	D < 75 mm; Face area < 64,000 mm ²



System component selection guidelines

- High load points were used to select base components [Expert Team Consensus]
 - Additional points were used to select ancillary components
 - i.e.; for oil separators and suction line heat exchanger sizing

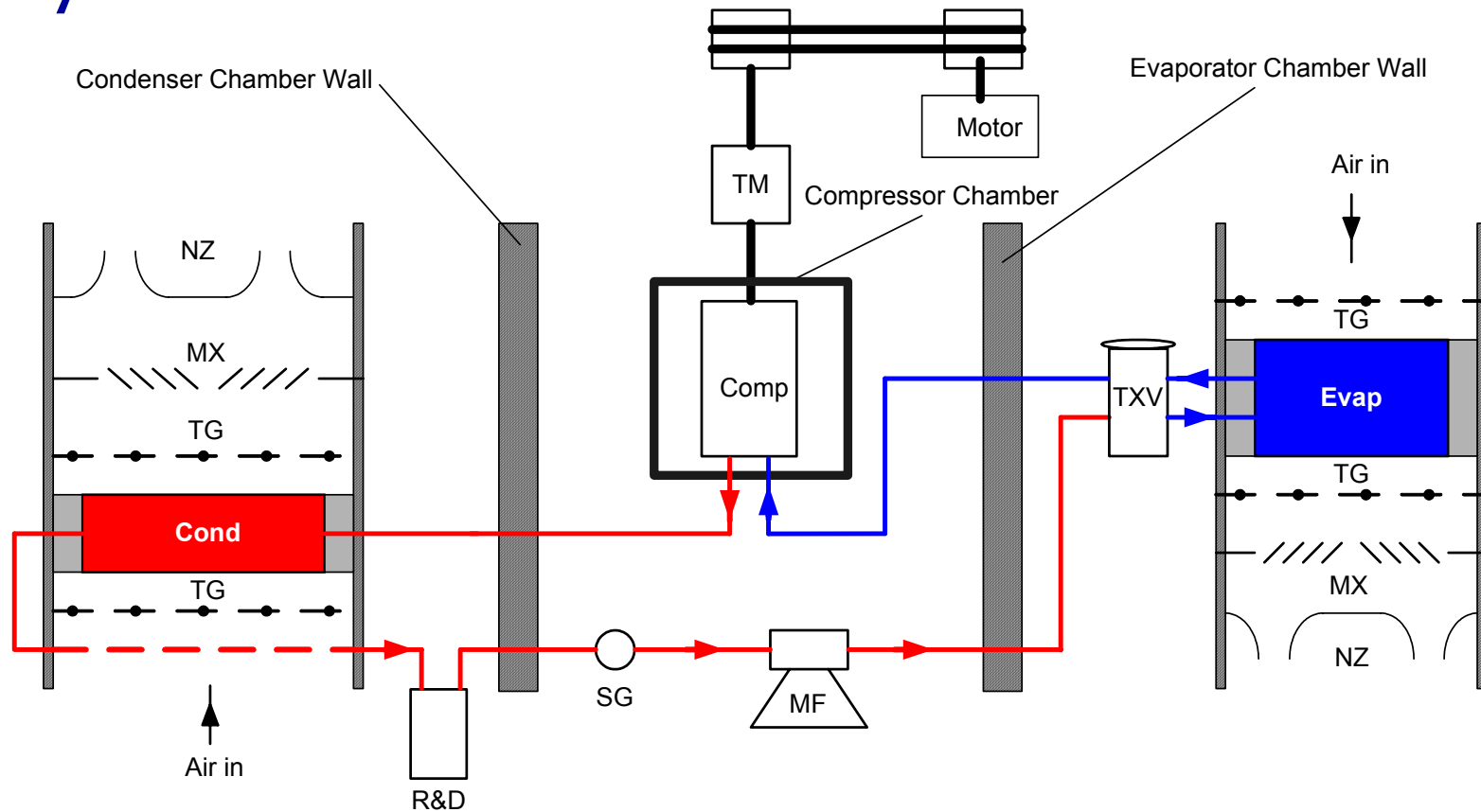
Cond Air In (°C)	Evap Air In (°C)	Compr (rpm)	Rhe (%)	evap airflow(scfm)	cond airflow (scfm)
45.28	45.13	896	27.2	229.5	897.7
60.37	45.09	897	27.3	228.7	916.3
60.32	45.11	897	27.3	228.4	918.5
70.45	45.20	898	27.3	231.6	932.3
45.20	45.23	1492	26.9	275.5	1816.0
45.25	45.22	2495	26.8	274.8	2814.0

R134a System

- System Capacity based on that for a mid-sized passenger car
- Component description
 - Variable displacement compressor-externally controlled, 160-170 cc maximum displacement
 - Plate/fin evaporator-single tank
 - Micro-channel condenser
 - Cross charge TXV-block type
 - Separate R/D

R134a System

System Schematic



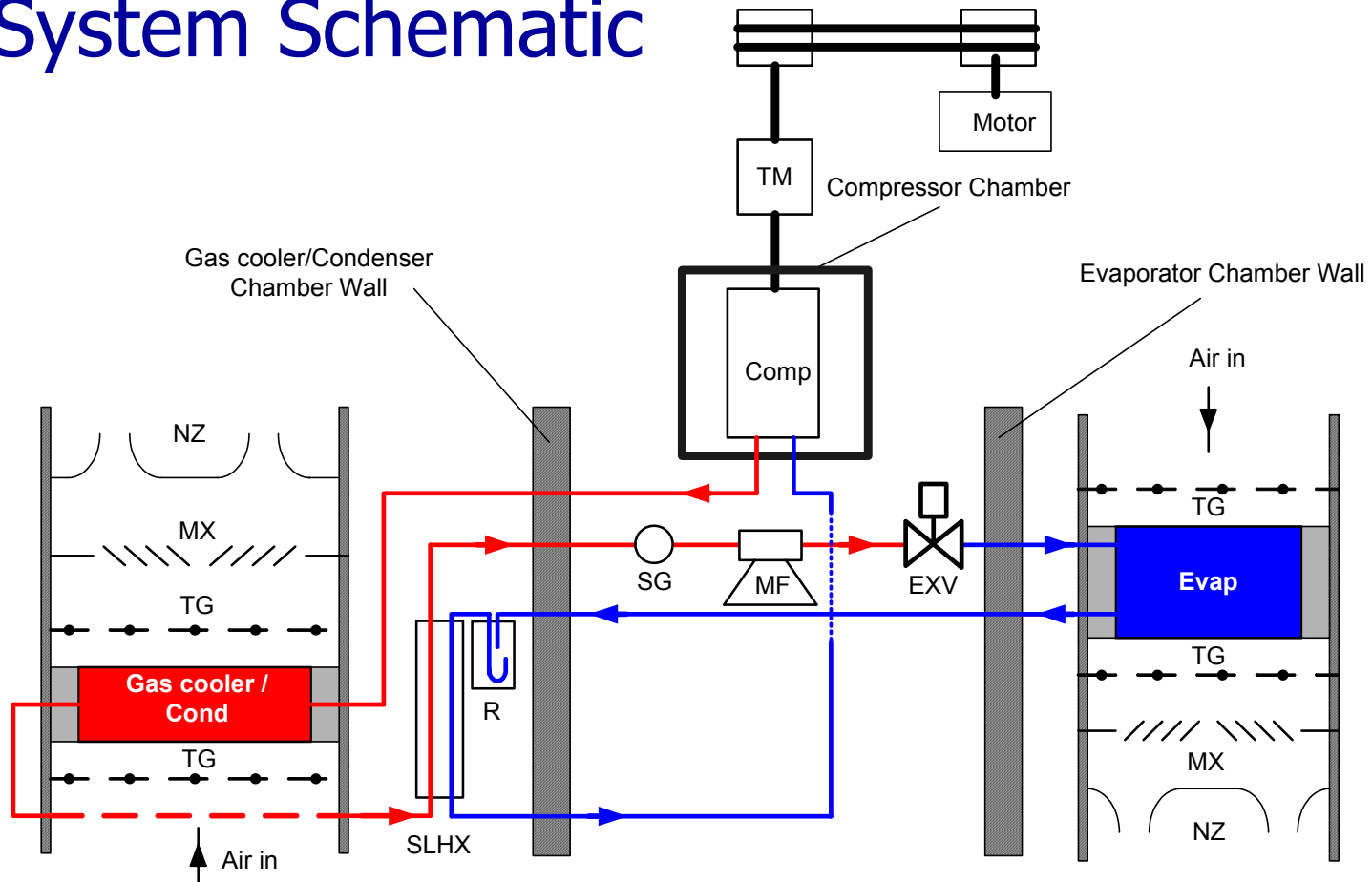
R744 System

■ Component description

- Variable displacement compressor-33 cc maximum displacement, externally controlled
- Micro-channel evaporator
- Micro-channel condenser
- Stepper motor expansion device
- Suction line heat exchanger
- Suction side, low pressure accumulator

R744 System

■ System Schematic



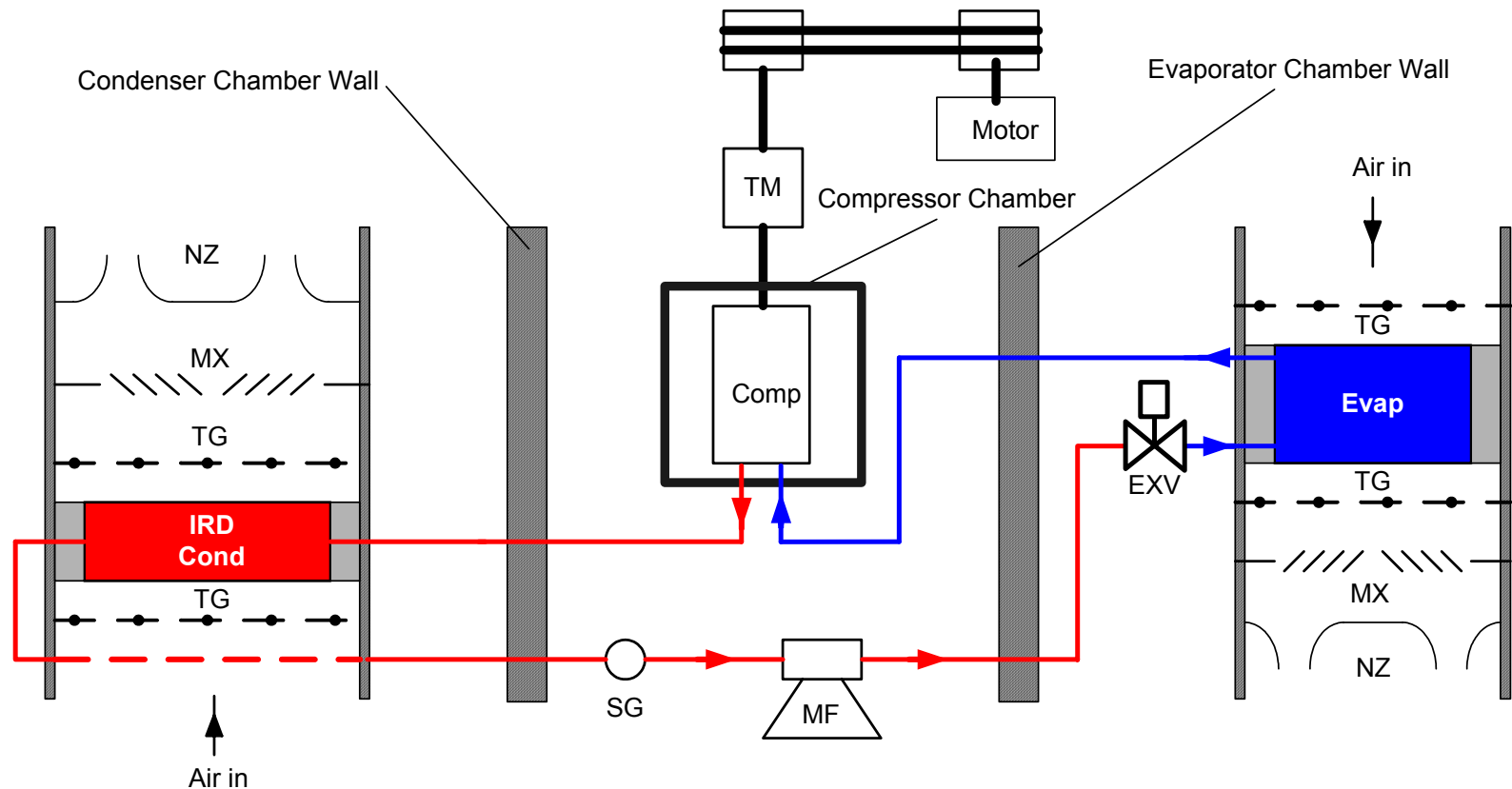
Enhanced R134a System

■ Component description

- Variable displacement compressor, externally controlled, 160-170 cc maximum displacement
- Micro-channel evaporator
- Micro-channel condenser w/Integrated R/D
- Stepper motor expansion device
- Oil separator and suction line heat exchanger was evaluated but not used [limited time for development/evaluation]

Enhanced R134a System

■ System Schematic

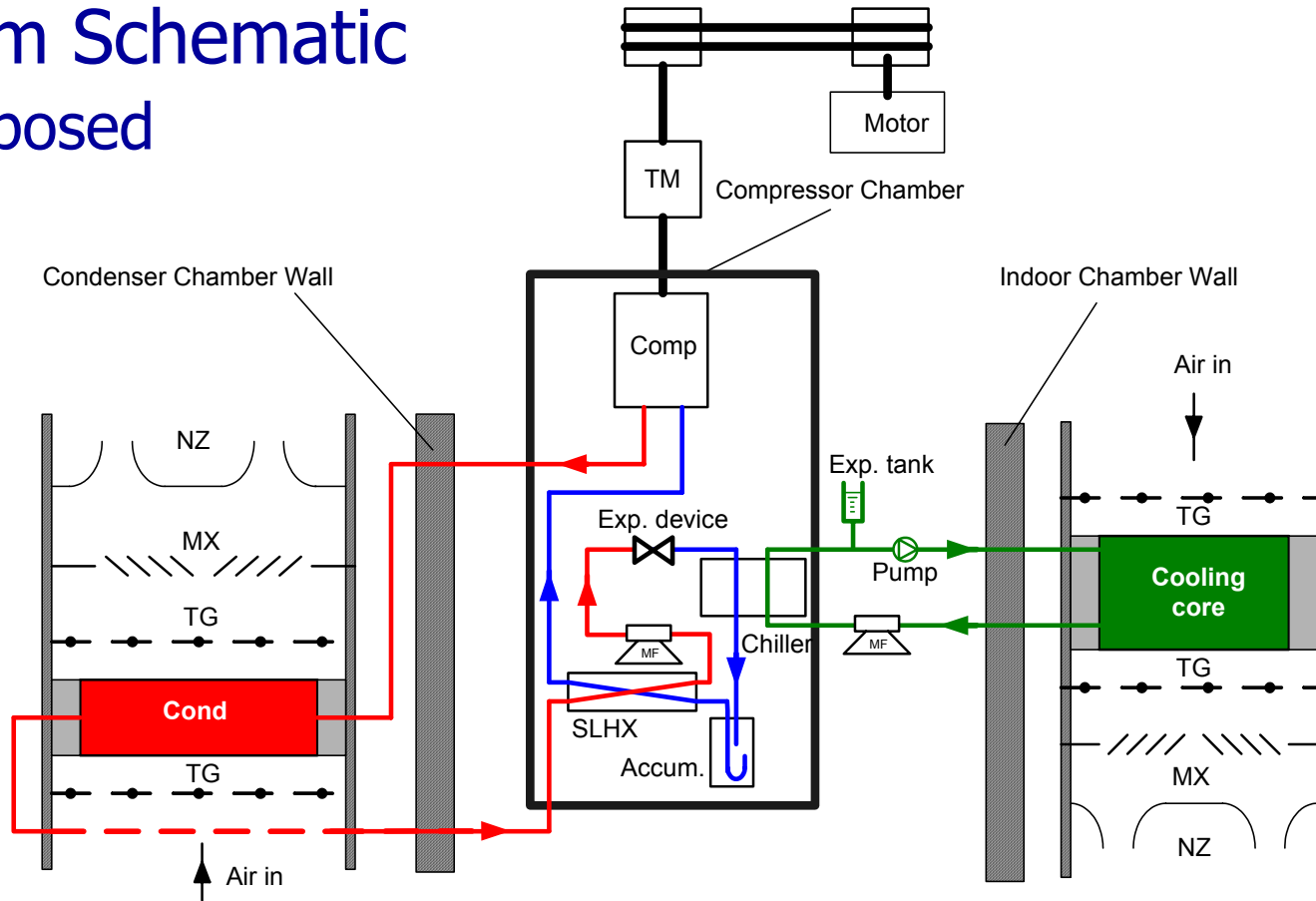


R290 System-proposed

- Component description
 - Variable displacement compressor
 - Laminated evaporator/chiller (refrigerant to secondary fluid)
 - Micro-channel condenser
 - Orifice tube-manual valve?? Two stage??
 - Low side accumulator [sight glass]
 - Suction line heat exchanger
 - Plate/fin Cooling core (Secondary fluid to air)
 - Coolant pump-10 GPM??

R290 System

■ System Schematic – proposed



Summary

- The systems evaluated were based on the best components made available to the Expert Team at the time of test.
- The data being collected is of the highest integrity possible.
- The lessons learned in this study will provide direction for future system development desired by sponsors.