Compressed Hydrogen Fuelling Standard
MF Twin Nozzle Fuelling Protocol

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draft

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Japan Petroleum and Carbon Neutral Fuels Energy Center

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1. Scope

The focus of this standard is to define MF (medium-flow) fuelling protocols, including their process limits for fuelling of compressed gaseous hydrogen vehicles at maximum flow rates 60, 90 and 180 g/sec using one or two nozzles with vehicle fuel system (VFS) volume capacities between 50 and 5000 L which have been qualified to UN GTR #13 or UNR134. However, Manifold type LDV and H35 vehicles are excluded. Descriptions of H35 in the referenced standards are also excluded.

1.1 Table Summarizing Content

Table 1.1 - Content of this protocol

Pressure Class	H70	H70	H70
Protocol Name	MF-Single-LT (Comm. & Non-comm.)	MF-Twin-LT (Comm. & Non-comm.)	NF-Single-LT (Comm. & Non-comm.)
VFS Capacity Range (liters)	248.6 to 5000	248.6 to 5000	50 to 5000
VFS Capacity Range (kilograms)	10 to 200	10 to 200	2 to 200
Range of Tank Sizes Within the TVL (liters)	50 to 800	50 to 800	50 to 800
Maximum Flow Rate (g/sec)	90	180	60
Fuel Delivery Temperature Categories	T40D (-40 to -33 °C)	T40D (-40 to -33 °C)	T40D (-40 to -33 °C)
	T30D (-40 to -26 °C)	T30D (-40 to -26 °C)	T30D (-40 to -26 °C)
	T20D (-40 to -17.5 °C)	T20D (-40 to -17.5 °C)	T20D (-40 to -17.5 °C)

NOTE: NF-Twin-LT (Comm. & Non-comm.) is out of scope.

1.2 Explanatory Material

Table 1.1 provides an overview of the fuelling protocols in this Annex. This Annex provides fuelling protocols which are applicable to the 70 MPa pressure class (H70). There are three sets of fuelling protocols; MF-Single-LT, MF-Twin-LT, and NF-Single-LT. The naming convention of "MF-Single-LT" is medium flow - single nozzle - look-up table method, "MF-Twin-LT" is medium flow - twin nozzle - look-up table method, and "NF-Single-LT" is normal flow - single nozzle – look-up table method. These protocols allow for fuelling with communications (communication fuelling) or without communications (non-communication fuelling) and provide end-of-fill pressure targets.

These fuelling protocols utilize numerous process limits on control parameters such as the maximum fuel flow rate, the rate of pressure increase, and the ending pressure. The control parameters and associated process limits are affected by factors such as ambient temperature, fuel delivery temperature, and initial pressure in the vehicle's VFS capacity.

An important factor in the performance of hydrogen fuelling is the station's dispensing equipment cooling capability and the resultant fuel delivery temperature. The fuelling protocols utilize fuel delivery temperatures in the range of -40 °C to -17.5°C. There are three fuel delivery temperature categories denoted by a "T" rating - T40D, T30D, T20D, where T40D is the coldest. Fuelling times are a function of the fuel delivery temperature, ambient temperature, initial pressure and VFS volume.

2. Normative References

Normative references are listed here.

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Standards

IEC 61508, Functional safety of electrical/electronic/programmable electronic safety-related systems

IEC 61511, Functional safety – Safety instrumented systems for the process industry sector

IEC 62061, Safety of machinery – Functional safety of safety-related electrical, electronic, and programmable electronic control systems

ISO 13849-1, Safety of machinery – Safety-related parts of control systems — Part 1: General principles for design

ISO 13849-2, Safety of machinery – Safety-related parts of control systems — Part 2: Validation

ISO 19881, Gaseous hydrogen – Land vehicle fuel containers, 2018 (or latest version)

ISO 19885-1 Gaseous hydrogen — Fuelling protocols for hydrogen-fueled vehicles — Part 1: Design and development process for fuelling protocols

ISO 17268-2, Gaseous hydrogen land vehicle fuelling connection devices

ISO 14687, Hydrogen fuel quality - Product specification

ISO 23273, Fuel cell road vehicles - Safety specifications - Protection against hydrogen hazards for vehicles fueled with compressed hydrogen

UN R134

GTR13, Hydrogen Fuel Cell Vehicles

SAE J2574, Fuel Cell Vehicle Terminology

SAE J2578, Recommended Practice for General Fuel Cell Vehicle Safety

SAE J2579, Standard for Fuel Systems in Fuel Cell and Other Hydrogen Fueled Vehicles

SAE J2600, Compressed Hydrogen Surface Vehicle Fuelling Connection Devices

SAE J2601, Surface Vehicle Standard

SAE J2601-5, High-Flow Prescriptive Fuelling Protocols for Gaseous Hydrogen Powered Medium and Heavy-Duty Vehicles

SAE J2719, Hydrogen Quality Standard for Fuel Cell Vehicles

SAE J2799, Hydrogen Surface Vehicle to Station Communications Hardware and Software

ISO 19880-1, Gaseous hydrogen – Fuelling stations – Part 1: General requirements, 2020-03 (Or latest version)

ISO/DIS 19880-2, Gaseous Hydrogen – Fuelling stations – Part 2: Dispensers and dispensing systems, 2020 (or latest version)

ISO/SAE 21434, Road vehicles – Cybersecurity engineering, 2021

ISO 26262, Road vehicles – Functional safety, 2018

Other References

3. General Definitions for Fuelling Protocols

“CHSS” in the quotation is used to mean “VFS”.

3.1 General Definitions

3.1.1 Compressed Hydrogen Storage System

See 3.1 COMPRESSED HYDROGEN STORAGE SYSTEM (CHSS) in SAEJ2601-5(2025).

3.1.2 Dispensing System

See 3.3 DISPENSER COMPONENTS in SAEJ2601-5(2025).

3.1.3 Dispenser

See 3.3.1 HYDROGEN DISPENSING EQUIPMENT (DISPENSER) in SAEJ2601-5(2025).

3.1.4 Connector or Coupling

See 3.3.2 CONNECTOR or COUPLING in SAEJ2601-5(2025).

3.1.5 Nozzle

See 3.3.3 NOZZLE in SAEJ2601-5(2025).

3.1.6 Receptacle

See 3.3.4 RECEPTACLE in SAEJ2601-5(2025).

3.1.7 Fuelling Hose

See 3.3.5 DISPENSER HOSE in SAEJ2601-5(2025).

3.1.8 Break-away

See 3.3.6 BREAK-AWAY in SAEJ2601-5(2025).

3.1.9 Communications Fuelling

See 3.4.1 COMMUNICATIONS FUELLING in SAEJ2601-5(2025).

3.1.10 Non-comm Fuelling

See 3.4.2 NON-COMMUNICATIONS FUELLING in SAEJ2601-5(2025).

3.1.11 Fuelling Time and Fuelling Events

See 3.5 UELING TIME AND FUELLING EVENTS in SAEJ2601-5(2025).

3.1.12 Overall Fuelling Time

See 3.5.1 OVERALL FUELLING TIME in SAEJ2601-5(2025).

3.1.13 Non-fuelling Time

See 3.5.2 NON-FUELLING TIME in SAEJ2601-5(2025).

3.1.14 Intended Non-fuelling Events

See 3.5.3 INTENDED NON-FUELLING EVENTS in SAEJ2601-5(2025).

3.1.15 Connection Pulse

See 3.5.3.1 CONNECTION PULSE in SAEJ2601-5(2025).

3.1.16 Initial Leak Check

See 3.5.3.2 INITIAL LEAK CHECK in SAEJ2601-5(2025).

3.1.17 Fuelling Leak Check

See 3.5.3.3 FUELLING LEAK CHECK in SAEJ2601-5(2025).

3.1.18 Bank Switching

See 3.5.3.4 BANK SWITCHING in SAEJ2601-5(2025).

3.1.19 Startup Time

See 3.5.4 STARTUP TIME in SAEJ2601-5(2025).

3.1.20 Start of Fuelling

See 3.5.5 START OF FUELLING in SAEJ2601-5(2025).

3.1.21 End of Fuelling (intended)

See 3.5.6 END OF FUELLING (INTENDED) in SAEJ2601-5(2025).

3.1.22 Main Fuelling Time

See 3.5.7 MAIN FUELLING TIME in SAEJ2601-5(2025).

3.1.23 Shutdown Time

See 3.5.8 SHUTDOWN TIME in SAEJ2601-5(2025).

3.1.24 Terminate Fuelling

See 3.5.9 TERMINATE FUELLING in SAEJ2601-5(2025).

3.1.25 Hydrogen Surface Vehicle

See 3.6 HYDROGEN SURFACE VEHICLE (HSV) in SAEJ2601-5(2025).

3.1.26 Nominal Working Pressure

See 3.7.6 NOMINAL WORKING PRESSURE (NWP) in SAEJ2601-5(2025).

3.1.27 Maximum Operating Pressure

See 3.7.7 MAXIMUM OPERATING PRESSURE (MOP) in SAEJ2601-5(2025).

3.1.28 Maximum Allowable Working Pressure

See 3.7.8 MAXIMUM ALLOWABLE WORKING PRESSURE (MAWP) in SAEJ2601-5(2025).

3.1.29 Pressure Class

See 3.7.9 PRESSURE CLASS in SAEJ2601-5(2025).

3.1.30 Process Limits

See 3.8 PROCESS LIMITS in SAEJ2601-5(2025).

3.1.31 State of Charge

See 3.10 STATE OF CHARGE (SOC) in SAEJ2601-5(2025).

3.2 General Definitions for L/T Fuelling Protocols

3.2.1 Total Volume

See 3.2.1 TOTAL VOLUME (TV) in SAEJ2601-5(2025).

3.2.2 Tank Volume Large

See 3.2.2 TANK VOLUME LARGE (TVL) in SAEJ2601-5(2025).

3.2.3 Optional Data Block

See 3.4.1.1 OPTIONAL DATA BLOCK (OD BLOCK) in SAEJ2601-5(2025).

3.2.4 Optional Data

See 3.4.1.2 OPTIONAL DATA (OD DATA) in SAEJ2601-5(2025).

3.2.5 Optional Data Block Header

See 3.4.1.3 OPTIONAL DATA BLOCK HEADER (OD HEADER) in SAEJ2601-5(2025).

3.2.6 Pressure Definitions

3.2.6.1 VFS Pressure

See 3.7.1 CHSS PRESSURE (Pvehicle) in SAEJ2601-5(2025).

3.2.6.2 Station Pressure

See 3.7.2 STATION PRESSURE (Pstation) in SAEJ2601-5(2025).

3.2.6.3 Initial Pressure

See 3.7.3 INITIAL PRESSURE (Pinitial) in SAEJ2601-5(2025).

3.2.6.4 Start-up Pressure

See 3.7.4 STARTUP PRESSURE (Pstartup) in SAEJ2601-5(2025).

3.2.6.5 Target Pressure

See 3.7.5 TARGET PRESSURE (Ptarget) in SAEJ2601-5(2025).

3.2.7 Flow Rate

See 3.9 FLOW RATE in SAEJ2601-5(2025).

3.2.8 Flow Rate Maximum

See 3.9.1 FLOW RATE MAXIMUM in SAEJ2601-5(2025).

3.2.9 Flow Rate Maximum Class

See 3.9.2 FLOW RATE MAXIMUM CLASS in SAEJ2601-5(2025).

3.2.10 Temperature Definitions

3.2.10.1 Ambient Temperature

See 3.11.1 AMBIENT TEMPERATURE (Tamb) in SAEJ2601-5(2025).

3.2.10.2 VFS Average Vehicle Gas Temperature

See 3.11.2 CHSS AVERAGE VEHICLE GAS TEMPERATURE in SAEJ2601-5(2025).

3.2.10.3 VFS Measured Temperature

See 3.11.3 CHSS MEASURED TEMPERATURE (MT) in SAEJ2601-5(2025).

3.2.10.4 VFS Soak Temperature

See 3.11.4 CHSS SOAK TEMPERATURE in SAEJ2601-5(2025).

3.2.10.5 Fuel Delivery Temperature

See 3.11.5 FUEL DELIVERY TEMPERATURE (Tfuel) in SAEJ2601-5(2025).

3.2.10.6 Fuel Delivery Temperature Category

See 3.11.6 FUEL DELIVERY TEMPERATURE CATEGORY in SAEJ2601-5(2025).

3.3 Specific Definitions for MF Twin Nozzle Protocol

There are two types of connections between the dispenser and the vehicle: single or twin nozzle connected. Two nozzles from one dispenser connected to one vehicle is defined as "Twin". On the other hand, each of nozzle connected to two different vehicles are defined as "Single".

3.3.1 Manifold HDV

Manifold HDV is a HDV with two receptacles where all fuel lines of the VFS are connected with each other and the communication signal from each receptacle is the same.

For the diagram of this structure, see vehicle fuel system 1 in Figure5.2.

3.3.2 Separate HDV

Separate HDV is a HDV with two receptacles with an independent tank configuration for each receptacle and a separate communication signal from each receptacle is different.

For the diagram of this structure, see vehicle fuel system 2 in Figure 5.2.

3.3.3 NF Receptacle

NF Receptacle is a H70 receptacle with an inner diameter of 3 mm as defined in ISO 17268.

3.3.4 MF Receptacle

MF Receptacle is a H70 receptacle with an inner diameter of 4 mm as defined in ISO 17268-1.

4. Abbreviated and Symbols

This section should only include general abbreviated terms and symbols applicable to all fuelling protocols. Specific abbreviated terms and symbols to be included in the communications protocol sections

4.1 General Abbreviated Terms

APRR	Average Pressure Ramp Rate
CFRP	Carbon fiber reinforced plastic
VFS	Vehicle Fuel System & Volume
CHSS	Compressed hydrogen storage system
FCEV	Fuel cell electric vehicle
FCV	Fuel Cell Vehicle
FP	Fuelling Pattern
GTR	Global Technical Regulation
H_2	Hydrogen
H70	Indication for 70 MPa NWP hydrogen fuelling
HF	High Flow
HRS	Hydrogen Refuelling Station
HSTA	Hydrogen station Test Apparatus
HSV	Hydrogen Surface Vehicle
ID	Protocol Identifier
IrDA	Infrared Data Association
MAWP	Maximum allowable working pressure
MF	Medium Flow
MOP	Maximum operating pressure
NF	Normal Flow
NIST	US National Institute of Standards and Technology
NWP	Nominal working pressure
OEM	Original Equipment Manufacturer

PRR	Pressure Ramp Rate
PRV	Pressure Relief Valve
SAE	Society of Automotive Engineers International
SOC	State of charge
UCDC	Use Classification of Communicated Data
WP	Work Package

4.2 Protocol Specific Symbols

Symbol	Description	Units of measurement
$APRR_{calculated}$	An average pressure ramp rate value calculated by an equation and used to determine the maximum APRR which does not exceed the maximum flow rate	MPa/min
FC	Fuelling Command	N/A
FM	The Flow Rate Maximum Class. A value for FM can be communicted in the OD field	g/s
FTI	Fuelling Time Indicator. FTI = 1 indicates fuelling is proceeding and FTI = 0 indicates fuelling is paused	Integer number of 0 or 1
i	A calculation time step counter, which advances every $1/10^{th}$ of a second	Integer number
K_0	A parameter is the pressure loss coefficient from the dispenser to the vehicle container. Also, which is measured during a pause in fuelling, after which it is used to calculate a synthetic measured pressure MP_{calc}	MPa/gL
m	The total mass dispensed from the beginning of the main fuelling time up to the current time	g
$\dot{m}$	The mass flow rate of dispensed hydrogen	g/s
$\dot{m}_{flow}$	The mass flow rate of dispensed hydrogen just before the mass flow is stopped for an intended non-fuelling event, utilized in the calculation of K_0	g/s
m_0	The value of the mass dispensed at time t = 0, i.e., the beginning of the main fuelling time	g
m_{tol}	The accuracy of the mass dispensed measurement, used in the VFS Volume Measurement	Percent (expressed as

		a fraction of 100)
Δm_{VC}	The change in mass dispensed from the beginning of the main fuelling time, used in the VFS Volume Measurement	g
Δm_{VC_tol}	The change in mass dispensed from the beginning of the main fuelling time, accounting for the accuracy of the mass measurement m_{tol}, used in the VFS Volume Measurement	g
$m_{startup}$	Mass dispensed during startup time	g
MFR_{min}	The mininum mass flow rate allowed by the fuelling protocol	g/s
MP	The VFS measured pressure communicated via IrDA according to SAE J2799	MPa
MP_{calc}	Synthetic measured pressure calculated using the K_0 method described Section A.23.8	MPa
MT	The VFS measured temperature communicated via IrDA according to SAE J2799	K
OD	Optional Data communicated via IrDA according to SAE J2799	N/A
ΔP	The difference between the ramp pressure P_{ramp} and vehicle pressure MP or MP_{calc}, used in the optional PRR Taper equation	MPa
P_0	A value for $P_{startup}$ adjusted for the pressure measurement accuracy P_{tol}	MPa
P_a	A parameter which provides margin for errors in the calculation of MP_{calc}	MPa
P_{final}	The final pressure used in the derivation of the t_{final} equation coefficients	MPa
$P_{initial}$	Initial pressure of hydrogen in the VFS as per the definition in Section 3.7.3	MPa
P_{limit_comm}	An upper limit on pressure for communications fuelling to provide protection against a fault in MT	MPa
P_{limit_high}	The upper boundary of the pressure corridor which $P_{station}$ must stay within	MPa
P_{limit_low}	The lower boundary of the pressure corridor which $P_{station}$ must stay within	MPa
P_{min}	The initial pressure used in the derivation of the t_{final} equation coefficients	MPa

P_{ramp}	The pressure upon which the PRR is based. Also used to define P_{limit_high}, and P_{limit_low}	MPa
$P_{ramp\_maximum}$	The maximum ramp pressure	MPa
$P_{station}$	Fuelling pressure as measured by station at the dispenser outlet	MPa
$P_{station\_flow}$	The station pressure $P_{station}$ right before the mass flow stops for an intended non-fuelling event, used in the calculation of K_0	MPa
$P_{station\_no\_flow}$	The station pressure $P_{station}$ after the mass flow has completely stopped for an intended non-fuelling event, used in the calculation of K_0	MPa
$P_{station\_pause}$	The station pressure $P_{station}$ after the mass flow has completely stopped when conducting the VFS Volume Measurement	MPa
$P_{startup}$	The pressure in the VFS as measured by the station at the end of the startup time as per the definition in Section 3.7.4	MPa
$P_{target\_non\_comm}$	The target end of fill pressure for non-communications fuelling	MPa
P_{target_comm}	The target end of fill pressure for communications fuelling	MPa
$P_{target\_comm\_calc}$	A prelimarily calculated target end of fill pressure for communications fuelling	MPa
$P_{threshold}$	A threshold pressure, which when P_{ramp} exceeds, initiates the PRR Taper method	MPa
P_{tol}	The accuracy of the station pressure measurement, used in the VFS Volume Measurement	MPa
ΔP_{tol_high}	A delta pressure added to P_{ramp} to define P_{limit_high}. Also used in calculating β	MPa
PRR	The control Pressure Ramp Rate. This represents the rate of change of P_{ramp}	MPa/s
PRR_{Max}	A maximum pressure ramp rate	MPa/s
PRR_{MP}	The pressure ramp rate of the measured pressure MP or MP_{calc} based on the current measured pressure and a previous measured pressure $t_{lookback}$ time steps ago, used in PRR Taper method	MPa/s
PRR_{taper}	The pressure ramp rate calculated by the PRR Taper method	MPa/s
P_{VC}	The station pressure $P_{station}$ after the mass flow has completely stopped when conducting the VFS Volume Measurement, adjusted for the pressure transducer accuracy P_{tol}	MPa
ΔP_{VC}	A formula which determines the change in pressure from $P_{startup}$ required for the VFS volume measurement to be conducted	MPa

SOC_{target}	The end of fill target SOC, used in calculating P_{target_comm}.	Percent
t	Fuelling time, representing the total time elapsed since the initiation of the main fuelling time, including the time elapsed during intended non-fuelling events	s
t_{final}	The time required to fill from P_{min} to P_{final} under hot case conditions in units of seconds	s
t_{final_calc}	The t_{final} value calculated by the t_{final} vector, a preliminary value prior to α, β, and ε being applied	s
t_{final_min}	A minimum value of t_{final}, utilized to ensure the peak mass flow rate is not exceeded	s
$t_{lookback}$	A period of time in seconds used to look back from the current time to determine a previous value of MP or MP_{calc}, used in the PRR Taper method	s
t_{remain}	A calculated time remaining for the measured pressure MP or MP_{calc} to reach the end of fill target pressure, used in the PRR Taper method	s
T_{amb}	Ambient temperature as measured by fuelling station, not in direct sunlight	°C
ΔT_{VFS}	A calculated change in the VFS gas temperature from the beginning of the main fuelling time, used in the VFS Volume Measurement	°C
T_{fuel}	Fuel Delivery Temperature	°C
T_{fuel_inst}	Instantaneous fuel delivery temperature	°C
$T_{fuel\_inst\_A}$, $T_{fuel\_inst\_B}$	Two independent measurements of the instantaneous fuel delivery temperature for redundancy	°C
T_{gas_high}	The highest value of the bulk average gas temperature in a multi-tank VFS	°C
T_{gas_low}	The lowest value of the bulk average gas temperature in a multi-tank VFS	°C
T_{init_cold}	The initial gas temperature in the cold case VFS. T_{init_cold} is a function of T_{amb} and $P_{initial}$	K
TT	A parameter which is a function of the ambient temparature and used in the equation for ω and ε	°C
T_{VC}	The calculated VFS gas temperature based on T_{amb} plus ΔT_{VFS}, used in the VFS Volume Measurement	°C
TV	Total volume of the VFS	L

TVL	Largest tank volume of any of individual tank in the VFS	L
V_{VFS}	Volume of the VFS measured or otherwise determined by the station (e.g. via communications)	L
$V_{station\_D}$	A volume parameter used to determine $APRR_{calculated}$	L
ε	A parameter which is multiplied by t_{final} to increase its value when $P_{initial}$ < 5 MPa (H70)	Dimensionless
ω	An intermediary parameter used in the equation for ε which is a function of the ambient temparature	Dimensionless
ρ	A calculated density of the hydrogen in the VFS using an equation of state	g/L or kg/m^3
ρ_0	A calculated density of the hydrogen in the VFS (using an equation of state) at the beginning of the main fuelling time, used in the VFS Volume Measurement	g/L or kg/m^3
ρ_{init_cold}	The MC Method ending pressure control option cold case initial density calculated based on $P_{initial}$ and T_{init_cold}	g/L or kg/m^3
ρ_{K0}	A calculated density of the hydrogen at the dispenser outlet (using an equation of state), used in the calculation of K_0	g/L or kg/m^3
ρ_{VC}	A calculated density of the hydrogen in the VFS after the mass flow has stopped (using an equation of state), used in the VFS Volume Measurement	g/L or kg/m^3
$\Delta\rho_{VC}$	The change in density from the beginning of the main fuelling time, used in the VFS Volume Measurement	g/L or kg/m^3

5. General Fuelling Protocol Description

5.1 What is a target of this fuelling protocol

5.1.1 Basics

The target for this protocol is mainly focused on FM90（Single dispenser）/FM180（Twin dispenser) HDV fuelling by conventional Look-up table method. But until HDV or HDV station get widely spread, it will take some time.

So this protocol makes it possible to fuel conventional LDV at the same time. The HDV station in this protocol shall have FM90/FM180 fuelling capacity.

5.2 Selection of Fuelling Protocol

In using MF (and NF) fuelling protocols an appropriate protocol shall be selected for each of the following cases.

- **Fuelling Mode; “Twin Nozzle” (both nozzles connected to the same vehicle), “Single Nozzle×2” (both nozzles connected to different vehicles) or “Single Nozzle×1” (one nozzle connected)**

- **Communication States; Communication fuelling or Non-communication fuelling**
- **Vehicle Type; HDV(Manifold, Separate or NF receptacle), or LDV**
- **Fuelling Pattern; Combination of vehicles to be fueled, Time lag of fuelling**

In addition to that, the following are some points to consider when following this MAP selection method.

- **For safeguards against incorrect fuelling mode selection by the fueler, See 8.1.**
- **The protocol（MAP）selected depends on the type of receptacle and the capacity of the VFS.**
- **Manifold-type vehicles using NF receptacles are fueled from only one side.**
- **Because the VFS and TVL are known, fuelling can continue with the same APRR. For the map selected for each condition, see Table 9.1.**
- **End condition: SOC on the dispenser side = 100% [to be determined]**
- **NF-Single and NF-Single [A,B,C] are protocols developed for MF stations and are different from protocols for LDVs.**
- **The determination of whether the dispenser is single or twin connected is made when the fuelling start button is pressed, not when the dispenser is connected.**
- **“Triple Pulse Check” measures the initial pressure (“Initial Pressure Pulse”), identifies the vehicle type (“Vehicle Type Detection”), and checks the VFS (“VFS Estimation”).**

5.3 Fuelling Pattern

For overview of twin nozzle fuelling pattern, see Figure 5.2 and Table 5.2.

Figure 5.2 - Combination of Twin Nozzle Dispenser and Vehicle Fuel System

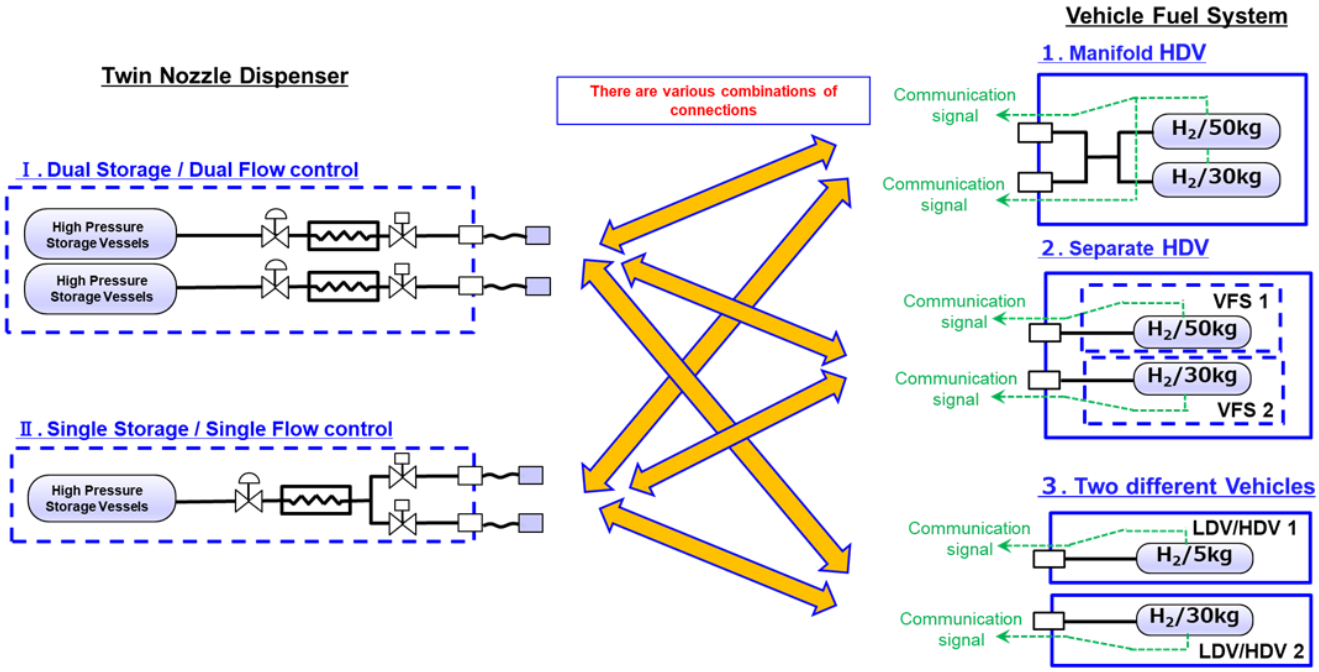
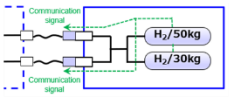
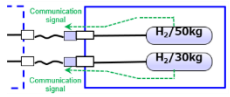
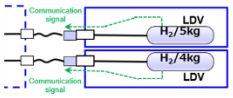
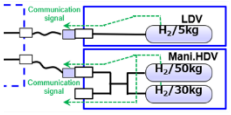
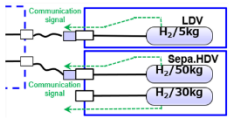
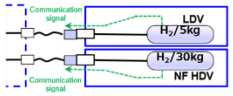
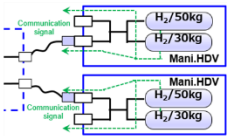
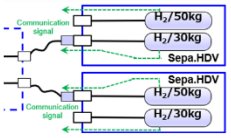
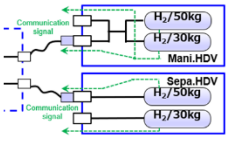
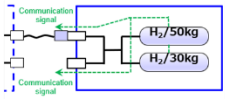


Table 5.2 - Fuelling Pattern of Vehicle Fuel System

Fuelling Pattern	Fuelling Mode	Vehicle Type	Vehicle Fuel System	Flow Control System	
				I	II
1	Twin Nozzle	Manifold HDV		○	○
2	Single Nozzle ×2	Separate HDV NF Receptacle HDV (2 Rece.(=Separate))		○	○ (※)
3A	Single Nozzle ×2	LDV & LDV		○	○ (※)
3B	Single Nozzle ×2	LDV & Manifold HDV		○	○ (※)
		LDV & Separate HDV			
		LDV & NF Receptacle HDV (1 & 2 Rece.)	 ※Diagram of NF Rece. 2 is omitted.		
3C	Single Nozzle ×2	Manifold HDV & Manifold HDV		○	○ (※)
		Separate HDV & Separate HDV			
		Manifold HDV & Separate HDV			
		NF Receptacle HDV (1 & 2 Rece.) & NF Receptacle HDV (1 & 2 Rece.)			
		NF Receptacle HDV (1 & 2 Rece.) & Manifold HDV	 ※Diagrams for combinations including NF Rece.1 & 2 are omitted.		
		NF Receptacle HDV (1 & 2 Rece.) & Separate HDV			
— (One Side Fuelling)	Single Nozzle	All Vehicle	 etc.	○	○

※This protocol focuses on twin nozzle fuelling side by side. In this sense, one side fuelling and the other side fuelling after the one is not its main target. But for customers, their HDV(or LDV) could be refueld even though by longer time.

5.4 Flowcharts

Section 5.1 and 5.2 are visualized in flowcharts in Figure 5.4.1 to Figure 5.4.13.

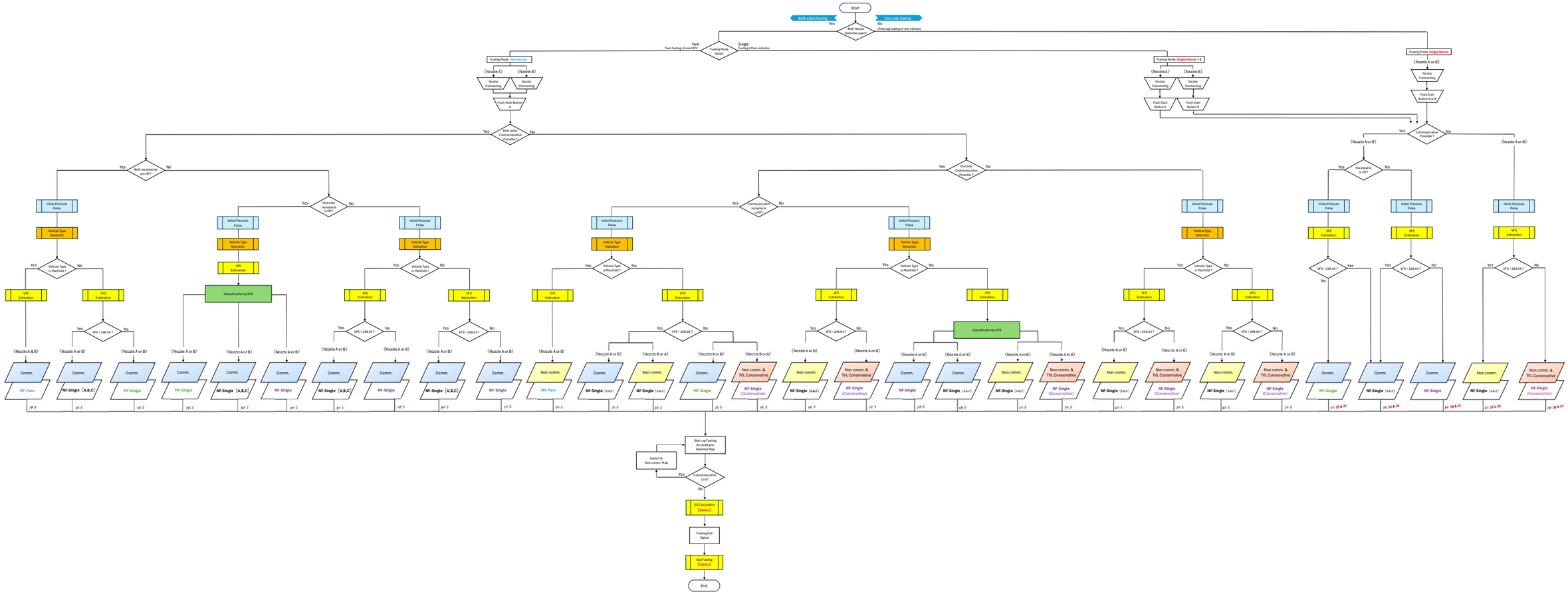


Figure 5.4.1 Flowchart overview

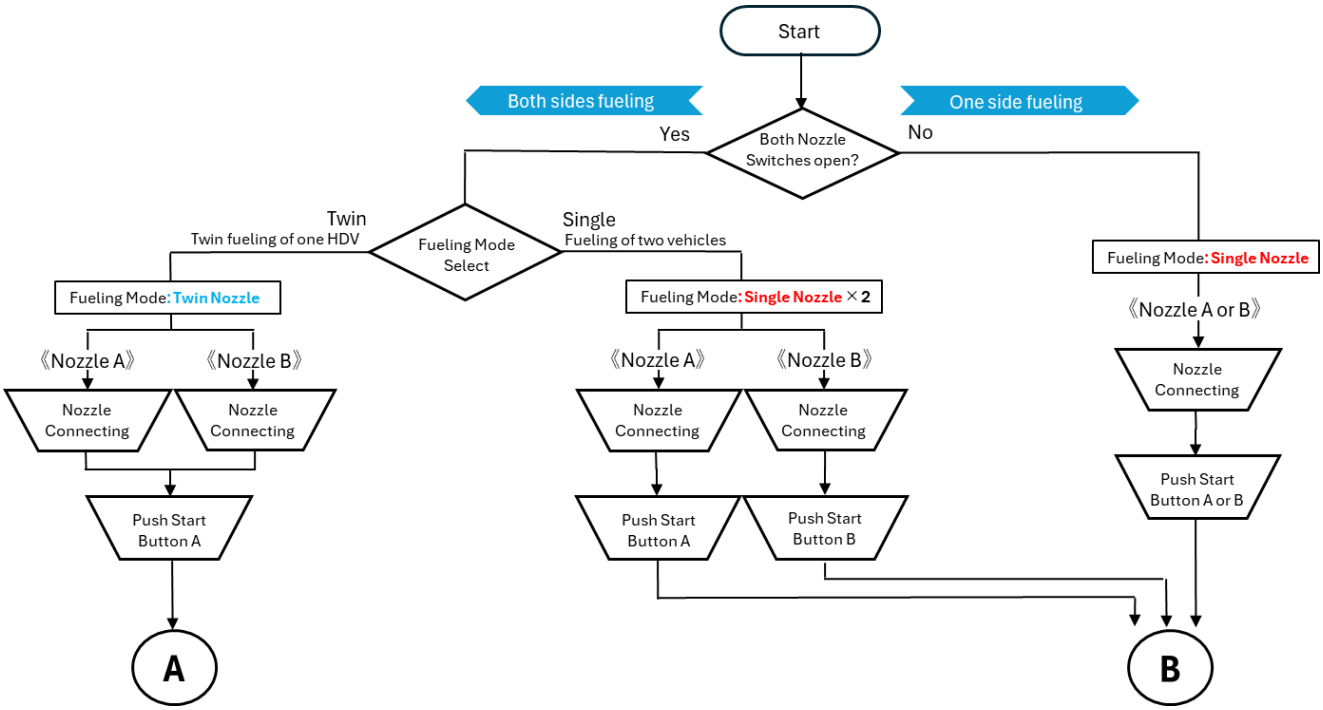


Figure 5.4.2 – Map Selection Flowchart（Start～Section A or B）

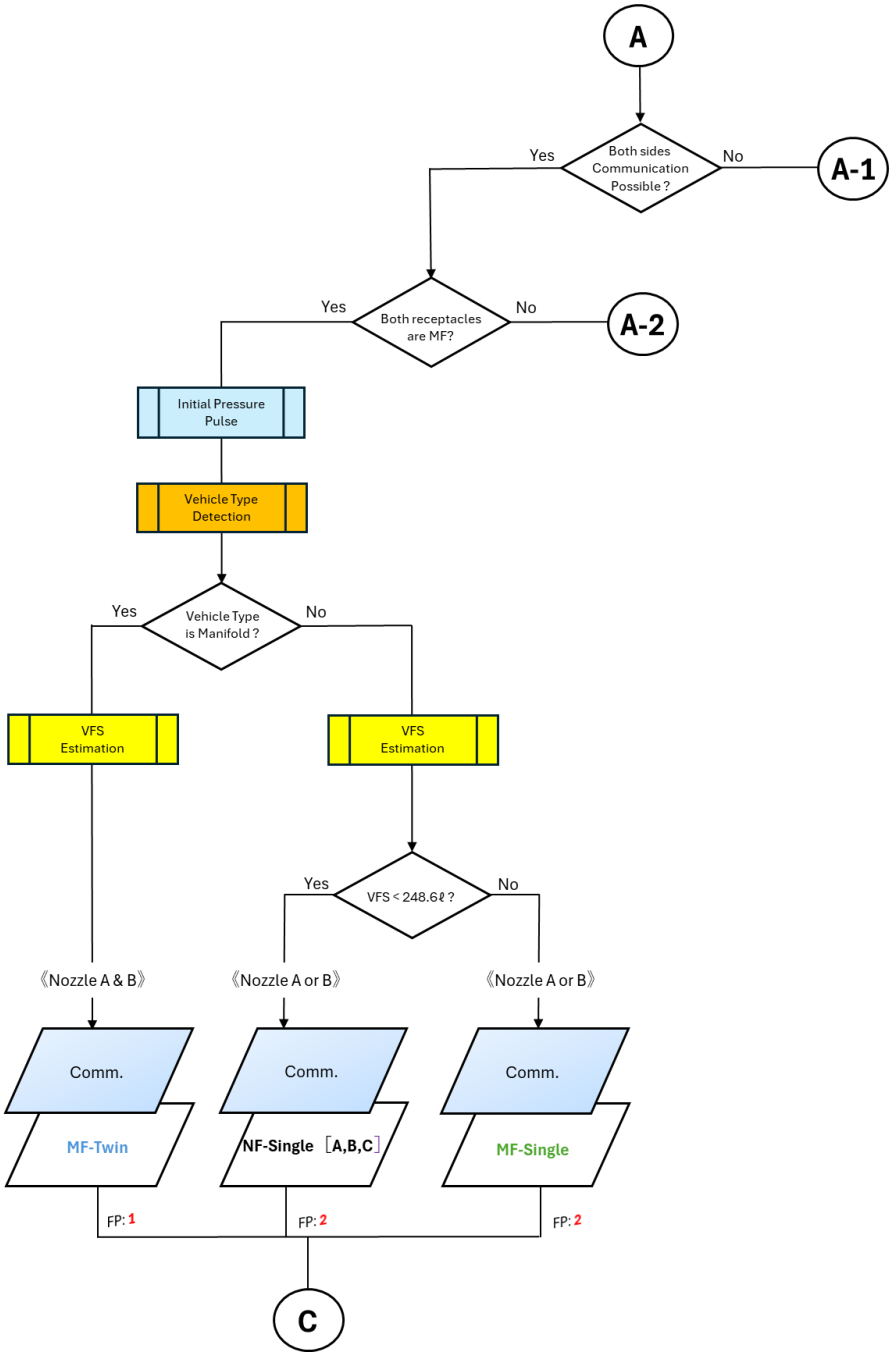


Figure 5.4.3 - Map Selection Flowchart（Section A～Section C）

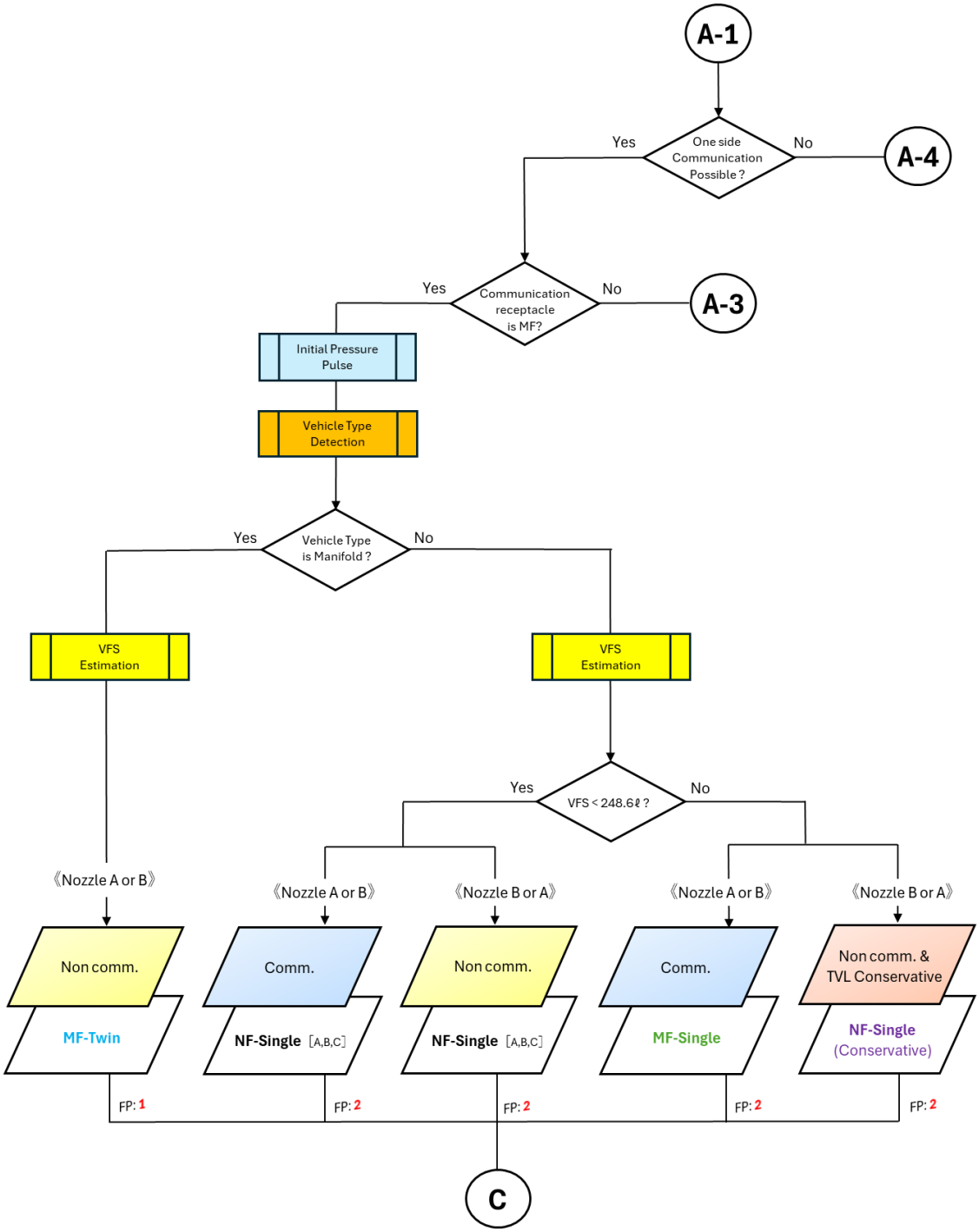


Figure 5.4.4 - Map Selection Flowchart（Section A-1～Section C）

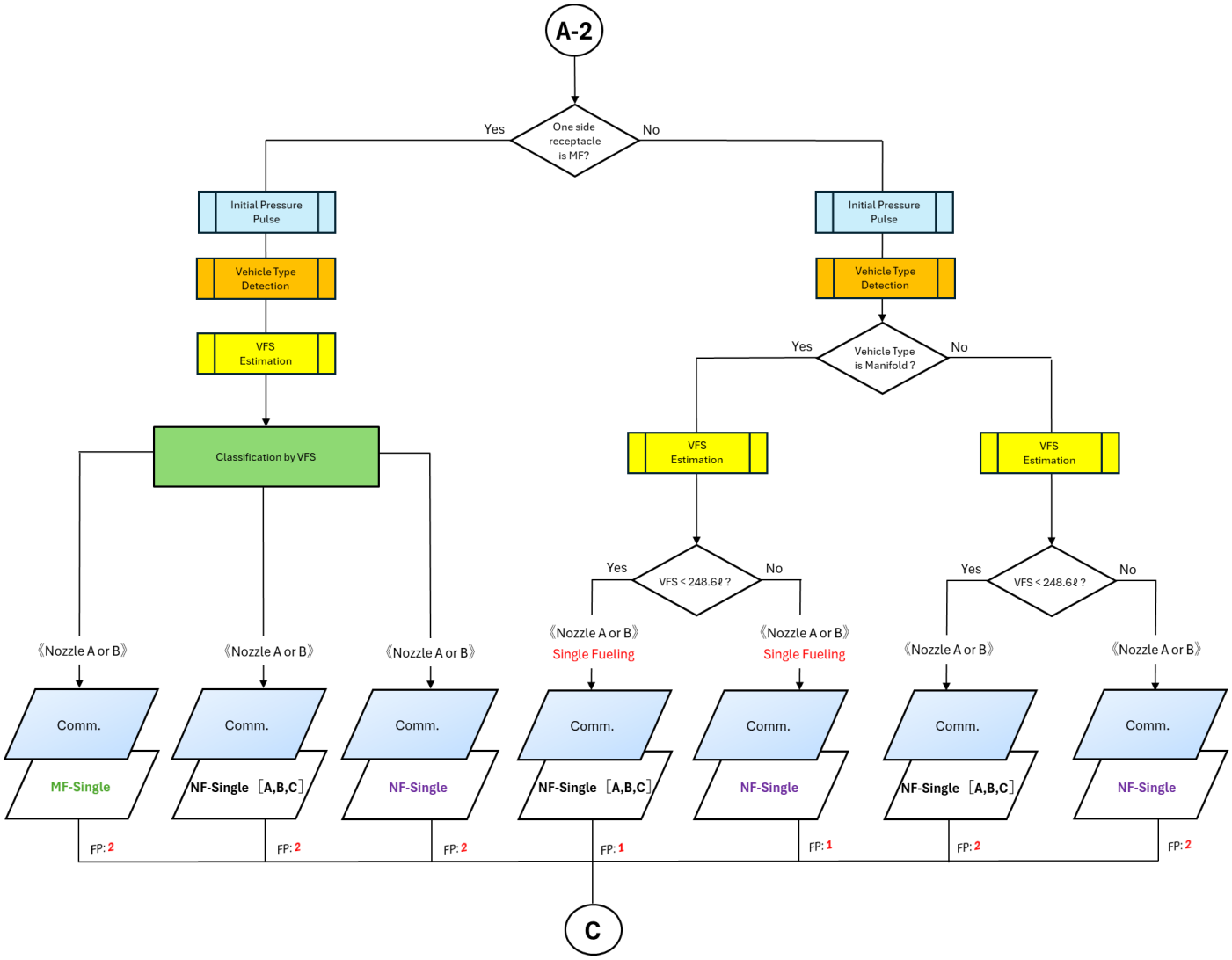


Figure 5.4.5 - Map Selection Flowchart（Section A-2～Section C）

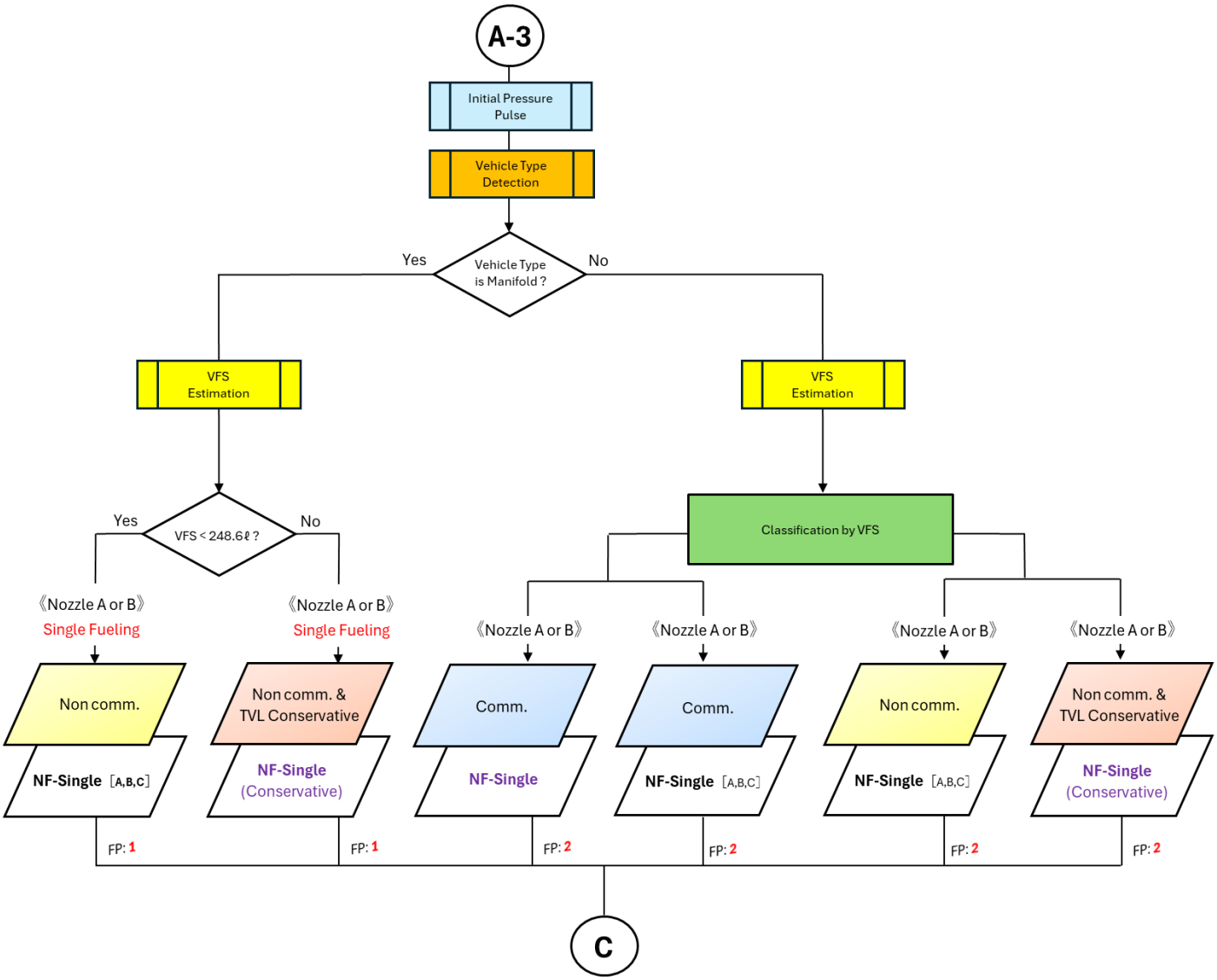


Figure 5.4.6 - Map Selection Flowchart（Section A-3～Section C）

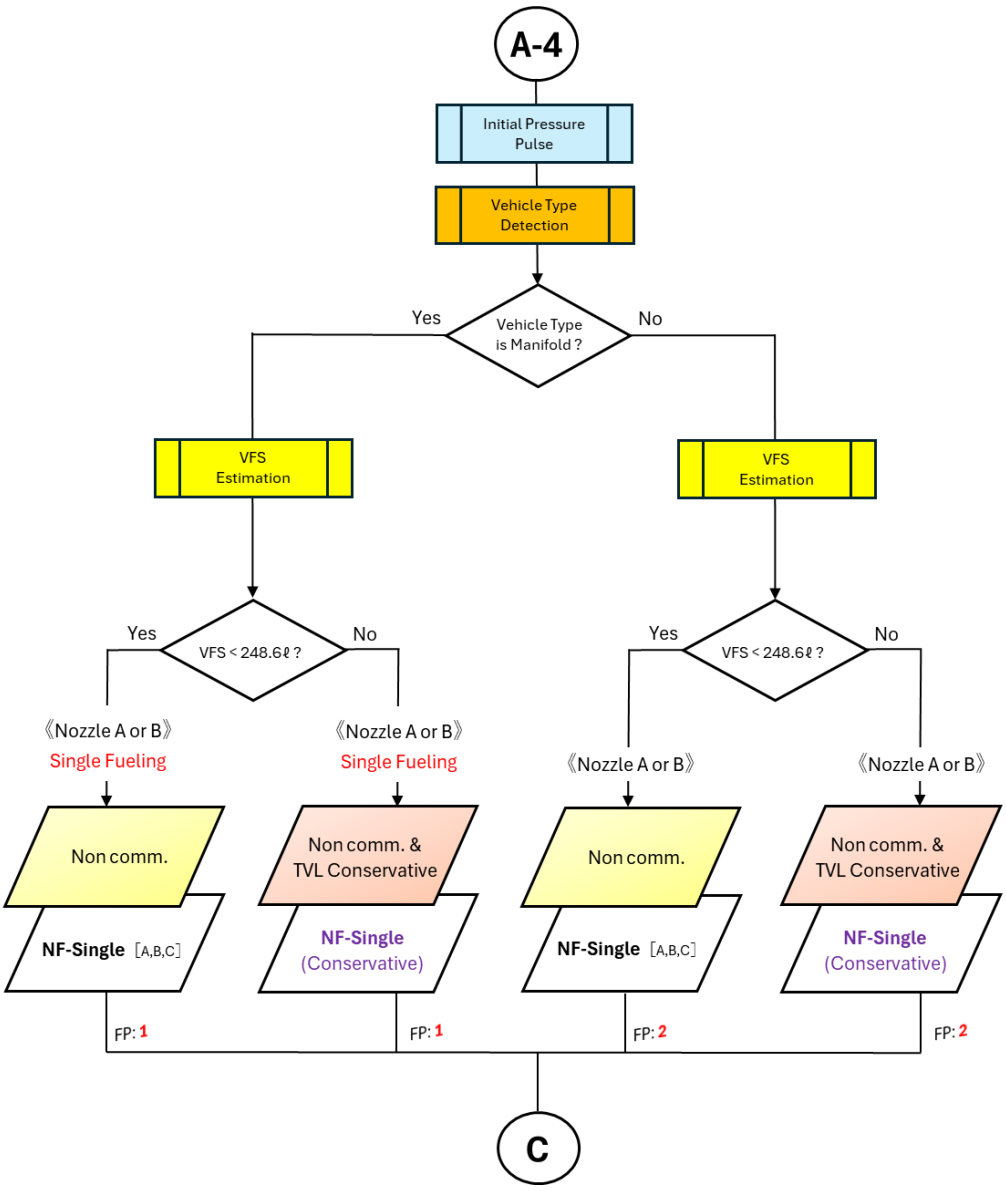


Figure 5.4.7 - Map Selection Flowchart（Section A-4～Section C）

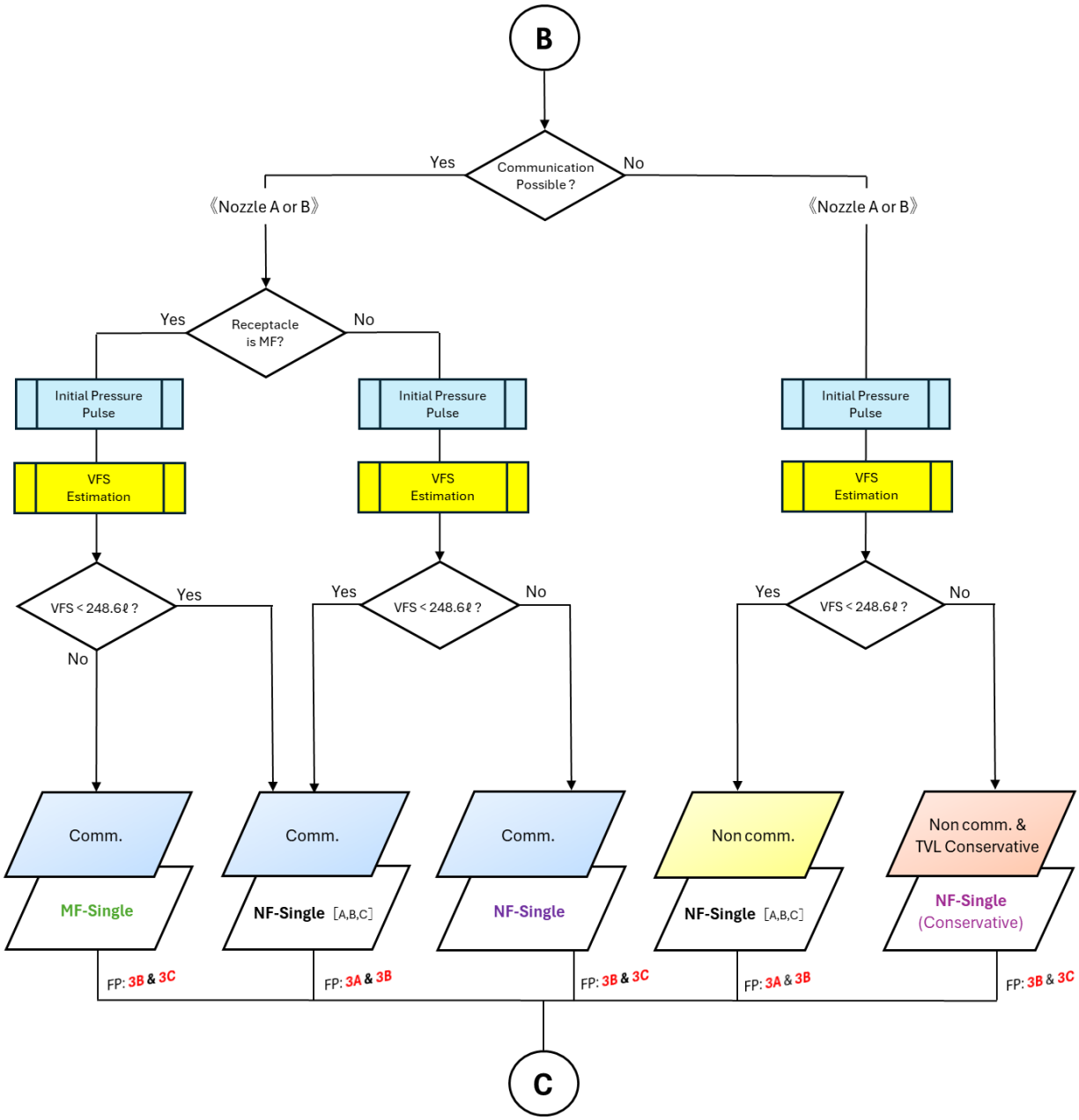


Figure 5.4.8 - Map Selection Flowchart（Section B～Section C）

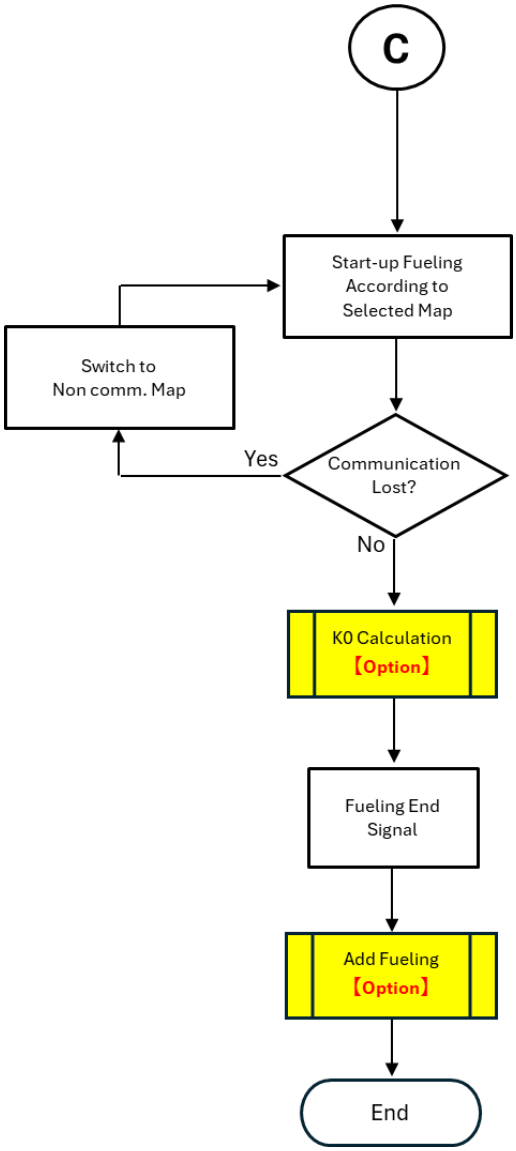
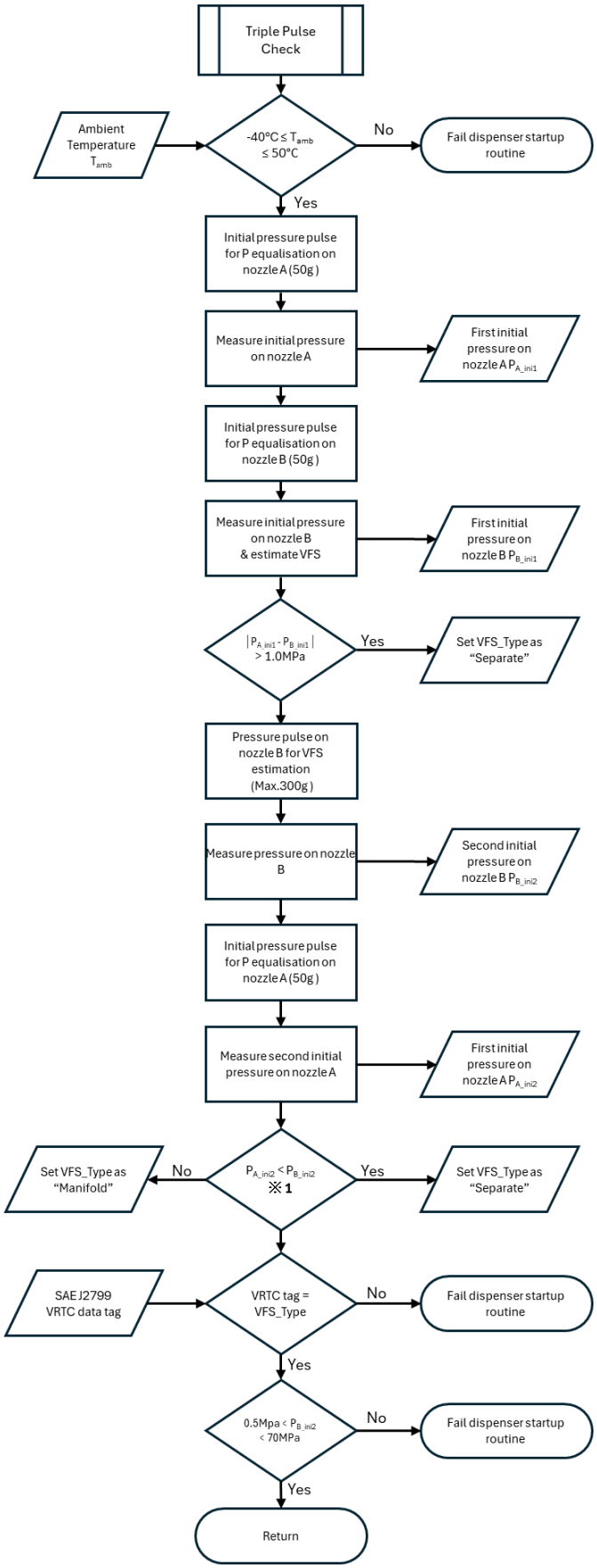


Figure 5.4.9 - Map Selection Flowchart（Section C）



※1. If the precision is as small enough as 0.1MPa, this determination whether the VHS type is manifold or separate can be made correctly. Otherwise, it could be wrong. So in that case single fuelling will be utilized instead of twin fuelling.

Figure 5.4.10 - Map Selection Flowchart（Triple Pulse Check of Twin Nozzle）

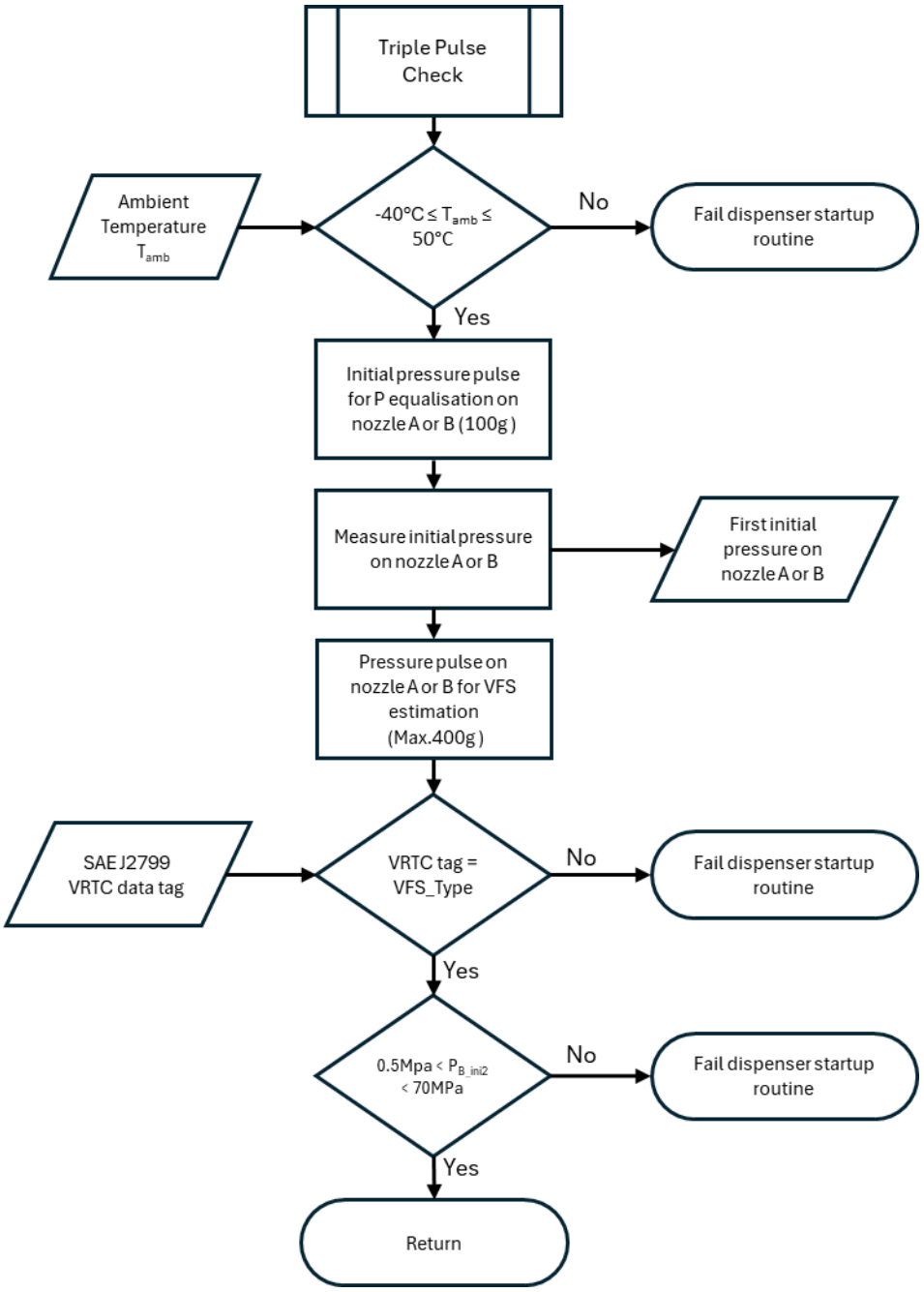


Figure 5.4.11 - Map Selection Flowchart（Triple Pulse Check of Single Nozzle）

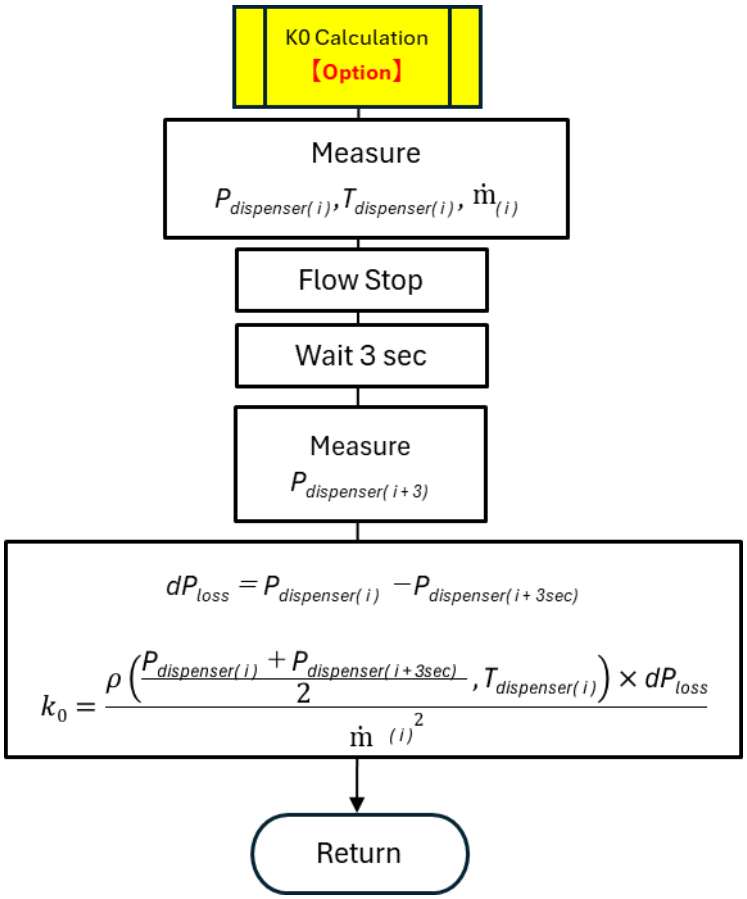


Figure 5.4.12 - Map Selection Flowchart（Subroutine "K0 Calculation"）

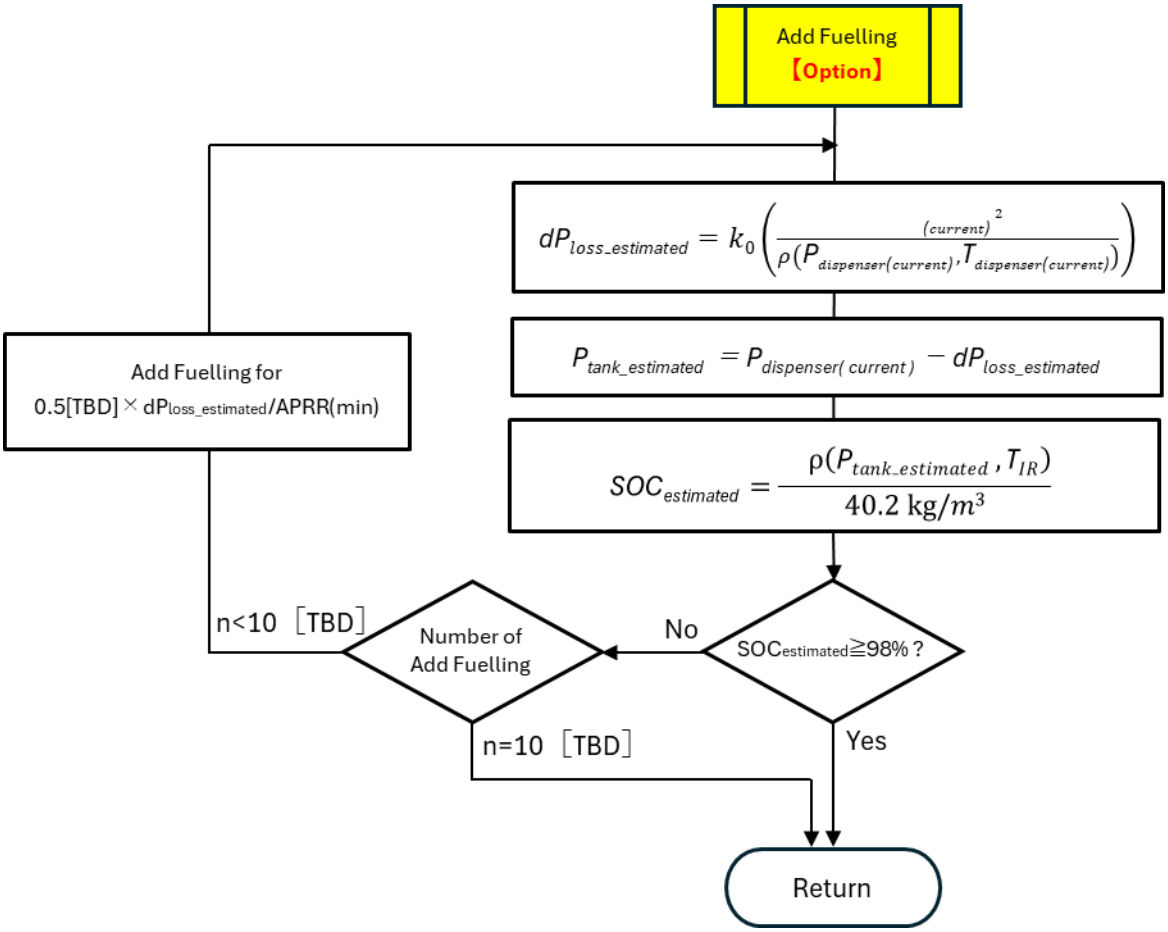


Figure 5.4.13 - Map Selection Flowchart（Subroutine "Add Fuelling"）

6. General Vehicle Requirements and Envelope for Protocol Design

This section defines the possible container sizes and configurations for vehicles using the MF-Twin protocol. The protocol is designed to be a tabular protocol with a wide range of containers, allowing for twin charging of large capacity HDVs and simultaneous charging of two older LDVs during the transitional period.

6.1 General Vehicle Requirements Description

6.1.1 Nominal Working Pressure

See 3.7.9 PRESSURE CLASS in SAEJ2601-5(2025).

6.1.2 VFS Material Temperature and Gas Pressure

See 5.3 Normal Operating Boundaries in SAEJ2601-5(2025).

6.1.3 Maximum VFS Density for 100% SOC

See 3.10 STATE OF CHARGE(SOC) in SAEJ2601-5(2025).

6.1.4 Vehicle-side Reference Pressure Drop

See A.3.2.8 Vehicle Side Reference Pressure Drop in SAEJ2601-5(2025).

6.2 VFS Thermophysical Properties and Geometrical Considerations

See A.3.2.6 Liner and CFRP Thermophysical Properties in SAEJ2601-5(2025).

6.3 Protocol-specific Vehicle Requirements for MF Twin Nozzle Fuelling Protocol

6.3.1 Vehicle Equipment

It is advised to have similar Cv values and pressure drop values from the receptacles towards the manifolds and tanks.

6.3.2 VFS Receptacle Type

VFS receptacle type shall be H70, and the inside diameter shall be 3 mm for NF receptacle or 4 mm for MF receptacle.

6.3.3 Receptacle Combinations

For Manifold HDV, the combination could be MF receptacle or NF receptacle on both sides. However, this protocol is not assuming a Manifold HDV with one MF receptacle and one NF receptacle.

a) With communication: If FM=60 or no OD FM data tag is communicated: NF-single fuelling using only 1 nozzle shall be applied.

b) Without communication: If Manifold HDV is detected by triple pulse check: NF-single fuelling using only 1 nozzle shall be applied. (See Section 10).

6.3.4 Vehicle Type

Vehicle type is classified as Manifold HDV and Separate HDV. In addition to that, MF/NF single receptacle HDV, conventional LDV and LDV equipped with MF-receptacle are also possible targets for fuelling.

7. General Dispenser Requirements

7.1 Dispensing Requirements

The following aspects of dispensing control shall meet the requirements given herein.

7.1.1 Pressure Integrity Check (leak check), Fuelling Protocol

The pressure integrity checks performed during a fuelling process (e.g. initial leak check, periodic hose leak check) shall comply with chapter 8.

7.1.2 Dispensing Instrumentation

The dispenser shall monitor the ambient temperature, fuel delivery temperature and pressure, and fuel delivery mass flow rate. The station dispenser controller shall use this data to manage the fuelling process according to the applicable fuelling protocol.

7.1.2.1 Measurement Accuracy

See 6.1.2 Accuracy in SAEJ2601-5(2025).

7.1.2.2 Measurement Reliability

See 6.1.4 Reliability in SAEJ2601-5(2025).

7.1.2.3 Measurement Frequency

See 6.1.3 Frequency in SAEJ2601-5(2025).

7.1.2.4 Ambient Temperature

See 6.1.1.2 Ambient temperature in SAEJ2601-5(2025).

7.1.2.5 Fuel Delivery Temperature

See 6.1.1.1 Station Pressure and Fuel Delivery Temperature in SAEJ2601-5(2025).

7.2 Dispensing Specific Requirements for MF Twin Nozzle Fuelling Protocol

7.2.1 Dispenser Equipment

For twin nozzle fuelling, it is desirable to use the same type of equipment (Breakaway, Hose, Nozzle, Valve, Piping and Fitting, etc.) for each fuel line.

In the case of each Cv of two fuel lines are different, either flow rate may become excessive, and although the system stops safely, it would be inconvenient for customers.

7.2.2 Precooling

Precooling category shall be identical in each fuel line.

7.2.3 Flow Control System

There are two types of flow control system as follows. It is preferable for fuelling in all patterns to select “Dual Storage / Dual Flow Control System” in 7.3.1. Another system in 7.3.2 may be selected for private ST, such as bus companies, when the HDV side specifications are fixed.

7.2.4 Dual Storage / Dual Flow Control System

This system is a combination of dual flow control and dual storage system, for the diagram of this structure, see twin nozzle dispenser type Ⅰ in Figure 5.2.

It ensure 90 g/sec from each storage vessels.

It can be fueled in all fuelling patterns.

NOTE: The storage system can be single instead of dual. Also, the storage may be configured with multiple banks. However, it is not recommended due to the following limitations.

- **If this system can ensure 90 g/sec in each fuel line from storage vessels it can fuel all fuelling patterns, otherwise it is limited only to fuelling pattern 1 or one side fuelling.**
- **When the initial pressure of each tanks are very different for fuelling pattern 2 or 3A to 3C, it is possible that the tanks cannot be fully fueled and stops halfway.**

7.2.5 Single Storage / Single Flow Control System

This system is a combination of single flow control and single storage system, for the diagram of this structure, see dispenser type Ⅱ in Figure 5.2.

It shall ensure 180g/sec from storage vessels. The storage may be configured with multiple banks.

Since it cannot ensure 90 g/sec in each fuel line from storage vessels, it is limited one side fuelling.

7.2.6 Selection of Fuelling Mode

Start-up process by the fueler shall enable to select the single/twin nozzle fuelling mode on the monitor or the switch.

It is mandatory to have a cancel button, etc. in case the fueler makes a mistake in making this selection.

NOTE:

- **It is allowed to use either a hard switch or a soft switch for both the Fuelling Mode Switch and the Cancel Button. In case of using a soft switch then it is advised that it returns to the single nozzle fuelling as a default.**
- **The introduction of “fuelling mode selection process” is necessary to ensure that the single/twin nozzle fuelling decision by the - dispenser is properly carried out in any fuelling pattern and no matter when start up button is pressed.**

8 General Process Requirements

8.1 Start-up Procedure

See 8.9.1 Dispenser Startup in SAEJ2601-5(2025).

8.2 Initial Leak Check

See 3.1.24 Initial Leak Check in this document.

See C.2.3 Initial Pressure Pulse, Leak Check, and Determine Initial CHSS Pressure in SAEJ2601-5(2025).

8.3 Start-up Mass

・VFS＜248.6L; less than 200g

See 6.5.3.1 Maximum Hydrogen Mass during Startup in SAEJ2601 (2020).

・VFS≧248.6L; less than 500g

See 8.4.3.1 Maximum Hydrogen Mass during Startup in SAEJ2601-5(2025).

8.4 Maximum Shut Down Time

See 8.8 "Abort" Signal from Vehicle in SAEJ2601-5(2025).

8.5 Flow Rate

8.5.1 Maximum Flow Rate

See 8.4.4.1 Maximum Flow Rate in SAEJ2601-5(2025).

Replace "The MCF-HF-G fuelling protocol" in the quoted text with "This".

8.5.2 Minimum Flow Rate

See 8.4.4.2 Minimum Mass Flow Rate in SAEJ2601-5(2025).

Replace "The MCF-HF-G fuelling protocol" in the quoted text with "This".

8.5.3 Number of Flow Cycles

See 6.4.4 Cycle Control in SAEJ2601-5(2025).

8.6 Fuel Delivery Temperature

Fuel Delivery Temperature Categories are summarized in Table1.1.

See 6.2.1 Fuel Delivery Temperature in SAEJ2601-5(2025).

8.7 Pressure

8.7.1 Initial Pressure

See 8.6.1 Initial Pressure in SAEJ2601-5(2025).

8.7.2 Maximum Pressure

See 6.3.2 Maximum Operating Pressure in SAEJ2601-5(2025).

8.8 Ambient Temperature

Fuelling is prohibited at the ambient temperature of above 50℃ or below -40℃.

See 6.1.1.2 Ambient Temperature in SAEJ2601-5(2025).

8.9 Specific Process Requirements for MF Twin Nozzle Fuelling Protocol

8.9.1 Start-up Procedure

When selecting the fuelling mode (In relation to 7.4), safeguards shall be put in place in case the fueler makes a wrong choice. For example, the safeguards listed in Table 8.1.

Table 8.1 Example of Safeguards for Error of Fuelling Mode Select

Fuelling Case		Fuelling Pattern	Fuelling Mode Select		Opened Nozzle Switches	Pushed Button	In Comm.		In Non-comm.	
			Correct	Error			Behavior	Safeguard	Behavior	Safeguard
Both sides	Twin fueling of one HDV	1	Twin	Single	A & B	A	Detects the selection error by Integrity Check, etc.	The fuelling process is interrupted.	Fuelling starts on one side only	None Only the selected side by push button goes to fueling process
			Twin	Single	A & B	B				
		2	Twin	Single	A & B	A		The fuelling process is interrupted.		Alarm system that shows the other button not selected shall be pushed may be adopted.
			Twin	Single	A & B	B				
	Simultaneous fueling of two vehicles	3A	Single	Twin	A & B	A	Detects the selection error by Integrity Check, etc.	The fuelling process is interrupted.	Detects not to be HDV during VFS Estimation	The fuelling process is interrupted.
			Single	Twin	A & B	B	Fuelling does not start	Settings are reset.	Fuelling does not start	Settings are reset.
		3B	Single	Twin	A & B	A	Detects the selection error by Integrity Check, etc.	The fuelling process is interrupted.	Detects not to be HDV during VFS Estimation	The fuelling process is interrupted.
			Single	Twin	A & B	B	Fuelling does not start	Settings are reset.	Fuelling does not start	Settings are reset.
		3C	Single	Twin	A & B	A	Detects the selection error by Integrity Check, etc.	The fuelling process is interrupted.	The fuelling control system recognize as one Separate HDV	None The fuelling for both sides might be finished.
							In case of two manifold HDVs, misidentified as one manifold HDV	Check by figure C.5.3.4 subroutine		
			Single	Twin	A & B	B	Fuelling does not start	Settings are reset.	Fuelling does not start	Settings are reset.
One side	Time lag fuelling of one vehicle	–	Single	Twin	A	A (or B)	Fuelling does not start	Detects connection on only one side & Settings are reset.	Fuelling does not start	Detects connection on only one side & Settings are reset.
			Single	Twin	B	B (or A)				

8.9.2 Start-up Mass Dispensed

Mass dispensed shall be for the estimation of VFS volume and vehicle type, these are identified by up to three times pulse fuelling.

The total amount of pulse fuelling is preferably 500g or less. In this case, the pulse fuelling volume shall be set within a range that does not cause deviation between true value and measured value of initial pressure and VFS estimation.

8.9.3 Maximum Flow Rate

Maximum flow rate follows each fuelling protocol in Table 1.1.

In addition to that, for MF-Twin-LT (Communication and Non-communication.), maximum flow rate in each fuel line shall be 90g/sec or less.

8.9.4 Minimum Pressure Ramp Rate

When fuelling an LDV, the allowable range of fuel supply pressure, the lower limit pressure (Ptarget - 2.5MPa), is set until the target pressure, target fuelling volume, or target fuelling rate (indicators) reaches at least 50% during fuelling, and the lower limit pressure can be abolished when at least one of such indicators exceeds 50%. On the other hand, when fuelling an HDV, the lower limit pressure is abolished, but the minimum pressure rump rate (1 MPa/min) shall be kept during fuelling. Those relaxations are applied to only Com. Fuelling for LDV but to both Com. Fuelling and Non-Com. Fuelling for HDV.

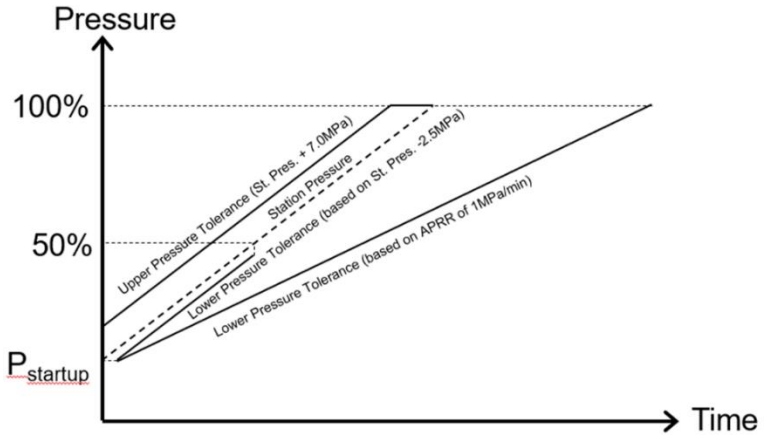


Figure 8.9.4.1 - Pressure Corridor for HDV Fuelling Protocol

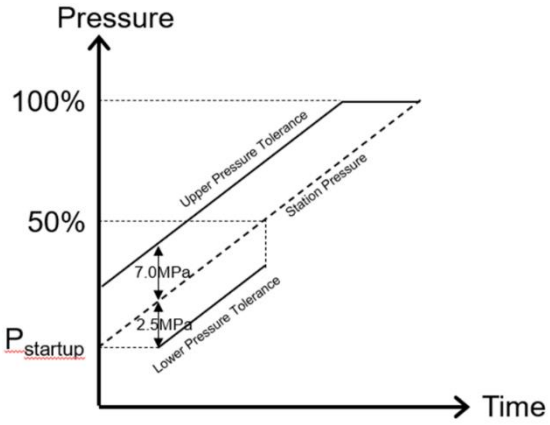


Figure 8.9.4.2 - Pressure Corridor for LDV Fuelling Protocol

9. Communication Requirements

9.1 Background

See 1.1 Gaseous Hydrogen Fuelling System Background in SAEJ2799(2024).

9.2 Communication Fuelling

See 8.9 Communications Fuelling in SAEJ2601(2020).

9.3 Non-Communication Fuelling

See 8.8 Non-Communications Fuelling in SAEJ2601(2020).

9.4 Data Definitions

See 5.5.1 Data Definitions in SAEJ2799(2024).

9.5 Specific Comments for MF Twin Nozzle Fuelling Protocol

9.5.1 Two-way Communication

Two-way or bi-directional communication is not used.

9.5.2 Loss of Communication During Fuelling

If communication is lost during fuelling, it is continued fuelling and switched to non-communication map according to Table 9.1, under the condition Initial T_{amb} and residual pressure at transition.

9.5.3 Non-communication Fuelling

As a general rule, non-communication fuelling is used only when the communication between the vehicle and the dispenser is not possible.

In the case of non-communication fuelling in fuelling pattern 2 and 3A to 3C, since NF receptacle HDV may be subject to fuelling, it shall be fueled with NF Single protocol (60 g/sec). But in fuelling pattern 1, it shall be fueled with MF twin protocol (90 g/sec), and if communication is lost on only one side, fuelling can be continued with MF twin protocol in communication. For detail, see Table 9.1.

Table 9.1 - Map Selected at Start-up Fuelling and Loss of Communication During Fuelling ※1

Fuelling Pattern	Nozzle	Start-up Fuelling			Loss of Communication During Fuelling				
		Comm. States	Selected Map		Comm. States			Selected Map	
1 ※3	A	Non-Comm.	Non-Comm.	MF-Single※2	–			–	
	B	Non-Comm.							
	A	Non-Comm.	Non-Comm.	MF-Twin※2	Non-Comm.	→	Non-Comm.	Non-Comm.	MF-Twin※2
	B	Comm.			Comm.		Non-Comm.		
	A	Comm.	Comm.	MF-Twin	Comm.	→	Non-Comm.	Non-Comm.	MF-Twin※2
	B	Comm.			Comm.		Non-Comm.		
	A	Comm.	Comm.	MF-Twin	Comm.	→	Non-Comm.	Comm.	MF-Twin
	B	Comm.			Comm.		Comm.		
2 & 3C	A	Non-Comm.	Non-Comm.	NF-Single※2	–			–	
	B	Non-Comm.	Non-Comm.	NF-Single※2					
	A	Non-Comm.	Non-Comm.	NF-Single※2	Non-Comm.	→	Non-Comm.	Non-Comm.	NF-Single※2
	B	Comm.	Comm.	MF-Single or NF-Single	Comm.		Non-Comm.	Non-Comm.	NF-Single※2
	A	Comm.	Comm.	MF-Single or NF-Single	Comm.	→	Non-Comm.	Non-Comm.	NF-Single※2
	B	Comm.	Comm.	MF-Single or NF-Single	Comm.		Non-Comm.	Non-Comm.	NF-Single※2
	A	Comm.	Comm.	MF-Single or NF-Single	Comm.	→	Non-Comm.	Non-Comm.	NF-Single※2
	B	Comm.	Comm.	MF-Single or NF-Single	Comm.		Comm.	Comm.	MF-Single or NF-Single
3A	A	Non-Comm.	Non-Comm.	NF-Single [A,B,C]	–			–	
	B	Non-Comm.	Non-Comm.	NF-Single [A,B,C]					
	A	Non-Comm.	Non-Comm.	NF-Single [A,B,C]	Non-Comm.	→	Non-Comm.	Non-Comm.	NF-Single [A,B,C]
	B	Comm.	Comm.	NF-Single [A,B,C]	Comm.		Non-Comm.	Non-Comm.	NF-Single [A,B,C]
	A	Comm.	Comm.	NF-Single [A,B,C]	Comm.	→	Non-Comm.	Non-Comm.	NF-Single [A,B,C]
	B	Comm.	Comm.	NF-Single [A,B,C]	Comm.		Non-Comm.	Non-Comm.	NF-Single [A,B,C]
	A	Comm.	Comm.	NF-Single [A,B,C]	Comm.	→	Non-Comm.	Non-Comm.	NF-Single [A,B,C]
	B	Comm.	Comm.	NF-Single [A,B,C]	Comm.		Comm.	Comm.	NF-Single [A,B,C]
3B	A	Non-Comm.	Non-Comm.	NF-Single [A,B,C]	–			–	
	B	Non-Comm.	Non-Comm.	NF-Single※2					
	A	Non-Comm.	Non-Comm.	NF-Single [A,B,C]	Non-Comm.	→	Non-Comm.	Non-Comm.	NF-Single [A,B,C]
	B	Comm.	Comm.	MF-Single or NF-Single	Comm.		Non-Comm.	Non-Comm.	NF-Single※2
	A	Comm.	Comm.	NF-Single [A,B,C]	Comm.	→	Non-Comm.	Non-Comm.	NF-Single [A,B,C]
	B	Non-Comm.	Non-Comm.	NF-Single※2	Non-Comm.		Non-Comm.	Non-Comm.	NF-Single※2
	A	Comm.	Comm.	NF-Single [A,B,C]	Comm.	→	Non-Comm.	Non-Comm.	NF-Single [A,B,C]
	B	Comm.	Comm.	MF-Single or NF-Single	Comm.		Non-Comm.	Non-Comm.	NF-Single※2
	A	Comm.	Comm.	NF-Single [A,B,C]	Comm.	→	Non-Comm.	Non-Comm.	NF-Single [A,B,C]
	B	Comm.	Comm.	MF-Single or NF-Single	Comm.		Comm.	Comm.	MF-Single or NF-Single

※1 For patterns not shown in the table, the already selected map is not switched.

※2 TVL Conservative.

※3 Though it is not the main scope of this protocol, both receptacles are NF-type in manifold type vehicle, "Selected MAP" shall not be MF-Twin as in this table, but NF-Single for one side receptacle.

10. Standard Fuelling Protocols

10.1 Applications Protocol

For applications of each protocol and reference clauses, see Table 10.1.

Table 10.1 - Applications of each protocol

Protocol Name	Comm. States	Reference Clause			Vehicle Type	VFS Capacity Range (liters)	Fuelling Pattern				
		APRR	P_{target}	P_{limit}			1	2	3A	3B	3C
MF-Single-LT	Non-Comm. (TVL Conservative)	10.2.1	10.2.2		—	248.6～5000					
	Comm.	10.2.1		10.2.3	Separate HDV Manifold HDV	248.6～5000		○		○	○
MF-Twin-LT	Non-Comm. (TVL Conservative)	10.3.1	10.3.2		Manifold HDV	248.6～5000	○				
	Comm.	10.3.1		10.3.3	Manifold HDV	248.6～5000	○				
NF-Single-LT	Non-Comm. (TVL Conservative)	10.4.1	10.4.2		All HDV	248.6～5000		○		○	○
	Comm.	10.4.1		10.4.3	NF Receptacle HDV	248.6～5000		○		○	○
NF-Single-LT [A, B, C]	Non-Comm.	10.5.1			LDV	～248.6			○	○	
	Comm.	10.5.1			LDV	～248.6			○	○	

NOTE:

- **APRR and P_{target} / P_{limit} shall be selected as appropriate from the tables specified in each reference clause according to the conditions.**
- **Each APRR table specifies a specific APRR depending on Tamb, TVL and VFS regardless if there is communication or not. But the non-communication fuelling has no information about TVL. In that case, APRR of the most conservative TVL (Max. TVL) shall be selected from the surrounded with a red frame in the table.**
- **P_{target} / P_{limit} table is divided into two sections which have a table for P_{ini}＜5MPa and the other for P_{ini}≧5MPa. In each section, a linear interpolation to calculate P_{target} / P_{limit} is used, but for 2MPa≦P_{ini} ＜5MPa the value of P_{target} / P_{limit} for 2MPa column shall be used.**
- **P_{target} values are based on cold case fuelling at 1MPa/min. Therefore, there are several points that are P_{limit} < P_{target}, although the effect is minor.**

10.2 Protocol of MF-Single-LT

10.2.1 Protocol of MF-Single-LT (Table for APRR)

MF-Single L/T For Pini<5MPa

※prerequisite condition：MAX Flow Rate≦90(g/sec)、SOC≦95(%)、MAX APRR≦28.4(MPa/min)（=HPRR32.0(MPa/min) equivalent）

VFS 250

Table 10.2.1.1 Pini<5MPa VFS250 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.5	2.3			
45	6.4	5.8			
40	11.0	10.2			
35	11.4	10.6			
30	12.9	12.0			
25	14.3	13.4			
20	15.6	14.7			
10	17.9	16.9			
0	21.5	20.3			
-10	22.6	21.3			
-20	23.7	22.4			
-30	24.9	23.5			
-40	26.2	24.6			

Table 10.2.1.2 Pini<5MPa VFS250 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.2	1.7			
45	3.8	3.2			
40	5.4	4.6			
35	5.7	4.9			
30	6.8	6.0			
25	8.0	7.1			
20	9.1	8.2			
10	11.0	10.0			
0	14.0	12.9			
-10	14.8	13.6			
-20	15.5	14.3			
-30	16.3	15.1			
-40	17.1	15.8			

Table 10.2.1.3 Pini<5MPa VFS250 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.5	0.4			
45	1.5	1.2			
40	2.4	2.0			
35	2.6	2.2			
30	3.3	2.7			
25	4.0	3.4			
20	4.7	4.0			
10	6.0	5.2			
0	8.2	7.2			
-10	8.7	7.7			
-20	9.2	8.1			
-30	9.7	8.6			
-40	10.3	9.1			

VFS 500

Table 10.2.1.4 Pini<5MPa VFS500 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	6.8	6.5	6.0	5.8	
45	8.3	8.0	7.4	7.2	
40	9.6	9.2	8.7	8.4	
35	9.8	9.4	8.9	8.6	
30	10.7	10.3	9.7	9.4	
25	11.6	11.2	10.5	10.2	
20	12.5	12.0	11.3	11.0	
10	12.5	12.5	12.6	12.2	
0	12.5	12.5	12.6	12.6	
-10	12.5	12.5	12.6	12.6	
-20	12.5	12.5	12.6	12.6	
-30	12.5	12.5	12.6	12.6	
-40	12.5	12.5	12.6	12.6	

Table 10.2.1.5 Pini<5MPa VFS500 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.9	2.6	2.1	1.9	
45	4.2	3.9	3.3	3.0	
40	5.5	5.1	4.4	4.1	
35	5.7	5.2	4.6	4.3	
30	6.5	6.0	5.4	5.1	
25	7.3	6.8	6.1	5.8	
20	8.0	7.5	6.8	6.5	
10	9.2	8.7	7.9	7.6	
0	11.2	10.6	9.7	9.3	
-10	11.6	10.9	10.0	9.6	
-20	11.9	11.3	10.3	9.9	
-30	12.3	11.6	10.6	10.2	
-40	12.5	12.0	11.0	10.5	

Table 10.2.1.6 Pini<5MPa VFS500 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.9	0.7	0.5	0.4	
45	1.8	1.6	1.2	1.1	
40	2.7	2.4	1.9	1.7	
35	2.8	2.5	2.0	1.9	
30	3.4	3.0	2.5	2.3	
25	4.0	3.6	3.0	2.8	
20	4.6	4.2	3.5	3.3	
10	5.6	5.1	4.4	4.1	
0	7.2	6.6	5.8	5.5	
-10	7.4	6.9	6.0	5.7	
-20	7.7	7.1	6.3	5.9	
-30	7.9	7.3	6.5	6.1	
-40	8.2	7.6	6.7	6.3	

VFS 1000

Table 10.2.1.7 Pini<5MPa VFS1000 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	4.7	4.7	4.6	4.5	4.6
45	5.8	5.6	5.4	5.3	5.3
40	6.2	6.3	6.1	6.0	6.0
35	6.2	6.3	6.2	6.1	6.1
30	6.2	6.3	6.3	6.3	6.3
25	6.2	6.3	6.3	6.3	6.3
20	6.2	6.3	6.3	6.3	6.3
10	6.2	6.3	6.3	6.3	6.3
0	6.2	6.3	6.3	6.3	6.3
-10	6.2	6.3	6.3	6.3	6.3
-20	6.2	6.3	6.3	6.3	6.3
-30	6.2	6.3	6.3	6.3	6.3
-40	6.2	6.3	6.3	6.3	6.3

Table 10.2.1.8 Pini<5MPa VFS1000 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.6	2.4	2.1	2.1	2.1
45	3.5	3.3	3.0	2.9	2.8
40	4.3	4.1	3.7	3.6	3.5
35	4.4	4.2	3.8	3.7	3.6
30	4.9	4.7	4.3	4.1	4.0
25	5.4	5.1	4.7	4.5	4.4
20	5.9	5.6	5.2	4.9	4.8
10	6.2	6.3	5.8	5.6	5.4
0	6.2	6.3	6.3	6.3	6.3
-10	6.2	6.3	6.3	6.3	6.3
-20	6.2	6.3	6.3	6.3	6.3
-30	6.2	6.3	6.3	6.3	6.3
-40	6.2	6.3	6.3	6.3	6.3

Table 10.2.1.9 Pini<5MPa VFS1000 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.9	0.8	0.7	0.6	0.7
45	1.7	1.6	1.3	1.2	1.2
40	2.4	2.2	1.9	1.8	1.7
35	2.5	2.3	2.0	1.8	1.8
30	3.0	2.7	2.4	2.2	2.1
25	3.4	3.2	2.8	2.6	2.5
20	3.8	3.5	3.1	2.9	2.8
10	4.5	4.1	3.7	3.4	3.3
0	5.5	5.1	4.6	4.3	4.2
-10	5.7	5.3	4.7	4.4	4.3
-20	5.8	5.4	4.9	4.5	4.4
-30	6.0	5.6	5.0	4.7	4.4
-40	6.1	5.7	5.1	4.8	4.5

VFS 1500

Table 10.2.1.10 Pini<5MPa VFS1500 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	3.4	3.4	3.4	3.4	3.4
45	4.1	4.1	4.1	4.1	4.1
40	4.1	4.1	4.1	4.1	4.1
35	4.1	4.1	4.1	4.1	4.1
30	4.1	4.1	4.1	4.1	4.1
25	4.1	4.1	4.1	4.1	4.1
20	4.1	4.1	4.1	4.1	4.1
10	4.1	4.1	4.1	4.1	4.1
0	4.1	4.1	4.1	4.1	4.1
-10	4.1	4.1	4.1	4.1	4.1
-20	4.1	4.1	4.1	4.1	4.1
-30	4.1	4.1	4.1	4.1	4.1
-40	4.1	4.1	4.1	4.1	4.1

Table 10.2.1.11 Pini<5MPa VFS1500 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.1	2.1	2.0	1.9	2.0
45	2.9	2.8	2.6	2.5	2.5
40	3.5	3.4	3.1	3.0	3.0
35	3.6	3.4	3.2	3.1	3.0
30	4.0	3.8	3.5	3.4	3.4
25	4.1	4.1	3.9	3.7	3.6
20	4.1	4.1	4.1	4.0	3.9
10	4.1	4.1	4.1	4.1	4.1
0	4.1	4.1	4.1	4.1	4.1
-10	4.1	4.1	4.1	4.1	4.1
-20	4.1	4.1	4.1	4.1	4.1
-30	4.1	4.1	4.1	4.1	4.1
-40	4.1	4.1	4.1	4.1	4.1

Table 10.2.1.12 Pini<5MPa VFS1500 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.9	0.9	0.8	0.8	0.8
45	1.6	1.5	1.3	1.3	1.2
40	2.2	2.0	1.8	1.7	1.7
35	2.3	2.1	1.9	1.8	1.7
30	2.6	2.4	2.2	2.0	2.0
25	2.9	2.8	2.5	2.3	2.2
20	3.2	3.0	2.7	2.6	2.5
10	3.7	3.5	3.2	3.0	2.9
0	4.1	4.1	3.9	3.6	3.5
-10	4.1	4.1	4.0	3.7	3.6
-20	4.1	4.1	4.1	3.8	3.6
-30	4.1	4.1	4.1	3.9	3.7
-40	4.1	4.1	4.1	4.0	3.8

The APRR value restricted at the t-final min model as is used for MCF model

MF-Single L/T For Pini<5MPa

※prerequisite condition：MAX Flow Rate≦90(g/sec)、SOC≦95(%)、MAX APRR≦28.4(MPa/min)（=HPRR32.0(MPa/min) equivalent）

VFS 2000

Table 10.2.1.13 Pini<5MPa VFS2000 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.8	2.9	2.9	2.9	2.9
45	3.1	3.1	3.1	3.1	3.1
40	3.1	3.1	3.1	3.1	3.1
35	3.1	3.1	3.1	3.1	3.1
30	3.1	3.1	3.1	3.1	3.1
25	3.1	3.1	3.1	3.1	3.1
20	3.1	3.1	3.1	3.1	3.1
10	3.1	3.1	3.1	3.1	3.1
0	3.1	3.1	3.1	3.1	3.1
-10	3.1	3.1	3.1	3.1	3.1
-20	3.1	3.1	3.1	3.1	3.1
-30	3.1	3.1	3.1	3.1	3.1
-40	3.1	3.1	3.1	3.1	3.1

Table 10.2.1.14 Pini<5MPa VFS2000 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.9	1.9	1.8	1.8	1.8
45	2.5	2.4	2.3	2.2	2.2
40	3.0	2.9	2.7	2.6	2.6
35	3.1	3.0	2.8	2.7	2.6
30	3.1	3.1	3.0	2.9	2.9
25	3.1	3.1	3.1	3.1	3.1
20	3.1	3.1	3.1	3.1	3.1
10	3.1	3.1	3.1	3.1	3.1
0	3.1	3.1	3.1	3.1	3.1
-10	3.1	3.1	3.1	3.1	3.1
-20	3.1	3.1	3.1	3.1	3.1
-30	3.1	3.1	3.1	3.1	3.1
-40	3.1	3.1	3.1	3.1	3.1

Table 10.2.1.15 Pini<5MPa VFS2000 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.9	0.9	0.8	0.8	0.8
45	1.5	1.4	1.3	1.2	1.2
40	2.0	1.9	1.7	1.6	1.5
35	2.1	1.9	1.7	1.6	1.6
30	2.3	2.2	2.0	1.9	1.8
25	2.6	2.4	2.2	2.1	2.0
20	2.9	2.7	2.4	2.3	2.2
10	3.1	3.1	2.8	2.6	2.5
0	3.1	3.1	3.1	3.1	3.1
-10	3.1	3.1	3.1	3.1	3.1
-20	3.1	3.1	3.1	3.1	3.1
-30	3.1	3.1	3.1	3.1	3.1
-40	3.1	3.1	3.1	3.1	3.1

VFS 2500

Table 10.2.1.16 Pini<5MPa VFS2500 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.4	2.4	2.5	2.5	2.5
45	2.4	2.4	2.5	2.5	2.5
40	2.4	2.4	2.5	2.5	2.5
35	2.4	2.4	2.5	2.5	2.5
30	2.4	2.4	2.5	2.5	2.5
25	2.4	2.4	2.5	2.5	2.5
20	2.4	2.4	2.5	2.5	2.5
10	2.4	2.4	2.5	2.5	2.5
0	2.4	2.4	2.5	2.5	2.5
-10	2.4	2.4	2.5	2.5	2.5
-20	2.4	2.4	2.5	2.5	2.5
-30	2.4	2.4	2.5	2.5	2.5
-40	2.4	2.4	2.5	2.5	2.5

Table 10.2.1.17 Pini<5MPa VFS2500 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.7	1.7	1.6	1.6	1.6
45	2.3	2.2	2.0	2.0	2.0
40	2.4	2.4	2.4	2.3	2.3
35	2.4	2.4	2.5	2.4	2.3
30	2.4	2.4	2.5	2.5	2.5
25	2.4	2.4	2.5	2.5	2.5
20	2.4	2.4	2.5	2.5	2.5
10	2.4	2.4	2.5	2.5	2.5
0	2.4	2.4	2.5	2.5	2.5
-10	2.4	2.4	2.5	2.5	2.5
-20	2.4	2.4	2.5	2.5	2.5
-30	2.4	2.4	2.5	2.5	2.5
-40	2.4	2.4	2.5	2.5	2.5

Table 10.2.1.18 Pini<5MPa VFS2500 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.9	0.9	0.8	0.8	0.8
45	1.4	1.3	1.2	1.2	1.1
40	1.8	1.7	1.5	1.5	1.4
35	1.9	1.8	1.6	1.5	1.5
30	2.1	2.0	1.8	1.7	1.7
25	2.4	2.2	2.0	1.9	1.9
20	2.4	2.4	2.2	2.1	2.0
10	2.4	2.4	2.5	2.4	2.3
0	2.4	2.4	2.5	2.5	2.5
-10	2.4	2.4	2.5	2.5	2.5
-20	2.4	2.4	2.5	2.5	2.5
-30	2.4	2.4	2.5	2.5	2.5
-40	2.4	2.4	2.5	2.5	2.5

VFS 3000

Table 10.2.1.19 Pini<5MPa VFS3000 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.0	2.0	2.0	2.0	2.0
45	2.0	2.0	2.0	2.0	2.0
40	2.0	2.0	2.0	2.0	2.0
35	2.0	2.0	2.0	2.0	2.0
30	2.0	2.0	2.0	2.0	2.0
25	2.0	2.0	2.0	2.0	2.0
20	2.0	2.0	2.0	2.0	2.0
10	2.0	2.0	2.0	2.0	2.0
0	2.0	2.0	2.0	2.0	2.0
-10	2.0	2.0	2.0	2.0	2.0
-20	2.0	2.0	2.0	2.0	2.0
-30	2.0	2.0	2.0	2.0	2.0
-40	2.0	2.0	2.0	2.0	2.0

Table 10.2.1.20 Pini<5MPa VFS3000 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.5	1.5	1.5	1.5	1.5
45	2.0	2.0	1.9	1.8	1.8
40	2.0	2.0	2.0	2.0	2.0
35	2.0	2.0	2.0	2.0	2.0
30	2.0	2.0	2.0	2.0	2.0
25	2.0	2.0	2.0	2.0	2.0
20	2.0	2.0	2.0	2.0	2.0
10	2.0	2.0	2.0	2.0	2.0
0	2.0	2.0	2.0	2.0	2.0
-10	2.0	2.0	2.0	2.0	2.0
-20	2.0	2.0	2.0	2.0	2.0
-30	2.0	2.0	2.0	2.0	2.0
-40	2.0	2.0	2.0	2.0	2.0

Table 10.2.1.21 Pini<5MPa VFS3000 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.9	0.9	0.8	0.8	0.8
45	1.3	1.3	1.2	1.1	1.1
40	1.7	1.6	1.4	1.4	1.4
35	1.7	1.6	1.5	1.4	1.4
30	2.0	1.8	1.7	1.6	1.6
25	2.0	2.0	1.9	1.8	1.7
20	2.0	2.0	2.0	1.9	1.9
10	2.0	2.0	2.0	2.0	2.0
0	2.0	2.0	2.0	2.0	2.0
-10	2.0	2.0	2.0	2.0	2.0
-20	2.0	2.0	2.0	2.0	2.0
-30	2.0	2.0	2.0	2.0	2.0
-40	2.0	2.0	2.0	2.0	2.0

VFS 5000

Table 10.2.1.22 Pini<5MPa VFS5000 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.2	1.2	1.2	1.2	1.2
45	1.2	1.2	1.2	1.2	1.2
40	1.2	1.2	1.2	1.2	1.2
35	1.2	1.2	1.2	1.2	1.2
30	1.2	1.2	1.2	1.2	1.2
25	1.2	1.2	1.2	1.2	1.2
20	1.2	1.2	1.2	1.2	1.2
10	1.2	1.2	1.2	1.2	1.2
0	1.2	1.2	1.2	1.2	1.2
-10	1.2	1.2	1.2	1.2	1.2
-20	1.2	1.2	1.2	1.2	1.2
-30	1.2	1.2	1.2	1.2	1.2
-40	1.2	1.2	1.2	1.2	1.2

Table 10.2.1.23 Pini<5MPa VFS5000 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.1	1.1	1.1	1.1	1.1
45	1.2	1.2	1.2	1.2	1.2
40	1.2	1.2	1.2	1.2	1.2
35	1.2	1.2	1.2	1.2	1.2
30	1.2	1.2	1.2	1.2	1.2
25	1.2	1.2	1.2	1.2	1.2
20	1.2	1.2	1.2	1.2	1.2
10	1.2	1.2	1.2	1.2	1.2
0	1.2	1.2	1.2	1.2	1.2
-10	1.2	1.2	1.2	1.2	1.2
-20	1.2	1.2	1.2	1.2	1.2
-30	1.2	1.2	1.2	1.2	1.2
-40	1.2	1.2	1.2	1.2	1.2

Table 10.2.1.24 Pini<5MPa VFS5000 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.8	0.8	0.7	0.7	0.7
45	1.1	1.0	1.0	0.9	0.9
40	1.2	1.2	1.2	1.1	1.1
35	1.2	1.2	1.2	1.1	1.1
30	1.2	1.2	1.2	1.2	1.2
25	1.2	1.2	1.2	1.2	1.2
20	1.2	1.2	1.2	1.2	1.2
10	1.2	1.2	1.2	1.2	1.2
0	1.2	1.2	1.2	1.2	1.2
-10	1.2	1.2	1.2	1.2	1.2
-20	1.2	1.2	1.2	1.2	1.2
-30	1.2	1.2	1.2	1.2	1.2
-40	1.2	1.2	1.2	1.2	1.2

The APRR value restricted at the t-final min model as is used for MCF model

MF-Single L/T For Pini≧5MPa

※prerequisite condition：MAX Flow Rate≦90(g/sec)、SOC≦95(%)、MAX APRR≦28.4(MPa/min)（=HPRR32.0(MPa/min) equivalent）

VFS 250

Table 10.2.1.25 Pini>5MPa VFS250 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	7.3	6.5			
45	10.2	9.4			
40	12.9	12.1			
35	13.5	12.7			
30	15.5	14.6			
25	17.5	16.6			
20	19.6	18.6			
10	23.1	22.0			
0	28.4	28.1			
-10	28.4	28.4			
-20	28.4	28.4			
-30	28.4	28.4			
-40	28.4	28.4			

VFS 500

Table 10.2.1.28 Pini>5MPa VFS500 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	7.8	7.4	6.9	6.7	
45	9.7	9.3	8.8	8.5	
40	11.5	11.1	10.5	10.2	
35	11.8	11.4	10.8	10.5	
30	13.1	12.6	12.0	11.7	
25	14.2	14.0	13.2	12.9	
20	14.2	14.2	14.3	14.1	
10	14.2	14.2	14.3	14.3	
0	14.2	14.2	14.3	14.3	
-10	14.2	14.2	14.3	14.3	
-20	14.2	14.2	14.3	14.3	
-30	14.2	14.2	14.3	14.3	
-40	14.2	14.2	14.3	14.3	

VFS 1000

Table 10.2.1.31 Pini>5MPa VFS1000 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	5.3	5.3	5.3	5.3	5.3
45	6.8	6.7	6.4	6.3	6.4
40	7.1	7.1	7.1	7.1	7.1
35	7.1	7.1	7.1	7.1	7.1
30	7.1	7.1	7.1	7.1	7.1
25	7.1	7.1	7.1	7.1	7.1
20	7.1	7.1	7.1	7.1	7.1
10	7.1	7.1	7.1	7.1	7.1
0	7.1	7.1	7.1	7.1	7.1
-10	7.1	7.1	7.1	7.1	7.1
-20	7.1	7.1	7.1	7.1	7.1
-30	7.1	7.1	7.1	7.1	7.1
-40	7.1	7.1	7.1	7.1	7.1

VFS 1500

Table 10.2.1.34 Pini>5MPa VFS1500 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	3.9	3.9	3.9	3.9	3.9
45	4.6	4.6	4.7	4.7	4.7
40	4.6	4.6	4.7	4.7	4.7
35	4.6	4.6	4.7	4.7	4.7
30	4.6	4.6	4.7	4.7	4.7
25	4.6	4.6	4.7	4.7	4.7
20	4.6	4.6	4.7	4.7	4.7
10	4.6	4.6	4.7	4.7	4.7
0	4.6	4.6	4.7	4.7	4.7
-10	4.6	4.6	4.7	4.7	4.7
-20	4.6	4.6	4.7	4.7	4.7
-30	4.6	4.6	4.7	4.7	4.7
-40	4.6	4.6	4.7	4.7	4.7

Table 10.2.1.26 Pini>5MPa VFS250 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.7	2.1			
45	4.6	3.9			
40	6.6	5.7			
35	7.0	6.1			
30	8.5	7.6			
25	10.1	9.1			
20	11.8	10.7			
10	14.6	13.4			
0	19.5	18.0			
-10	20.7	19.2			
-20	22.1	20.4			
-30	23.5	21.8			
-40	25.1	23.3			

Table 10.2.1.29 Pini>5MPa VFS500 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	3.5	3.1	2.6	2.3	
45	5.1	4.7	4.1	3.8	
40	6.7	6.3	5.6	5.3	
35	6.9	6.5	5.8	5.5	
30	8.1	7.6	6.8	6.5	
25	9.1	8.6	7.9	7.5	
20	10.2	9.7	8.9	8.5	
10	12.0	11.4	10.5	10.1	
0	14.2	14.2	13.6	13.1	
-10	14.2	14.2	14.1	13.6	
-20	14.2	14.2	14.3	14.2	
-30	14.2	14.2	14.3	14.3	
-40	14.2	14.2	14.3	14.3	

Table 10.2.1.32 Pini>5MPa VFS1000 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	3.1	2.9	2.6	2.5	2.5
45	4.2	4.0	3.7	3.5	3.5
40	5.2	5.0	4.6	4.4	4.4
35	5.3	5.1	4.7	4.5	4.5
30	6.0	5.7	5.3	5.1	5.0
25	6.7	6.4	6.0	5.7	5.6
20	7.1	7.1	6.6	6.3	6.2
10	7.1	7.1	7.1	7.1	7.1
0	7.1	7.1	7.1	7.1	7.1
-10	7.1	7.1	7.1	7.1	7.1
-20	7.1	7.1	7.1	7.1	7.1
-30	7.1	7.1	7.1	7.1	7.1
-40	7.1	7.1	7.1	7.1	7.1

Table 10.2.1.35 Pin>5MPa VFS1500 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.6	2.6	2.4	2.4	2.4
45	3.5	3.4	3.1	3.1	3.1
40	4.2	4.1	3.8	3.7	3.7
35	4.3	4.2	3.9	3.8	3.7
30	4.6	4.6	4.4	4.2	4.2
25	4.6	4.6	4.7	4.7	4.6
20	4.6	4.6	4.7	4.7	4.7
10	4.6	4.6	4.7	4.7	4.7
0	4.6	4.6	4.7	4.7	4.7
-10	4.6	4.6	4.7	4.7	4.7
-20	4.6	4.6	4.7	4.7	4.7
-30	4.6	4.6	4.7	4.7	4.7
-40	4.6	4.6	4.7	4.7	4.7

Table 10.2.1.27 Pini>5MPa VFS500 T40

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.8	0.5			
45	1.9	1.5			
40	3.0	2.5			
35	3.2	2.7			
30	4.1	3.4			
25	5.1	4.3			
20	6.1	5.2			
10	8.0	7.0			
0	11.6	10.3			
-10	12.4	11.0			
-20	13.2	11.8			
-30	14.0	12.6			
-40	15.0	13.5			

Table 10.2.1.30 Pini>5MPa VFS500 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.2	1.0	0.7	0.6	
45	2.3	2.0	1.6	1.4	
40	3.3	3.0	2.4	2.2	
35	3.5	3.1	2.6	2.4	
30	4.3	3.8	3.2	3.0	
25	5.1	4.6	3.9	3.6	
20	5.9	5.4	4.7	4.3	
10	7.3	6.7	5.9	5.5	
0	9.7	9.1	8.1	7.7	
-10	10.1	9.4	8.5	8.1	
-20	10.5	9.8	8.8	8.4	
-30	10.9	10.2	9.2	8.7	
-40	11.3	10.6	9.5	9.1	

Table 10.2.1.33 Pini>5MPa VFS1000 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.3	1.1	0.9	0.9	0.9
45	2.2	2.0	1.7	1.6	1.5
40	3.0	2.8	2.4	2.2	2.2
35	3.1	2.9	2.5	2.3	2.2
30	3.7	3.4	3.0	2.8	2.7
25	4.2	3.9	3.5	3.3	3.2
20	4.8	4.5	4.0	3.7	3.6
10	5.7	5.3	4.8	4.5	4.3
0	7.1	6.9	6.2	5.9	5.7
-10	7.1	7.1	6.4	6.0	5.8
-20	7.1	7.1	6.6	6.2	5.9
-30	7.1	7.1	6.8	6.4	6.1
-40	7.1	7.1	7.0	6.5	6.2

Table 10.2.1.36 Pini>5MPa VFS1500 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.3	1.2	1.0	1.0	1.0
45	2.0	1.9	1.6	1.6	1.5
40	2.7	2.5	2.2	2.1	2.1
35	2.8	2.6	2.3	2.2	2.1
30	3.2	3.0	2.7	2.5	2.5
25	3.6	3.4	3.1	2.9	2.8
20	4.0	3.8	3.4	3.2	3.1
10	4.6	4.4	4.0	3.8	3.7
0	4.6	4.6	4.7	4.7	4.7
-10	4.6	4.6	4.7	4.7	4.7
-20	4.6	4.6	4.7	4.7	4.7
-30	4.6	4.6	4.7	4.7	4.7
-40	4.6	4.6	4.7	4.7	4.7

The APRR value restricted at the t-final min model as is used for MCF model

MF-Single L/T For Pini≧5MPa

※prerequisite condition：MAX Flow Rate≦90(g/sec)、SOC≦95(%)、MAX APRR≦28.4(MPa/min)（=HPRR32.0(MPa/min) equivalent）

VFS 2000

Table 10.2.1.37 Pini>5MPa VFS2000 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	3.3	3.3	3.3	3.3	3.3
45	3.5	3.5	3.5	3.5	3.5
40	3.5	3.5	3.5	3.5	3.5
35	3.5	3.5	3.5	3.5	3.5
30	3.5	3.5	3.5	3.5	3.5
25	3.5	3.5	3.5	3.5	3.5
20	3.5	3.5	3.5	3.5	3.5
10	3.5	3.5	3.5	3.5	3.5
0	3.5	3.5	3.5	3.5	3.5
-10	3.5	3.5	3.5	3.5	3.5
-20	3.5	3.5	3.5	3.5	3.5
-30	3.5	3.5	3.5	3.5	3.5
-40	3.5	3.5	3.5	3.5	3.5

Table 10.2.1.38 Pini>5MPa VFS2000 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.3	2.3	2.2	2.1	2.1
45	3.0	2.9	2.7	2.7	2.7
40	3.5	3.5	3.3	3.2	3.2
35	3.5	3.5	3.4	3.3	3.2
30	3.5	3.5	3.5	3.5	3.5
25	3.5	3.5	3.5	3.5	3.5
20	3.5	3.5	3.5	3.5	3.5
10	3.5	3.5	3.5	3.5	3.5
0	3.5	3.5	3.5	3.5	3.5
-10	3.5	3.5	3.5	3.5	3.5
-20	3.5	3.5	3.5	3.5	3.5
-30	3.5	3.5	3.5	3.5	3.5
-40	3.5	3.5	3.5	3.5	3.5

Table 10.2.1.39 Pini>5MPa VFS2000 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.2	1.2	1.0	1.0	1.0
45	1.9	1.7	1.6	1.5	1.5
40	2.4	2.3	2.0	1.9	1.9
35	2.5	2.3	2.1	2.0	2.0
30	2.8	2.7	2.4	2.3	2.2
25	3.2	3.0	2.7	2.6	2.5
20	3.5	3.3	3.0	2.9	2.8
10	3.5	3.5	3.5	3.3	3.2
0	3.5	3.5	3.5	3.5	3.5
-10	3.5	3.5	3.5	3.5	3.5
-20	3.5	3.5	3.5	3.5	3.5
-30	3.5	3.5	3.5	3.5	3.5
-40	3.5	3.5	3.5	3.5	3.5

VFS 2500

Table 10.2.1.40 Pini>5MPa VFS2500 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.8	2.8	2.8	2.8	2.8
45	2.8	2.8	2.8	2.8	2.8
40	2.8	2.8	2.8	2.8	2.8
35	2.8	2.8	2.8	2.8	2.8
30	2.8	2.8	2.8	2.8	2.8
25	2.8	2.8	2.8	2.8	2.8
20	2.8	2.8	2.8	2.8	2.8
10	2.8	2.8	2.8	2.8	2.8
0	2.8	2.8	2.8	2.8	2.8
-10	2.8	2.8	2.8	2.8	2.8
-20	2.8	2.8	2.8	2.8	2.8
-30	2.8	2.8	2.8	2.8	2.8
-40	2.8	2.8	2.8	2.8	2.8

Table 10.2.1.41 Pini>5MPa VFS2500 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.0	2.0	1.9	1.9	1.9
45	2.7	2.6	2.4	2.4	2.4
40	2.8	2.8	2.8	2.8	2.8
35	2.8	2.8	2.8	2.8	2.8
30	2.8	2.8	2.8	2.8	2.8
25	2.8	2.8	2.8	2.8	2.8
20	2.8	2.8	2.8	2.8	2.8
10	2.8	2.8	2.8	2.8	2.8
0	2.8	2.8	2.8	2.8	2.8
-10	2.8	2.8	2.8	2.8	2.8
-20	2.8	2.8	2.8	2.8	2.8
-30	2.8	2.8	2.8	2.8	2.8
-40	2.8	2.8	2.8	2.8	2.8

Table 10.2.1.42 Pini>5MPa VFS2500 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.2	1.1	1.0	1.0	1.0
45	1.7	1.6	1.5	1.4	1.4
40	2.2	2.1	1.9	1.8	1.8
35	2.3	2.1	1.9	1.8	1.8
30	2.6	2.4	2.2	2.1	2.0
25	2.8	2.7	2.5	2.3	2.3
20	2.8	2.8	2.8	2.6	2.5
10	2.8	2.8	2.8	2.8	2.8
0	2.8	2.8	2.8	2.8	2.8
-10	2.8	2.8	2.8	2.8	2.8
-20	2.8	2.8	2.8	2.8	2.8
-30	2.8	2.8	2.8	2.8	2.8
-40	2.8	2.8	2.8	2.8	2.8

VFS 3000

Table 10.2.1.43 Pini>5MPa VFS3000 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.3	2.3	2.3	2.3	2.3
45	2.3	2.3	2.3	2.3	2.3
40	2.3	2.3	2.3	2.3	2.3
35	2.3	2.3	2.3	2.3	2.3
30	2.3	2.3	2.3	2.3	2.3
25	2.3	2.3	2.3	2.3	2.3
20	2.3	2.3	2.3	2.3	2.3
10	2.3	2.3	2.3	2.3	2.3
0	2.3	2.3	2.3	2.3	2.3
-10	2.3	2.3	2.3	2.3	2.3
-20	2.3	2.3	2.3	2.3	2.3
-30	2.3	2.3	2.3	2.3	2.3
-40	2.3	2.3	2.3	2.3	2.3

Table 10.2.1.44 Pini>5MPa VFS3000 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.9	1.9	1.8	1.8	1.8
45	2.3	2.3	2.2	2.2	2.2
40	2.3	2.3	2.3	2.3	2.3
35	2.3	2.3	2.3	2.3	2.3
30	2.3	2.3	2.3	2.3	2.3
25	2.3	2.3	2.3	2.3	2.3
20	2.3	2.3	2.3	2.3	2.3
10	2.3	2.3	2.3	2.3	2.3
0	2.3	2.3	2.3	2.3	2.3
-10	2.3	2.3	2.3	2.3	2.3
-20	2.3	2.3	2.3	2.3	2.3
-30	2.3	2.3	2.3	2.3	2.3
-40	2.3	2.3	2.3	2.3	2.3

Table 10.2.1.45 Pini>5MPa VFS3000 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.2	1.1	1.0	1.0	1.0
45	1.6	1.5	1.4	1.3	1.3
40	2.0	1.9	1.7	1.7	1.7
35	2.1	2.0	1.8	1.7	1.7
30	2.3	2.2	2.0	1.9	1.9
25	2.3	2.3	2.3	2.2	2.1
20	2.3	2.3	2.3	2.3	2.3
10	2.3	2.3	2.3	2.3	2.3
0	2.3	2.3	2.3	2.3	2.3
-10	2.3	2.3	2.3	2.3	2.3
-20	2.3	2.3	2.3	2.3	2.3
-30	2.3	2.3	2.3	2.3	2.3
-40	2.3	2.3	2.3	2.3	2.3

VFS 5000

Table 10.2.1.46 Pini>5MPa VFS5000 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.4	1.4	1.4	1.4	1.4
45	1.4	1.4	1.4	1.4	1.4
40	1.4	1.4	1.4	1.4	1.4
35	1.4	1.4	1.4	1.4	1.4
30	1.4	1.4	1.4	1.4	1.4
25	1.4	1.4	1.4	1.4	1.4
20	1.4	1.4	1.4	1.4	1.4
10	1.4	1.4	1.4	1.4	1.4
0	1.4	1.4	1.4	1.4	1.4
-10	1.4	1.4	1.4	1.4	1.4
-20	1.4	1.4	1.4	1.4	1.4
-30	1.4	1.4	1.4	1.4	1.4
-40	1.4	1.4	1.4	1.4	1.4

Table 10.2.1.47 Pini>5MPa VFS5000 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.4	1.4	1.4	1.4	1.4
45	1.4	1.4	1.4	1.4	1.4
40	1.4	1.4	1.4	1.4	1.4
35	1.4	1.4	1.4	1.4	1.4
30	1.4	1.4	1.4	1.4	1.4
25	1.4	1.4	1.4	1.4	1.4
20	1.4	1.4	1.4	1.4	1.4
10	1.4	1.4	1.4	1.4	1.4
0	1.4	1.4	1.4	1.4	1.4
-10	1.4	1.4	1.4	1.4	1.4
-20	1.4	1.4	1.4	1.4	1.4
-30	1.4	1.4	1.4	1.4	1.4
-40	1.4	1.4	1.4	1.4	1.4

Table 10.2.1.48 Pini>5MPa VFS5000 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.0	0.9	0.9	0.9	0.9
45	1.3	1.2	1.1	1.1	1.1
40	1.4	1.4	1.4	1.3	1.3
35	1.4	1.4	1.4	1.4	1.4
30	1.4	1.4	1.4	1.4	1.4
25	1.4	1.4	1.4	1.4	1.4
20	1.4	1.4	1.4	1.4	1.4
10	1.4	1.4	1.4	1.4	1.4
0	1.4	1.4	1.4	1.4	1.4
-10	1.4	1.4	1.4	1.4	1.4
-20	1.4	1.4	1.4	1.4	1.4
-30	1.4	1.4	1.4	1.4	1.4
-40	1.4	1.4	1.4	1.4	1.4

The APRR value restricted at the t-final min model as is used for MCF model

10.2.2 Protocol of MF-Single-LT / Non-comm (Table for Ptarget)

Table 10.2.2.1 MF-Single P-target Table

H70MF_Single Non Communication Fueling Table_Almighty(T40-T20) Conservative

	P_{target} [MPa]			P_{target} [MPa]									
T_{amb} [℃]	$P_{initial}$ [MPa]			$P_{initial}$ [MPa]									
	< 0.5	0.5	2	5	10	15	20	30	40	50	60	70	> 70
> 50	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling
50	no fueling	81.0	81.7	81.5	80.7	79.9	79.0	77.4	75.8	74.4	73.1	72.5	no fueling
45	no fueling	79.9	80.6	80.4	79.7	78.9	78.2	76.7	75.3	74.0	73.0	72.5	no fueling
40	no fueling	78.8	79.5	79.4	78.7	78.0	77.3	75.9	74.7	73.6	72.8	72.4	no fueling
35	no fueling	77.7	78.5	78.3	77.7	77.1	76.4	75.2	74.1	73.2	72.6	72.4	no fueling
30	no fueling	76.8	77.2	77.0	76.4	75.7	75.1	73.9	72.8	71.9	71.3	71.2	no fueling
25	no fueling	75.8	75.9	75.7	75.1	74.4	73.8	72.5	71.5	70.6	70.0	no fueling	no fueling
20	no fueling	74.9	74.6	74.4	73.8	73.1	72.4	71.2	70.1	69.3	68.7	no fueling	no fueling
10	no fueling	73.0	72.7	72.0	71.2	70.5	69.8	68.5	67.4	66.6	66.2	no fueling	no fueling
0	no fueling	71.2	70.9	70.3	69.2	68.0	67.1	65.8	64.8	63.9	63.6	no fueling	no fueling
-10	no fueling	69.4	69.1	68.6	67.6	66.6	65.5	63.1	62.1	61.3	61.1	no fueling	no fueling
-20	no fueling	67.6	67.4	66.9	66.1	65.1	64.2	62.2	60.0	58.7	no fueling	no fueling	no fueling
-30	no fueling	65.9	65.7	65.3	64.5	63.7	62.9	61.2	59.4	57.5	no fueling	no fueling	no fueling
-40	no fueling	64.1	64.0	63.7	63.0	62.4	61.7	60.3	58.8	57.3	no fueling	no fueling	no fueling
< -40	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling

※This table is divided into two sections which have a table for Pini＜5MPa and the other for Pini≧5MPa. In each section, a linear interpolation to calculate Ptarget is used, but for 2MPa ≦Pini＜5MPa the value of Ptarget for 2MPa column shall be used.

10.2.3 Protocol of MF-Single-LT / Comm (Table for Plimit)

Table 10.2.3.1 MF-Single P-limit Table T40

H70MF_Single Communication Fueling Table_T40

T40	P_{limit} [MPa]			P_{limit} [MPa]									
T_{amb} [°C]	$P_{initial}$ [MPa]			$P_{initial}$ [MPa]									
	< 0.5	0.5	2	5	10	15	20	30	40	50	60	70	> 70
> 50	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling
50	no fueling	86.2	86.1	80.7	86.1	86.8	86.6	86.0	85.3	84.3	83.1	81.5	no fueling
45	no fueling	86.4	86.3	80.7	86.8	86.5	86.2	85.4	84.5	83.3	82.0	80.1	no fueling
40	no fueling	80.5	83.3	80.6	86.6	86.2	85.7	84.8	83.7	82.3	80.7	78.5	no fueling
35	no fueling	80.5	83.5	80.6	86.6	86.1	85.7	84.7	83.6	82.2	80.6	78.4	no fueling
30	no fueling	80.5	84.3	80.5	86.4	85.9	85.3	84.2	83.0	81.4	79.7	77.3	no fueling
25	no fueling	80.5	85.2	80.4	86.3	85.7	85.0	83.7	82.3	80.6	78.8	no fueling	no fueling
20	no fueling	80.4	86.1	80.3	86.2	85.4	84.6	83.2	81.6	79.8	77.8	no fueling	no fueling
10	no fueling	80.1	86.3	80.5	85.9	85.0	84.1	82.3	80.4	78.5	76.3	no fueling	no fueling
0	no fueling	80.1	86.1	82.8	85.3	84.1	82.8	80.5	78.2	75.9	73.2	no fueling	no fueling
-10	no fueling	80.0	86.1	86.3	85.0	83.7	82.5	80.1	77.8	75.5	72.9	no fueling	no fueling
-20	no fueling	80.1	86.0	86.0	84.7	83.4	82.2	79.8	77.4	75.1	no fueling	no fueling	no fueling
-30	no fueling	80.0	86.0	85.7	84.4	83.1	81.8	79.4	77.1	74.7	no fueling	no fueling	no fueling
-40	no fueling	79.7	85.9	85.4	84.0	82.7	81.5	79.0	76.6	74.4	no fueling	no fueling	no fueling
< -40	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling

※This table is divided into two sections which have a table for Pini＜5MPa and the other for Pini≧5MPa. In each section, a linear interpolation to calculate Plimit is used, but for 2MPa ≦Pini＜5MPa the value of Plimit for 2MPa column shall be used.

Table 10.2.3.2 MF-Single P-limit Table T30

H70MF_Single Communication Fueling Table_T30

T30	P_{limit} [MPa]			P_{limit} [MPa]									
T_{amb} [°C]	$P_{initial}$ [MPa]			$P_{initial}$ [MPa]									
	< 0.5	0.5	2	5	10	15	20	30	40	50	60	70	> 70
> 50	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling
50	no fueling	80.5	81.9	80.4	86.5	86.4	86.1	85.5	84.7	83.9	82.8	81.3	no fueling
45	no fueling	80.3	82.2	80.3	86.4	86.1	85.8	85.0	84.1	83.1	81.8	79.9	no fueling
40	no fueling	80.1	82.8	80.2	86.2	85.9	85.4	84.5	83.4	82.1	80.6	78.4	no fueling
35	no fueling	80.1	82.8	80.2	86.2	85.8	85.4	84.4	83.3	82.0	80.5	78.3	no fueling
30	no fueling	80.0	83.3	80.1	86.1	85.6	85.1	84.0	82.7	81.3	79.6	77.3	no fueling
25	no fueling	80.0	84.0	80.3	86.0	85.4	84.8	83.5	82.1	80.5	78.7	no fueling	no fueling
20	no fueling	79.9	84.6	80.1	85.8	85.2	84.5	83.0	81.4	79.8	77.8	no fueling	no fueling
10	no fueling	79.9	85.9	80.0	85.6	84.7	83.9	82.2	80.3	78.4	76.2	no fueling	no fueling
0	no fueling	79.6	85.7	79.8	85.2	84.0	82.8	80.5	78.2	75.8	73.2	no fueling	no fueling
-10	no fueling	79.7	85.7	79.8	85.1	83.9	82.7	80.3	77.9	75.5	72.9	no fueling	no fueling
-20	no fueling	79.5	85.6	79.9	85.0	83.8	82.5	80.0	77.6	75.2	no fueling	no fueling	no fueling
-30	no fueling	79.6	85.6	79.9	85.0	83.6	82.3	79.8	77.3	74.8	no fueling	no fueling	no fueling
-40	no fueling	79.5	85.5	79.9	84.9	83.5	82.2	79.5	77.0	74.5	no fueling	no fueling	no fueling
< -40	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling

※This table is divided into two sections which have a table for Pini＜5MPa and the other for Pini≧5MPa. In each section, a linear interpolation to calculate Plimit is used, but for 2MPa ≦Pini＜5MPa the value of Plimit for 2MPa column shall be used.

Table 10.2.3.3 MF-Single P-limit Table T20

H70MF_Single Communication Fueling Table_T20

T20	P_{limit} [MPa]			P_{limit} [MPa]									
T_{amb} [°C]	$P_{initial}$ [MPa]			$P_{initial}$ [MPa]									
	< 0.5	0.5	2	5	10	15	20	30	40	50	60	70	> 70
> 50	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling
50	no fueling	80.2	82.3	80.4	86.5	86.2	85.8	85.0	84.2	83.2	82.2	80.9	no fueling
45	no fueling	80.1	82.4	80.1	86.2	85.8	85.4	84.6	83.6	82.6	81.4	79.7	no fueling
40	no fueling	79.8	82.6	79.9	85.9	85.4	85.0	84.0	82.9	81.7	80.3	78.3	no fueling
35	no fueling	79.7	82.6	79.8	85.8	85.4	84.9	84.0	82.9	81.7	80.2	78.2	no fueling
30	no fueling	79.5	82.9	79.6	85.7	85.2	84.7	83.6	82.4	81.0	79.4	77.2	no fueling
25	no fueling	79.6	83.4	79.8	85.5	85.0	84.4	83.1	81.8	80.3	78.5	no fueling	no fueling
20	no fueling	79.4	83.8	79.6	85.4	84.8	84.1	82.7	81.2	79.5	77.6	no fueling	no fueling
10	no fueling	79.3	84.7	79.6	85.2	84.4	83.6	81.9	80.2	78.2	76.1	no fueling	no fueling
0	no fueling	79.2	85.2	79.6	84.8	83.7	82.6	80.4	78.1	75.7	73.1	no fueling	no fueling
-10	no fueling	79.1	85.2	79.4	84.8	83.6	82.5	80.2	77.9	75.4	72.9	no fueling	no fueling
-20	no fueling	79.0	85.1	79.4	84.7	83.5	82.4	80.0	77.6	75.2	no fueling	no fueling	no fueling
-30	no fueling	79.0	85.1	79.4	84.6	83.4	82.2	79.8	77.3	74.9	no fueling	no fueling	no fueling
-40	no fueling	79.1	85.1	79.4	84.6	83.3	82.0	79.5	77.0	74.5	no fueling	no fueling	no fueling
< -40	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling

※This table is divided into two sections which have a table for Pini＜5MPa and the other for Pini≧5MPa. In each section, a linear interpolation to calculate Plimit is used, but for 2MPa ≦Pini＜5MPa the value of Plimit for 2MPa column shall be used.

10.3 Protocol of MF-Twin-LT

10.3.1 Protocol of MF-Twin-LT (Table for APRR)

MF-Twin L/T For Pini<5MPa

※prerequisite condition：MAX Flow Rate≦180(g/sec)、SOC≦95(%)、MAX APRR≦28.4(MPa/min)（=HPRR32.0(MPa/min) equivalent）

VFS 250

Table 10.3.1.1 Pini<5MPa VFS250 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.6	1.4			
45	3.2	2.9			
40	7.6	6.7			
35	9.4	8.3			
30	11.2	10.2			
25	13.1	12.0			
20	15.0	13.9			
10	18.2	17.0			
0	23.1	21.6			
-10	24.9	23.5			
-20	27.0	25.5			
-30	28.4	27.8			
-40	28.4	28.4			

Table 10.3.1.2 Pini<5MPa VFS250 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.6	0.3			
45	2.5	2.0			
40	4.1	3.4			
35	4.4	3.7			
30	5.6	4.8			
25	6.9	6.0			
20	8.3	7.2			
10	10.7	9.5			
0	14.7	13.3			
-10	16.0	14.6			
-20	17.5	16.0			
-30	19.0	17.5			
-40	20.7	19.1			

Table 10.3.1.3 Pini<5MPa VFS250 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.3	0.2			
45	1.0	0.7			
40	1.9	1.5			
35	2.1	1.7			
30	2.8	2.3			
25	3.5	2.9			
20	4.3	3.6			
10	5.7	4.9			
0	8.3	7.2			
-10	9.1	7.9			
-20	10.0	8.7			
-30	10.9	9.6			
-40	11.9	10.5			

VFS 500

Table 10.3.1.4 Pini<5MPa VFS500 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	3.4	3.2	2.8	3.0	
45	8.9	8.4	7.6	7.2	
40	10.9	10.4	9.5	9.1	
35	11.4	10.8	9.9	9.5	
30	12.8	12.2	11.3	10.9	
25	14.1	13.5	12.6	12.1	
20	15.4	14.8	13.8	13.4	
10	17.7	16.9	15.8	15.4	
0	21.2	20.3	19.0	18.5	
-10	22.2	21.4	20.0	19.4	
-20	23.3	22.3	21.0	20.4	
-30	24.5	23.4	21.9	21.4	
-40	25.8	24.6	23.1	22.4	

Table 10.3.1.5 Pini<5MPa VFS500 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.3	2.0	1.4	1.2	
45	3.9	3.4	2.8	2.5	
40	5.4	4.9	4.1	3.8	
35	5.7	5.2	4.4	4.0	
30	6.8	6.3	5.4	5.0	
25	8.0	7.3	6.4	6.0	
20	9.1	8.4	7.4	7.0	
10	11.0	10.2	9.1	8.6	
0	13.9	13.1	11.8	11.3	
-10	14.6	13.7	12.5	11.9	
-20	15.3	14.4	13.1	12.6	
-30	16.0	15.1	13.9	13.3	
-40	16.8	15.9	14.5	14.0	

Table 10.3.1.6 Pini<5MPa VFS500 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.6	0.5	0.3	0.3	
45	1.6	1.3	1.0	0.8	
40	2.5	2.1	1.7	1.5	
35	2.6	2.3	1.8	1.7	
30	3.3	2.9	2.4	2.1	
25	4.0	3.6	2.9	2.7	
20	4.7	4.2	3.5	3.2	
10	6.0	5.4	4.6	4.2	
0	8.2	7.5	6.4	6.0	
-10	8.6	7.9	6.8	6.3	
-20	9.1	8.3	7.2	6.7	
-30	9.6	8.8	7.7	7.2	
-40	10.1	9.3	8.1	7.6	

VFS 1000

Table 10.3.1.7 Pini<5MPa VFS1000 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	5.8	5.8	5.8	5.8	5.8
45	7.8	7.6	7.2	7.1	7.1
40	9.1	8.9	8.4	8.2	8.2
35	9.3	9.0	8.6	8.4	8.3
30	10.2	9.9	9.4	9.2	9.1
25	11.1	10.7	10.2	9.9	9.8
20	12.0	11.6	10.9	10.6	10.5
10	13.2	12.9	12.2	11.9	11.7
0	13.2	13.2	13.3	13.3	13.3
-10	13.2	13.2	13.3	13.3	13.3
-20	13.2	13.2	13.3	13.3	13.3
-30	13.2	13.2	13.3	13.3	13.3
-40	13.2	13.2	13.3	13.3	13.3

Table 10.3.1.8 Pini<5MPa VFS1000 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.7	2.4	2.1	2.0	2.0
45	4.0	3.7	3.3	3.1	3.0
40	5.2	4.9	4.4	4.1	4.0
35	5.4	5.1	4.5	4.3	4.2
30	6.2	5.8	5.3	5.0	4.8
25	7.0	6.6	6.0	5.7	5.5
20	7.7	7.3	6.7	6.3	6.2
10	8.9	8.4	7.7	7.3	7.1
0	10.9	10.3	9.5	9.0	8.8
-10	11.3	10.6	9.7	9.3	9.0
-20	11.6	11.0	10.0	9.6	9.3
-30	12.0	11.3	10.4	9.8	9.5
-40	12.4	11.7	10.7	10.1	9.8

Table 10.3.1.9 Pini<5MPa VFS1000 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.8	0.7	0.5	0.5	0.5
45	1.7	1.5	1.2	1.1	1.1
40	2.6	2.3	1.9	1.8	1.7
35	2.7	2.4	2.0	1.9	1.8
30	3.3	3.0	2.5	2.3	2.2
25	3.9	3.5	3.0	2.8	2.6
20	4.5	4.1	3.5	3.2	3.1
10	5.4	5.0	4.3	4.0	3.8
0	7.0	6.5	5.7	5.3	5.1
-10	7.3	6.7	5.9	5.5	5.2
-20	7.5	7.0	6.2	5.7	5.4
-30	7.8	7.2	6.4	5.9	5.6
-40	8.1	7.5	6.6	6.1	5.8

VFS 1500

Table 10.3.1.10 Pini<5MPa VFS1500 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	4.5	4.5	4.5	4.5	4.5
45	6.1	6.1	6.0	5.9	6.0
40	7.3	7.2	6.8	6.7	6.7
35	7.5	7.3	7.0	6.8	6.8
30	8.2	7.9	7.5	7.4	7.4
25	8.4	8.4	8.1	7.9	7.9
20	8.4	8.4	8.5	8.5	8.4
10	8.4	8.4	8.5	8.5	8.5
0	8.4	8.4	8.5	8.5	8.5
-10	8.4	8.4	8.5	8.5	8.5
-20	8.4	8.4	8.5	8.5	8.5
-30	8.4	8.4	8.5	8.5	8.5
-40	8.4	8.4	8.5	8.5	8.5

Table 10.3.1.11 Pini<5MPa VFS1500 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.4	2.4	2.2	2.2	2.2
45	3.7	3.5	3.2	3.0	3.0
40	4.6	4.4	4.0	3.8	3.8
35	4.7	4.5	4.1	3.9	3.9
30	5.3	5.1	4.6	4.5	4.4
25	5.9	5.6	5.2	4.9	4.8
20	6.4	6.1	5.7	5.4	5.3
10	7.3	6.9	6.4	6.1	6.0
0	8.4	8.4	7.7	7.4	7.2
-10	8.4	8.4	7.9	7.6	7.3
-20	8.4	8.4	8.1	7.7	7.5
-30	8.4	8.4	8.4	7.9	7.6
-40	8.4	8.4	8.5	8.1	7.8

Table 10.3.1.12 Pini<5MPa VFS1500 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.9	0.8	0.7	0.7	0.7
45	1.7	1.6	1.4	1.3	1.3
40	2.5	2.3	2.0	1.8	1.8
35	2.6	2.4	2.1	1.9	1.9
30	3.1	2.8	2.5	2.3	2.2
25	3.6	3.3	2.9	2.7	2.6
20	4.0	3.7	3.3	3.1	2.9
10	4.8	4.4	3.9	3.7	3.5
0	6.0	5.6	5.0	4.7	4.5
-10	6.2	5.7	5.1	4.8	4.6
-20	6.3	5.9	5.3	4.9	4.7
-30	6.5	6.1	5.4	5.1	4.8
-40	6.7	6.2	5.6	5.2	4.9

The APRR value restricted at the t-final min model as is used for MCF model

MF-Twin L/T For Pini<5MPa

※prerequisite condition：MAX Flow Rate≦180(g/sec)、SOC≦95(%)、MAX APRR≦28.4(MPa/min)（=HPRR32.0(MPa/min) equivalent）

VFS 2000

Table 10.3.1.13 Pini<5MPa VFS2000 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	4.0	4.0	4.0	4.0	4.0
45	5.3	5.3	5.1	5.1	5.1
40	6.2	6.1	5.8	5.7	5.7
35	6.3	6.2	5.9	5.8	5.8
30	6.3	6.3	6.3	6.2	6.2
25	6.3	6.3	6.3	6.3	6.3
20	6.3	6.3	6.3	6.3	6.3
10	6.3	6.3	6.3	6.3	6.3
0	6.3	6.3	6.3	6.3	6.3
-10	6.3	6.3	6.3	6.3	6.3
-20	6.3	6.3	6.3	6.3	6.3
-30	6.3	6.3	6.3	6.3	6.3
-40	6.3	6.3	6.3	6.3	6.3

Table 10.3.1.14 Pini<5MPa VFS2000 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.3	2.3	2.2	2.1	2.1
45	3.3	3.2	2.9	2.8	2.8
40	4.1	3.9	3.6	3.5	3.4
35	4.2	4.0	3.7	3.6	3.5
30	4.7	4.4	4.1	4.0	3.9
25	5.1	4.9	4.5	4.3	4.3
20	5.6	5.3	4.9	4.7	4.6
10	6.3	6.0	5.5	5.3	5.2
0	6.3	6.3	6.3	6.3	6.2
-10	6.3	6.3	6.3	6.3	6.3
-20	6.3	6.3	6.3	6.3	6.3
-30	6.3	6.3	6.3	6.3	6.3
-40	6.3	6.3	6.3	6.3	6.3

Table 10.3.1.15 Pini<5MPa VFS2000 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.9	0.9	0.8	0.8	0.8
45	1.7	1.6	1.4	1.3	1.3
40	2.4	2.2	1.9	1.8	1.8
35	2.5	2.3	2.0	1.9	1.8
30	2.9	2.7	2.4	2.2	2.1
25	3.3	3.1	2.7	2.5	2.4
20	3.7	3.4	3.0	2.9	2.7
10	4.3	4.0	3.6	3.3	3.2
0	5.3	4.9	4.4	4.2	4.0
-10	5.4	5.1	4.5	4.3	4.1
-20	5.6	5.2	4.7	4.4	4.2
-30	5.7	5.3	4.8	4.4	4.3
-40	5.9	5.4	4.9	4.5	4.3

VFS 2500

Table 10.3.1.16 Pini<5MPa VFS2500 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	3.6	3.6	3.6	3.6	3.6
45	4.7	4.7	4.5	4.4	4.4
40	5.0	5.0	5.1	5.0	5.0
35	5.0	5.0	5.1	5.0	5.0
30	5.0	5.0	5.1	5.1	5.1
25	5.0	5.0	5.1	5.1	5.1
20	5.0	5.0	5.1	5.1	5.1
10	5.0	5.0	5.1	5.1	5.1
0	5.0	5.0	5.1	5.1	5.1
-10	5.0	5.0	5.1	5.1	5.1
-20	5.0	5.0	5.1	5.1	5.1
-30	5.0	5.0	5.1	5.1	5.1
-40	5.0	5.0	5.1	5.1	5.1

Table 10.3.1.17 Pini<5MPa VFS2500 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.2	2.2	2.1	2.0	2.1
45	3.1	2.9	2.7	2.6	2.6
40	3.7	3.5	3.3	3.2	3.1
35	3.8	3.6	3.3	3.2	3.2
30	4.2	4.0	3.7	3.6	3.5
25	4.6	4.4	4.0	3.9	3.8
20	5.0	4.7	4.4	4.2	4.1
10	5.0	5.0	4.9	4.7	4.6
0	5.0	5.0	5.1	5.1	5.1
-10	5.0	5.0	5.1	5.1	5.1
-20	5.0	5.0	5.1	5.1	5.1
-30	5.0	5.0	5.1	5.1	5.1
-40	5.0	5.0	5.1	5.1	5.1

Table 10.3.1.18 Pini<5MPa VFS2500 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.0	0.9	0.8	0.8	0.8
45	1.7	1.6	1.4	1.3	1.3
40	2.3	2.1	1.8	1.7	1.7
35	2.3	2.2	1.9	1.8	1.8
30	2.7	2.5	2.2	2.1	2.0
25	3.0	2.8	2.5	2.4	2.3
20	3.4	3.2	2.8	2.7	2.6
10	3.9	3.6	3.3	3.1	3.0
0	4.8	4.5	4.0	3.8	3.6
-10	4.9	4.6	4.1	3.9	3.7
-20	5.0	4.7	4.2	3.9	3.8
-30	5.0	4.8	4.3	4.0	3.8
-40	5.0	4.9	4.4	4.1	3.9

VFS 3000

Table 10.3.1.19 Pini<5MPa VFS3000 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	3.2	3.2	3.2	3.2	3.3
45	4.2	4.2	4.0	4.0	4.0
40	4.2	4.2	4.2	4.2	4.2
35	4.2	4.2	4.2	4.2	4.2
30	4.2	4.2	4.2	4.2	4.2
25	4.2	4.2	4.2	4.2	4.2
20	4.2	4.2	4.2	4.2	4.2
10	4.2	4.2	4.2	4.2	4.2
0	4.2	4.2	4.2	4.2	4.2
-10	4.2	4.2	4.2	4.2	4.2
-20	4.2	4.2	4.2	4.2	4.2
-30	4.2	4.2	4.2	4.2	4.2
-40	4.2	4.2	4.2	4.2	4.2

Table 10.3.1.20 Pini<5MPa VFS3000 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.1	2.1	2.0	2.0	2.0
45	2.8	2.7	2.5	2.5	2.5
40	3.4	3.2	3.0	2.9	2.9
35	3.4	3.3	3.1	3.0	2.9
30	3.8	3.6	3.4	3.3	3.2
25	4.2	4.0	3.7	3.6	3.5
20	4.2	4.2	4.0	3.8	3.8
10	4.2	4.2	4.2	4.2	4.2
0	4.2	4.2	4.2	4.2	4.2
-10	4.2	4.2	4.2	4.2	4.2
-20	4.2	4.2	4.2	4.2	4.2
-30	4.2	4.2	4.2	4.2	4.2
-40	4.2	4.2	4.2	4.2	4.2

Table 10.3.1.21 Pini<5MPa VFS3000 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.0	1.0	0.9	0.8	0.8
45	1.6	1.5	1.4	1.3	1.3
40	2.1	2.0	1.8	1.7	1.7
35	2.2	2.1	1.9	1.8	1.7
30	2.5	2.4	2.1	2.0	2.0
25	2.8	2.7	2.4	2.3	2.2
20	3.1	2.9	2.6	2.5	2.4
10	3.6	3.4	3.0	2.9	2.8
0	4.2	4.1	3.7	3.5	3.4
-10	4.2	4.2	3.8	3.6	3.4
-20	4.2	4.2	3.9	3.6	3.5
-30	4.2	4.2	4.0	3.7	3.5
-40	4.2	4.2	4.1	3.8	3.6

VFS 5000

Table 10.3.1.22 Pini<5MPa VFS5000 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.4	2.3	2.4	2.4	2.4
45	2.5	2.5	2.5	2.5	2.5
40	2.5	2.5	2.5	2.5	2.5
35	2.5	2.5	2.5	2.5	2.5
30	2.5	2.5	2.5	2.5	2.5
25	2.5	2.5	2.5	2.5	2.5
20	2.5	2.5	2.5	2.5	2.5
10	2.5	2.5	2.5	2.5	2.5
0	2.5	2.5	2.5	2.5	2.5
-10	2.5	2.5	2.5	2.5	2.5
-20	2.5	2.5	2.5	2.5	2.5
-30	2.5	2.5	2.5	2.5	2.5
-40	2.5	2.5	2.5	2.5	2.5

Table 10.3.1.23 Pini<5MPa VFS5000 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.7	1.7	1.6	1.6	1.6
45	2.2	2.1	2.0	1.9	2.0
40	2.5	2.5	2.3	2.3	2.2
35	2.5	2.5	2.4	2.3	2.3
30	2.5	2.5	2.5	2.5	2.5
25	2.5	2.5	2.5	2.5	2.5
20	2.5	2.5	2.5	2.5	2.5
10	2.5	2.5	2.5	2.5	2.5
0	2.5	2.5	2.5	2.5	2.5
-10	2.5	2.5	2.5	2.5	2.5
-20	2.5	2.5	2.5	2.5	2.5
-30	2.5	2.5	2.5	2.5	2.5
-40	2.5	2.5	2.5	2.5	2.5

Table 10.3.1.24 Pini<5MPa VFS5000 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.0	1.0	0.9	0.8	0.8
45	1.4	1.3	1.2	1.2	1.2
40	1.8	1.7	1.5	1.5	1.4
35	1.8	1.7	1.6	1.5	1.5
30	2.0	1.9	1.8	1.7	1.6
25	2.3	2.1	1.9	1.9	1.8
20	2.5	2.3	2.1	2.0	2.0
10	2.5	2.5	2.4	2.3	2.2
0	2.5	2.5	2.5	2.5	2.5
-10	2.5	2.5	2.5	2.5	2.5
-20	2.5	2.5	2.5	2.5	2.5
-30	2.5	2.5	2.5	2.5	2.5
-40	2.5	2.5	2.5	2.5	2.5

The APRR value restricted at the t-final min model as is used for MCF model

MF-Twin L/T For Pini≧5MPa

※prerequisite condition：MAX Flow Rate≦180(g/sec)、SOC≦95(%)、MAX APRR≦28.4(MPa/min)（=HPRR32.0(MPa/min) equivalent）

VFS 250

Table 10.3.1.25 Pini>5MPa VFS250 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	4.1	3.3			
45	6.9	6.0			
40	10.0	8.9			
35	10.8	9.7			
30	13.3	12.2			
25	15.9	14.8			
20	18.6	17.4			
10	23.3	22.1			
0	28.4	28.4			
-10	28.4	28.4			
-20	28.4	28.4			
-30	28.4	28.4			
-40	28.4	28.4			

Table 10.3.1.26 Pini>5MPa VFS250 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.3	0.6			
45	3.0	2.4			
40	4.9	4.1			
35	5.3	4.5			
30	6.9	5.9			
25	8.7	7.6			
20	10.6	9.4			
10	14.3	12.8			
0	20.6	18.9			
-10	22.7	21.0			
-20	25.1	23.4			
-30	27.9	26.1			
-40	28.4	28.4			

Table 10.3.1.27 Pini>5MPa VFS500 T40

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.4	0.3			
45	1.3	1.0			
40	2.3	1.9			
35	2.6	2.1			
30	3.4	2.8			
25	4.4	3.7			
20	5.5	4.6			
10	7.6	6.5			
0	11.8	10.4			
-10	13.2	11.6			
-20	14.7	13.0			
-30	16.4	14.6			
-40	18.2	16.3			

VFS 500

Table 10.3.1.28 Pini>5MPa VFS500 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	7.4	6.9	6.1	5.8	
45	10.2	9.7	8.8	8.5	
40	12.9	12.3	11.4	11.1	
35	13.4	12.9	12.0	11.6	
30	15.4	14.8	13.8	13.5	
25	17.3	16.7	15.7	15.3	
20	19.3	18.7	17.6	17.2	
10	22.9	22.1	20.9	20.4	
0	28.4	28.2	26.7	26.1	
-10	28.4	28.4	28.3	27.7	
-20	28.4	28.4	28.4	28.4	
-30	28.4	28.4	28.4	28.4	
-40	28.4	28.4	28.4	28.4	

Table 10.3.1.29 Pini>5MPa VFS500 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.8	2.4	1.8	1.6	
45	4.6	4.2	3.4	3.1	
40	6.6	6.1	5.2	4.8	
35	7.0	6.4	5.5	5.1	
30	8.5	7.9	6.9	6.5	
25	10.1	9.4	8.4	7.9	
20	11.7	11.0	9.9	9.4	
10	14.5	13.7	12.4	11.9	
0	19.2	18.2	16.8	16.3	
-10	20.4	19.4	18.0	17.3	
-20	21.7	20.7	19.1	18.5	
-30	23.1	21.9	20.4	19.7	
-40	24.6	23.4	21.8	21.0	

Table 10.3.1.30 Pini>5MPa VFS500 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.9	0.7	0.4	0.4	
45	2.0	1.7	1.3	1.1	
40	3.0	2.7	2.1	1.9	
35	3.2	2.9	2.3	2.1	
30	4.1	3.7	3.0	2.7	
25	5.1	4.5	3.8	3.5	
20	6.1	5.5	4.7	4.3	
10	8.0	7.3	6.2	5.8	
0	11.5	10.6	9.3	8.8	
-10	12.2	11.3	10.0	9.4	
-20	13.0	12.1	10.7	10.1	
-30	13.8	12.9	11.5	10.8	
-40	14.7	13.7	12.2	11.6	

VFS 1000

Table 10.3.1.31 Pini>5MPa VFS1000 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	6.4	6.4	6.4	6.4	6.5
45	8.8	8.8	8.8	8.4	8.5
40	10.9	10.6	10.9	10.0	10.0
35	11.2	10.9	11.2	10.2	10.2
30	12.5	12.1	12.5	11.4	11.3
25	13.8	13.4	13.8	12.5	12.4
20	14.8	14.7	14.8	13.7	13.6
10	14.8	14.8	14.8	14.9	14.9
0	14.8	14.8	14.8	14.9	14.9
-10	14.8	14.8	14.8	14.9	14.9
-20	14.8	14.8	14.8	14.9	14.9
-30	14.8	14.8	14.8	14.9	14.9
-40	14.8	14.8	14.8	14.9	14.9

Table 10.3.1.32 Pini>5MPa VFS1000 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	3.2	3.0	3.2	2.5	2.5
45	4.8	4.5	4.8	3.8	3.8
40	6.4	6.0	6.4	5.2	5.1
35	6.6	6.3	6.6	5.4	5.3
30	7.7	7.3	7.7	6.4	6.3
25	8.7	8.3	8.7	7.3	7.2
20	9.8	9.4	9.8	8.3	8.1
10	11.6	11.0	11.6	9.8	9.6
0	14.8	14.3	14.8	12.7	12.4
-10	14.8	14.8	14.8	13.1	12.8
-20	14.8	14.8	14.8	13.6	13.3
-30	14.8	14.8	14.8	14.1	13.8
-40	14.8	14.8	14.8	14.7	14.3

Table 10.3.1.33 Pini>5MPa VFS1000 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.1	1.0	1.1	0.7	0.7
45	2.2	1.9	2.2	1.5	1.4
40	3.2	2.9	3.2	2.2	2.2
35	3.4	3.0	3.4	2.4	2.3
30	4.1	3.8	4.1	3.0	2.8
25	4.9	4.5	4.9	3.6	3.4
20	5.7	5.3	5.7	4.3	4.1
10	7.1	6.6	7.1	5.4	5.2
0	9.5	8.9	9.5	7.5	7.2
-10	9.9	9.2	9.9	7.8	7.5
-20	10.3	9.6	10.3	8.1	7.7
-30	10.7	10.0	10.7	8.4	8.0
-40	11.1	10.4	11.1	8.7	8.3

VFS 1500

Table 10.3.1.34 Pini>5MPa VFS1500 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	5.1	5.1	5.1	5.1	5.1
45	6.9	6.9	6.9	6.9	6.9
40	8.7	8.6	8.3	8.2	8.2
35	9.0	8.8	8.5	8.4	8.4
30	9.5	9.5	9.3	9.2	9.2
25	9.5	9.5	9.5	9.5	9.5
20	9.5	9.5	9.5	9.5	9.5
10	9.5	9.5	9.5	9.5	9.5
0	9.5	9.5	9.5	9.5	9.5
-10	9.5	9.5	9.5	9.5	9.5
-20	9.5	9.5	9.5	9.5	9.5
-30	9.5	9.5	9.5	9.5	9.5
-40	9.5	9.5	9.5	9.5	9.5

Table 10.3.1.35 Pin>5MPa VFS1500 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.9	2.9	2.7	2.7	2.7
45	4.4	4.2	3.9	3.8	3.8
40	5.6	5.3	5.0	4.8	4.7
35	5.7	5.5	5.1	4.9	4.9
30	6.5	6.2	5.8	5.6	5.5
25	7.3	7.0	6.5	6.3	6.2
20	8.1	7.8	7.2	7.0	6.9
10	9.5	9.1	8.4	8.1	7.9
0	9.5	9.5	9.5	9.5	9.5
-10	9.5	9.5	9.5	9.5	9.5
-20	9.5	9.5	9.5	9.5	9.5
-30	9.5	9.5	9.5	9.5	9.5
-40	9.5	9.5	9.5	9.5	9.5

Table 10.3.1.36 Pini>5MPa VFS1500 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.2	1.1	1.0	0.9	1.0
45	2.2	2.0	1.7	1.6	1.6
40	3.1	2.8	2.5	2.3	2.2
35	3.2	3.0	2.6	2.4	2.3
30	3.8	3.6	3.1	2.9	2.8
25	4.5	4.2	3.7	3.4	3.3
20	5.1	4.8	4.2	4.0	3.8
10	6.1	5.7	5.1	4.8	4.6
0	8.0	7.5	6.8	6.4	6.2
-10	8.3	7.7	7.0	6.6	6.3
-20	8.6	8.0	7.2	6.8	6.5
-30	8.9	8.3	7.4	6.9	6.7
-40	9.2	8.5	7.7	7.2	6.8

The APRR value restricted at the t-final min model as is used for MCF model

MF-Twin L/T For Pini≧5MPa

※prerequisite condition：MAX Flow Rate≦180(g/sec)、SOC≦95(%)、MAX APRR≦28.4(MPa/min)（=HPRR32.0(MPa/min) equivalent）

VFS 2000

Table 10.3.1.37 Pini>5MPa VFS2000 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	4.5	4.5	4.5	4.5	4.6
45	6.0	6.0	6.0	6.0	6.0
40	7.1	7.1	7.1	7.0	7.0
35	7.1	7.1	7.1	7.1	7.1
30	7.1	7.1	7.1	7.1	7.1
25	7.1	7.1	7.1	7.1	7.1
20	7.1	7.1	7.1	7.1	7.1
10	7.1	7.1	7.1	7.1	7.1
0	7.1	7.1	7.1	7.1	7.1
-10	7.1	7.1	7.1	7.1	7.1
-20	7.1	7.1	7.1	7.1	7.1
-30	7.1	7.1	7.1	7.1	7.1
-40	7.1	7.1	7.1	7.1	7.1

Table 10.3.1.38 Pini>5MPa VFS2000 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.8	2.8	2.6	2.6	2.6
45	4.0	3.8	3.6	3.5	3.5
40	4.9	4.7	4.4	4.3	4.3
35	5.0	4.8	4.5	4.4	4.3
30	5.7	5.5	5.1	4.9	4.9
25	6.4	6.1	5.7	5.5	5.4
20	7.1	6.7	6.3	6.0	5.9
10	7.1	7.1	7.1	7.0	6.8
0	7.1	7.1	7.1	7.1	7.1
-10	7.1	7.1	7.1	7.1	7.1
-20	7.1	7.1	7.1	7.1	7.1
-30	7.1	7.1	7.1	7.1	7.1
-40	7.1	7.1	7.1	7.1	7.1

Table 10.3.1.39 Pini>5MPa VFS2000 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.3	1.2	1.0	1.0	1.0
45	2.1	2.0	1.7	1.6	1.6
40	2.9	2.7	2.4	2.3	2.2
35	3.0	2.8	2.5	2.3	2.3
30	3.6	3.3	3.0	2.8	2.7
25	4.1	3.8	3.4	3.2	3.1
20	4.6	4.3	3.9	3.6	3.5
10	5.4	5.1	4.6	4.3	4.2
0	7.0	6.6	5.9	5.6	5.4
-10	7.1	6.8	6.1	5.8	5.5
-20	7.1	7.0	6.3	5.9	5.7
-30	7.1	7.1	6.5	6.1	5.8
-40	7.1	7.1	6.7	6.2	5.9

VFS 2500

Table 10.3.1.40 Pini>5MPa VFS2500 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	4.1	4.1	4.1	4.1	4.1
45	5.4	5.4	5.3	5.3	5.3
40	5.7	5.7	5.7	5.7	5.7
35	5.7	5.7	5.7	5.7	5.7
30	5.7	5.7	5.7	5.7	5.7
25	5.7	5.7	5.7	5.7	5.7
20	5.7	5.7	5.7	5.7	5.7
10	5.7	5.7	5.7	5.7	5.7
0	5.7	5.7	5.7	5.7	5.7
-10	5.7	5.7	5.7	5.7	5.7
-20	5.7	5.7	5.7	5.7	5.7
-30	5.7	5.7	5.7	5.7	5.7
-40	5.7	5.7	5.7	5.7	5.7

Table 10.3.1.41 Pini>5MPa VFS2500 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.7	2.7	2.5	2.5	2.5
45	3.6	3.5	3.3	3.2	3.2
40	4.4	4.3	4.0	3.9	3.9
35	4.5	4.4	4.1	4.0	3.9
30	5.1	4.9	4.6	4.4	4.4
25	5.7	5.4	5.1	4.9	4.8
20	5.7	5.7	5.6	5.4	5.3
10	5.7	5.7	5.7	5.7	5.7
0	5.7	5.7	5.7	5.7	5.7
-10	5.7	5.7	5.7	5.7	5.7
-20	5.7	5.7	5.7	5.7	5.7
-30	5.7	5.7	5.7	5.7	5.7
-40	5.7	5.7	5.7	5.7	5.7

Table 10.3.1.42 Pini>5MPa VFS2500 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.3	1.2	1.1	1.0	1.0
45	2.1	2.0	1.7	1.6	1.6
40	2.7	2.7	2.3	2.2	2.1
35	2.8	2.8	2.4	2.2	2.2
30	3.3	3.3	2.8	2.6	2.5
25	3.7	3.8	3.2	3.0	2.9
20	4.2	4.3	3.6	3.4	3.3
10	4.9	5.1	4.2	3.9	3.8
0	5.7	5.7	5.4	5.1	4.9
-10	5.7	5.7	5.5	5.2	5.0
-20	5.7	5.7	5.7	5.3	5.1
-30	5.7	5.7	5.7	5.5	5.2
-40	5.7	5.7	5.7	5.6	5.3

VFS 3000

Table 10.3.1.43 Pini>5MPa VFS3000 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	3.7	3.7	3.7	3.7	3.7
45	4.7	4.7	4.7	4.7	4.7
40	4.7	4.7	4.7	4.7	4.7
35	4.7	4.7	4.7	4.7	4.7
30	4.7	4.7	4.7	4.7	4.7
25	4.7	4.7	4.7	4.7	4.7
20	4.7	4.7	4.7	4.7	4.7
10	4.7	4.7	4.7	4.7	4.7
0	4.7	4.7	4.7	4.7	4.7
-10	4.7	4.7	4.7	4.7	4.7
-20	4.7	4.7	4.7	4.7	4.7
-30	4.7	4.7	4.7	4.7	4.7
-40	4.7	4.7	4.7	4.7	4.7

Table 10.3.1.44 Pini>5MPa VFS3000 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.5	2.5	2.4	2.3	2.3
45	3.4	3.2	3.1	3.0	3.0
40	4.1	3.9	3.7	3.6	3.5
35	4.2	4.0	3.7	3.6	3.6
30	4.7	4.5	4.2	4.0	4.0
25	4.7	4.7	4.6	4.5	4.4
20	4.7	4.7	4.7	4.7	4.7
10	4.7	4.7	4.7	4.7	4.7
0	4.7	4.7	4.7	4.7	4.7
-10	4.7	4.7	4.7	4.7	4.7
-20	4.7	4.7	4.7	4.7	4.7
-30	4.7	4.7	4.7	4.7	4.7
-40	4.7	4.7	4.7	4.7	4.7

Table 10.3.1.45 Pini>5MPa VFS3000 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.3	1.2	1.1	1.1	1.1
45	2.0	1.9	1.7	1.6	1.6
40	2.6	2.4	2.2	2.1	2.1
35	2.7	2.5	2.3	2.2	2.1
30	3.1	2.9	2.6	2.5	2.4
25	3.5	3.3	3.0	2.8	2.7
20	3.9	3.6	3.3	3.1	3.0
10	4.6	4.3	3.9	3.6	3.5
0	4.7	4.7	4.7	4.7	4.5
-10	4.7	4.7	4.7	4.7	4.6
-20	4.7	4.7	4.7	4.7	4.7
-30	4.7	4.7	4.7	4.7	4.7
-40	4.7	4.7	4.7	4.7	4.7

VFS 5000

Table 10.3.1.46 Pini>5MPa VFS5000 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.8	2.8	2.8	2.8	2.8
45	2.8	2.8	2.8	2.8	2.8
40	2.8	2.8	2.8	2.8	2.8
35	2.8	2.8	2.8	2.8	2.8
30	2.8	2.8	2.8	2.8	2.8
25	2.8	2.8	2.8	2.8	2.8
20	2.8	2.8	2.8	2.8	2.8
10	2.8	2.8	2.8	2.8	2.8
0	2.8	2.8	2.8	2.8	2.8
-10	2.8	2.8	2.8	2.8	2.8
-20	2.8	2.8	2.8	2.8	2.8
-30	2.8	2.8	2.8	2.8	2.8
-40	2.8	2.8	2.8	2.8	2.8

Table 10.3.1.47 Pini>5MPa VFS5000 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.0	2.0	1.9	1.9	1.9
45	2.6	2.5	2.3	2.3	2.3
40	2.8	2.8	2.8	2.8	2.7
35	2.8	2.8	2.8	2.8	2.8
30	2.8	2.8	2.8	2.8	2.8
25	2.8	2.8	2.8	2.8	2.8
20	2.8	2.8	2.8	2.8	2.8
10	2.8	2.8	2.8	2.8	2.8
0	2.8	2.8	2.8	2.8	2.8
-10	2.8	2.8	2.8	2.8	2.8
-20	2.8	2.8	2.8	2.8	2.8
-30	2.8	2.8	2.8	2.8	2.8
-40	2.8	2.8	2.8	2.8	2.8

Table 10.3.1.48 Pini>5MPa VFS5000 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.2	1.2	1.0	1.0	1.0
45	1.7	1.6	1.4	1.4	1.4
40	2.1	2.0	1.8	1.8	1.7
35	2.2	2.1	1.8	1.8	1.8
30	2.5	2.3	2.0	2.0	2.0
25	2.8	2.6	2.3	2.3	2.2
20	2.8	2.8	2.5	2.5	2.4
10	2.8	2.8	2.8	2.8	2.8
0	2.8	2.8	2.8	2.8	2.8
-10	2.8	2.8	2.8	2.8	2.8
-20	2.8	2.8	2.8	2.8	2.8
-30	2.8	2.8	2.8	2.8	2.8
-40	2.8	2.8	2.8	2.8	2.8

The APRR value restricted at the t-final min model as is used for MCF model

10.3.2 Protocol of MF-Twin-LT / Non-comm (Table for Ptarget)

Table 10.3.2.1 MF-Twin P-target Table

H70MF_Twin Non Communication Fueling Table_Almighty(T40-T20) Conservative

	P_{target} [MPa]			P_{target} [MPa]									
T_{amb} [℃]	$P_{initial}$ [MPa]			$P_{initial}$ [MPa]									
	< 0.5	0.5	2	5	10	15	20	30	40	50	60	70	> 70
> 50	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling
50	no fueling	81.2	81.9	81.7	80.9	80.0	79.2	77.5	75.9	74.4	73.1	72.5	no fueling
45	no fueling	80.1	80.8	80.6	79.9	79.1	78.3	76.8	75.3	74.0	73.0	72.5	no fueling
40	no fueling	79.0	79.7	79.6	78.9	78.1	77.4	76.0	74.7	73.6	72.8	72.4	no fueling
35	no fueling	77.9	78.6	78.5	77.9	77.2	76.5	75.3	74.2	73.3	72.6	72.4	no fueling
30	no fueling	77.0	77.4	77.2	76.6	75.9	75.2	74.0	72.8	71.9	71.3	71.2	no fueling
25	no fueling	76.0	76.1	75.9	75.2	74.6	73.9	72.6	71.5	70.6	70.0	no fueling	no fueling
20	no fueling	75.1	74.8	74.6	73.9	73.2	72.5	71.3	70.2	69.3	68.7	no fueling	no fueling
10	no fueling	73.2	72.8	72.1	71.3	70.6	69.9	68.6	67.5	66.6	66.2	no fueling	no fueling
0	no fueling	71.3	71.0	70.4	69.3	68.1	67.2	65.9	64.8	64.0	63.6	no fueling	no fueling
-10	no fueling	69.5	69.2	68.6	67.7	66.6	65.5	63.2	62.1	61.3	61.1	no fueling	no fueling
-20	no fueling	67.7	67.4	67.0	66.1	65.2	64.2	62.2	60.0	58.7	no fueling	no fueling	no fueling
-30	no fueling	65.9	65.7	65.3	64.6	63.8	62.9	61.2	59.4	57.5	no fueling	no fueling	no fueling
-40	no fueling	64.2	64.0	63.7	63.1	62.4	61.7	60.3	58.8	57.3	no fueling	no fueling	no fueling
< -40	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling

※This table is divided into two sections which have a table for Pini＜5MPa and the other for Pini≧5MPa. In each section, a linear interpolation to calculate Ptarget is used, but for 2MPa ≦Pini＜5MPa the value of Ptarget for 2MPa column shall be used.

10.3.3 Protocol of MF-Twin-LT / Comm (Table for Plimit)

Table 10.3.3.1 MF-Twin P-limit Table T40

H70MF_Twin Communication Fueling Table_T40

T40	P_{limit} [MPa]			P_{limit} [MPa]									
T_{amb} [°C]	$P_{initial}$ [MPa]			$P_{initial}$ [MPa]									
	< 0.5	0.5	2	5	10	15	20	30	40	50	60	70	> 70
> 50	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling
50	no fueling	86.5	86.5	80.5	84.8	86.6	86.4	85.9	85.3	84.5	83.3	81.4	no fueling
45	no fueling	86.0	85.9	80.4	86.7	86.5	86.2	85.5	84.7	83.7	82.2	80.0	no fueling
40	no fueling	86.2	86.4	80.4	86.5	86.2	85.9	85.0	84.0	82.7	81.0	78.5	no fueling
35	no fueling	80.3	82.4	80.4	86.5	86.2	85.8	84.9	83.9	82.6	80.9	78.4	no fueling
30	no fueling	80.3	83.1	80.3	86.4	86.0	85.5	84.5	83.3	81.8	80.0	77.3	no fueling
25	no fueling	80.4	84.1	80.6	86.3	85.8	85.2	84.0	82.6	81.0	79.0	no fueling	no fueling
20	no fueling	80.2	84.8	80.4	86.2	85.5	84.9	83.5	81.9	80.2	78.0	no fueling	no fueling
10	no fueling	80.3	86.4	80.4	86.0	85.1	84.3	82.6	80.8	78.8	76.4	no fueling	no fueling
0	no fueling	79.8	86.1	86.3	85.2	84.1	82.9	80.7	78.4	76.0	73.3	no fueling	no fueling
-10	no fueling	80.3	86.1	86.0	84.8	83.6	82.5	80.2	78.0	75.6	73.0	no fueling	no fueling
-20	no fueling	80.0	86.1	85.5	84.3	83.2	82.0	79.8	77.5	75.2	no fueling	no fueling	no fueling
-30	no fueling	82.4	85.9	85.2	83.9	82.7	81.6	79.3	77.0	74.7	no fueling	no fueling	no fueling
-40	no fueling	86.0	85.5	84.7	83.5	82.3	81.1	78.8	76.5	74.3	no fueling	no fueling	no fueling
< -40	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling

※This table is divided into two sections which have a table for Pini＜5MPa and the other for Pini≧5MPa. In each section, a linear interpolation to calculate Plimit is used, but for 2MPa ≦Pini＜5MPa the value of Plimit for 2MPa column shall be used.

Table 10.3.3.2 MF-Twin P-limit Table T30

H70MF_Twin Communication Fueling Table_T30

T30	P_{limit} [MPa]			P_{limit} [MPa]									
T_{amb} [°C]	$P_{initial}$ [MPa]			$P_{initial}$ [MPa]									
	< 0.5	0.5	2	5	10	15	20	30	40	50	60	70	> 70
> 50	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling
50	no fueling	80.3	82.2	80.5	86.6	86.3	86.0	85.3	84.5	83.7	82.6	81.1	no fueling
45	no fueling	80.2	81.9	80.2	86.3	86.0	85.7	85.0	84.1	83.2	81.8	79.8	no fueling
40	no fueling	80.0	82.2	80.0	86.1	85.8	85.4	84.5	83.5	82.3	80.7	78.4	no fueling
35	no fueling	80.0	82.3	80.1	86.1	85.8	85.4	84.5	83.4	82.2	80.6	78.3	no fueling
30	no fueling	79.8	82.7	79.9	86.0	85.6	85.2	84.1	82.9	81.5	79.8	77.3	no fueling
25	no fueling	80.0	83.4	80.1	85.9	85.4	84.9	83.7	82.3	80.8	78.8	no fueling	no fueling
20	no fueling	79.9	84.0	80.0	85.8	85.2	84.6	83.2	81.7	80.0	77.9	no fueling	no fueling
10	no fueling	79.7	85.0	79.9	85.6	84.9	84.1	82.4	80.6	78.6	76.3	no fueling	no fueling
0	no fueling	79.7	85.7	79.8	85.3	84.1	83.0	80.8	78.4	76.0	73.2	no fueling	no fueling
-10	no fueling	79.7	85.7	80.1	85.2	84.0	82.8	80.5	78.1	75.6	73.0	no fueling	no fueling
-20	no fueling	79.5	85.7	80.0	85.1	83.9	82.6	80.2	77.7	75.3	no fueling	no fueling	no fueling
-30	no fueling	79.6	85.7	79.9	85.1	83.7	82.4	79.9	77.3	74.9	no fueling	no fueling	no fueling
-40	no fueling	79.7	85.7	84.6	84.7	83.3	82.0	79.4	76.9	74.5	no fueling	no fueling	no fueling
< -40	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling

※This table is divided into two sections which have a table for Pini＜5MPa and the other for Pini≧5MPa. In each section, a linear interpolation to calculate Plimit is used, but for 2MPa ≦Pini＜5MPa the value of Plimit for 2MPa column shall be used.

Table 10.3.3.3 MF-Twin P-limit Table T20

H70MF_Twin Communication Fueling Table_T20

T20	P_{limit} [MPa]			P_{limit} [MPa]									
T_{amb} [°C]	$P_{initial}$ [MPa]			$P_{initial}$ [MPa]									
	< 0.5	0.5	2	5	10	15	20	30	40	50	60	70	> 70
> 50	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling
50	no fueling	79.7	82.2	79.9	85.9	85.7	85.4	84.7	83.9	83.0	81.9	80.6	no fueling
45	no fueling	80.1	82.4	80.1	86.1	85.8	85.4	84.5	83.6	82.6	81.3	79.6	no fueling
40	no fueling	79.8	82.5	79.8	85.8	85.4	85.0	84.0	83.0	81.8	80.4	78.2	no fueling
35	no fueling	79.7	82.4	79.7	85.7	85.3	84.9	84.0	82.9	81.8	80.3	78.2	no fueling
30	no fueling	79.4	82.6	79.5	85.6	85.1	84.7	83.6	82.5	81.1	79.5	77.2	no fueling
25	no fueling	79.5	83.1	79.6	85.4	84.9	84.4	83.2	81.9	80.4	78.6	no fueling	no fueling
20	no fueling	79.3	83.5	79.5	85.3	84.8	84.1	82.8	81.3	79.6	77.6	no fueling	no fueling
10	no fueling	79.3	84.3	79.5	85.2	84.5	83.7	82.1	80.3	78.4	76.1	no fueling	no fueling
0	no fueling	79.1	85.2	79.5	84.9	83.8	82.7	80.6	78.3	75.8	73.2	no fueling	no fueling
-10	no fueling	79.2	85.2	79.5	84.8	83.7	82.6	80.3	78.0	75.5	72.9	no fueling	no fueling
-20	no fueling	79.1	85.2	79.5	84.8	83.6	82.4	80.1	77.6	75.2	no fueling	no fueling	no fueling
-30	no fueling	79.1	85.2	79.5	84.7	83.5	82.3	79.8	77.3	74.9	no fueling	no fueling	no fueling
-40	no fueling	79.2	85.2	79.6	84.7	83.4	82.1	79.5	77.0	74.5	no fueling	no fueling	no fueling
< -40	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling

※This table is divided into two sections which have a table for Pini＜5MPa and the other for Pini≧5MPa. In each section, a linear interpolation to calculate Plimit is used, but for 2MPa ≦Pini＜5MPa the value of Plimit for 2MPa column shall be used.

10.4 Protocol of NF-Single-LT

10.4.1 Protocol of NF-Single-LT (Table for APRR)

NF-Single L/T For Pini<5MPa

※prerequisite condition：MAX Flow Rate≦60(g/sec)、SOC≦95(%)、MAX APRR≦28.4(MPa/min)（=HPRR32.0(MPa/min) equivalent）

VFS 250

Table 10.4.1.1 Pini<5MPa VFS250 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	3.1	2.8			
45	7.9	7.3			
40	9.6	8.9			
35	9.9	9.3			
30	11.1	10.4			
25	12.2	11.5			
20	13.3	12.5			
10	15.1	14.3			
0	16.3	16.4			
-10	16.3	16.4			
-20	16.3	16.4			
-30	16.3	16.4			
-40	16.3	16.4			

Table 10.4.1.2 Pini<5MPa VFS250 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.2	1.7			
45	3.7	3.1			
40	5.1	4.4			
35	5.3	4.7			
30	6.3	5.6			
25	7.3	6.5			
20	8.2	7.5			
10	9.7	8.9			
0	12.2	11.3			
-10	12.7	11.8			
-20	13.3	12.3			
-30	13.9	12.9			
-40	14.5	13.5			

Table 10.4.1.3 Pini<5MPa VFS250 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.5	0.4			
45	1.5	1.2			
40	2.4	2.0			
35	2.6	2.1			
30	3.2	2.7			
25	3.9	3.3			
20	4.5	3.9			
10	5.6	4.9			
0	7.6	6.7			
-10	8.0	7.1			
-20	8.4	7.5			
-30	8.8	7.9			
-40	9.2	8.3			

VFS 500

Table 10.4.1.4 Pini<5MPa VFS500 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	5.5	5.3	4.9	4.7	
45	6.6	6.4	5.9	5.8	
40	7.6	7.3	6.9	6.7	
35	7.8	7.5	7.0	6.8	
30	7.8	7.8	7.6	7.4	
25	7.8	7.8	7.8	7.9	
20	7.8	7.8	7.8	7.9	
10	7.8	7.8	7.8	7.9	
0	7.8	7.8	7.8	7.9	
-10	7.8	7.8	7.8	7.9	
-20	7.8	7.8	7.8	7.9	
-30	7.8	7.8	7.8	7.9	
-40	7.8	7.8	7.8	7.9	

Table 10.4.1.5 Pini<5MPa VFS500 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.7	2.4	1.9	1.8	
45	3.8	3.5	3.0	2.8	
40	4.7	4.4	3.9	3.7	
35	4.9	4.5	4.0	3.8	
30	5.5	5.1	4.6	4.4	
25	6.1	5.7	5.2	4.9	
20	6.6	6.3	5.7	5.5	
10	7.5	7.1	6.5	6.3	
0	7.8	7.8	7.8	7.6	
-10	7.8	7.8	7.8	7.8	
-20	7.8	7.8	7.8	7.9	
-30	7.8	7.8	7.8	7.9	
-40	7.8	7.8	7.8	7.9	

Table 10.4.1.6 Pini<5MPa VFS500 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.9	0.7	0.5	0.4	
45	1.8	1.5	1.2	1.1	
40	2.5	2.2	1.8	1.7	
35	2.7	2.4	2.0	1.8	
30	3.2	2.8	2.4	2.2	
25	3.7	3.3	2.8	2.6	
20	4.1	3.8	3.3	3.0	
10	4.9	4.5	3.9	3.7	
0	6.1	5.7	5.1	4.8	
-10	6.3	5.9	5.3	5.0	
-20	6.5	6.1	5.4	5.1	
-30	6.7	6.2	5.6	5.3	
-40	6.9	6.4	5.8	5.5	

VFS 1000

Table 10.4.1.7 Pini<5MPa VFS1000 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	3.6	3.6	3.5	3.4	3.5
45	3.9	3.9	3.9	3.9	3.9
40	3.9	3.9	3.9	3.9	3.9
35	3.9	3.9	3.9	3.9	3.9
30	3.9	3.9	3.9	3.9	3.9
25	3.9	3.9	3.9	3.9	3.9
20	3.9	3.9	3.9	3.9	3.9
10	3.9	3.9	3.9	3.9	3.9
0	3.9	3.9	3.9	3.9	3.9
-10	3.9	3.9	3.9	3.9	3.9
-20	3.9	3.9	3.9	3.9	3.9
-30	3.9	3.9	3.9	3.9	3.9
-40	3.9	3.9	3.9	3.9	3.9

Table 10.4.1.8 Pini<5MPa VFS1000 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.2	2.1	1.9	1.8	1.8
45	2.9	2.7	2.5	2.4	2.4
40	3.5	3.3	3.0	2.9	2.9
35	3.5	3.4	3.1	3.0	2.9
30	3.9	3.7	3.5	3.3	3.2
25	3.9	3.9	3.8	3.6	3.6
20	3.9	3.9	3.9	3.9	3.8
10	3.9	3.9	3.9	3.9	3.9
0	3.9	3.9	3.9	3.9	3.9
-10	3.9	3.9	3.9	3.9	3.9
-20	3.9	3.9	3.9	3.9	3.9
-30	3.9	3.9	3.9	3.9	3.9
-40	3.9	3.9	3.9	3.9	3.9

Table 10.4.1.9 Pini<5MPa VFS1000 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.9	0.8	0.7	0.6	0.6
45	1.6	1.5	1.2	1.2	1.1
40	2.2	2.0	1.7	1.6	1.6
35	2.3	2.1	1.8	1.7	1.6
30	2.6	2.4	2.1	2.0	1.9
25	2.9	2.7	2.4	2.3	2.2
20	3.2	3.0	2.7	2.5	2.4
10	3.7	3.5	3.1	2.9	2.8
0	3.9	3.9	3.8	3.6	3.5
-10	3.9	3.9	3.9	3.7	3.5
-20	3.9	3.9	3.9	3.8	3.6
-30	3.9	3.9	3.9	3.9	3.7
-40	3.9	3.9	3.9	3.9	3.8

VFS 1500

Table 10.4.1.10 Pini<5MPa VFS1500 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.6	2.6	2.6	2.6	2.6
45	2.6	2.6	2.6	2.6	2.6
40	2.6	2.6	2.6	2.6	2.6
35	2.6	2.6	2.6	2.6	2.6
30	2.6	2.6	2.6	2.6	2.6
25	2.6	2.6	2.6	2.6	2.6
20	2.6	2.6	2.6	2.6	2.6
10	2.6	2.6	2.6	2.6	2.6
0	2.6	2.6	2.6	2.6	2.6
-10	2.6	2.6	2.6	2.6	2.6
-20	2.6	2.6	2.6	2.6	2.6
-30	2.6	2.6	2.6	2.6	2.6
-40	2.6	2.6	2.6	2.6	2.6

Table 10.4.1.11 Pini<5MPa VFS1500 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.7	1.7	1.6	1.6	1.6
45	2.3	2.2	2.1	2.0	2.0
40	2.6	2.6	2.5	2.4	2.4
35	2.6	2.6	2.5	2.5	2.4
30	2.6	2.6	2.6	2.6	2.6
25	2.6	2.6	2.6	2.6	2.6
20	2.6	2.6	2.6	2.6	2.6
10	2.6	2.6	2.6	2.6	2.6
0	2.6	2.6	2.6	2.6	2.6
-10	2.6	2.6	2.6	2.6	2.6
-20	2.6	2.6	2.6	2.6	2.6
-30	2.6	2.6	2.6	2.6	2.6
-40	2.6	2.6	2.6	2.6	2.6

Table 10.4.1.12 Pini<5MPa VFS1500 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.9	0.8	0.7	0.7	0.8
45	1.4	1.3	1.2	1.1	1.1
40	1.9	1.7	1.6	1.5	1.5
35	1.9	1.8	1.6	1.5	1.5
30	2.2	2.1	1.9	1.8	1.7
25	2.4	2.3	2.1	2.0	1.9
20	2.6	2.5	2.3	2.2	2.1
10	2.6	2.6	2.6	2.5	2.4
0	2.6	2.6	2.6	2.6	2.6
-10	2.6	2.6	2.6	2.6	2.6
-20	2.6	2.6	2.6	2.6	2.6
-30	2.6	2.6	2.6	2.6	2.6
-40	2.6	2.6	2.6	2.6	2.6

The APRR value restricted at the t-final min model as is used for MCF model

NF-Single L/T For Pini<5MPa

※prerequisite condition：MAX Flow Rate≦60(g/sec)、SOC≦95(%)、MAX APRR≦28.4(MPa/min)（=HPRR32.0(MPa/min) equivalent）

VFS 2000

Table 10.4.1.13 Pini<5MPa VFS2000 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.9	1.9	1.9	1.9	1.9
45	1.9	1.9	1.9	1.9	1.9
40	1.9	1.9	1.9	1.9	1.9
35	1.9	1.9	1.9	1.9	1.9
30	1.9	1.9	1.9	1.9	1.9
25	1.9	1.9	1.9	1.9	1.9
20	1.9	1.9	1.9	1.9	1.9
10	1.9	1.9	1.9	1.9	1.9
0	1.9	1.9	1.9	1.9	1.9
-10	1.9	1.9	1.9	1.9	1.9
-20	1.9	1.9	1.9	1.9	1.9
-30	1.9	1.9	1.9	1.9	1.9
-40	1.9	1.9	1.9	1.9	1.9

Table 10.4.1.14 Pini<5MPa VFS2000 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.5	1.5	1.5	1.4	1.4
45	1.9	1.9	1.8	1.8	1.8
40	1.9	1.9	1.9	1.9	1.9
35	1.9	1.9	1.9	1.9	1.9
30	1.9	1.9	1.9	1.9	1.9
25	1.9	1.9	1.9	1.9	1.9
20	1.9	1.9	1.9	1.9	1.9
10	1.9	1.9	1.9	1.9	1.9
0	1.9	1.9	1.9	1.9	1.9
-10	1.9	1.9	1.9	1.9	1.9
-20	1.9	1.9	1.9	1.9	1.9
-30	1.9	1.9	1.9	1.9	1.9
-40	1.9	1.9	1.9	1.9	1.9

Table 10.4.1.15 Pini<5MPa VFS2000 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.9	0.8	0.7	0.7	0.7
45	1.3	1.2	1.1	1.1	1.1
40	1.6	1.6	1.4	1.3	1.3
35	1.7	1.6	1.5	1.4	1.4
30	1.9	1.8	1.6	1.6	1.5
25	1.9	1.9	1.8	1.7	1.7
20	1.9	1.9	1.9	1.9	1.8
10	1.9	1.9	1.9	1.9	1.9
0	1.9	1.9	1.9	1.9	1.9
-10	1.9	1.9	1.9	1.9	1.9
-20	1.9	1.9	1.9	1.9	1.9
-30	1.9	1.9	1.9	1.9	1.9
-40	1.9	1.9	1.9	1.9	1.9

VFS 2500

Table 10.4.1.16 Pini<5MPa VFS2500 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.7	1.5	1.5	1.5	1.5
45	1.7	1.5	1.5	1.5	1.5
40	1.7	1.5	1.5	1.5	1.5
35	1.7	1.5	1.5	1.5	1.5
30	1.7	1.5	1.5	1.5	1.5
25	1.7	1.5	1.5	1.5	1.5
20	1.7	1.5	1.5	1.5	1.5
10	1.7	1.5	1.5	1.5	1.5
0	1.7	1.5	1.5	1.5	1.5
-10	1.7	1.5	1.5	1.5	1.5
-20	1.7	1.5	1.5	1.5	1.5
-30	1.7	1.5	1.5	1.5	1.5
-40	1.7	1.5	1.5	1.5	1.5

Table 10.4.1.17 Pini<5MPa VFS2500 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.3	1.3	1.3	1.3	1.3
45	1.7	1.5	1.5	1.5	1.5
40	1.7	1.5	1.5	1.5	1.5
35	1.7	1.5	1.5	1.5	1.5
30	1.7	1.5	1.5	1.5	1.5
25	1.7	1.5	1.5	1.5	1.5
20	1.7	1.5	1.5	1.5	1.5
10	1.7	1.5	1.5	1.5	1.5
0	1.7	1.5	1.5	1.5	1.5
-10	1.7	1.5	1.5	1.5	1.5
-20	1.7	1.5	1.5	1.5	1.5
-30	1.7	1.5	1.5	1.5	1.5
-40	1.7	1.5	1.5	1.5	1.5

Table 10.4.1.18 Pini<5MPa VFS2500 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.8	0.8	0.7	0.7	0.7
45	1.2	1.1	1.0	1.0	1.0
40	1.5	1.4	1.3	1.2	1.2
35	1.5	1.5	1.3	1.3	1.2
30	1.7	1.5	1.5	1.4	1.4
25	1.7	1.5	1.5	1.5	1.5
20	1.7	1.5	1.5	1.5	1.5
10	1.7	1.5	1.5	1.5	1.5
0	1.7	1.5	1.5	1.5	1.5
-10	1.7	1.5	1.5	1.5	1.5
-20	1.7	1.5	1.5	1.5	1.5
-30	1.7	1.5	1.5	1.5	1.5
-40	1.7	1.5	1.5	1.5	1.5

VFS 3000

Table 10.4.1.19 Pini<5MPa VFS3000 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.3	1.3	1.3	1.3	1.3
45	1.3	1.3	1.3	1.3	1.3
40	1.3	1.3	1.3	1.3	1.3
35	1.3	1.3	1.3	1.3	1.3
30	1.3	1.3	1.3	1.3	1.3
25	1.3	1.3	1.3	1.3	1.3
20	1.3	1.3	1.3	1.3	1.3
10	1.3	1.3	1.3	1.3	1.3
0	1.3	1.3	1.3	1.3	1.3
-10	1.3	1.3	1.3	1.3	1.3
-20	1.3	1.3	1.3	1.3	1.3
-30	1.3	1.3	1.3	1.3	1.3
-40	1.3	1.3	1.3	1.3	1.3

Table 10.4.1.20 Pini<5MPa VFS3000 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.2	1.2	1.2	1.2	1.2
45	1.3	1.3	1.3	1.3	1.3
40	1.3	1.3	1.3	1.3	1.3
35	1.3	1.3	1.3	1.3	1.3
30	1.3	1.3	1.3	1.3	1.3
25	1.3	1.3	1.3	1.3	1.3
20	1.3	1.3	1.3	1.3	1.3
10	1.3	1.3	1.3	1.3	1.3
0	1.3	1.3	1.3	1.3	1.3
-10	1.3	1.3	1.3	1.3	1.3
-20	1.3	1.3	1.3	1.3	1.3
-30	1.3	1.3	1.3	1.3	1.3
-40	1.3	1.3	1.3	1.3	1.3

Table 10.4.1.21 Pini<5MPa VFS3000 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.8	0.8	0.9	0.7	0.7
45	1.1	1.0	1.2	0.9	0.9
40	1.3	1.3	1.4	1.1	1.1
35	1.3	1.3	1.5	1.2	1.2
30	1.3	1.3	1.5	1.3	1.3
25	1.3	1.3	1.5	1.3	1.3
20	1.3	1.3	1.5	1.3	1.3
10	1.3	1.3	1.5	1.3	1.3
0	1.3	1.3	1.5	1.3	1.3
-10	1.3	1.3	1.5	1.3	1.3
-20	1.3	1.3	1.5	1.3	1.3
-30	1.3	1.3	1.5	1.3	1.3
-40	1.3	1.3	1.5	1.3	1.3

VFS 5000

Table 10.4.1.22 Pini<5MPa VFS5000 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.7	0.7	0.8	0.8	0.8
45	0.7	0.7	0.8	0.8	0.8
40	0.7	0.7	0.8	0.8	0.8
35	0.7	0.7	0.8	0.8	0.8
30	0.7	0.7	0.8	0.8	0.8
25	0.7	0.7	0.8	0.8	0.8
20	0.7	0.7	0.8	0.8	0.8
10	0.7	0.7	0.8	0.8	0.8
0	0.7	0.7	0.8	0.8	0.8
-10	0.7	0.7	0.8	0.8	0.8
-20	0.7	0.7	0.8	0.8	0.8
-30	0.7	0.7	0.8	0.8	0.8
-40	0.7	0.7	0.8	0.8	0.8

Table 10.4.1.23 Pini<5MPa VFS5000 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.7	0.7	0.8	0.8	0.8
45	0.7	0.7	0.8	0.8	0.8
40	0.7	0.7	0.8	0.8	0.8
35	0.7	0.7	0.8	0.8	0.8
30	0.7	0.7	0.8	0.8	0.8
25	0.7	0.7	0.8	0.8	0.8
20	0.7	0.7	0.8	0.8	0.8
10	0.7	0.7	0.8	0.8	0.8
0	0.7	0.7	0.8	0.8	0.8
-10	0.7	0.7	0.8	0.8	0.8
-20	0.7	0.7	0.8	0.8	0.8
-30	0.7	0.7	0.8	0.8	0.8
-40	0.7	0.7	0.8	0.8	0.8

Table 10.4.1.24 Pini<5MPa VFS5000 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.6	0.6	0.6	0.6	0.6
45	0.7	0.7	0.8	0.7	0.7
40	0.7	0.7	0.8	0.8	0.8
35	0.7	0.7	0.8	0.8	0.8
30	0.7	0.7	0.8	0.8	0.8
25	0.7	0.7	0.8	0.8	0.8
20	0.7	0.7	0.8	0.8	0.8
10	0.7	0.7	0.8	0.8	0.8
0	0.7	0.7	0.8	0.8	0.8
-10	0.7	0.7	0.8	0.8	0.8
-20	0.7	0.7	0.8	0.8	0.8
-30	0.7	0.7	0.8	0.8	0.8
-40	0.7	0.7	0.8	0.8	0.8

The APRR value restricted at the t-final min model as is used for MCF model

NF-Single L/T For Pini≧5MPa

※prerequisite condition：MAX Flow Rate≦60(g/sec)、SOC≦95(%)、MAX APRR≦28.4(MPa/min)（=HPRR32.0(MPa/min) equivalent）

VFS 250

Table 10.4.1.25 Pini>5MPa VFS250 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	6.8	6.1			
45	9.2	8.5			
40	11.4	10.7			
35	11.8	11.1			
30	13.4	12.7			
25	15.0	14.2			
20	16.7	15.8			
10	18.5	18.6			
0	18.5	18.6			
-10	18.5	18.6			
-20	18.5	18.6			
-30	18.5	18.6			
-40	18.5	18.6			

Table 10.4.1.26 Pini>5MPa VFS250 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.7	2.1			
45	4.4	3.8			
40	6.2	5.5			
35	6.5	5.8			
30	7.9	7.0			
25	9.2	8.3			
20	10.5	9.6			
10	12.7	11.8			
0	16.8	15.5			
-10	17.7	16.4			
-20	18.5	17.4			
-30	18.5	18.4			
-40	18.5	18.6			

Table 10.4.1.27 Pini>5MPa VFS500 T40

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.8	0.5			
45	1.9	1.5			
40	3.0	2.5			
35	3.2	2.6			
30	4.0	3.4			
25	4.9	4.2			
20	5.8	5.0			
10	7.5	6.6			
0	10.4	9.4			
-10	11.0	9.9			
-20	11.6	10.5			
-30	12.3	11.1			
-40	13.0	11.7			

VFS 500

Table 10.4.1.28 Pini>5MPa VFS500 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	6.3	6.1	5.7	5.5	
45	7.8	7.5	7.0	6.9	
40	9.0	8.8	8.3	8.1	
35	9.0	9.0	8.5	8.3	
30	9.0	9.0	9.0	9.1	
25	9.0	9.0	9.0	9.1	
20	9.0	9.0	9.0	9.1	
10	9.0	9.0	9.0	9.1	
0	9.0	9.0	9.0	9.1	
-10	9.0	9.0	9.0	9.1	
-20	9.0	9.0	9.0	9.1	
-30	9.0	9.0	9.0	9.1	
-40	9.0	9.0	9.0	9.1	

Table 10.4.1.29 Pini>5MPa VFS500 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	3.2	2.9	2.4	2.2	
45	4.5	4.2	3.7	3.5	
40	5.7	5.4	4.9	4.6	
35	5.9	5.6	5.0	4.8	
30	6.7	6.4	5.8	5.5	
25	7.5	7.1	6.6	6.3	
20	8.4	7.9	7.3	7.0	
10	9.0	9.0	8.6	8.3	
0	9.0	9.0	9.0	9.1	
-10	9.0	9.0	9.0	9.1	
-20	9.0	9.0	9.0	9.1	
-30	9.0	9.0	9.0	9.1	
-40	9.0	9.0	9.0	9.1	

Table 10.4.1.30 Pini>5MPa VFS500 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.2	1.0	0.7	0.6	
45	2.2	1.9	1.6	1.4	
40	3.1	2.8	2.3	2.1	
35	3.3	2.9	2.5	2.3	
30	3.9	3.6	3.1	2.8	
25	4.6	4.2	3.6	3.4	
20	5.2	4.8	4.2	4.0	
10	6.3	5.8	5.2	4.9	
0	8.2	7.7	6.9	6.6	
-10	8.5	7.9	7.2	6.8	
-20	8.8	8.2	7.4	7.1	
-30	9.0	8.5	7.7	7.3	
-40	9.0	8.8	7.9	7.6	

VFS 1000

Table 10.4.1.31 Pini>5MPa VFS1000 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	4.2	4.2	4.1	4.0	4.1
45	4.5	4.5	4.5	4.5	4.5
40	4.5	4.5	4.5	4.5	4.5
35	4.5	4.5	4.5	4.5	4.5
30	4.5	4.5	4.5	4.5	4.5
25	4.5	4.5	4.5	4.5	4.5
20	4.5	4.5	4.5	4.5	4.5
10	4.5	4.5	4.5	4.5	4.5
0	4.5	4.5	4.5	4.5	4.5
-10	4.5	4.5	4.5	4.5	4.5
-20	4.5	4.5	4.5	4.5	4.5
-30	4.5	4.5	4.5	4.5	4.5
-40	4.5	4.5	4.5	4.5	4.5

Table 10.4.1.32 Pini>5MPa VFS1000 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.6	2.5	2.3	2.2	2.2
45	3.4	3.3	3.0	2.9	2.9
40	4.2	4.0	3.7	3.6	3.5
35	4.3	4.1	3.8	3.7	3.6
30	4.5	4.5	4.3	4.1	4.0
25	4.5	4.5	4.5	4.5	4.5
20	4.5	4.5	4.5	4.5	4.5
10	4.5	4.5	4.5	4.5	4.5
0	4.5	4.5	4.5	4.5	4.5
-10	4.5	4.5	4.5	4.5	4.5
-20	4.5	4.5	4.5	4.5	4.5
-30	4.5	4.5	4.5	4.5	4.5
-40	4.5	4.5	4.5	4.5	4.5

Table 10.4.1.33 Pini>5MPa VFS1000 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.2	1.1	0.9	0.9	0.9
45	2.0	1.8	1.6	1.5	1.4
40	2.6	2.4	2.2	2.0	2.0
35	2.7	2.5	2.2	2.1	2.0
30	3.1	2.9	2.6	2.5	2.4
25	3.6	3.3	3.0	2.8	2.7
20	4.0	3.7	3.4	3.2	3.1
10	4.5	4.4	4.0	3.7	3.6
0	4.5	4.5	4.5	4.5	4.5
-10	4.5	4.5	4.5	4.5	4.5
-20	4.5	4.5	4.5	4.5	4.5
-30	4.5	4.5	4.5	4.5	4.5
-40	4.5	4.5	4.5	4.5	4.5

VFS 1500

Table 10.4.1.34 Pini>5MPa VFS1500 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.9	2.9	3.0	3.0	3.0
45	2.9	2.9	3.0	3.0	3.0
40	2.9	2.9	3.0	3.0	3.0
35	2.9	2.9	3.0	3.0	3.0
30	2.9	2.9	3.0	3.0	3.0
25	2.9	2.9	3.0	3.0	3.0
20	2.9	2.9	3.0	3.0	3.0
10	2.9	2.9	3.0	3.0	3.0
0	2.9	2.9	3.0	3.0	3.0
-10	2.9	2.9	3.0	3.0	3.0
-20	2.9	2.9	3.0	3.0	3.0
-30	2.9	2.9	3.0	3.0	3.0
-40	2.9	2.9	3.0	3.0	3.0

Table 10.4.1.35 Pin>5MPa VFS1500 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.1	2.1	2.0	1.9	2.0
45	2.8	2.7	2.5	2.4	2.4
40	2.9	2.9	3.0	2.9	2.9
35	2.9	2.9	3.0	3.0	3.0
30	2.9	2.9	3.0	3.0	3.0
25	2.9	2.9	3.0	3.0	3.0
20	2.9	2.9	3.0	3.0	3.0
10	2.9	2.9	3.0	3.0	3.0
0	2.9	2.9	3.0	3.0	3.0
-10	2.9	2.9	3.0	3.0	3.0
-20	2.9	2.9	3.0	3.0	3.0
-30	2.9	2.9	3.0	3.0	3.0
-40	2.9	2.9	3.0	3.0	3.0

Table 10.4.1.36 Pini>5MPa VFS1500 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.2	1.1	1.0	0.9	1.0
45	1.7	1.6	1.5	1.4	1.4
40	2.2	2.1	1.9	1.8	1.8
35	2.3	2.2	2.0	1.9	1.8
30	2.6	2.5	2.3	2.1	2.1
25	2.9	2.8	2.5	2.4	2.4
20	2.9	2.9	2.8	2.7	2.6
10	2.9	2.9	3.0	3.0	3.0
0	2.9	2.9	3.0	3.0	3.0
-10	2.9	2.9	3.0	3.0	3.0
-20	2.9	2.9	3.0	3.0	3.0
-30	2.9	2.9	3.0	3.0	3.0
-40	2.9	2.9	3.0	3.0	3.0

The APRR value restricted at the t-final min model as is used for MCF model

NF-Single L/T For Pini≧5MPa

※prerequisite condition：MAX Flow Rate≦60(g/sec)、SOC≦95(%)、MAX APRR≦28.4(MPa/min)（=HPRR32.0(MPa/min) equivalent）

VFS 2000

Table 10.4.1.37 Pini>5MPa VFS2000 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	2.2	2.2	2.2	2.2	2.2
45	2.2	2.2	2.2	2.2	2.2
40	2.2	2.2	2.2	2.2	2.2
35	2.2	2.2	2.2	2.2	2.2
30	2.2	2.2	2.2	2.2	2.2
25	2.2	2.2	2.2	2.2	2.2
20	2.2	2.2	2.2	2.2	2.2
10	2.2	2.2	2.2	2.2	2.2
0	2.2	2.2	2.2	2.2	2.2
-10	2.2	2.2	2.2	2.2	2.2
-20	2.2	2.2	2.2	2.2	2.2
-30	2.2	2.2	2.2	2.2	2.2
-40	2.2	2.2	2.2	2.2	2.2

Table 10.4.1.38 Pini>5MPa VFS2000 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.8	1.8	1.7	1.7	1.7
45	2.2	2.2	2.2	2.1	2.1
40	2.2	2.2	2.2	2.2	2.2
35	2.2	2.2	2.2	2.2	2.2
30	2.2	2.2	2.2	2.2	2.2
25	2.2	2.2	2.2	2.2	2.2
20	2.2	2.2	2.2	2.2	2.2
10	2.2	2.2	2.2	2.2	2.2
0	2.2	2.2	2.2	2.2	2.2
-10	2.2	2.2	2.2	2.2	2.2
-20	2.2	2.2	2.2	2.2	2.2
-30	2.2	2.2	2.2	2.2	2.2
-40	2.2	2.2	2.2	2.2	2.2

Table 10.4.1.39 Pini>5MPa VFS2000 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.1	1.0	0.9	0.9	0.9
45	1.6	1.5	1.3	1.3	1.3
40	2.0	1.9	1.7	1.6	1.6
35	2.0	1.9	1.8	1.7	1.6
30	2.2	2.2	2.0	1.9	1.9
25	2.2	2.2	2.2	2.1	2.1
20	2.2	2.2	2.2	2.2	2.2
10	2.2	2.2	2.2	2.2	2.2
0	2.2	2.2	2.2	2.2	2.2
-10	2.2	2.2	2.2	2.2	2.2
-20	2.2	2.2	2.2	2.2	2.2
-30	2.2	2.2	2.2	2.2	2.2
-40	2.2	2.2	2.2	2.2	2.2

VFS 2500

Table 10.4.1.40 Pini>5MPa VFS2500 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.7	1.8	1.8	1.8	1.8
45	1.7	1.8	1.8	1.8	1.8
40	1.7	1.8	1.8	1.8	1.8
35	1.7	1.8	1.8	1.8	1.8
30	1.7	1.8	1.8	1.8	1.8
25	1.7	1.8	1.8	1.8	1.8
20	1.7	1.8	1.8	1.8	1.8
10	1.7	1.8	1.8	1.8	1.8
0	1.7	1.8	1.8	1.8	1.8
-10	1.7	1.8	1.8	1.8	1.8
-20	1.7	1.8	1.8	1.8	1.8
-30	1.7	1.8	1.8	1.8	1.8
-40	1.7	1.8	1.8	1.8	1.8

Table 10.4.1.41 Pini>5MPa VFS2500 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.6	1.6	1.5	1.5	1.5
45	1.7	1.8	1.8	1.8	1.8
40	1.7	1.8	1.8	1.8	1.8
35	1.7	1.8	1.8	1.8	1.8
30	1.7	1.8	1.8	1.8	1.8
25	1.7	1.8	1.8	1.8	1.8
20	1.7	1.8	1.8	1.8	1.8
10	1.7	1.8	1.8	1.8	1.8
0	1.7	1.8	1.8	1.8	1.8
-10	1.7	1.8	1.8	1.8	1.8
-20	1.7	1.8	1.8	1.8	1.8
-30	1.7	1.8	1.8	1.8	1.8
-40	1.7	1.8	1.8	1.8	1.8

Table 10.4.1.42 Pini>5MPa VFS2500 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.0	1.0	0.9	0.9	0.9
45	1.4	1.4	1.2	1.2	1.2
40	1.8	1.7	1.5	1.5	1.5
35	1.7	1.7	1.6	1.5	1.5
30	1.7	1.8	1.8	1.7	1.7
25	1.7	1.8	1.8	1.8	1.8
20	1.7	1.8	1.8	1.8	1.8
10	1.7	1.8	1.8	1.8	1.8
0	1.7	1.8	1.8	1.8	1.8
-10	1.7	1.8	1.8	1.8	1.8
-20	1.7	1.8	1.8	1.8	1.8
-30	1.7	1.8	1.8	1.8	1.8
-40	1.7	1.8	1.8	1.8	1.8

VFS 3000

Table 10.4.1.43 Pini>5MPa VFS3000 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.4	1.5	1.5	1.5	1.5
45	1.4	1.5	1.5	1.5	1.5
40	1.4	1.5	1.5	1.5	1.5
35	1.4	1.5	1.5	1.5	1.5
30	1.4	1.5	1.5	1.5	1.5
25	1.4	1.5	1.5	1.5	1.5
20	1.4	1.5	1.5	1.5	1.5
10	1.4	1.5	1.5	1.5	1.5
0	1.4	1.5	1.5	1.5	1.5
-10	1.4	1.5	1.5	1.5	1.5
-20	1.4	1.5	1.5	1.5	1.5
-30	1.4	1.5	1.5	1.5	1.5
-40	1.4	1.5	1.5	1.5	1.5

Table 10.4.1.44 Pini>5MPa VFS3000 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.4	1.4	1.4	1.4	1.4
45	1.4	1.5	1.5	1.5	1.5
40	1.4	1.5	1.5	1.5	1.5
35	1.4	1.5	1.5	1.5	1.5
30	1.4	1.5	1.5	1.5	1.5
25	1.4	1.5	1.5	1.5	1.5
20	1.4	1.5	1.5	1.5	1.5
10	1.4	1.5	1.5	1.5	1.5
0	1.4	1.5	1.5	1.5	1.5
-10	1.4	1.5	1.5	1.5	1.5
-20	1.4	1.5	1.5	1.5	1.5
-30	1.4	1.5	1.5	1.5	1.5
-40	1.4	1.5	1.5	1.5	1.5

Table 10.4.1.45 Pini>5MPa VFS3000 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	1.0	0.9	0.9	0.8	0.8
45	1.3	1.2	1.2	1.1	1.1
40	1.4	1.5	1.4	1.4	1.4
35	1.4	1.5	1.5	1.4	1.4
30	1.4	1.5	1.5	1.5	1.5
25	1.4	1.5	1.5	1.5	1.5
20	1.4	1.5	1.5	1.5	1.5
10	1.4	1.5	1.5	1.5	1.5
0	1.4	1.5	1.5	1.5	1.5
-10	1.4	1.5	1.5	1.5	1.5
-20	1.4	1.5	1.5	1.5	1.5
-30	1.4	1.5	1.5	1.5	1.5
-40	1.4	1.5	1.5	1.5	1.5

VFS 5000

Table 10.4.1.46 Pini>5MPa VFS5000 T40

Tamb (℃)	T40-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.9	0.9	0.9	0.9	0.9
45	0.9	0.9	0.9	0.9	0.9
40	0.9	0.9	0.9	0.9	0.9
35	0.9	0.9	0.9	0.9	0.9
30	0.9	0.9	0.9	0.9	0.9
25	0.9	0.9	0.9	0.9	0.9
20	0.9	0.9	0.9	0.9	0.9
10	0.9	0.9	0.9	0.9	0.9
0	0.9	0.9	0.9	0.9	0.9
-10	0.9	0.9	0.9	0.9	0.9
-20	0.9	0.9	0.9	0.9	0.9
-30	0.9	0.9	0.9	0.9	0.9
-40	0.9	0.9	0.9	0.9	0.9

Table 10.4.1.47 Pini>5MPa VFS5000 T30

Tamb (℃)	T30-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.9	0.9	0.9	0.9	0.9
45	0.9	0.9	0.9	0.9	0.9
40	0.9	0.9	0.9	0.9	0.9
35	0.9	0.9	0.9	0.9	0.9
30	0.9	0.9	0.9	0.9	0.9
25	0.9	0.9	0.9	0.9	0.9
20	0.9	0.9	0.9	0.9	0.9
10	0.9	0.9	0.9	0.9	0.9
0	0.9	0.9	0.9	0.9	0.9
-10	0.9	0.9	0.9	0.9	0.9
-20	0.9	0.9	0.9	0.9	0.9
-30	0.9	0.9	0.9	0.9	0.9
-40	0.9	0.9	0.9	0.9	0.9

Table 10.4.1.48 Pini>5MPa VFS5000 T20

Tamb (℃)	T20-APRR(MPa/min)				
	TVL 200 (8kg)	TVL 250 (10kg)	TVL 350 (14kg)	TVL 500 (20kg)	TVL 800 (32kg)
50	0.8	0.7	0.7	0.7	0.7
45	0.9	0.9	0.9	0.9	0.9
40	0.9	0.9	0.9	0.9	0.9
35	0.9	0.9	0.9	0.9	0.9
30	0.9	0.9	0.9	0.9	0.9
25	0.9	0.9	0.9	0.9	0.9
20	0.9	0.9	0.9	0.9	0.9
10	0.9	0.9	0.9	0.9	0.9
0	0.9	0.9	0.9	0.9	0.9
-10	0.9	0.9	0.9	0.9	0.9
-20	0.9	0.9	0.9	0.9	0.9
-30	0.9	0.9	0.9	0.9	0.9
-40	0.9	0.9	0.9	0.9	0.9

tekomi

The APRR value restricted at the t-final min model as is used for MCF model

10.4.2 Protocol of NF-Single-LT / Non-comm (Table for Ptarget)

Table 10.4.2.1 NF-Single P-target Table

H70NF_Single Non Communication Fueling Table_Almighty(T40-T20) Conservative

	P_{target} [MPa]			P_{target} [MPa]									
T_{amb} [℃]	$P_{initial}$ [MPa]			$P_{initial}$ [MPa]									
	< 0.5	0.5	2	5	10	15	20	30	40	50	60	70	> 70
> 50	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling
50	no fueling	81.0	81.7	81.5	80.7	79.9	79.0	77.4	75.8	74.4	73.1	72.5	no fueling
45	no fueling	79.9	80.6	80.4	79.7	78.9	78.2	76.7	75.3	74.0	73.0	72.5	no fueling
40	no fueling	78.8	79.5	79.4	78.7	78.0	77.3	75.9	74.7	73.6	72.8	72.4	no fueling
35	no fueling	77.7	78.5	78.3	77.7	77.1	76.4	75.2	74.1	73.2	72.6	72.4	no fueling
30	no fueling	76.8	77.2	77.0	76.4	75.7	75.1	73.9	72.8	71.9	71.3	71.2	no fueling
25	no fueling	75.8	75.9	75.7	75.1	74.4	73.8	72.5	71.5	70.6	70.0	no fueling	no fueling
20	no fueling	74.9	74.6	74.4	73.8	73.1	72.4	71.2	70.1	69.3	68.7	no fueling	no fueling
10	no fueling	73.0	72.7	72.0	71.2	70.5	69.8	68.5	67.4	66.6	66.2	no fueling	no fueling
0	no fueling	71.2	70.9	70.3	69.2	68.0	67.1	65.8	64.8	63.9	63.6	no fueling	no fueling
-10	no fueling	69.4	69.1	68.6	67.6	66.6	65.5	63.1	62.1	61.3	61.1	no fueling	no fueling
-20	no fueling	67.6	67.4	66.9	66.1	65.1	64.2	62.2	60.0	58.7	no fueling	no fueling	no fueling
-30	no fueling	65.9	65.7	65.3	64.5	63.8	62.9	61.2	59.4	57.5	no fueling	no fueling	no fueling
-40	no fueling	64.1	64.0	63.7	63.0	62.4	61.7	60.3	58.8	57.3	no fueling	no fueling	no fueling
< -40	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling

※This table is divided into two sections which have a table for Pini＜5MPa and the other for Pini≧5MPa. In each section, a linear interpolation to calculate Ptarget is used, but for 2MPa ≦Pini＜5MPa the value of Ptarget for 2MPa column shall be used.

10.4.3 Protocol of NF-Single-LT / Comm (Table for Plimit)

Table 10.4.3.1 NF-Single P-limit Table T40

H70NF_Single Communication Plimit Table_T40

T40	P_{limit} [MPa]			P_{limit} [MPa]									
T_{amb} [°C]	$P_{initial}$ [MPa]			$P_{initial}$ [MPa]									
	< 0.5	0.5	2	5	10	15	20	30	40	50	60	70	> 70
> 50	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling
50	no fueling	86.3	86.3	80.7	86.8	86.7	86.5	85.9	85.2	84.2	83.1	81.5	no fueling
45	no fueling	80.6	82.9	80.6	86.7	86.4	86.1	85.3	84.4	83.2	81.9	80.0	no fueling
40	no fueling	80.5	84.0	80.5	86.5	86.1	85.6	84.6	83.6	82.2	80.6	78.5	no fueling
35	no fueling	80.4	84.1	80.6	86.5	86.0	85.6	84.5	83.4	82.1	80.5	78.4	no fueling
30	no fueling	80.4	84.9	80.4	86.3	85.8	85.2	84.1	82.8	81.3	79.6	77.3	no fueling
25	no fueling	80.4	85.8	80.4	86.2	85.5	84.8	83.5	82.1	80.5	78.7	no fueling	no fueling
20	no fueling	80.2	86.4	80.4	86.0	85.3	84.5	83.0	81.4	79.7	77.7	no fueling	no fueling
10	no fueling	80.0	86.3	84.3	85.6	84.7	83.7	82.0	80.2	78.3	76.2	no fueling	no fueling
0	no fueling	85.9	85.5	85.4	84.2	83.1	82.0	79.9	77.8	75.6	73.1	no fueling	no fueling
-10	no fueling	85.6	85.3	85.1	83.9	82.8	81.7	79.6	77.4	75.2	72.9	no fueling	no fueling
-20	no fueling	85.4	85.0	84.9	83.7	82.5	81.4	79.2	77.1	74.9	no fueling	no fueling	no fueling
-30	no fueling	85.2	84.8	84.6	83.4	82.2	81.1	78.9	76.7	74.6	no fueling	no fueling	no fueling
-40	no fueling	84.9	84.5	84.3	83.1	81.9	80.8	78.6	76.4	74.2	no fueling	no fueling	no fueling
< -40	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling

※This table is divided into two sections which have a table for Pini＜5MPa and the other for Pini≧5MPa. In each section, a linear interpolation to calculate Plimit is used, but for 2MPa ≦Pini＜5MPa the value of Plimit for 2MPa column shall be used.

Table 10.4.3.2 NF-Single P-limit Table T30

H70NF_Single Communication Plimit Table_T30

T30	P_{limit} [MPa]			P_{limit} [MPa]									
T_{amb} [°C]	$P_{initial}$ [MPa]			$P_{initial}$ [MPa]									
	< 0.5	0.5	2	5	10	15	20	30	40	50	60	70	> 70
> 50	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling
50	no fueling	80.5	82.0	80.4	86.6	86.4	86.1	85.4	84.7	83.9	82.8	81.3	no fueling
45	no fueling	80.2	82.4	80.3	86.4	86.1	85.7	85.0	84.1	83.0	81.8	79.9	no fueling
40	no fueling	80.1	83.1	80.2	86.2	85.8	85.4	84.4	83.3	82.1	80.5	78.4	no fueling
35	no fueling	80.1	83.1	80.2	86.2	85.8	85.3	84.3	83.2	82.0	80.5	78.3	no fueling
30	no fueling	79.9	83.7	80.1	86.0	85.5	85.0	83.9	82.6	81.3	79.6	77.3	no fueling
25	no fueling	80.0	84.5	80.2	85.9	85.3	84.7	83.4	82.0	80.5	78.6	no fueling	no fueling
20	no fueling	79.9	85.3	80.1	85.7	85.0	84.3	82.9	81.3	79.6	77.7	no fueling	no fueling
10	no fueling	79.8	85.9	80.1	85.5	84.6	83.8	82.0	80.2	78.3	76.2	no fueling	no fueling
0	no fueling	79.6	85.6	79.8	85.1	83.9	82.7	80.4	78.1	75.7	73.1	no fueling	no fueling
-10	no fueling	79.7	85.6	79.7	85.0	83.8	82.5	80.2	77.8	75.4	72.9	no fueling	no fueling
-20	no fueling	79.7	85.5	80.6	84.9	83.6	82.3	79.9	77.5	75.1	no fueling	no fueling	no fueling
-30	no fueling	79.5	85.5	83.9	84.6	83.3	82.0	79.6	77.2	74.8	no fueling	no fueling	no fueling
-40	no fueling	79.6	85.4	85.7	84.3	83.0	81.7	79.2	76.8	74.4	no fueling	no fueling	no fueling
< -40	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling

※This table is divided into two sections which have a table for Pini＜5MPa and the other for Pini≧5MPa. In each section, a linear interpolation to calculate Plimit is used, but for 2MPa ≦Pini＜5MPa the value of Plimit for 2MPa column shall be used.

Table 10.4.3.3 NF-Single P-limit Table T20

H70NF_Single Communication Plimit Table_T20

T20	P_{limit} [MPa]			P_{limit} [MPa]									
T_{amb} [°C]	$P_{initial}$ [MPa]			$P_{initial}$ [MPa]									
	< 0.5	0.5	2	5	10	15	20	30	40	50	60	70	> 70
> 50	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling
50	no fueling	80.2	82.3	80.4	86.5	86.2	85.8	85.0	84.2	83.2	82.2	80.9	no fueling
45	no fueling	80.1	82.5	80.1	86.2	85.8	85.4	84.5	83.6	82.6	81.4	79.7	no fueling
40	no fueling	79.8	82.8	79.9	85.9	85.4	85.0	84.0	82.9	81.7	80.3	78.3	no fueling
35	no fueling	79.7	82.8	79.8	85.8	85.4	84.9	83.9	82.9	81.6	80.2	78.2	no fueling
30	no fueling	79.5	83.1	79.6	85.6	85.2	84.6	83.5	82.3	81.0	79.4	77.2	no fueling
25	no fueling	79.6	83.7	79.7	85.5	84.9	84.3	83.1	81.7	80.2	78.5	no fueling	no fueling
20	no fueling	79.4	84.2	79.6	85.3	84.7	84.0	82.6	81.1	79.5	77.6	no fueling	no fueling
10	no fueling	79.3	85.1	79.5	85.1	84.3	83.5	81.9	80.1	78.2	76.0	no fueling	no fueling
0	no fueling	79.1	85.1	79.5	84.7	83.6	82.5	80.3	78.0	75.7	73.1	no fueling	no fueling
-10	no fueling	79.1	85.1	79.5	84.6	83.5	82.4	80.1	77.8	75.4	72.9	no fueling	no fueling
-20	no fueling	79.1	85.0	79.4	84.6	83.4	82.2	79.9	77.5	75.1	no fueling	no fueling	no fueling
-30	no fueling	79.1	85.0	79.3	84.5	83.3	82.1	79.7	77.3	74.8	no fueling	no fueling	no fueling
-40	no fueling	78.9	85.0	79.3	84.5	83.2	81.9	79.5	77.0	74.5	no fueling	no fueling	no fueling
< -40	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling	no fueling

※This table is divided into two sections which have a table for Pini＜5MPa and the other for Pini≧5MPa. In each section, a linear interpolation to calculate Plimit is used, but for 2MPa ≦Pini＜5MPa the value of Plimit for 2MPa column shall be used.

10.5 Protocol of MF-Single-LT-A,B,C Category

10.5.1 Protocol of MF-Single-LT-A,B,C Category (Table for APRR)

NF-Single L/T -A,B,C Category

※prerequisite condition：MAX Flow Rate≦60(g/sec)、SOC≦95(%)、MAX APRR≦28.4(MPa/min)（=HPRR32.0(MPa/min) equivalent）

For Pini<5MPa

Table 10.5.1.1 Pini<5MPa T40

Tamb (℃)	T40		
	2-4kg (A)	4-7kg (B)	7-10kg (C)
50	2.8	4.2	7.1
45	5.7	9.1	9.1
40	11.8	11.5	11.0
35	12.7	12.1	11.4
30	15.2	13.9	12.6
25	17.7	15.5	13.9
20	20.2	17.1	15.1
10	24.4	19.9	16.6
0	28.4	24.4	16.6
-10	28.4	24.5	16.6
-20	28.4	24.5	16.6
-30	28.4	24.5	16.6
-40	28.4	24.5	16.6

Table 10.5.1.2 Pini<5MPa T30

Tamb (℃)	T30		
	2-4kg (A)	4-7kg (B)	7-10kg (C)
50	1.5	2.1	2.7
45	3.9	3.9	4.3
40	6.2	5.7	5.9
35	6.7	6.1	6.2
30	8.5	7.5	7.3
25	10.4	8.9	8.4
20	12.4	10.3	9.5
10	15.9	12.6	11.2
0	21.4	16.3	14.0
-10	23.3	17.3	14.6
-20	25.3	18.3	15.3
-30	27.6	19.5	16.0
-40	28.4	20.6	16.6

Table 10.5.1.3 Pini<5MPa T20

Tamb (℃)	T20		
	2-4kg (A)	4-7kg (B)	7-10kg (C)
50	0.5	0.5	0.8
45	1.6	1.5	1.8
40	3.0	2.6	2.7
35	3.4	2.8	2.9
30	4.5	3.6	3.6
25	5.6	4.5	4.4
20	6.9	5.4	5.1
10	9.2	7.0	6.4
0	13.3	9.8	8.7
-10	14.6	10.5	9.1
-20	16.0	11.2	9.6
-30	17.6	11.9	10.0
-40	19.1	12.7	10.5

For Pini≧5MPa

Table 10.5.1.4 Pini>5MPa T40

Tamb (℃)	T40		
	2-4kg (A)	4-7kg (B)	7-10kg (C)
50	5.5	7.0	7.9
45	9.3	10.3	10.6
40	13.2	13.5	13.0
35	14.4	14.2	13.5
30	17.6	16.5	15.3
25	20.8	18.9	17.1
20	24.2	21.3	18.9
10	28.4	25.6	18.9
0	28.4	27.7	18.9
-10	28.4	27.7	18.9
-20	28.4	27.7	18.9
-30	28.4	27.7	18.9
-40	28.4	27.7	18.9

Table 10.5.1.5 Pini>5MPa T30

Tamb (℃)	T30		
	2-4kg (A)	4-7kg (B)	7-10kg (C)
50	2.2	2.6	3.3
45	4.6	4.7	5.2
40	7.2	7.0	7.2
35	7.9	7.5	7.6
30	10.2	9.3	9.1
25	12.7	11.2	10.6
20	15.4	13.2	12.1
10	20.4	16.6	14.6
0	28.4	22.3	18.9
-10	28.4	24.0	18.9
-20	28.4	25.9	18.9
-30	28.4	27.7	18.9
-40	28.4	27.7	18.9

Table 10.5.1.6 Pini>5MPa T20

Tamb (℃)	T20		
	2-4kg (A)	4-7kg (B)	7-10kg (C)
50	0.7	0.7	1.1
45	2.2	2.0	2.2
40	3.7	3.2	3.4
35	4.1	3.5	3.6
30	5.5	4.5	4.6
25	7.0	5.7	5.6
20	8.7	7.0	6.7
10	12.0	9.3	8.6
0	18.3	13.7	12.0
-10	20.4	14.8	12.7
-20	22.7	15.9	13.4
-30	25.2	17.1	14.1
-40	28.2	18.5	14.9

The APRR value restricted at the t-final min model as is used for MCF model