Data sheet

Large CO_2 Ejector
Type HP and LP

Improves COP and reduces the swept volume of compressors in CO_2 systems

Description

The solution consist of Large CO_2 Ejectors and EKE 80 controller. Reduces energy costs while optimizing overall system performance.

CO_2 systems with Large CO_2 Ejectors deliver lower energy consumption. This solution eliminates the CO_2 equator entirely.

The Large CO_2 Ejector HP type is designed for CO_2 systems with parallel compression. It lifts a part of the gas from MT suction and mixes it with the gas coming from the gas cooler at medium pressure level.

Large CO_2 Ejectors LP type is designed for CO_2 booster systems. It lifts the entire gas from MT suction and mixes it with the gas coming from the gas cooler at medium pressure level.

List of Abbreviations in this document:
GC - Gas cooler
HP - High Pressure Lift
LP - Low Pressure Lift
HT - Hight Temperature
IT - Intermediate Temperature
LT - Low Temperature
MT - Medium Temperature

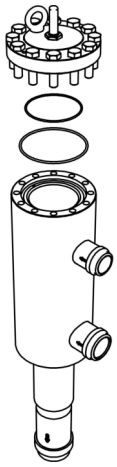
Features & benefits

- Improved COP and enhanced system operation, with reduced compressor swept volume, resulting in lower energy consumption
- Fixed geometry enhances efficiency by optimizing flow dynamics and minimizing energy loses
- The combination of Large CO_2 Ejector and EKE 80 Ejector Controller ensures easy setup and commissioning, and optimizes ejector operation to achieve maximum system performance
- Reliable and robust design
- Fully integrated solution requiring no additional components such as check valves or filters
- Fully serviceable, with a complete spare parts program (cartridge, filter, O-rings)
- Easily accessible strainer / filter for fast maintenance
- Housing and cartridge delivered separately

Ordering

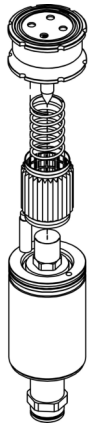
Product code numbers

Table: Housing assembly



Type	Connector type	Code number
HP 16000 / LP 8800	Butt weld, DIN (EN 10220)	**032F1604**
HP 8000 / LP 4400	Butt weld, DIN (EN 10220)	**032F1605**
HP 16000 / LP 8800	Butt weld, ANSI (ASME B 36.10M Schedule 80/40)	**032F1606**
HP 8000 / LP 4400	Butt weld, ANSI (ASME B 36.10M Schedule 80/40)	**032F1607**

Table: Cartridge assembly



Type	Capacity - Mass flow[1]	Capacity - Mass flow[2]	Code no. Single pack
	[kg/h]	[lb/h]	
HP 16000	16000	35274	**032F1600**
HP 8000	8000	17637	**032F1601**
LP 8800	8800	19400	**032F1602**
LP 4400	4400	9700	**032F1603**

[1] R744 at 90 bar / 35 °C

[2] R744 at 1305 psi / 95 °F

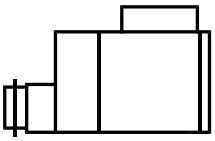
The above code numbers are without coils which should be ordered separately.

Ejector Controller

Type	Code Number
EKE 80	**080G5022**

Accessories code numbers

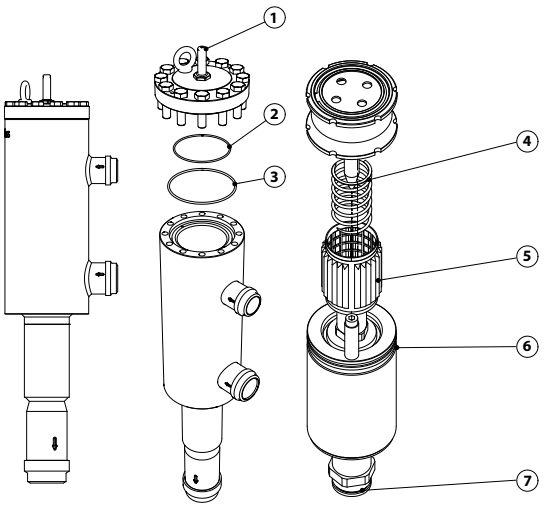
Coils



Type	$T_{ambient}$	Supply voltage	Voltage variation	Frequency	Power consumption	Code number
	[°C]	[V]		[Hz]	[W]	
BE230AS	-40T50	220	-15%, +10%	50	11	**018F6176**
		230	-15%, +10%	50	12	
BT240C	-40T50	110	-10%, +10%	50	12	**018F4180**
		110 - 120	-10%, +10%	60	12	
		230	-10%, +10%	50	12	
		208 - 240	-10%, +10%	60	12	
BE024CS	-40T50	24	-10%, +10%	50	13	**018F6077**
				60	11	

Spare parts code numbers

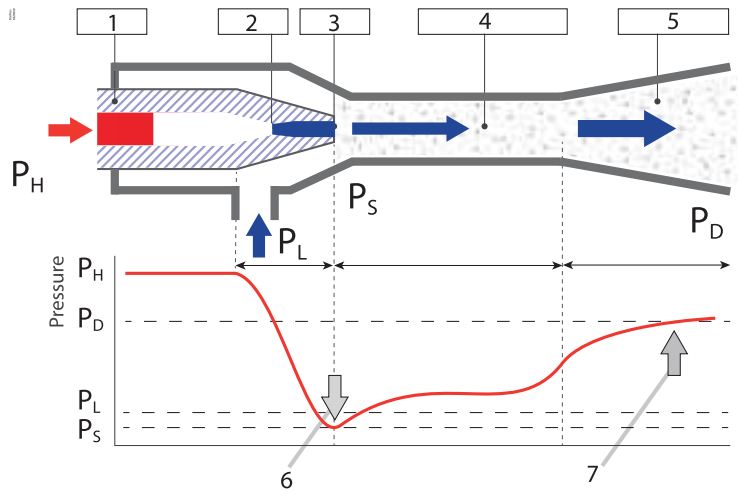
Table: Spare parts



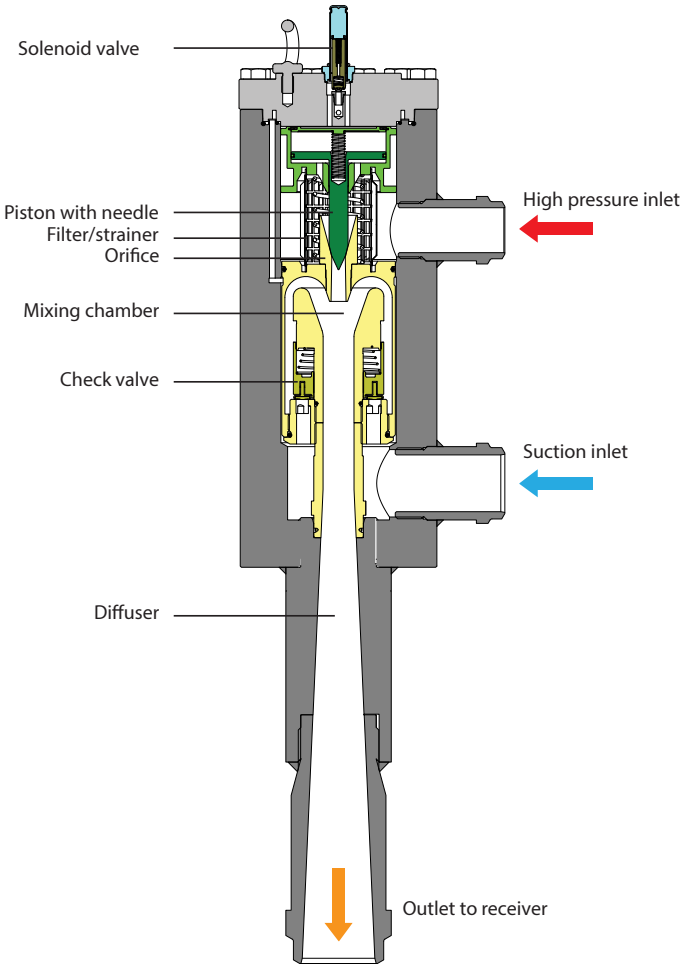
Type	Parts included (see drawing)	Code number
Inspection kit	2, 3	**032F1611**
Repair kit	1, 2, 3	**032F1612**
Overhaul kit	2, 3, 4, 5, 6, 7	**032F1610**

Functions

Figure 1: The Ejector function



1	Motive nozzle
2	Throat
3	Exit
4	Mixing chamber
5	Diffuser
6	Intake due to pressure differential
7	Pressure increases due to reducing flow velocity



The ejector is essentially an expansion nozzle that accelerates the flow to very high velocities, resulting in a low-pressure region downstream of the throat (3).

In this case with the Large CO_2 Ejector, the energy comes from the CO_2 leaving the gas cooler. The high-pressure CO_2 (P_H) enters the motive nozzle where the expansion is taking place. At the exit of the orifice, the CO_2 velocity is very high, which consequently results in a low pressure.

This low pressure is used to pull CO_2 from suction side of the system (P_L). From there the two flows are mixed in the mixing chamber where pressure will be lower than at the high-pressure inlet due to the mixing of vapor from a higher pressure.

After mixing, the flow enters the diffuser, where it slows down. The diffuser's shape converts kinetic energy (velocity) into potential energy (pressure). After the diffuser, the flow is returned to the receiver.

A check valve protects the system's suction side from refrigerant leakage from the high-pressure side during ejector standstill.

The built-in strainer ensures proper operation of the valve.

Product details

Main functionalities

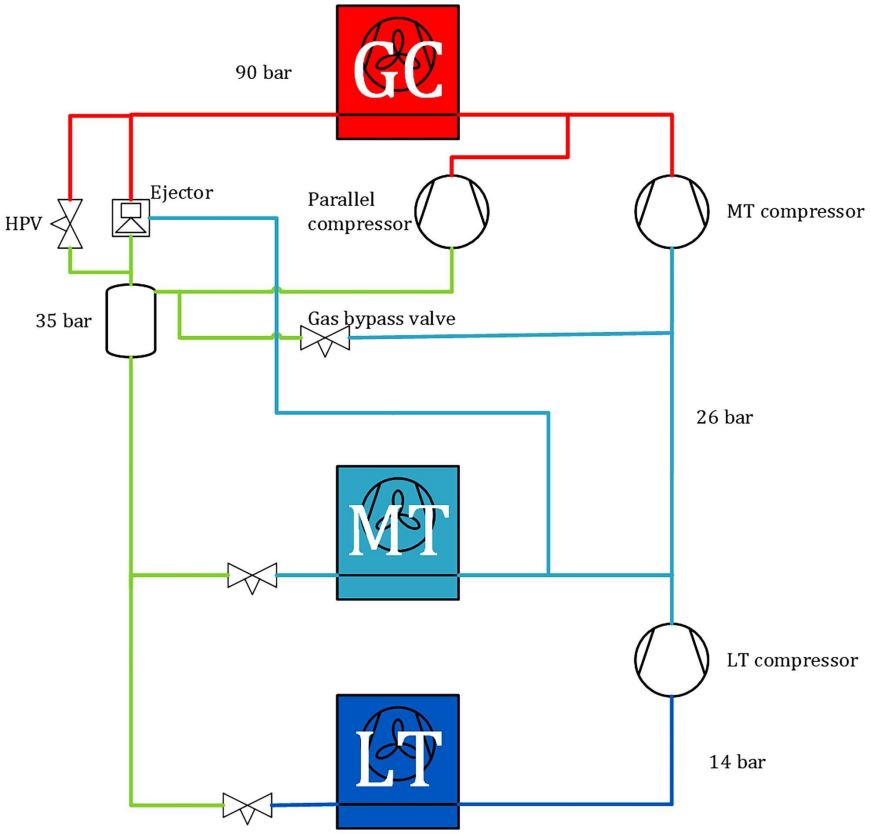
Ejector system types

Ejectors are normally used in several different configurations, which are described below.

High Pressure Ejector

The high-pressure ejector lifts MT flow to IT receiver pressure where it is taken by the parallel compressors. Parallel compressors operate with higher efficiency and require less swept volume than MT compressors, as the suction pressure is higher. This results in savings in both installation and operation.

Figure 2: HP Ejector with sample pressure levels



At lower gas cooler pressures, the ejector and parallel compressors are deactivated, and the gas content of the IT receiver is flashed to MT pressure. This corresponds to traditional booster operation; however, because the gas cooler pressure is low (most likely subcritical), the system efficiency remains high.

As the ambient temperature increases, the amount of gas generated by flashing in the HPV valve increases. In systems without ejectors, it typically becomes beneficial to start the parallel compressors at ambient temperatures of 15 – 20 °C. With ejectors, however, the parallel compressors can be started at ambient temperatures 5 – 7 K lower, allowing the benefits of parallel compression to be utilized over a larger portion of the year.

Using ejectors therefore enhances and extends the effective use of parallel compressors.

Low Pressure Ejector

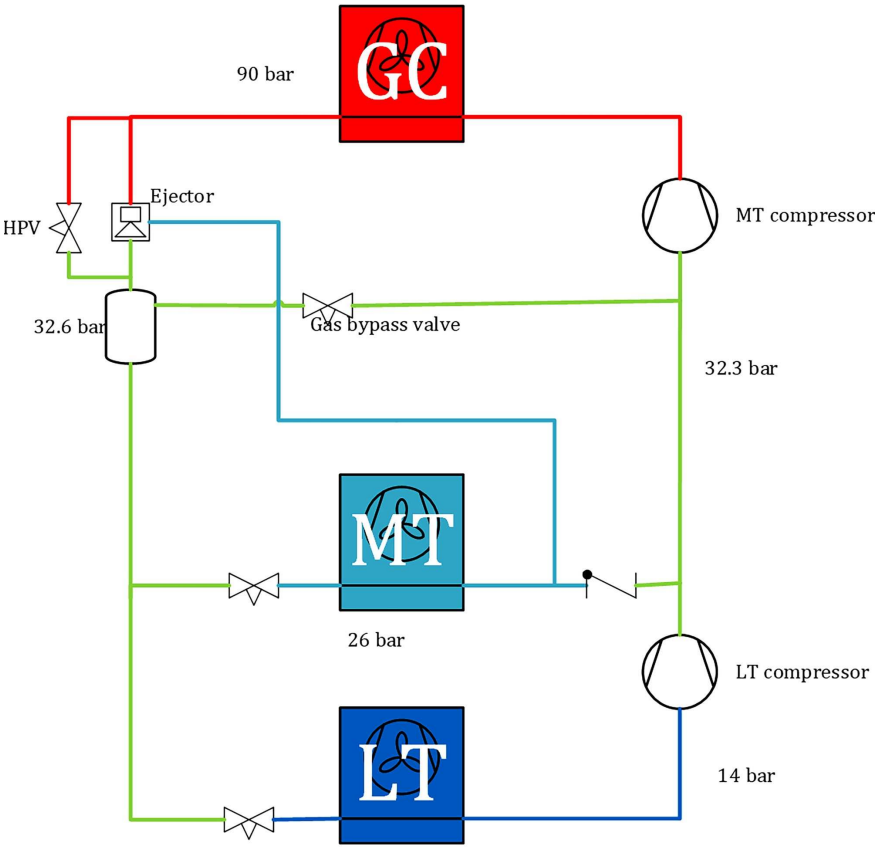
The low-pressure ejector takes the entire flow from the MT evaporator and lifts it to the IT tank pressure. In this way, the MT compressor suction is no longer directly tied to the MT evaporating pressure and can operate at a higher pressure, resulting in improved compressor efficiency.

The MT compressor suction pressure can be set slightly below the IT tank pressure—sufficient to allow adequate flow through the gas bypass valve. As the LT compressor discharge pressure increases, the efficiency of the LT compressors decreases, partially offsetting the efficiency gains achieved in the MT compressors. If the LT load is relatively high compared to the MT load, the overall efficiency gain may not be positive. In such cases, an HP ejector system is recommended. This assessment must be made during the system design phase.

When the ejector is activated, the check valve in the MT evaporator line to the LT discharge/MT suction line closes as the MT evaporating pressure drops, allowing the LT discharge/MT suction pressure to remain above the MT evaporator pressure.

When the ejector is not activated—such as during low gas cooler outlet temperatures (low gas cooler pressure)—there is no flow in the ejector suction line, and the MT compressors must handle the entire flow. In this operating mode, the MT compressor suction pressure and MT evaporator pressure are the same (minus the check valve pressure drop), and the system operates as a conventional booster unit. As this occurs at low gas cooler pressure (most likely subcritical), system efficiency remains high.

Figure 3: LP ejector with sample pressure levels



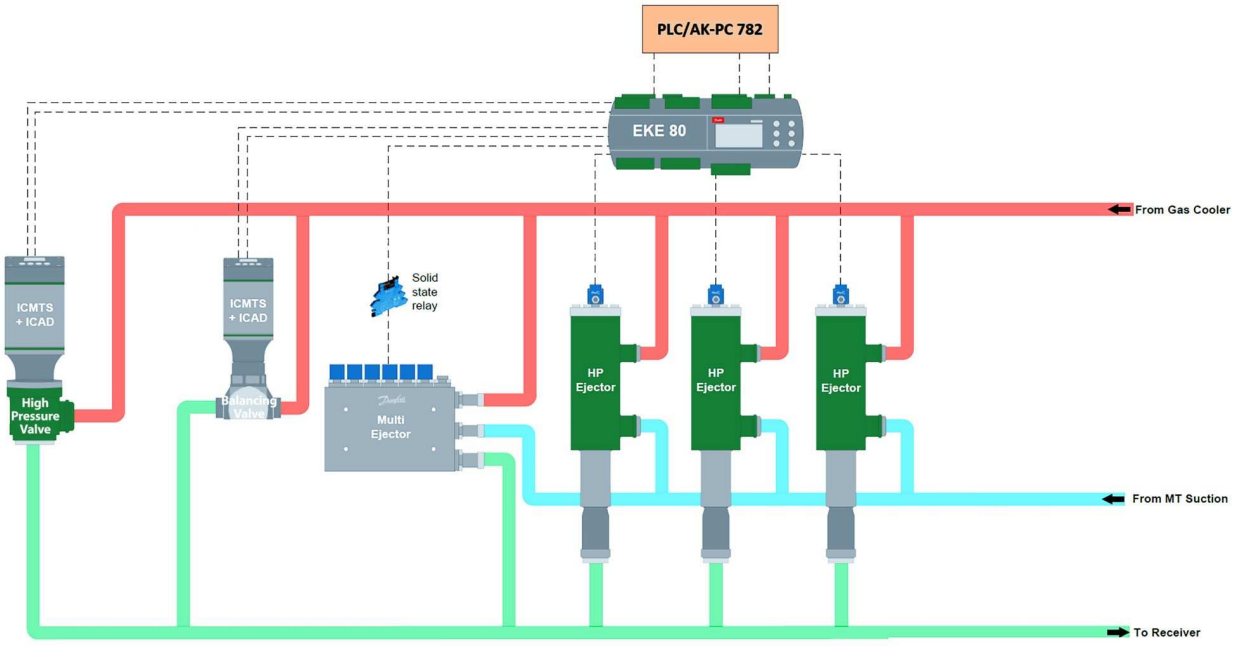
When the ejector is activated (at high gas cooler outlet temperatures), the ejector controls the evaporating pressure. As mentioned earlier, the ejector itself cannot regulate flow; therefore, the HPV valve or a dedicated balancing valve (see the control section) must regulate the flow to the ejector motive port. This regulation ensures that the ejector suction flow maintains the MT evaporating pressure at the required level.

Ejector control

In trans critical systems, the ejector replaces the high pressure valve (HPV) by controlling the gas cooler pressure. Since the Danfoss ejector has fixed geometry, it is not possible to modulate its capacity directly. The solution is to use multiple ejectors and, if necessary, a (small) HPV valve to smooth the capacity steps between ejectors. In this context, the HPV is referred to as a balancing valve.

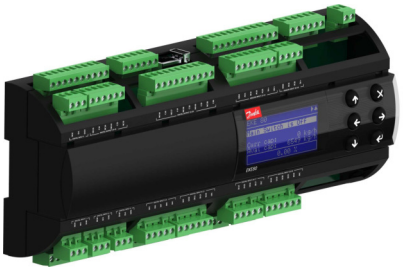
Accordingly, in the above application drawings, the ejector arrangement consists of an array of large ejectors, a small multi-ejector, and a balancing valve. The ejectors and the balancing valve are paired with the EKE 80 Ejector Controller, which ensures smooth regulation across the entire capacity range by sequencing the ejectors.

Figure 4: Ejector control example 1



Controller for Large CO_2 Ejector

Figure 5: EKE 80 Ejector Controller



The EKE 80 Ejector Controller can drive a range of High-Pressure (HP) and Low-Pressure (LP) Large CO_2 Ejectors, Multi Ejectors (ME), as well as ICAD B actuators operating Danfoss ICMTS motor-operated valves. The EKE 80 helps reduce overall energy consumption by enabling the lifting of the Medium Temperature (MT) suction flow and by offloading the MT compressors.

The controller is compatible with Danfoss AK-PC 782A and AK-PC 782B controllers and is Modbus RTU interoperable with PLCs. The EKE 80 Ejector Controller can be easily integrated into existing cooling solutions with minimal effort, both in terms of physical installation and regulatory compliance.

The EKE 80 Ejector Controller requires two input signals from the main controller or PLC: one digital input (DI) enabling signal and one analog input (AI) capacity reference signal. It provides the appropriate output signals to the ejectors and valve actuators.

When more than four ejectors are used, the EKE 80 can also drive an expansion module. Together, the EKE 80 and the EKE 80 Expansion Module can operate up to eight Large Ejectors (LE), or seven Large Ejectors and one Multi Ejector, as well as two ICAD B actuators.

Features & Benefits

- Designed ready-to-connect supply power, sensors, ejectors and MOV actuators needed for HP and LP control applications using ejectors
- Modbus RTU communication
- LCD interface
- Seamless ejector and valve control of a wide load range
- Alarms

Disclaimer

WARNING:

The Large CO_2 Ejector is approved for use only with Danfoss EKE 80 Ejector Controller.

Danfoss expressly disclaims any responsibility or liability, whether based on contract, breach of warranty, tort, statute or otherwise, shall be excluded, if Large CO_2 Ejector is used with any controller other than a Danfoss controller type EKE 80.

For further information on EKE 80, please see separate document.

Materials

Description	Values
Housing and connectors	S355J2+N, EN 10025
Top cover	S355J2+N, EN 10025
Armature tube	1.4306 EN 10272
Bolts	Stainless steel A2-70
O-rings	EPDM

Pressure and temperature data

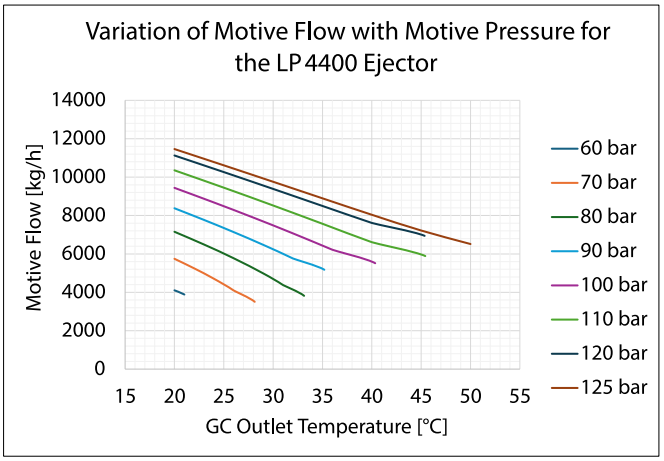
Description	Values
Refrigerant	R744 with POE or PAG oil
Maximum working pressure	140 bar / 2031 psi
Max. OPD	90 bar / 1305 psi
Min. OPD	1 bar / 14.5 psi
Media temp. range	-30 °C – +50 °C / -22 °F – 122 °F
Ambient temp. range	-30 °C – +50 °C / -22 °F – 122 °F

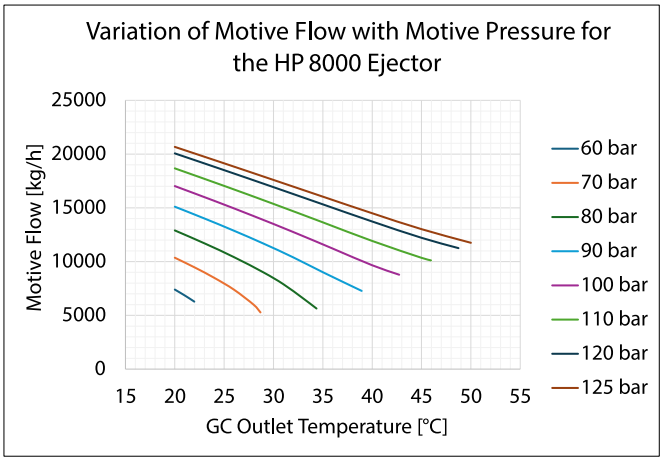
Performance and environmental conditions

Operating range

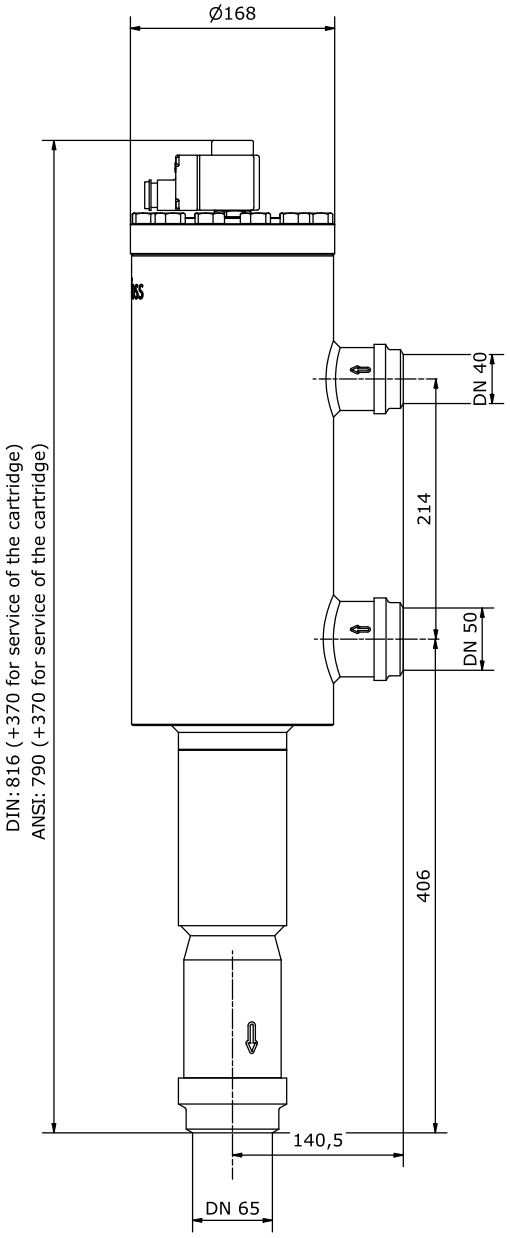
Large CO_2 Ejector Type	High Pressure (HP)	Low Pressure (LP)
CO_2 system	Parallel compression	Booster
Media on suction side	Primarily gas	Primarily gas
Lift/entrainment @ low ambient	7 bar/0.26 @ 27 °C & 70 bar	3.4 bar/0.62 @ 27 °C & 70 bar
Lift/entrainment @ high ambient	11 bar/0.3 @ 39 °C & 100 bar	6.6 bar/0.51 @ 39 °C & 100 bar

The gas cooler (GC) temperature is maintained within the valid operating range for the respective pressure



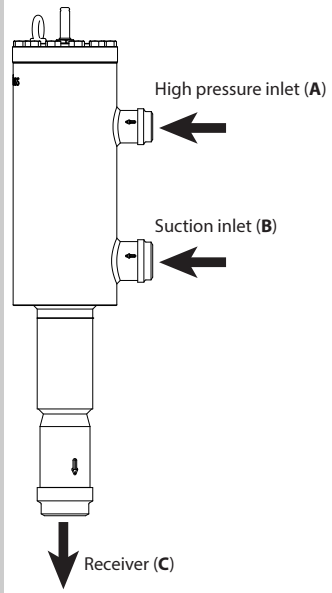


Dimensions



NOTE:
Weight: 70 kg/154 lb.

Connections



Connector type	Connector size	
	Butt weld DIN (2448)	Butt weld, ANSI (ASME B 36.10)
High pressure inlet (A)	DN 40	1½ inch
Suction inlet (B)	DN 50	2 inch
Outlet to - receiver (C)	DN 65	2½ inch

Figure: D: Butt-weld DIN (2448)

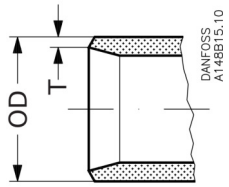


Table: Butt-weld DIN

Size	Size	OD	T	OD	T
[mm]	[in]	[mm]	[mm]	[in]	[in]
40	1½	48.3	2.6	1.902	0.103
50	2	60.3	2.9	2.37	0.11
65	2½	76.1	2.9	3	0.11

Figure: A: Butt-weld ANSI (B 36.10)

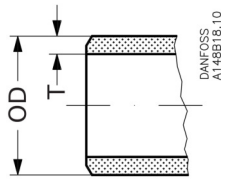


Table: Butt-weld ANSI

Size	Size	OD	T	OD	T	Schedule
[mm]	[in]	[mm]	[mm]	[in]	[in]	
40	1½	48.3	5.1	1.902	0.201	80
50	2	60.3	3.9	2.37	0.15	40
65	2½	73.0	5.2	2.87	0.20	40

Certificates, declarations and approvals

The list contains all certificates, declarations, and approvals for this product type. Individual code number may have some or all of these approvals, and certain local approvals may not appear on the list.

When you click on the link you will be directed to the latest version of the 'Declaration of Conformity'. Products developed and sold before this date of issue conform to the directives/standards in force at the time of their sale.

Approval type	Title	Certification body	Approval topic
Export Control Declaration	Large Ejector	Danfoss	

Contact details

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