Danfoss

Solenoid valves for
R410A and R744 (CO$_2$)
EVR 2 and 3,
EVRH 6 $\rightarrow$ 20

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Technical Leaflet   **Solenoid Valves for R410A and R744 (CO_2), EVR 2 and 3, EVRH 6 to 20 Normally Closed**

Introduction

EVRH high pressure range is a direct (EVR) or servo operated (EVRH) solenoid valve special designed to meet the requirements for high pressure refrigerants as R410A and R744 (CO2). The EVRH valve can be used for liquid, suction and hot gas lines
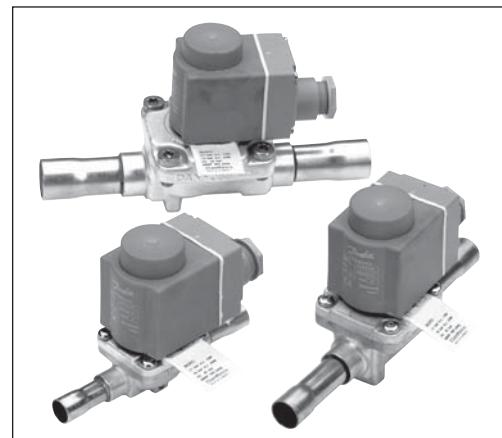
Features

- Normally closed
- Wide choice of coils for a.c. and d.c. voltage
- Suitable for R410A and R744 (CO2)
- Designed for media temperatures up to +105°C / 221°F

- Design pressure 45.2 barg / 655 psig
- MOPD up to 38 bar / 550 psi with 20 watt coil
- Solder connection up to 7/8 inch
- Extended ends for soldering
- It is not necessary to dismantle the valve during soldering.

Approvals

The Low Voltage Directive (LVD) 73/23/EC with amendments EN 60730-2-8.

Technical data

SI unit

Type	Opening differential pressure with standard coil Δp bar					k_v value [1] m^3/h	Temperature of medium	Refrigerant	Max. working pressure PB
	Max. (MOPD liquid [2])								
	Min.	10 w.a.c.	12 w.a.c.	20 w.a.c.	20 w.d.c.				
EVR 2	0.0	25	25	38	18	0.16	-40°C → +105°C for 10 or 12 w coil Max. 130°C during defrost -40°C → 80°C for 20 watt coil	R410A R744 (CO_2) HCFC HFC	45.2 barg
EVR 3	0.0	21	25	38	18	0.27			
EVRH 6	0.05	21	25	38	18	0.8			
EVRH 10	0.05	21	25	38	18	1.9			
EVRH 15	0.05	21	25	38	18	2.6			
EVRH 20 (a.c.)	0.05	21	25	38		5.0			
EVRH 20 (d.c.)	0.05				16	5.0			

[1] The k_v value is the water flow in m^3/h at a pressure drop across the valve of 1 bar ρ = 1000 kg/m^3
[2] MOPD for media in gas form is approx. 1bar greater

US unit

Type	Opening differential pressure with standard coil Δp psi					C_v value [3] gal/min	Temperature of medium	Refrigerant	Max. working pressure MWP
	Max. (= MOPD) liquid [4]								
	Min.	10 w	12 w	20 w	20 w				
EVR 2	0.0	360	360	550	550	0.19	-40°F → +220°F for 10 or 12 w coil Max. 266°F during defrost -40°F → 176°F for 20 watt coil	R410A R744 (CO_2) HCFC HFC	655 psig
EVR 3	0.0	305	360	550	260	0.32			
EVRH 6	0.7	305	360	550	260	0.93			
EVRH 10	0.7	305	360	550	260	2.2			
EVRH 15	0.7	305	360	550	260	3.0			
EVRH 20 (a.c.)	0.7	305	360	550		5.8			
EVRH 20 (d.c.)	0.7				230	5.8			

[3] The C_v value is the water flow in gal/min at a pressure drop across the valve of 1 psi ρ = 10 lbs/gal
[4] MOPD for media in gas form is approx. 14.5 psi greater.

Ambient temperature and enclosure for coil:
see "coils for solenoid valve", RD.3J.E2.02

Ordering

Solenoid valve - Normally closed (NC) - Soldering
ODF without manual stem - without coil

Type	Required coil type	Connection		Code no.	
		in.	mm	in.	mm
EVR 2		1/4	6	**032F1201**	**032F1202**
EVR 3		3/8	10	**032F1204**	**032F1208**
EVR 3		1/4	6	**032F1206**	**032G1207**
EVRH 6	a.c. / d.c.	3/8	10	**032G1052**	**032G1053**
EVRH 10		1/2	12	**032G1054**	**032G1055**
EVRH 15		5/8	16	**032G1056**	**032G1056**
EVRH 20	a.c.	7/8	22	**032G1057**	**032G1057**
EVRH 20	d.c.	7/8	22	**032G1058**	**032G1058**

Coils

See "coils for solenoid valve", RD.3J.E2.02

Note:

EVRH 22, 25, 32 and 40 for R410A and R744 can
be supplied on request. Please contact Danfoss

Capacity R410A SI units

Liquid capacity Q$_c$ kW   **R410A**

Type	Liquid capacity Qc at pressure drop across valve Δp bar				
	0.1	0.2	0.3	0.4	0.5
EVR 2	2.59	3.66	4.48	5.18	5.79
EVR 3	4.37	6.18	7.56	8.75	9.77
EVRH 6	13.0	18.3	22.4	25.9	29.0
EVRH 10	30.8	43.5	53.2	61.5	68.9
EVRH 15	42.1	59.5	72.8	84.2	94.1
EVRH 20	81.0	114.5	140.0	162	181.0

Capacities are based on:
Liquid temperature t_l = +25°C ahead of the valve
Evaporarating temperature t_e = -10°C
Superheat 0 K

Correction factors
When sizing valves, the plant capacity must be
multiplied by a correction factor depending
on liquid temperature t_l ahead of the valve/
evaporator. When the corrected capacity is
known, the selection can be made from the table.

Correction factors for liquid temperature t_l

t_f °C	-10	0	10	15	20	25	30	35	40	45	50
R410A	0.73	0.79	0.86	0.9	0.95	1	1.06	1.14	1.23	1.33	1.47

Capacity R410A SI units

Suction vapour capacity Q$_c$

R410A

Type	Pressure drop Δ bar	Suction vapour capacity Q$_c$ kW at evaporating temperature t$_e$ °C					
		-40	-30	-20	-10	0	+10
EVR 2	0.10	0.20	0.25	0.31	0.37	0.45	0.53
	0.15	0.24	0.30	0.37	0.46	0.55	0.65
	0.20	0.28	0.35	0.43	0.53	0.63	0.75
EVR 3	0.10	0.33	0.42	0.52	0.63	0.76	0.90
	0.15	0.41	0.51	0.63	0.77	0.92	1.10
	0.20	0.47	0.59	0.73	0.89	1.07	1.27
EVRH 6	0.10	0.99	1.25	1.54	1.87	2.24	2.67
	0.15	1.20	1.52	1.87	2.29	2.74	3.26
	0.20	1.39	1.76	2.16	2.64	3.17	3.76
EVRH 10	0.10	2.36	2.96	3.65	4.45	5.32	6.35
	0.15	2.85	3.61	4.45	5.43	6.50	7.75
	0.20	3.31	4.18	5.13	6.27	7.52	8.93
EVRH 15	0.10	3.22	4.06	5.00	6.08	7.28	8.68
	0.15	3.90	4.94	6.08	7.44	8.89	10.6
	0.20	4.52	5.72	7.02	8.58	10.3	12.2
EVRH 20	0.10	6.20	7.80	9.60	11.7	14.0	16.7
	0.15	7.50	9.50	11.7	14.3	17.1	20.4
	0.20	8.70	11.0	13.5	16.5	19.8	23.5

Capacities are based on liquid temperature t$_l$ = +25°C ahead of evaporator.
The table values refer to the evaporator capacity and are given as a function of evaporating temperature t$_e$ and pressure drop Δp across the valve.
Capacities are based on dry, satuated vapour ahead of the valve.
During operation with superheated vapour ahead of the valve, the capacities are reduced by 4% for each 10 K superheat

Correction factors
When sizing valves, the evaporator capacity must be multiplied by a correction factor depending on liquid temperature t$_l$ ahead of expansion valve.
When the corrected capacity is known, the selection can be made from the table

t$_f$°C	-10	0	10	15	20	25	30	35	40	45	50
R410A	0.76	0.80	0.89	0.92	0.96	1.0	1.05	1.11	1.18	1.26	1.37

Capacity R410A SI units

Hot gas capcity Q$_h$ kW

R410A

Type	Pressure drop Δp bar	Evaporating temp. t$_e$ -10˚C, hot gas temp. t$_h$ = t$_c$ +25˚C, Subcooling Δt$_{sub}$ = 4K				
		Condensing temperataure t$_c$ ˚C				
		+20	+30	+40	+50	+60
EVR 2	0.10	0.54	0.56	0.56	0.55	0.51
	0.20	0.77	0.79	0.79	0.77	0.72
	0.4	1.09	1.11	1.12	1.09	1.02
	0.8	1.54	1.57	1.58	1.55	1.46
	1.6	2.17	2.22	2.24	2.19	2.04
EVR 3	0.10	0.92	0.94	0.95	0.93	0.86
	0.20	1.30	1.33	1.33	1.31	1.22
	0.4	1.84	1.88	1.89	1.85	1.72
	0.8	2.59	2.66	2.67	2.61	2.46
	1.6	3.66	3.75	3.78	3.69	3.45
EVRH 6	0.10	2.72	2.78	2.80	2.75	2.56
	0.20	3.84	3.94	3.95	3.87	3.60
	0.4	5.44	5.57	5.6	5.47	5.10
	0.8	7.68	7.87	7.92	7.73	7.30
	1.6	10.85	11.1	11.2	10.9	10.2
EVRH 10	0.10	6.46	6.61	6.65	6.54	6.08
	0.20	9.12	9.35	9.39	9.20	8.55
	0.4	12.9	13.2	13.3	13.0	12.1
	0.8	18.2	18.7	18.8	18.3	17.3
	1.6	25.7	26.4	26.6	26.0	24.2
EVRH 15	0.10	8.84	9.05	9.10	8.94	8.32
	0.20	12.5	12.8	12.8	12.6	11.7
	0.4	17.7	18.1	18.2	17.8	16.6
	0.8	25.0	25.6	25.7	25.1	23.7
	1.6	35.3	36.1	36.4	35.6	33.2

An increase in hot gas temperature t$_h$ of 10 K, based on t$_h$ = t$_c$ + 25°C reduces valve capacity approx. 2% and vice versa.

A change in evaporating temperature t$_e$ changes valve capacity: see correction factor table below.

Correction factors
When sizing valves, the table value must be multiplied by a correction factor depending on evaporting temperature t$_e$.

Correction factors for liquid temperature t$_l$

t$_f$ °C	-40	-30	-20	-10	0	+10
R410A	0.92	0.95	0.98	1.0	1.02	1.03

An increase in hot gas temperature t$_h$ of 10 K reduces valve capacity approx 2% and vice versa.

Capacity R410A US unit

Liquid capacity Q_0 tons **R410A**

Type	Liquid capacity Q_0 tons at pressure drop across valve Δp psi						
	1	2	**3**	4	5	6	7
EVR 2	0.56	0.78	**0.96**	1.10	1.23	1.35	1.46
EVR 3	0.98	1.37	**1.68**	1.93	2.15	2.36	2.55
EVRH 6	2.79	3.92	**4.80**	5.52	6.16	6.75	7.30
EVRH 10	6.63	9.31	**11.4**	13.1	14.6	16.0	17.3
EVRH 15	9.07	12.7	**15.6**	17.9	20.0	21.9	23.7
EVRH 20	17.5	24.5	**30.0**	34.5	38.5	42.2	45.6

Note: Bold figures refer to rated capacity

Capacities are based on:
liquid temperature t_l = 100°F
Evaporating temperature t_e = 40°F
Superheat 10°F

Correction factors for liquid temperature t_l
When liquid temperature t_l ahead of the expansion valve is other than 100°F, adjust the table capacities by multiplying them by the appropriate correction factor found in the following table.

t_l°F	80	90	100	110	120
Factor	1.10	1.05	1.00	0.95	0.90

Suction vapour capacity Q_0 **R410A**

Type	Pressure drop Δp psi	Suction vapour capacity Q_0 tons at evaporating temperature t_e °F							
		-40	-20	0	+10	+20	+30	**+40**	+50
EVR 2	1	0.04	0.05	0.07	0.07	0.08	0.09	0.10	0.11
	2	0.06	0.07	0.09	0.11	0.12	0.13	0.14	0.16
	3	0.07	0.09	0.12	0.13	0.14	0.16	0.18	0.19
EVR 3	1	0.07	0.09	0.12	0.13	0.14	0.16	**0.18**	0.20
	2	0.10	0.13	0.16	0.18	0.21	0.23	0.25	0.28
	3	0.12	0.16	0.20	0.23	0.25	0.28	0.31	0.34
EVRH 6	1	0.20	0.26	0.33	0.37	0.41	0.46	**0.51**	0.56
	2	0.29	0.37	0.47	0.53	0.59	0.65	0.72	0.79
	3	0.35	0.46	0.58	0.65	0.72	0.80	0.88	0.97
EVRH 10	1	0.48	0.62	0.79	0.89	0.98	1.09	**1.20**	1.33
	2	0.68	0.88	1.12	1.25	1.39	1.54	1.70	1.87
	3	0.84	1.08	1.37	1.54	1.71	1.89	2.09	2.30
EVRH 15	1	0.66	0.85	1.09	1.21	1.35	1.50	**1.65**	1.81
	2	0.93	1.21	1.53	1.72	1.91	2.11	2.33	2.56
	3	1.14	1.48	1.88	2.10	2.33	2.59	2.85	3.14
EVRH 20	1	1.27	1.64	2.09	2.33	2.59	2.88	**3.17**	3.49
	2	1.79	2.32	2.95	3.30	3.67	4.06	4.48	4.93
	3	2.20	2.85	3.61	4.04	4.49	4.98	5.49	6.04

Note: Bold figures refer to rated capacity

The table values refer to evaporator capacity and are given as a function of evaporating temperature t_e and pressure drop Δp across the valve.
Capacities are based on liquid temperature t_l = 100 °F ahead of the expansion valve and superheat t_s = 7°F
For each additional 10°F of superheat, the table capacities must be reduced by 2%.

Correction factors for liquid temperature t_l
When liquid temperature t_l ahead of the expansion valve is other than 100°F, adjust the table capacities by multiplying them by the appropriate correction factor found in the following table

t_l°F	80	90	100	110	120
Factor	1.10	1.05	1.00	0.95	0.90

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Capacity R410A US unit

Hot gas capacity Q$_h$ tons

Type	Pressure drop Δp psi	Evaporating temp. t$_e$=+40˚F, hotgas temp. t$_h$=t$_c$+40˚F, Subcooling t$_u$=10˚F		
		Condensing temperature t$_c$˚F		
		+70	+100	+140
EVR 2	**2** 5 10 15 20 25	0.19 0.30 0.42 0.52 0.60 0.67	0.20 0.31 0.44 0.54 0.62 0.69	0.18 0.29 0.41 0.50 0.58 0.65
EVR 3	**2** 5 10 15 20 25	0.33 0.52 0.74 0.90 1.04 1.16	**0.34** 0.54 0.76 0.94 1.08 1.21	0.32 0.50 0.71 0.87 1.01 1.13
EVRH 6	**2** 5 10 15 20 25	0.94 1.49 2.11 2.59 2.98 3.34	**0.98** 1.55 2.19 2.68 3.10 3.46	0.91 1.44 2.04 2.50 2.88 3.23
EVRH 10	**2** 5 10 15 20 25	2.24 3.54 5.02 6.14 7.08 7.92	**2.33** 3.68 5.20 6.36 7.36 8.22	2.17 3.42 4.85 5.93 6.84 7.66
EVRH 15	**2** 5 10 15 20 25	3.07 4.85 6.86 8.40 9.69 10.8	**3.18** 5.03 7.11 8.70 10.0 11.2	2.96 4.68 6.64 8.11 9.36 10.5
EVRH 20	**2** 5 10 15 20 25	5.90 9.32 13.2 16.1 18.6 20.8	**6.12** 9.68 13.7 16.7 19.3 21.6	5.70 9.00 12.7 15.6 18.0 20.1

Correction factors for t$_h$ and t$_c$
The table values refer to hot gas capacity and are given as a function of condensing temperature t$_c$ and pressure drop Δp across the valve.
Capacities are based on a hot gas temperature superheated 40°F above condensing temperature (t$_h$ = t$_c$ + 40°F).
For each additional 10°F of superheat above 40°F, the table capacities must be reduced by 1%.

When the valve is used in a hot gas defrost circuit, evaporatore temperature affects the capacity. When the evaporator temperature differs from +40°F, adjust the table capacities by multiplying them by the appropriate correction factor found in the following table.

t$_l$˚F	-40	-20	0	20	40	50
Factor	1.18	1.14	1.09	1.04	1	0.97

Capacity R744 (CO$_2$)

Due to the fact that EVRH only can be used for sub critical CO$_2$ application, capacity tables are not illustrated in this catalog. For capacity dimension please refer to DIR-Calc or contact your local Danfoss office.

Design/ Function

4. Coil
16. Armature
18. Valve plate/ Pilot valve plate
20. Earth terminal
24. Connection for flexible steel hose
28. Gasket
29. Pilot orifice
36. DIN plug
37. DIN socket (to DIN 43650)
40. Protective cap/ Terminal box
43. Valve cover
45. Valve cover gasket
49. Valve body
73. Equalization hole
80. Diaphragm/ Servo piston
83. Valve seat
90. Mounting hole
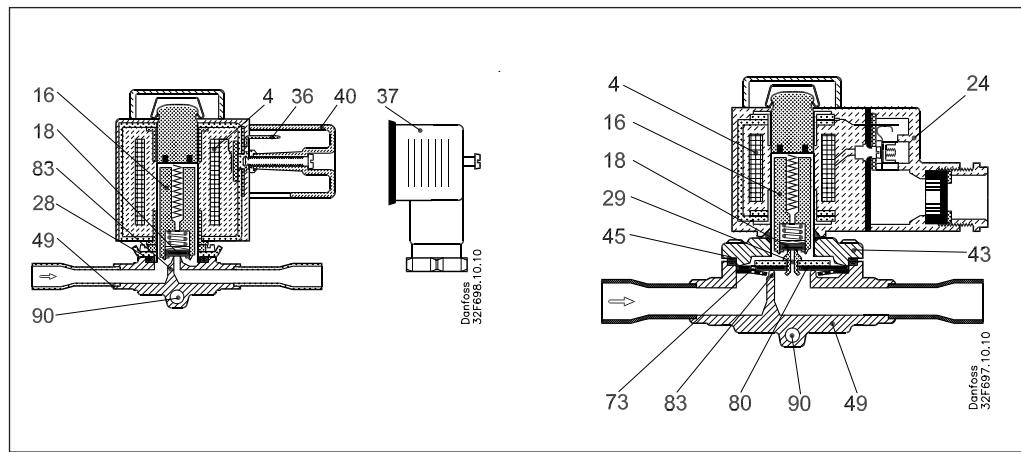
EVRH solenoid valves are designed on two different
principles:
1. Direct operation
2. Servo operation

1. Direct operation
EVR2 and 3 are direct operated. The valve opens direct for full flow when the armature (16) moves up into the magnetic field of the coil.
This means that the valve operates with a min. differential pressur of 0 bar.
The teflon valve plate (18) is fitted direct on the armature (16).
Inlet pressure acts from above on the armature and the valve plate. Thus inlet pressure, spring force and the weight of armature act to close the valve when the coil is currentless.

2. Servo operation
EVRH 6 to 20 are servo operated with a "floating" diaphragm (80). The pilot orifice (29) of stainless steel is placed in the centre of the diaphragm. The teflon pilot valve plate (18) is fitted direct to the armature (16). When the coil is currentless, the main orifice and pilot orifice are closed. The pilot orifice and main orifice are held closed by the weight of the armature, the armature spring force and the differential pressure between inlet and outlet sides.

When current is applied to the coil the armature is drawn up into the magnetic field and opens the pilot orifice. This relieves the pressure above the diaphragm i.e. the space above the diaphragm becomes connected to the outlet side of the valve. The differential pressure between inlet and outlet sides then presses the diaphragm away from the main orifice and opens it for full flow. Therefore a certain minimum differential pressure is necessary to open the valve and keep it open. For EVRH 6 to 20 valves this differential pressure is 0.5 bar.

When current is switched off, the pilot orifice closes. Via the equalization holes (73) in the diaphragm, the pressure above the diaphragm then rises to the same value as the inlet pressure and the diaphragm closes the main orifice.

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Material specifications

EVR 2 and 3
EVRH 6 to 20
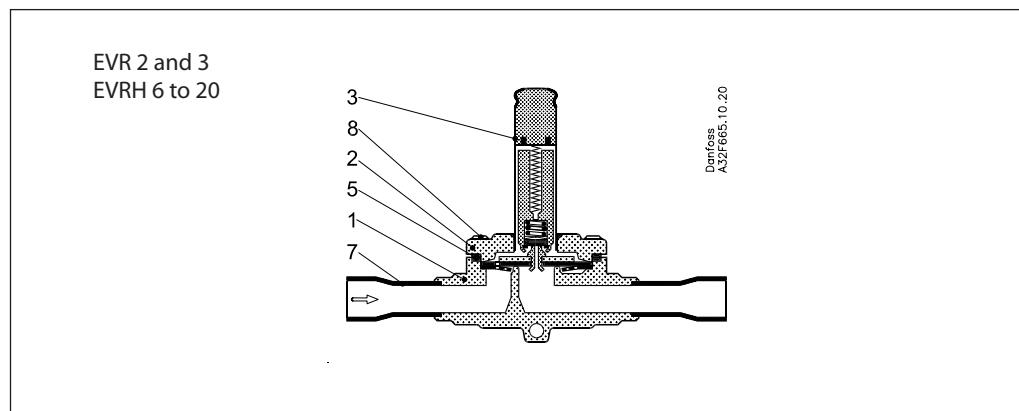
No.	Description	Type	Material	Analysis	Mat. no.	W. no.	DIN	EN
		Solenoid valve						Standard
1	Valve body	EVR 2, 3 and EVRH 6 → 20	Brass	CuZn40Pb2	CW617N	2.0402	17672-1	12165
2	Cover	EVR 2 and 3	Stainless steel	X5CrNi18-10		1.4301		10088
		EVRH 6 → 20	Brass	CuZn40Pb2	CW617N	2.0402	17672-1	12165
3	Armature tube	EVR 2, 3 and EVRH 6 → 20	Stainless steel	X2CrNi19-11		1.4306		10088
5	Gasket	EVR 2, 3 and EVRH 6 → 20	Rubber	Cr				
7	Solder tube	EVR 2, 3 and EVRH 6 → 20	Copper	SF-Cu	CW024A	2.0090	1787	12449
8	Screws	EVR 2, 3 and EVRH 6 → 20	Stainless steel	A2-70			3506	

Dimensions and weight
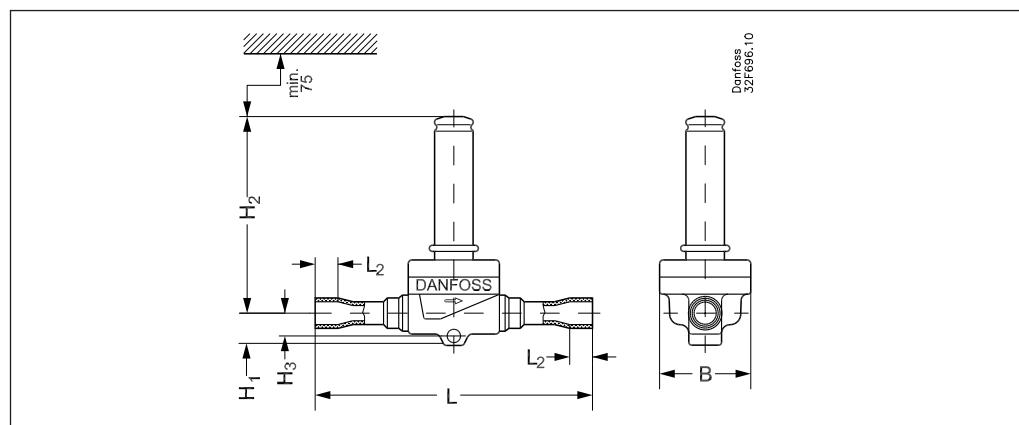
SI unit

Type	Connection solder		H1	H2	H3	L	L2	B	Weight
	in.	mm	mm	mm	mm	mm	mm	mm	kg
EVR 2 & 3	1/4	6	14	64	9	102	7	33	0.2
EVRH 6	3/8	10	14	75	10	111	9	36	0.3
EVRH 10	1/2	12	16	76	10	127	10	46	0.5
EVRH 15	5/8	16	19	83		176	12	56	0.8
EVRH 20	7/8	22	20	87		191	17	72	1.0

SU unit

Type	Connection solder		H1	H2	H3	L	L2	B	Weight
	in.	mm	in.	in.	in.	in.	in.	in.	lbs
EVR 2 & 3	1/4	6	9/16	2 1/2	5/16	4	9/32	1 5/16	0.44
EVRH 6	3/8	10	9/16	3	3/8	4 3/8	3/8	1 7/16	0.66
EVRH 10	1/2	12	5/8	3	7/16	5	3/8	1 13/16	1.10
EVRH 15	5/8	16	3/4	3 1/4	3/4	6 15/16	1/2	2 3/16	1.75
EVRH 20	7/8	22	25/32	3 7/16		7 1/2	5/8	2 13/16	2.21