Selecting a suction cup

Introduction:

A suction cup is a gripper that can be used to handle all types of objects of various weights, surface areas, shapes and dimensions, etc.
Here, we describe all the parameters to be taken into account in order to choose a suitable type of suction cup.

Shapes:

VP - VPG

VSA - VSAG

VS

Flat suction cups:

• Flat suction cups without stops:
For the handling of flat or slightly curved, rigid and smooth objects.
These suction cups withstand lateral loads and allow vertical handling.

• Flat suction cups with stops:
For the gripping of objects that are thin, flexible, deformable, etc.
These suction cups increase resistance to lateral loads and horizontal handling operations.

Bellows type suction cups:

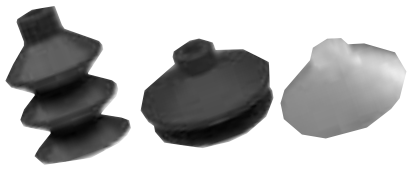
• Bellows type suction cups:
For the gripping of objects that are spherical, cylindrical or ovoid, etc.
The more bellows there are, the greater their technical characteristics.
These suction cups allow gripping at different levels, a ball joint effect, lifting motion and angular gripping.
Bags, etc.

Diameters:

This parameter is related to the strength of the suction cup and the available gripping area on the object.

The COVAL ranges combine to offer standard suction cups with diameters of between 2 mm and 580 mm.

Selecting a suction cup



Materials:

Material	Shore hardness	Flexibility	Abrasion resistance	U.V. and weather resistance	Resistance to oils	Temperature resistance in C°	Compatibility with food	Colour
Neoprene ***NE***	60	+	+	+ +	+	-10 to 80	-	Black
Nitrile ***NBR***	60	+	+	-	+ +	0 to 80	-	Black
Translucent silicone ***SIT5***	50	+ + +	-	+ + +	-	-40 to 220	+ + +	Transl.
Natural rubber ***NR***	50	+ + +	+ +	- -	- -	-20 to 70	+	Grey
Siton® ***STN***	60	+	+	-	+ +	0 to 160	-	Blue
Antistatic silicone ***SIA***	60	+ +	-	+ + +	-	-20 to 200	+	Black
Polyurethane ***PU***	60	+	+ + +	+ +	+ +	-20 to 80	-	Black
Vulkollan ***V***	70	-	+ + + +	+ +	+ +	-40 to 80	-	Green
Viton ***FPM***	60	+	+	+ + +	+ + +	-20 to 250	-	Black

COVAL has developed a new material in its laboratory: **SITON ®.**
SITON ® is a **silicone free** material that does not stain and is especially suitable for the handling of hot items.
Example of application: Removal from mould of plastic parts which can be painted.

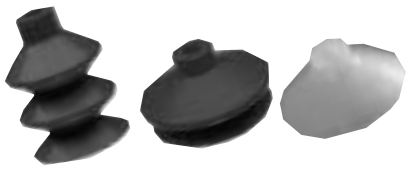
Special manufacture:

To respond to the specific needs of our customers, our design office develops ranges of special suction cups. These suction cups are specially shaped for eggs, paper, CDs, pastries, light bulbs, bags, etc. and of specific materials: Siton®, Antistatic silicone, Polyurethane, etc.
For the study of new ranges of special suction cups, we ask our customers to provide us with work specifications, with or without financial contribution. It should be noted that a mould can be designed for quantities of between 500 and 1,000 items per order.

Calculation of suction cup force:

The force of a suction cup is proportional to its area under vacuum and also depends on its general shape, its flexibility, its material and, above all, the level of vacuum reached in the internal chamber of the suction cup.

Selecting a suction cup



• *Theoretical force:*

F(N) = Suction cup area (cm²) x Percentage of vacuum (%) x 0.1013

The force shown in the **COVAL** suction cup tables is the **actual practical force** of the suction cup at 90% vacuum. In addition, the value shown comprises a safety factor of 2.

• *Actual force:*

As indicated by its name, this force represents the effective force of the suction cup in use. This is, generally, 50% less than the calculated theoretical force. This difference is explained by the deformation of the suction cup during handling, which reduces the gripping area, and by the surface finish of the part handled.

• *Safety factor:*

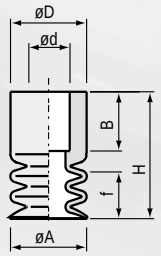
All the forces are indicated in the tables showing the various suction cup ranges.
These are **actual forces at 90% vacuum calculated** with a safety factor of:
2 for horizontal gripping,
4 for vertical gripping.
In the case of applications involving high acceleration rates, the safety coefficient is calculated accordingly.

Parameters:

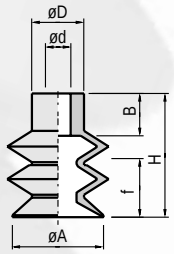
The following table gives the fullest possible list of parameters to be taken into account when choosing a suction cup.

Shape of load	Flat - Curved - Cylindrical - Ovoid - Spherical, etc.
Load material	Porous - Sealed - Deformable - Rigid - Fragile, etc.
Load surface finish	Smooth - Grainy - Silicone-coated - Abrasive, etc.
State of load	Damp - Oily - Dusty - Viscous - Dry, etc.
Weight of load	Heavy - Light, etc.
Temperature of load	From -40°C to 250°C according to materials selected
Direction of grabbing	Horizontal - Vertical - Angular - Different levels, etc.
Type of grip	Handling - Lifting - Holding - Unstacking, etc. of objects
Available gripping areas	
Duration of cycles	Accelerations

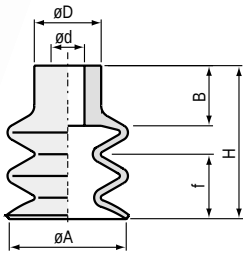
Bellows type suction cups 2.5, series VS, 5 to 88 mm ø



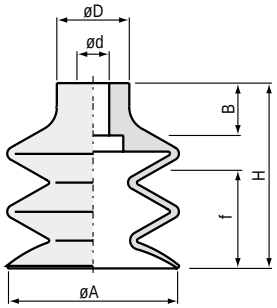
VS 5 to 9



VSP 14



VS 12 to 25



VS 32 to 88

Applications:

The bellows type suction cups in series VS are recommended for the **gripping of products on various planes** (large deflection), as a replacement for spring systems, and **spherical or cylindrical items** gripped at an angle (ball joint effect).

Characteristics:

Models	ø A	H	ø d	ø D	f	B	Int.volume	Fr*	Weight	Materials							Inserts**
	mm	mm	mm	mm	mm	mm	(cm^3)	N	g	NBR	SIT5	NR	STN	SIA	PU	NBRA	page
VS 5	**5**	13.5	4	7	3	8	0.04	**0.66**	0.5	°	°						74
VS 6	**6**	13.2	4	7	3	7	0.04	**0.68**	0.5	°	°						74
VS 7	**7**	14	5	9	4	6	0.0425	**1.3**	0.5	°	°						74
VS 9	**9**	15	5	9	3	7	0.15	**1.5**	0.6	°	°	°	°	°	°	°	74
VS 12	**12**	21	5	10	7	9	0.54	**3.9**	1.1	°	°	°					74
VS 14	**14**	23	5	10	10	9	0.975	**4.1**	1.4	°	°	°	°				74
VSP 14	**14**	19	4	8	9	6.5	0.9	**3.7**	0.9		°						74
VS 18	**17.5**	23	5	10	10	9	1.35	**6.1**	1.8	°	°	°	°		°		74
VS 20	**20**	23	4.7	10	10	9	2	**6.4**	2.2	°	°	°					74
VS 25	**25**	34	4.7	10	20	9	5.4	**9**	3.8	°	°	°	°				74
VS 32	**32**	37.5	8	18	14.5	13	10	**16.8**	9.4	°	°	°					75
VS 42	**42**	46	8	18	22	13	19.5	**29**	18.5	°	°	°	°		°		75
VS 52	**52**	49	8	18	27	13	36	**40**	24.6	°	°	°					75
VS 62	**62**	55	8	21	31	13	72.5	**57**	50	°	°	°			°		75
VS 88	**88**	87.5	12	25	48.5	20	165	**184**	175	°	°	°					76

The values are representative of the mean characteristics of our products.
*(*) Fr (in newtons): Actual practical force of the suction cup with a 90% vacuum and a safety factor of **2 inclusive**.*
(**): Reference of the range and installation diagram for connections.

Materials:

NBR: Nitrile
SIT5: Translucent silicone
NR: Natural rubber
NBRA: Antistatic nitrile
STN: Siton
SIA: Antistatic silicone
PU: Polyurethane

Suction cup sections :

For minimum quantities of 50 pieces, these standard cups can be altered within the parameters of individual cup dimensions.

Special designs:

To meet the specific needs of our customers, our design office develops ranges of special suction cups with special shapes for eggs, paper, CDs, pastries, light bulbs and bags, etc. and of specific materials: Siton, Vulkollan, polyurethane, etc.
For the study of new ranges of special suction cups, we ask our customers to provide us with work specifications, with or without financial contribution. It should be noted that a mould can be designed for quantities of between 500 and 1,000 items per order.

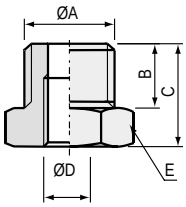
Suction cup VSP14 :

Extremely flexible suction cup ideal for pastries.
It is available in two materials: Translucent silicone, shore hardness 60 (SIT6), and Silicone, shore hardness 30 (SI3).

Male inserts, series IM

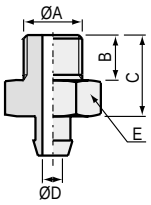
Adapters for socket head screws:

Models	ø A	B	C	ø D	E			Page
IM18 M5F	1/8 G	6	10.5	M5	13			77
IM18 M6F(°)	1/8 G	6	10.5	M6	13			75/78
IM10 M6F(°)	M10	7	10.5	M6	13			78
IM14 M6F(°)	1/4 G	8	13	M6	17			75/78
IM14 F18	1/4 G	8	13	1/8 G	17			76
IM12 F18	1/2 G	9	14	1/8 G	19			76
IM38 F18	3/8 G	10	15.5	1/8 G	24			76



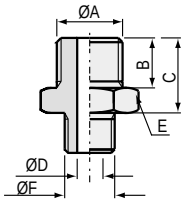
With hollow shafts:

Models	ø A	B	C	ø D	E			Page
IM 11 A (°)	1/8 G	7.5	13.5	3.5	14			74
IM 21 (°°)(°°°)	M5	4.5	9.5	2.5	7			74
IM 22	M6	5	10	3.5	7			74
IM 23	10-32	4.5	9.5	2.5	7			74
IM 5 VPG 2	M5	4.5	8	1	8			77
IM 5 VPG 5	M5	4.5	8	2.5	8			77
IM 20	M3	3	5	1.2	5			74
IMC 14	1/4 G	10	31	7	17			75



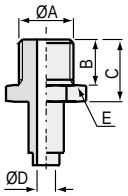
Threaded:

Model	ø A	B	C	ø D	ø E	F		Page
IM14M10M	1/4 G	10	15	5	17	M10*		79



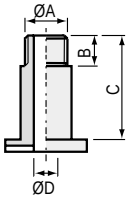
Riveted:

Models	ø A	B	C	ø D	ø E			Page
IM 41(°°°)	1/4G	11	15	4,4	17			75
IM 51	1/4G	11	17	8	21			76
IM 52	3/8G	11	17	8	21			76



Socket head screws:

Models	ø A	B	C	ø D				Page
IM 50	M5	5	16	2.8				75
IM 5 M 15	M5	5	6	2.5				77
IM 5 M 20	M5	4	7	2.5				77
IM 60 (°°°)	M6	7	18	3.5				75
IM 68	M8	8	19	5.2				75
IM 6 M 25	M6	5	10	3.5				78
IM 6 M 50	M6	6	11	3.5				78
IM 80	1/8 G	8	26	6				76
IM 85	M10**	8	26	6				76



(*) M10, pitch 125

(**) M10, pitch 150

(°) Available in version NPT

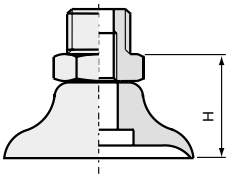
(°°) Possibility of incorporating a calibrated diameter jet to reduce leaks in case of use with multiple suction cup tank (0.45 mm diameter, standard, in stock)

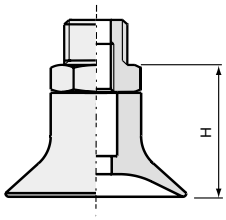
(°°°) Available in stainless steel

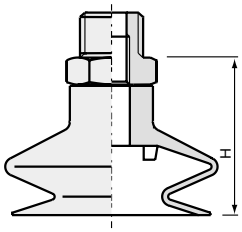
9

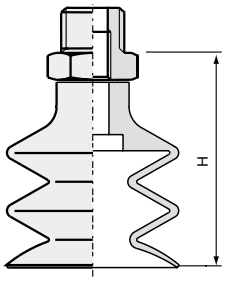
Dimensions and characteristics may be modified without notice.

Table of sizes: Suction cups - Male inserts







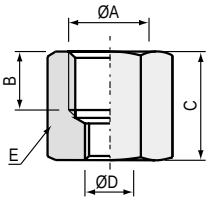


MODELS	M3 MALE (H)	M5 MALE (H)	M6 MALE (H)	M8 MALE (H)	M10 MALE (H)	1/8 MALE (H)	1/4 MALE (H)	3/8 MALE (H)	1/2 MALE (H)	EDGE 1/4 MALE (H)	EDGE 3/8 MALE (H)
VPG 2		7.5									
VPG 3.5		7.5									
VPG 5		10									
VPG 6		10									
VPG 8		10.5									
VPG 10		11									
VPG 15		8				12.5					
VPG 20		10				14.5					
VPG 25			14		17.5	18.5	19				
VPG 30			12		15.5	16.5	17				
VPG 35			14		17.5	18.5	19				
VPG 40			14		17.5	18.5	19				
VPG 50			15		18.5	19.5	20				
VPG 60							21				
VPG 80							23				
VPG 95							24				
VP 5	11	14	14			15					
VP 8		15	15			16					
VP 10		15.5	15.5			16.5					
VP 15		16.5	16.5			17					
VP 20		17	17			18					
VP 25		17	17			18					
VP 30	19	19	19	19	22.5	23.5	24			23	
VP 35	20	20	20	20	23.5	24.5	25			24	
VP 40	20	20	20	20	23.5	24.5	25			24	
VP 50	22	22	22	22	25.5	26.5	27			26	
VP 60	22	22	22	22	25.5	26.5	27			26	
VP 75						32	37	37	37.5	38	38
VP 95						38	43	43	43.5	44	44
VSA 5	13	16	16			17					
VSA 11		21	21			22					
VSA 14		21	21			22					
VSA 16		24	24			25					
VSA 20		21	21			22					
VSA 22		24	24			25					
VSA 25		28	28			29					
VSA 33		27.5	27.5	27.5	31	32	32.5			31.5	
VSA 43		28	28	28	31.5	32.5	33			32	
VSA 53		34	34	34	37.5	38.5	39			38	
VSA 63		34	34	34	37.5	38.5	39			38	
VSA 78						47	52	52	52.5	53	53
VS 5	15.5	18.5	18.5			19.5					
VS 6	15.2	18.2	18.2			19.2					
VS 7		19	19			20					
VS 9		20	20			21					
VS 12		26	26			27					
VS 14		28	28			29					
VSP 14		24	24			25					
VS 18		28	28			29					
VS 20		28	28			29					
VS 25		39	39			40					
VS 32		37.5	37.5	37.5	41	42	42.5			41.5	
VS 42		46	46	46	49.5	50.5	51			50	
VS 52		49	49	49	52.5	53.5	54			53	
VS 62		55	55	55	58.5	59.5	60			59	
VS 88						87.5	92.5	92.5	93	93.5	93.5

Female inserts, series IF

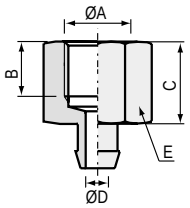
Adapter for socket head screws:

Models	ø A	B	C	ø D	E			Page
IF18 M5F	1/8G	7.5	13	M5	13			77
IF18 M6F(°)	1/8G	7.5	13	M6	13			75/78
IF14 M6F(°)	1/4G	11	17	M6	17			75/78
IF14 F18	1/4G	9	19	1/8G	17			76



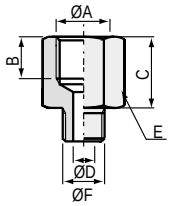
With hollow shaft:

Model	ø A	B	C	ø D	E			Page
IF 10 A(°)	1/8G	8	12	3.5	14			74



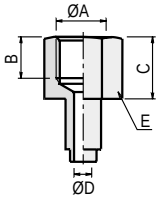
Threaded:

Model	ø A	B	C	ø D	E	ø F		Page
IF 14 M10 M	1/4G	10	17	5	17	M10*		79



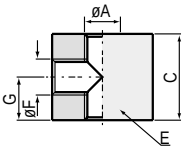
Riveted:

Models	ø A	B	C	ø D	E			Page
IF 40 (°°°)	1/4G	10	15	4.4	17			75
IF 50	1/4G	10	15	8	21			76

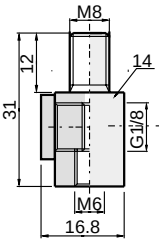


With radial outlet:

Models	ø A	B	C	ø D	E	ø F	G	Page
IR M5	M5	-	12	-	14X8	M5	6	
IRP M6								74



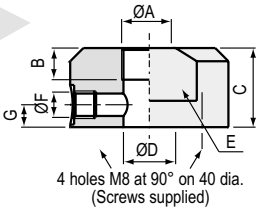
IR M5



IRP M6

For suction cups VPG 120 to 200 and VSAG 110 and 150:

Models	ø A	B	C	ø D	E	Dia.F	G	Page
IF 12 120(°°)	1/2G	24	30	ø 19	ø 60	1/8G	8,7	79
IFS 12 120(°°)	1/2G	13	13	-	ø 65	-	-	79



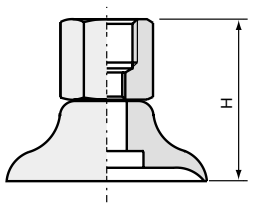
4 holes M8 at 90° on 40 dia.
(Screws supplied)

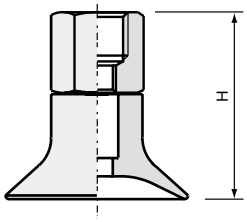
(*) M10, pitch 125
(**) Hollow shaft outlet for pipe connection
(°) Available in version NPT
(°°) Insert comprising four M8 holes for the attachment of suction cups VPG 120 to 200 and VSAG 110 and 150
(°°°) Available in stainless steel

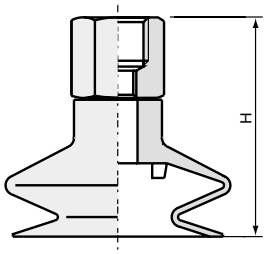
9

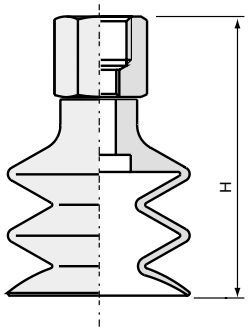
Dimensions and characteristics may be modified without notice.

Table of sizes: Suction cups - Female inserts







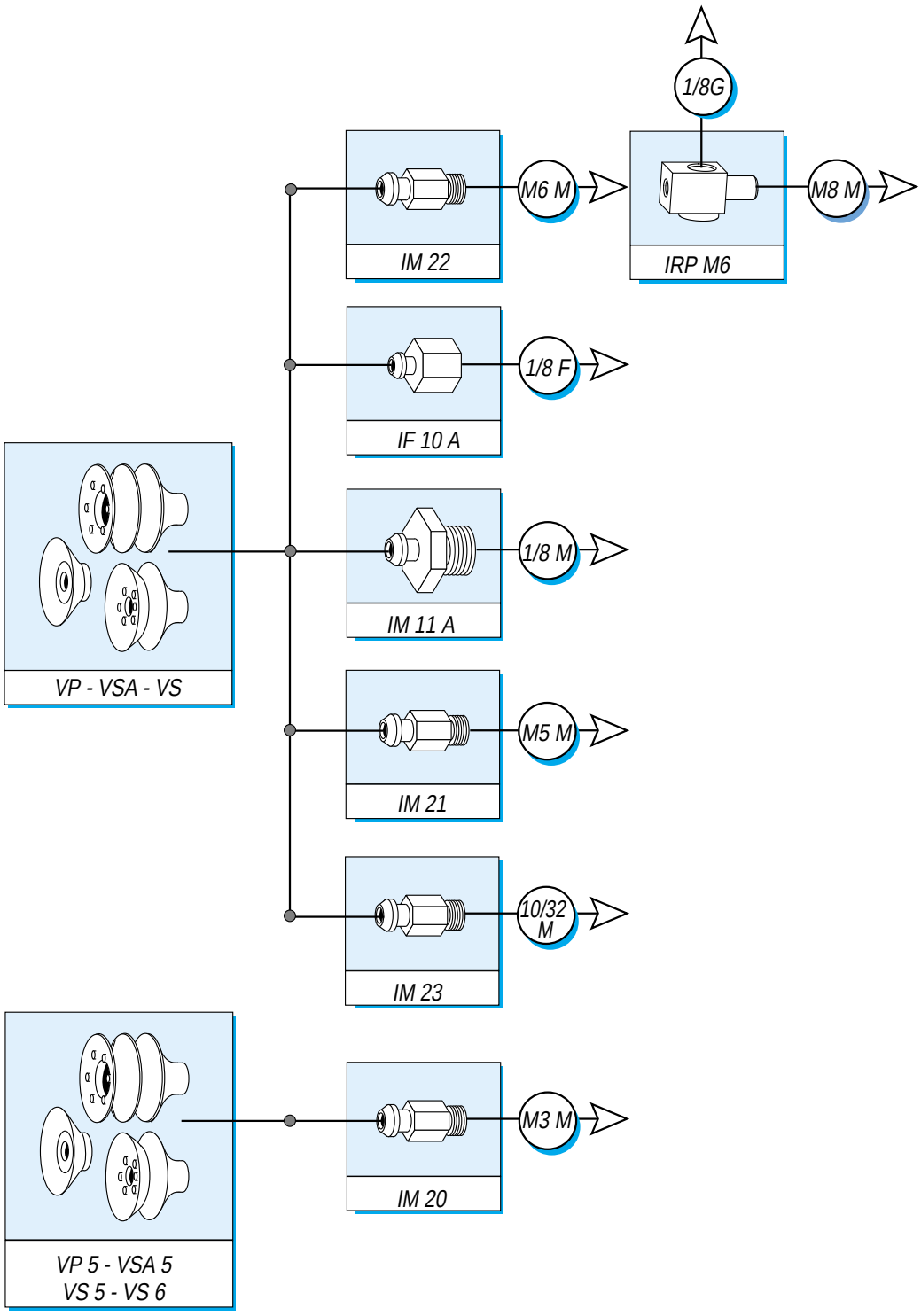


MODELS	1/8 FEMALE (H)	1/4 FEMALE (H)	EDGE 1/4 FEMALE (H)	IF 12 120 (H)	IFS 12 120 (H)
VPG 15	21				
VPG 20	23				
VPG 25	27	31			
VPG 30	25	29			
VPG 35	27	31			
VPG 40	27	31			
VPG 50	28	32			
VPG 60		33			
VPG 80		35			
VPG 95		36			
VPG 120				54.5	37.5
VPG 150				60.5	43.5
VPG 200				65.5	48.5
VP 5	21				
VP 8	22				
VP 10	22.5				
VP 15	23				
VP 20	23.5				
VP 25	24				
VP 30	32	36	34		
VP 35	33	37	35		
VP 40	33	37	35		
VP 50	35	39	37		
VP 60	35	39	37		
VP 75		51	47		
VP 95		57	53		
VSA 5	23				
VSA 11	28				
VSA 14	28				
VSA 16	31				
VSA 20	28				
VSA 22	31				
VSA 25	35				
VSA 33	40.5	44.5	42.5		
VSA 43	41	45	43		
VSA 53	47	51	49		
VSA 63	47	51	49		
VSA 78		66	62		
VSAG 110				85	68
VSAG 150				105.5	88.5
VS 5	25.5				
VS 6	25.2				
VS 7	26				
VS 9	27				
VS 12	33				
VS 14	35				
VSP 14	31				
VS 18	35				
VS 20	35				
VS 25	46				
VS 32	50.5	54.5	52.5		
VS 42	59	63	61		
VS 52	62	66	64		
VS 62	68	72	70		
VS 88		106.5	102.5		

Installation diagrams

VP - VSA - VS

Diameters from 5 to 25 mm



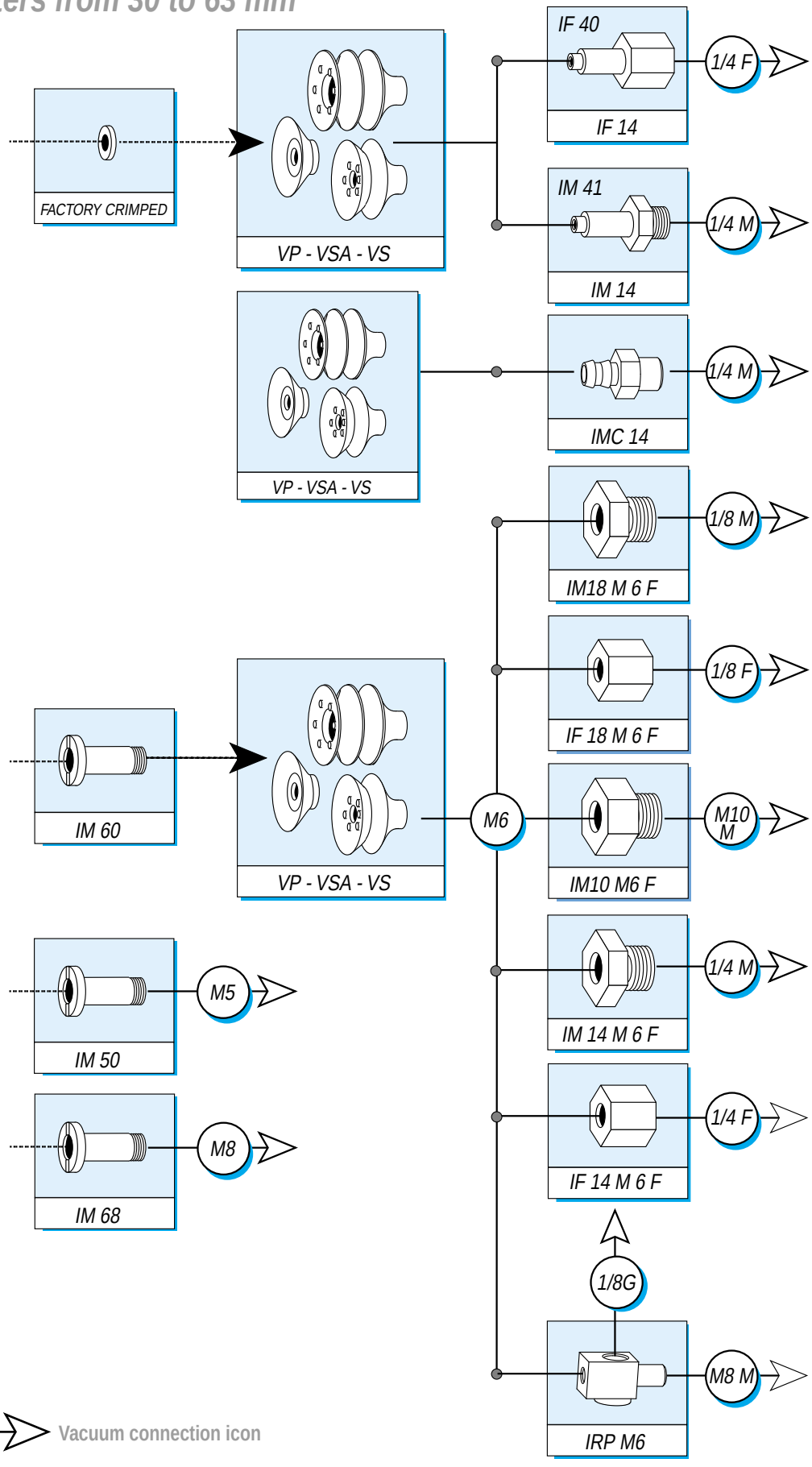
Note: IM21 type inserts (M5 male) with built-in jets are available for these suction cups. Please consult us.

Vacuum connection icon

Drawings and details of inserts on pages 78 to 81. Ball joints and spring systems on pages 90, 102 and 103.

VP - VSA - VS

Diameters from 30 to 63 mm

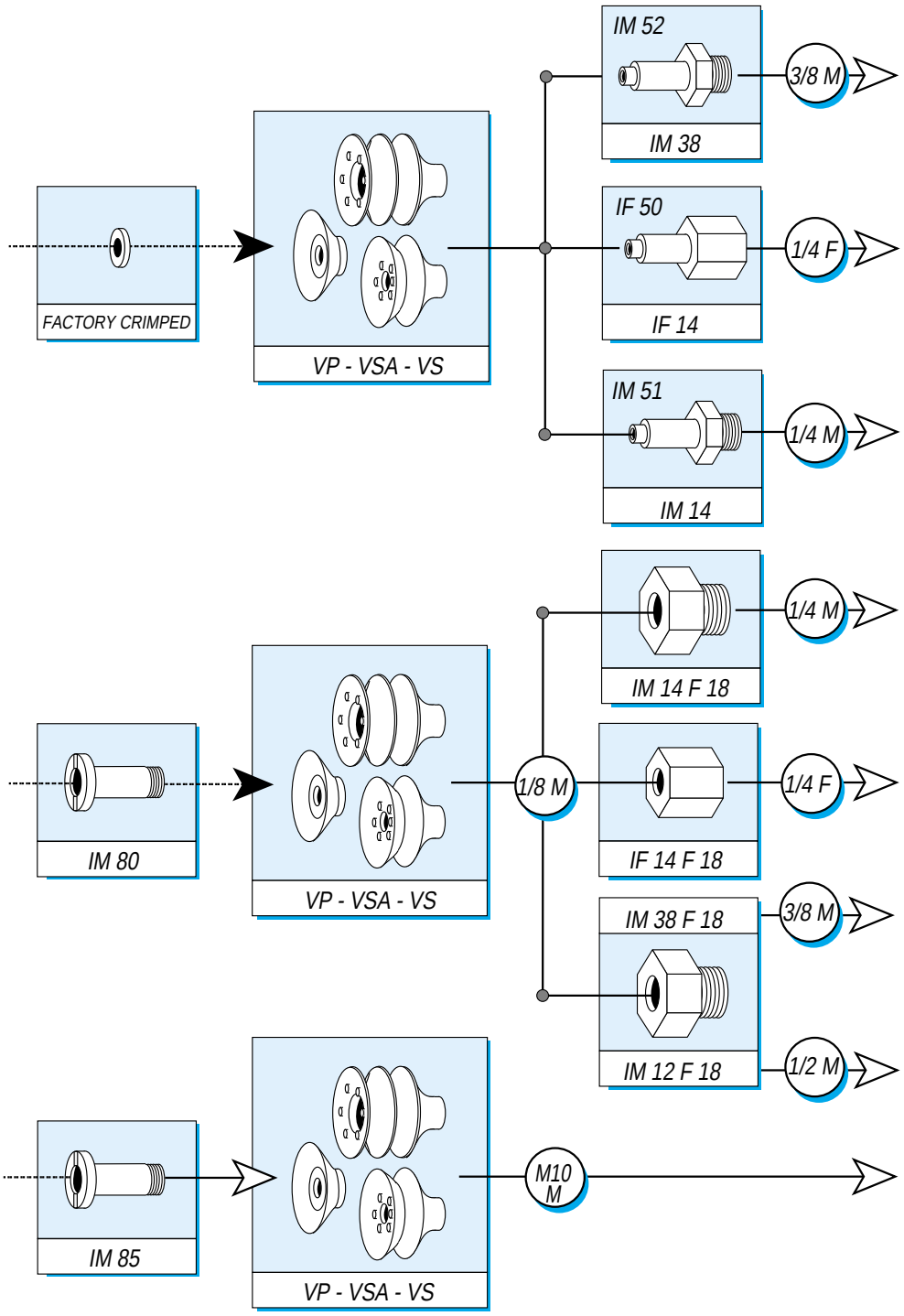


Vacuum connection icon

Drawings and details of inserts on pages 78 to 81. Ball joints and spring systems on pages 90, 102 and 103.

VP - VSA - VS

Diameters from 75 to 95 mm

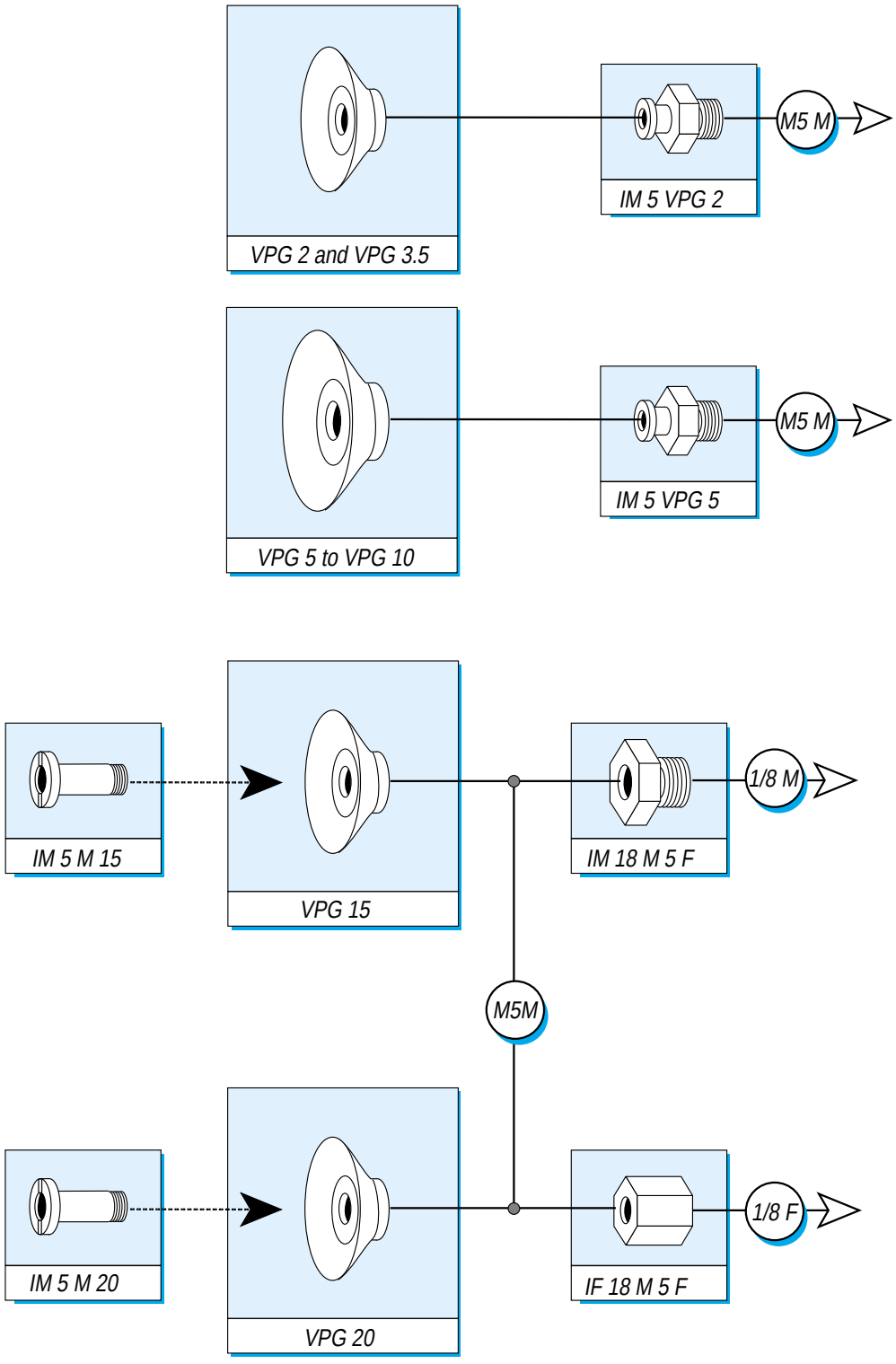


Vacuum connection icon

Drawings and details of inserts on pages 70 to 73. Spring systems on pages 90, 91 and 92.

9

Installation diagrams
VPG 2 and 20

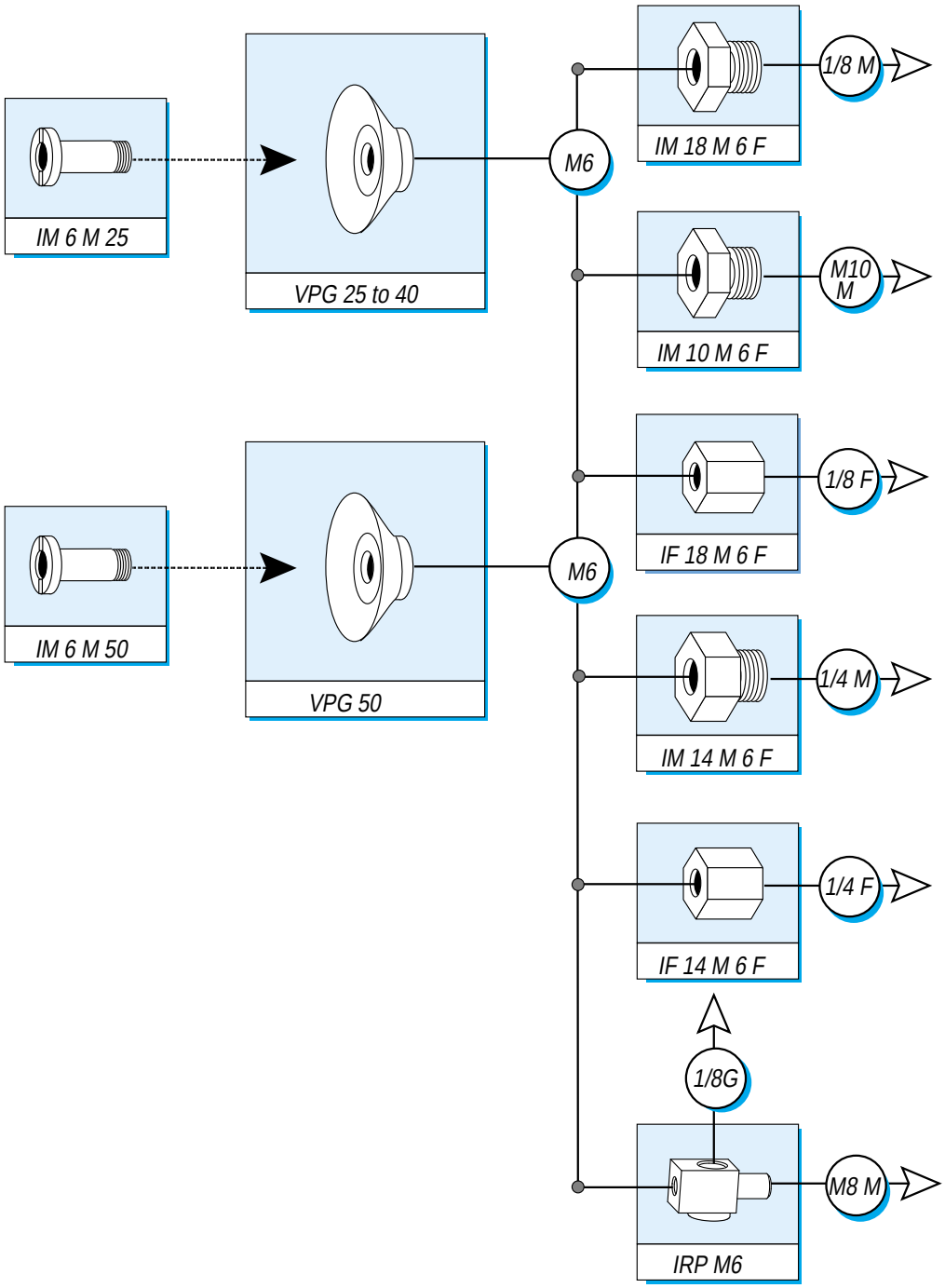


Vacuum connection icon

Drawings and details of inserts on pages 70 to 73. Spring systems on pages 90, 91 and 92.

Installation diagrams

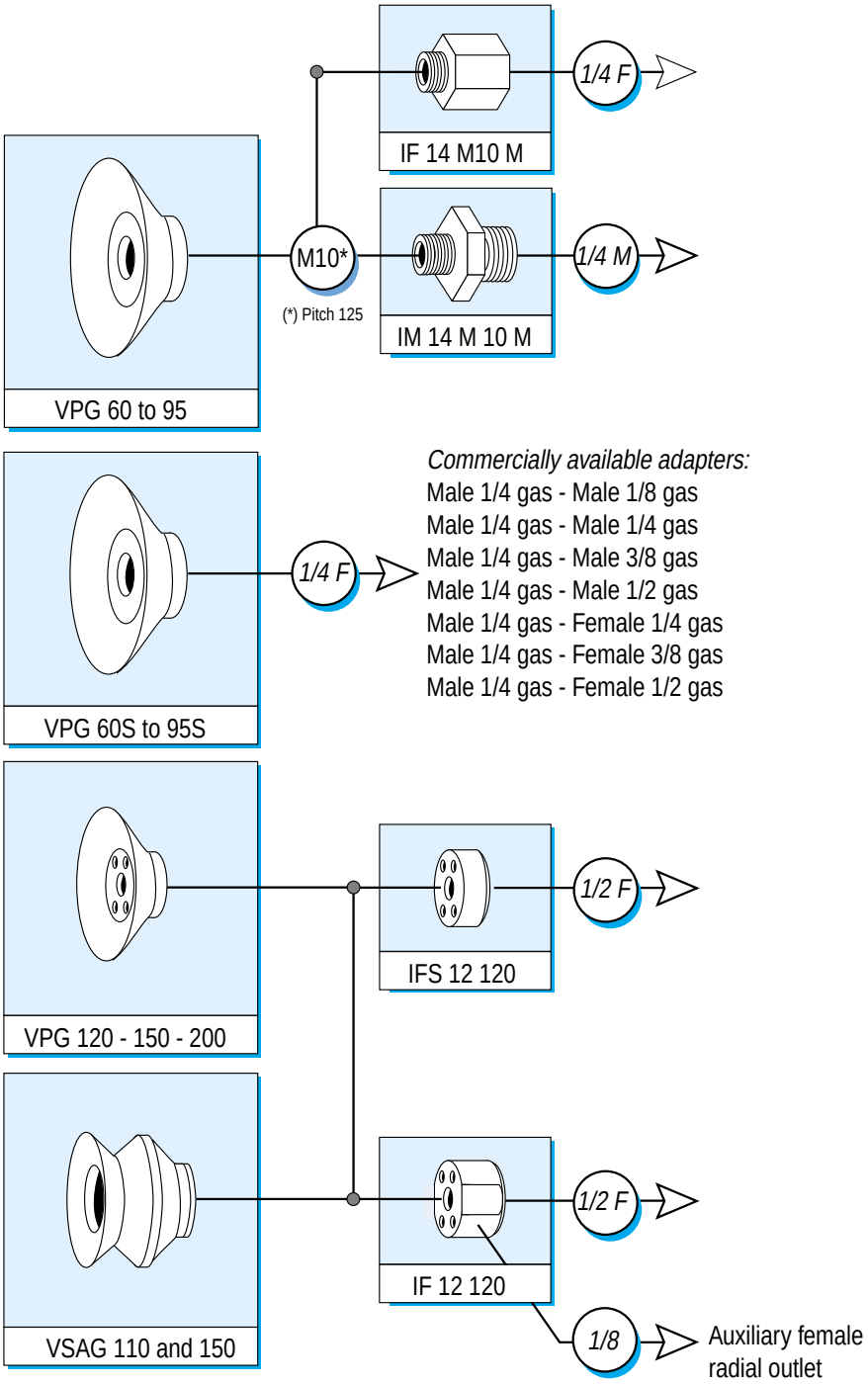
VPG 25 to 50



Vacuum connection icon

Drawings and details of inserts on pages 70 to 73. Spring systems on pages 90, 91 and 92.

Installation diagrams
VPG 60 to 200
VSAG 110 and 150



Vacuum connection icon

Drawings and details of inserts on pages 70 to 73. Spring systems on pages 90, 91 and 92.