PONTIFICIA UNIVERSIDAD CATÓLICA DEL PERÚ

FACULTAD DE CIENCIAS E INGENIERÍA

DISEÑO MECÁNICO DEL CABEZAL Y EL BASTIDOR DE UNA FRESADORA CNC DE 500x500x300 mm PARA UNA MESA DE TRABAJO DE 6 GDL

Tesis para optar el Título de Ingeniero Mecánico

ANEXOS

Que presenta el bachiller:
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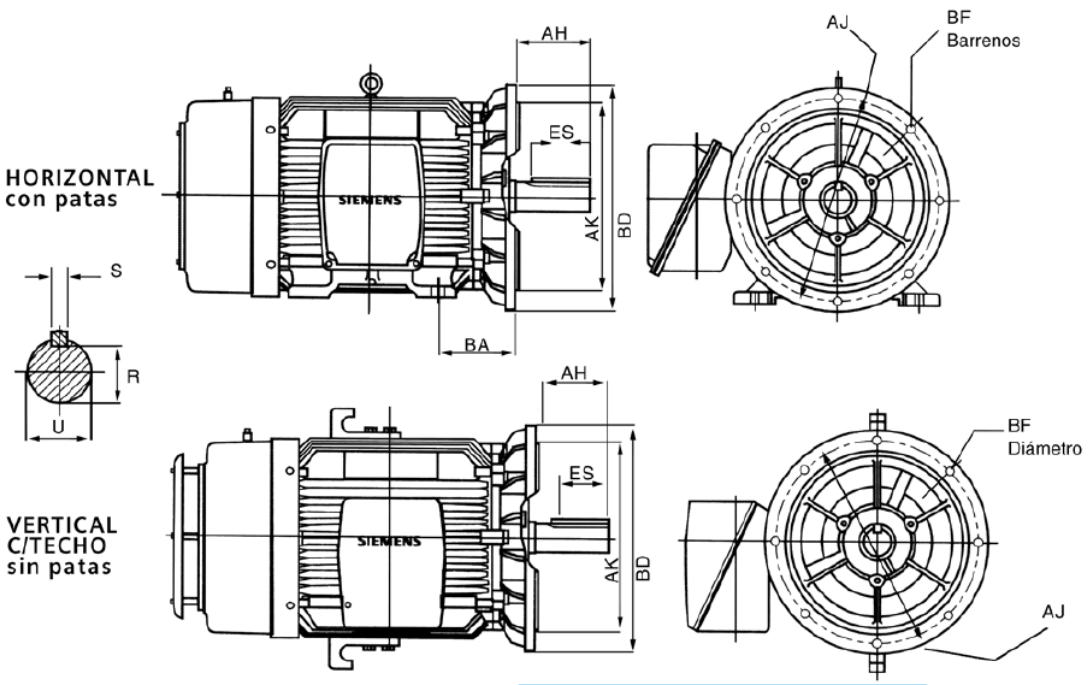
ASESOR: Ing. Dante Ángel Elías Giordano

Lima, noviembre de 2012

ÍNDICE DE ANEXOS

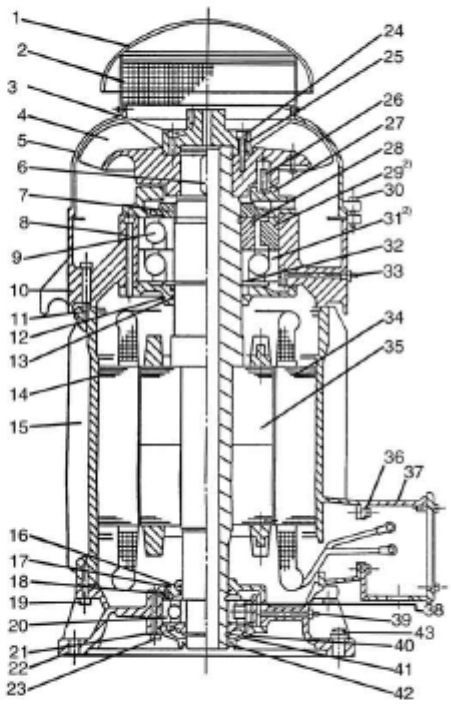
A.1: Catálogo del motor eléctrico de accionamiento del husillo

Descripción				Modelo		
Potencia en HP	Velocidad en RPM	Tensión a 60 Hz en Volts	Tamaño Armazón NEMA	RGZE Uso general Catálogo Spiridon	RGZESD Servicio pesado No. de parte	RGZZESD A prueba de explosión Catálogo Spiridon
0.5	900	220/440	143T	1LA01438YK30	N/A	N/A
0.75	1800	220/440	143T	1LA01434YK30	N/A	1MJ91434YP30
	1200	220/440	143T	1LA01436YK30	N/A	1MJ91436YP30
	900	220/440	145T	1LA01458YK30	N/A	N/A
1	3600	220/440	143T	1LA01432YK30	1LA91432YK30*	1MJ91432YP30
	1800	220/440	143T	1LA01444YK30	1LA91444YK30*	1MJ91444YP30
	1200	220/440	145T	1LA01456YK30	1LA91456YK30*	1MJ91456YP30
	900	220/440	182T	1LA01828YK30	1LA91828YK30*	1MJ91828YP30
1.5	3600	220/440	143T	1LA01442YK30	1LA91442YK30*	1MJ91442YP30
	1800	220/440	145T	1LA01454YK30	1LA91454YK30*	1MJ91454YP30
	1200	220/440	182T	1LA01826YK30	1LA91826YK30*	1MJ91826YP30
	900	220/440	184T	1LA01848YK30	1LA91848YK30*	1MJ91848YP30
2	3600	220/440	145T	1LA01452YK30	1LA91452YK30*	1MJ91452YP30
	1800	220/440	145T	1LA01464YK30	1LA91464YK30*	1MJ91464YP30
	1200	220/440	184T	1LA01846YK30	1LA91846YK30*	1MJ91846YP30
	900	220/440	213T	1LA02138YK30	1LA92138YK30*	1MJ92138YP30
3	3600	220/440	182T	A7B82500006685	1LA91822YK30*	1MJ91822YP30
	1800	220/440	182T	1LA01824YK30	1LA91824YK30*	1MJ91824YP30
	1200	220/440	213T	1LA02136YK30	1LA92136YK30*	1MJ92136YP30
	900	220/440	215T	1LA02158YK30	1LA92158YK30*	1MJ92158YP30
5	3600	220/440	184T	1LA01842YK30	1LA91842YK30*	1MJ91842YP30
	1800	220/440	184T	1LA01844YK30	1LA91844YK30*	1MJ91844YP30
	1200	220/440	215T	1LA02156YK30	1LA92156YK30*	1MJ92156YP30
	900	220/440	254T	1LA02548YK30	1LA92548YK30*	1MJ92548YP30
7.5	3600	220/440	213T	1LA02132YK30	1LA92132YK30*	1MJ92132YP30
	1800	220/440	213T	1LA02134YK30	1LA92134YK30*	1MJ92134YP30
	1200	220/440	254T	1LA02546YK30	1LA92546YK30*	1MJ92546YP30
	900	220/440	256T	1LA02568YK30	1LA92568YK30*	1MJ92568YP30
10	3600	220/440	215T	1LA02152YK30	1LA92152YK30*	1MJ92152YP30
	1800	220/440	215T	1LA02154YK30	1LA92154YK30*	1MJ92154YP30
	1200	220/440	256T	1LA02566YK30	1LA92566YK30*	1MJ92566YP30
	900	220/440	284T	1LA02848FE71	1LA02848SE71*	*
15	3600	220/440	254T	1LA02542FE71	1LA92542YK30*	1MJ92542YP30
	1800	220/440	254T	1LA02544FE71	1LA92544YK30*	1MJ92544YP30
	1200	220/440	284T	1LA02846FE71	1LA02846SE71*	*
	900	220/440	286T	1LA02868FE71	1LA02868SE71*	*
20	3600	220/440	256T	1LA02562FE71	1LA92562YK30*	1MJ92562YP30
	1800	220/440	256T	1LA02564FE71	1LA92564YK30*	1MJ92564YP30
	1200	220/440	286T	1LA02866FE71	1LA02866SE71*	*
	900	220/440	324T	1LA03248FE71	1LA03248SE71*	*
25	3600	220/440	284TS	1LA02842FE72	1LA02842SE72*	*
	1800	220/440	284T	1LA02844FE71	1LA02844SE71*	*
	1200	220/440	324T	1LA03246FE71	1LA03246SE71*	*
	900	220/440	326T	1LA03268FE71	1LA03268SE71*	*
30	3600	220/440	286TS	1LA02862FE72	1LA02862SE72*	*
	1800	220/440	286T	1LA02864FE71	1LA02864SE71*	*
	1200	220/440	326T	1LA03266FE71	1LA03266SE71*	*
	900	220/440	364T	*	1LA03648SE71*	*
40	3600	220/440	324TS	1LA03242FE72	1LA03242SE72*	*
	1800	220/440	324T	1LA03244FE71	1LA03244SE71*	*
	1200	220/440	364T	1LA03646FE71	1LA03646SE71*	*
	900	220/440	365T	*	1LA03658SE71*	*



Despiece, Montaje

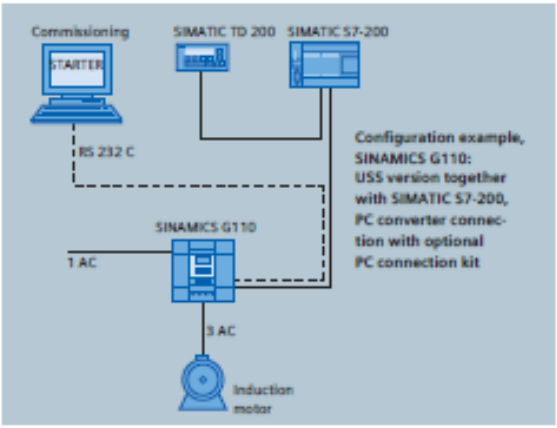
1. Cubierta superior. (Techo)
2. Rejilla.
3. Cople *
4. Ventilador
5. Capuchón.
6. Cuña Ventilador.
7. Salpicador roscado para ajuste de baleros.
8. Tornillo Allen.
9. Rodamiento de contacto angular [1] (Doble)
10. Escudo opuesto.
11. Tornillo C.Hexagonal.
12. Tapa balero interior lado opuesto.
13. Sellos para grasa.
14. Flecha hueca.
15. Carcasa.
16. Anillo de fieltro.
17. Tapa balero interior.
18. Muelle de precarga.
19. Tornillo C.Hexagonal.
20. Rodamiento de bolas.
21. Salpicador.
22. Brida "P".
23. Tornillo C.Hexagonal.
24. Tornillo Allen.
25. Anillo de seguridad.
26. Perno trinquete.
27. Tapa balero exterior lado opuesto.
28. Anillo separador *.
29. Pieza de relleno *.
30. Tornillo C.Hexagonal.
31. Rodamiento de contacto angular [2] (Simple).
32. Anillo de seguridad.
33. Grasera.
34. Paquete estator.
35. Paquete rotor.
36. Tornillo C.Hexagonal.
37. Caja de conexiones.
38. Rodamiento guía (rodillos).
39. Grasera.
40. Anillo de seguridad.
41. Tapa balero exterior lado brida.
42. Retén (V-Ring).
43. Placa de apriete para la apuesta de tierra.



A.2: Catálogo del variador de frecuencia y panel de operación

SINAMICS G110:

The versatile single-motor drive for low power ratings



Design

SINAMICS G110 converters have an especially compact design and are supplied ready to be connected up. Further, they can be quickly installed and simply wired. The digital inputs can be freely parameterized and can be flexibly adapted to the widest range of applications. SINAMICS G110 is either parameterized using STARTER, the PC-based tool, or using an optional operator panel (Basic Operator Panel).

Applications

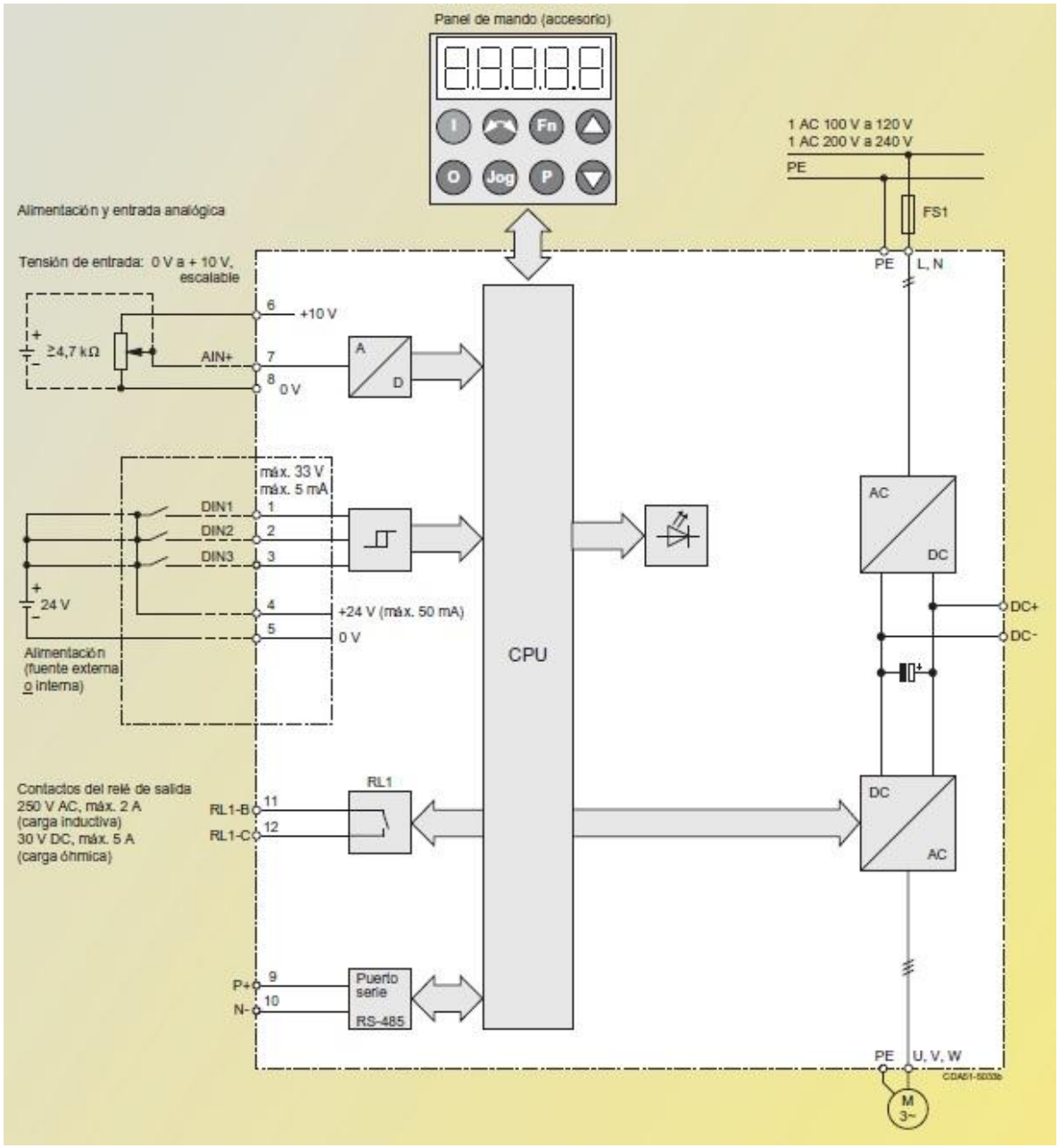
- As drive in industry and the trades
- In many sectors – e.g. food & beverage, textiles, packaging
- Conveyor, pump and fan applications
- For factory/garage door drives and barriers
- For moveable billboards
- Series commissioning of several converters with the same parameters can be transferred to other converters

Your advantages

- Can be flexibly used as a result of the diverse parameterization options (analog and USS)
- For low-profile electrical cabinets – also with heat sinks without ribs
- Simple installation, parameterization and commissioning
- Powerful diagnostics using the optional operator panel
- Fast series commissioning by copying parameters
- Freely parameterizable digital inputs
- Reduced stress on the mechanical system as a result of the skippable frequency bandwidth to avoid resonance effects, parameterizable ramp-up/ramp-down times and by switching the converter to a rotating motor (flying restart)
- Higher plant availability through automatic restart after a power failure
- Fast current limiting for disturbance-free operation when sudden load surges occur
- Integrated EMC filter for industrial and public line supplies
- Low-noise motor operation through a high pulse frequency
- Increased plant and system availability through an automatic restart after line failure or an operational fault

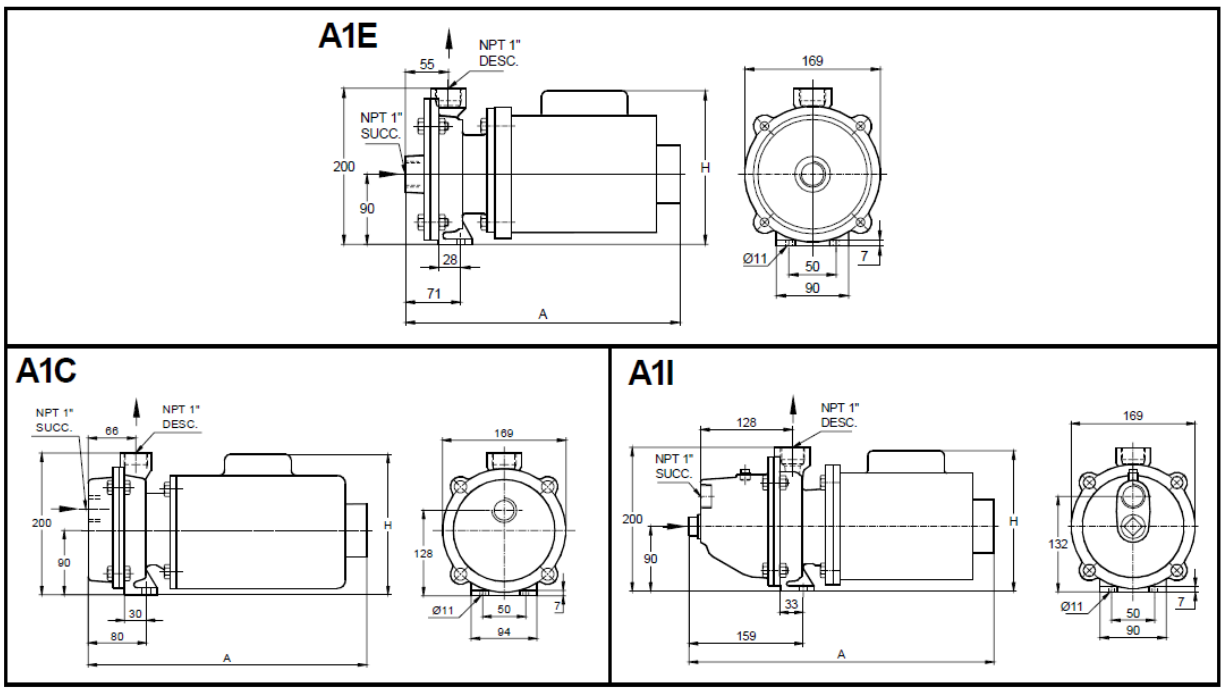
Technical data

Electrical data	SINAMICS G110
Line voltages; power ranges	1-ph. 200 ... 240 V AC, ± 10 %; 0.12 ... 3.0 kW
Line supply types	IT, TN, TT
Line frequency	50 Hz/60 Hz
Output frequency	0 ... 650 Hz
Open-loop control techniques	V/f control, linear (M~n) V/f control, square law (M~n²) V/f control, parameterizable
Fixed frequencies	3, parameterizable
Skippable frequency ranges	1, parameterizable
Digital inputs	3 parameterizable digital inputs, 24 V DC
Analog version: Analog input	Optional, 1 analog input for set point from 0 ... 10 V scalable or can be used as 4th digital input
Digital output	1x 24 V DC digital output
Communication interface	USS version: serial RS 485 interface for operation with the USS protocol
Functions	
Software functions	Automatic restart following operational interruption due to line failure: Parameterizable ramp-up times 0 ... 650 s; ramp rounding-off. The converter can be bumplessly switched to a rotating motor.
Protection functions	Undervoltage, overvoltage; ground fault; short circuit; stall protection; thermal motor protection I²t; converter overtemperature; motor overtemperature
Motors that can be connected	Induction motors
Mechanical data	
Degree of protection	IP20
Cooling type	≤ 0.75 kW: convection cooling, version with flat heat sink; > 0.75 kW: internal air cooling (integrated fan)
Standards	
In conformance with the following standards	CE, UL, cUL, c-tick



A.3: Catálogo de la electrobomba para el sistema de refrigeración

DIMENSIONES



DATOS TECNICOS

MODELO	DIMENSIONES		PRESION DE PRUEBA HIDROSTATICA (m)	DIAMETRO EJE (PULG.)		MOTOR			PESO (Kg.)
	A	H		IMPULSOR	SELLO	HP	FACTOR DE SERVICIO	FRAME	
A1E-0.6M	330	202	70	NF 7/16	5/8	0.6	1.0	NEMA C56	14.8
A1E-0.8M						0.8			15.8
A1E-1.4M	387	220				1.4		NEMA D56	20.8
A1E-1.9T	458	173				1.9			19.4
A1C-0.6M	335	202				0.6		NEMA C56	16.1
A1C-0.8M						0.8			17.1
A1C-1.4M	395	220				1.4		NEMA D56	22.1
A1I-0.6M	432	202				0.6		NEMA C56	19.0
A1I-0.8M						0.8			19.0
A1I-1.4M	458	220				1.4		NEMA D56	24.2
A1I-1.9T	387	173				1.9			23.2

A.4: Esquema de instalación de la electrobomba para el sistema de refrigeración

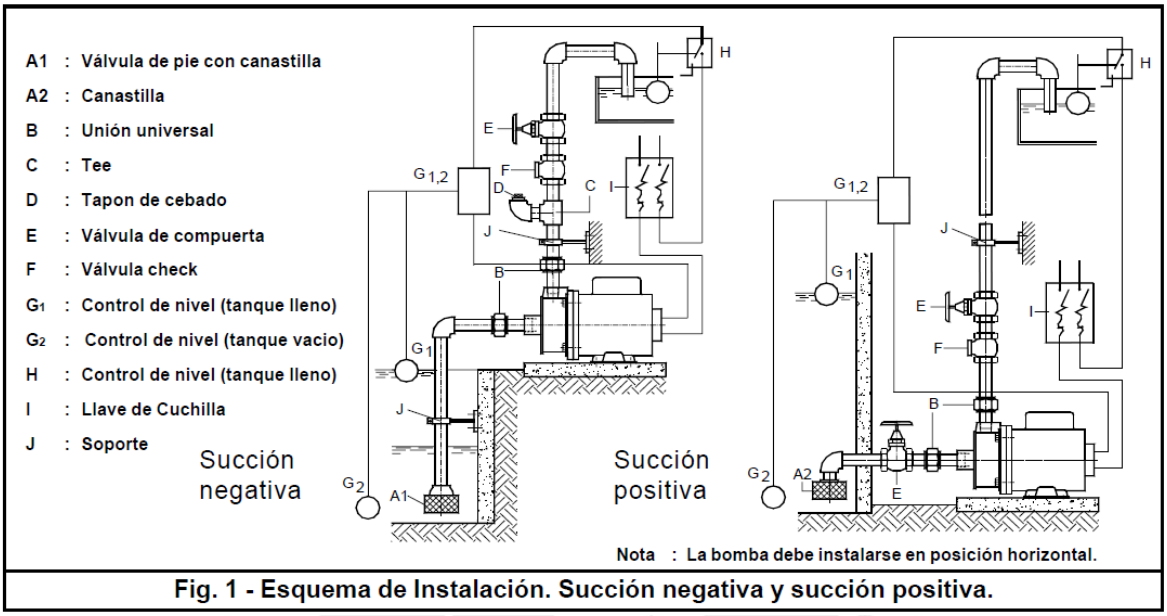
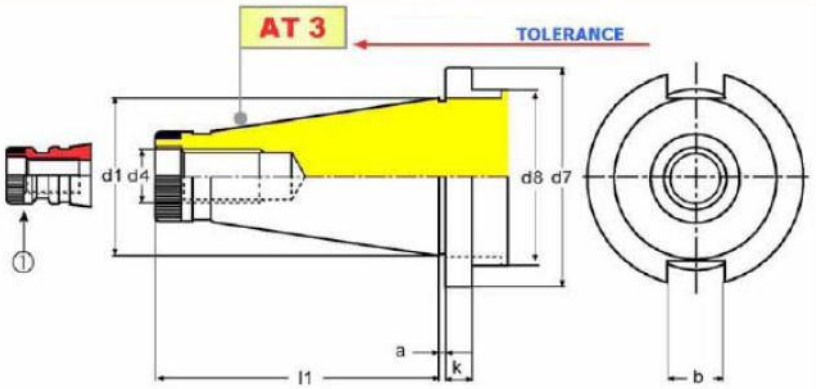


Fig. 1 - Esquema de Instalación. Succión negativa y succión positiva.

A.5: Catálogo del cono y portafresas del husillo

driven by technology

NORMA ISO DIN 2080



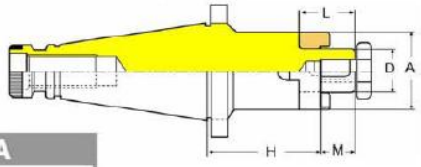
CONO TAPER		d_1	a	b	d_4	d_7	l_1	k	d_8
ISO 30		31,75	1,6	16,1	M12	50	68,4	8	36
ISO 40	①	44,45	1,6	16,1	M16	63	93,4	10	50
ISO 50		69,85	3,2	25,7	M24	97,5	126,8	12	78

driven by technology

NORMA ISO DIN 2080

COMBI SHELL END MILL HOLDERS

ISO - KOMBI



30 Taper - Form A

Ref.	Order Nr.	A	M
350-260	ISO30.H50.D16C	32	17
	ISO30.H50.D22C	40	19
	ISO30.H50.D27C	48	21
	ISO30.H50.D32C	58	24

50 Taper - Form A

Ref.	Order Nr.	A	M
350-260	ISO50.H55.D16C	32	17
	ISO50.H100.D16C	32	17
	ISO50.H125.D16C	32	17
	ISO50.H55.D22C	40	19
	ISO50.H100.D22C	40	19
	ISO50.H125.D22C	40	19
	ISO50.H55.D27C	48	21
	ISO50.H100.D27C	48	21
	ISO50.H125.D27C	48	21
	ISO50.H55.D32C	58	24
	ISO50.H100.D32C	58	24
	ISO50.H125.D32C	58	24
	ISO50.H55.D40C	70	27
	ISO50.H100.D40C	70	27
	ISO50.H125.D40C	70	27
	ISO50.H55.D50C	90	30

40 Taper - Form A

Ref.	Order Nr.	A	M
350-260	ISO40.H52.D13C	28	12
	ISO40.H52.D16C	32	17
	ISO40.H90.D16C	32	17
	ISO40.H52.D22C	40	19
	ISO40.H90.D22C	40	19
	ISO40.H52.D27C	48	21
	ISO40.H90.D27C	48	21
	ISO40.H52.D32C	58	24
	ISO40.H100.D32C	58	24
	ISO40.H52.D40C	70	27
	ISO40.H100.D40C	70	27

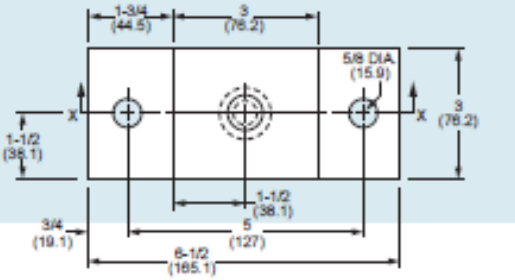
A.6: Catálogo y especificaciones técnicas del aislador de vibración

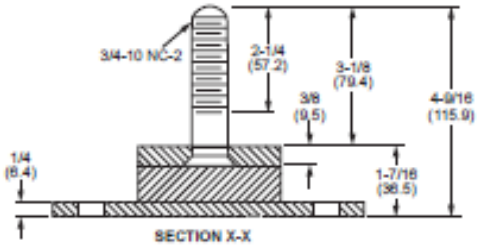
ADVANCED ANTIVIBRATION COMPONENTS

Rectangular Mounts – To 900 lbs.

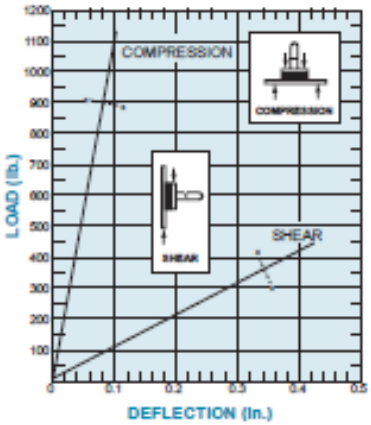
www.vibrationmounts.com Phone: 516.328.3662 Fax: 516.328.3365

- MATERIAL: Isolator – Natural Rubber
  Base – Steel
- FOR COMPRESSION LOADS TO 900 POUNDS (408 kgf)
- FOR SHEAR LOADS TO 360 POUNDS (163.3 kgf)





NOTE: Dimensions in ( ) are mm.



LOAD DEFLECTION GRAPH
Deflection below the line x-x are considered safe practice for static loads; data above that line are useful for calculating deflections under dynamic loads.

Compression Catalog Number[Δ]	Maximum Load lb. (kgf)	Forcing Frequency In Cycles per Minute									
		750	850	950	1100	1250	1500	1750	2000	2500	3000
		Minimum Load for 81% Isolation lb. (kgf)									
V10Z 6-530C	900 (408)	—	—	—	—	—	—	800 (362.9)	590 (267.6)	390 (177)	270 (122.5)

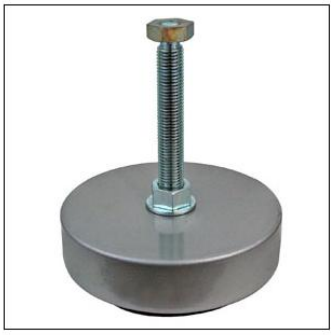
Shear Catalog Number[Δ]	Maximum Load lb. (kgf)	Forcing Frequency In Cycles per Minute									
		750	850	950	1100	1250	1500	1750	2000	2500	3000
		Minimum Load for 81% Isolation lb. (kgf)									
V10Z 6-530C	360 (163.3)	360 (163.3)	335 (152)	260 (118)	195 (88.5)	155 (70.3)	102 (46.3)	75 (34)	55 (25)	*	*

NOTE: 81% vibration absorption (usually satisfactory) will be obtained when the mounting indicated is operating at the minimum load shown for each forced frequency. Better than 81% absorption will be obtained either with a greater load (within the limits shown) for a given forced frequency, or with a higher forced frequency for a given load.

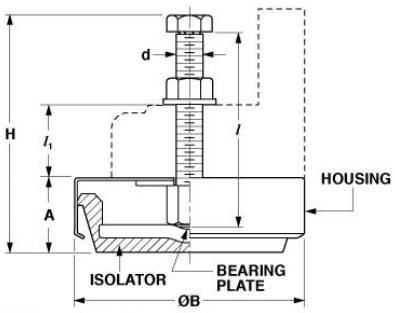
*At these forcing frequencies, lesser loads will yield 81% isolation.

[Δ]To be discontinued when present stock is depleted.

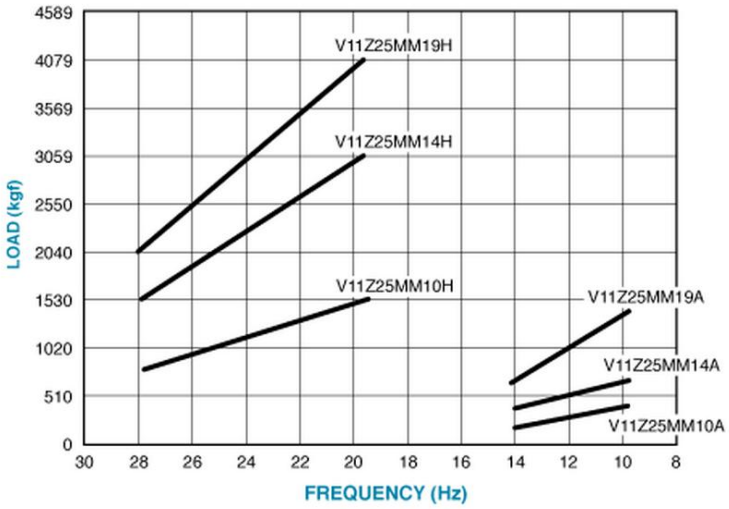
A.7: Catálogo y especificaciones técnicas del montaje nivelador



BOLT & NUT :
Steel, Zinc Plated
BEARING PLATE:
Steel
HOUSING:
Steel, Painted
ISOLATOR:
Neoprene



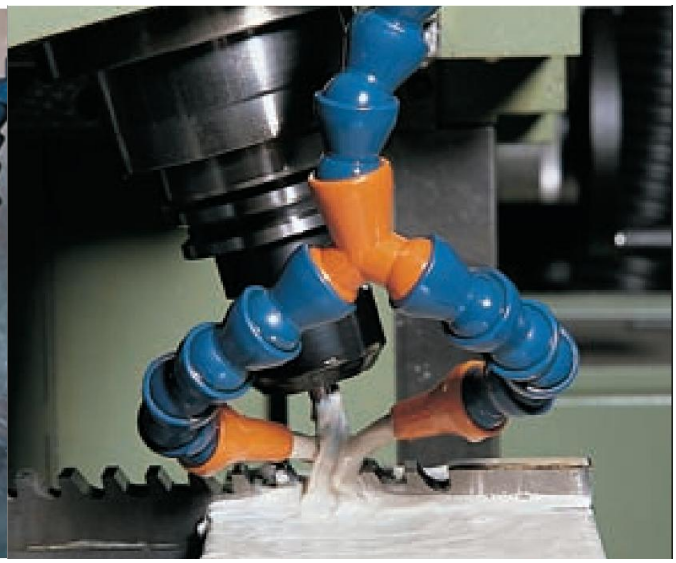
NOTE: Dimensions in ( ) are inch.



CAD	Catalog Number	Load		B	A	H	l	d	l_1 Max Height Adjustment	Spring Rate kgf/mm (lb./in.) x 10^3
		Max. kgf (lb.)	Min. kgf (lb.)							
●	V11Z25MM10A	316.1 (696.9)	158.1 (348.6)	100 (3.94)	39 (1.54)	121 (4.76)	90 (3.54)	M12	18 (.71)	122.4 (6.85)
●	V11Z25MM10H	1529.6 (3372.2)	764.8 (1686.1)		35 (1.38)	148 (5.83)	120 (4.72)		22 (.87)	2345.3 (131.3)
●	V11Z25MM14A	642.4 (1416.2)	316.1 (696.9)	140 (5.51)	47 (1.85)	157 (6.18)		M16	19 (.75)	244.7 (13.7)
●	V11Z25MM14H	3059.1 (6744.1)	1529.6 (3372.2)		42 (1.65)				24 (.95)	4690.7 (262.7)
●	V11Z25MM19A	1274.6 (2810)	642.4 (1416.2)	190 (7.48)	56 (2.21)	164 (6.46)		M20	25 (.98)	489.5 (27.4)
●	V11Z25MM19H	4078.9 (8992.3)	2039.4 (4496.1)		54 (2.13)				27 (1.06)	6322.2 (354)

CLICK CATALOG NUMBER TO CHECK PRICE AND AVAILABILITY.

A.8: Catálogo de la manguera para refrigeración *Loc-line*



Loc-Line® Materials and Properties Information

Standard Hose and Fittings:

Colors: Blue, Orange, Black, White, Grey
Material: Acetal Copolymer

Compatibility:
Yes: Acetone, Alcohol, Ethyl, Greases, Oils, Commercial Dish Detergents, Gasoline, Lacquer Solvents, Sodium Hydroxide

No: Acids, Ammonium Hydroxide, Bases Strong, Hypochlorite Ion Solutions, Sodium Hypochlorite
Melting Point: 329° F
Maximum Operating Temperature: 170° F *(Repeated exposure over this temperature will cause fatigue)*

Acid Resistant Hose and Fittings:

Colors: Yellow
Material: Polyester
Compatibility:
Yes: Acids under 150F, Alcohols, Aromatic Solvents, Gasoline, Grease, Hydrocarbons, Oils, Salt Solutions
No: Acetone, Chlorinated Solvents, Bases Strong, Ethyl Acetate, Water Hotter than 150F
Melting Point: 475°
Maximum Operating Temperature: 170° F *(Repeated exposure over this temperature will cause fatigue)*

Vacuum Hose and Fittings:

Colors: Blue, Orange
Material: Acetal Copolymer
PVC Adapter: PVC
Compatibility: *(See Standard Acetal Hose)*

Anti-static Vacuum Hose
Color: Black
Material: Electro Conductive Acetal Copolymer
(Anti-Static Surface Resistance: 1.000E3 Ohms. Volume Resistance: <6.000E2 Ohms)

General Mechanical Properties:

Line Pressure & Flow Rates:
1/4" System 30-50 PSI 250 gal/hour
1/2" System 20-30 PSI 478 gal/hour
3/4" System 10-20 PSI 1,140 gal/hour
Please note that all applications have variables and conditions that will affect the maximum hose pressures. Testing is always recommended whenever possible.

A.9: Tabla de valores de “K” para el cálculo del requerimiento de potencia

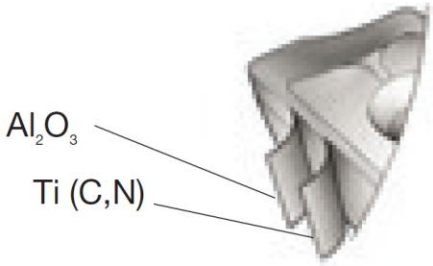
ISO	CMC No.	Description		a_e/D_c=0.8			a_e/D_c=0.4			a_e/D_c=0.2		
				f_z=0.1	f_z=0.2	f_z=0.4	f_z=0.1	f_z=0.2	f_z=0.4	f_z=0.1	f_z=0.2	f_z=0.4
P		**Steel**										
	01.1	**Unalloyed**	C = 0.10–0.25%	5.7	4.8	4.0	6.2	5.2	4.4	6.8	5.7	4.8
	01.2		C = 0.25–0.55%	6.1	5.1	4.3	6.6	5.6	4.7	7.2	6.1	5.1
	01.3		C = 0.55–0.80%	6.5	5.4	4.6	7.1	5.9	5.0	7.7	6.5	5.4
	01.4			6.9	5.8	4.8	7.5	6.3	5.3	8.2	6.9	5.8
	01.5			7.6	6.4	5.4	8.3	7.0	5.9	9.1	7.6	6.4
	02.1	**Low-alloyed**	Non-hardened	6.5	5.4	4.6	7.1	5.9	5.0	7.7	6.5	5.4
	02.2	**(alloying elements ≤5%)**	Hardened and tempered	7.6	6.4	5.4	8.3	7.0	5.9	9.1	7.6	6.4
	03.11	**High-alloyed**	Annealed	7.4	6.2	5.3	8.1	6.8	5.7	8.8	7.4	6.2
	03.13	**(alloying elements ≤5%)**	Hardened tool steel	8.2	6.9	5.8	8.9	7.5	6.3	9.7	8.2	6.9
	03.21			11.0	9.3	7.8	12.0	10.1	8.5	13.1	11.0	9.3
	03.22			11.8	9.9	8.4	12.9	10.8	9.1	14.0	11.8	9.9
	06.1	**Castings**	Unalloyed	5.3	4.5	3.8	5.8	4.9	4.1	6.3	5.3	4.5
	06.2		Low-alloy, alloying elements ≤5%	6.1	5.1	4.3	6.6	5.6	4.7	7.2	6.1	5.1
	06.3		High-alloy, alloying elements >5%	7.4	6.2	5.3	8.1	6.8	5.7	8.8	7.4	6.2
M		**Stainless steel**										
	05.11	Ferritic/Martensitic	Non-hardened	6.2	5.4	4.7	6.7	5.8	5.0	7.2	6.2	5.4
	05.12		PH-hardened	9.7	8.4	7.2	10.4	9.0	7.8	11.2	9.7	8.4
	05.13		Hardened	8.0	6.9	5.9	8.6	7.4	6.4	9.2	8.0	6.9
	05.21	Austenitic	Non-hardened	6.9	6.0	5.2	7.4	6.4	5.6	8.0	6.9	6.0
	05.22		PH-hardened	9.7	8.4	7.2	10.4	9.0	7.8	11.2	9.7	8.4
	05.51	Austenitic-Ferritic	Non-weldable ≥0.05%C	6.9	6.0	5.2	7.4	6.4	5.6	8.0	6.9	6.0
	05.52	(Duplex)	Weldable <0.05%C	8.3	7.2	6.2	8.9	7.7	6.7	9.6	8.3	7.2
		Stainless steel – cast										
	15.11	Ferritic/Martensitic	Non-hardened	6.5	5.4	4.6	7.1	5.9	5.0	7.7	6.5	5.4
	15.12		PH-hardened	9.5	8.0	6.7	10.4	8.7	7.3	11.3	9.5	8.0
	15.13		Hardened	8.0	6.7	5.7	8.7	7.3	6.2	9.5	8.0	6.7
	15.21	Austenitic	Non-hardened	6.9	5.8	4.8	7.5	6.3	5.3	8.2	6.9	5.8
	15.22		PH-hardened	9.5	8.0	6.7	10.4	8.7	7.3	11.3	9.5	8.0
	15.51	Austenitic-Ferritic	Non-weldable ≥0.05%C	6.9	5.8	4.8	7.5	6.3	5.3	8.2	6.9	5.8
	15.52	(Duplex)	Weldable <0.05%C	8.4	7.0		9.1	7.7		10.0	8.4	
S		**Heat resistant super alloys**										
	20.11	Iron base	Annealed or solution treated	9.1	7.7		10.0	8.4		10.9	9.1	
	20.12		Aged or solution treated and aged	9.5	8.0		10.4	8.7		11.3	9.5	
	20.21	Nickel base	Annealed or solution treated	10.1	8.5		11.0	9.3		12.0	10.1	
	20.22		Aged or solution treated and aged	11.0	9.3		12.0	10.1		13.1	11.0	
	20.24		Cast or cast and aged	11.4	9.6		12.5	10.5		13.6	11.4	
	20.31	Cobalt base	Annealed or solution treated	10.3	8.6		11.2	9.4		12.2	10.3	
	20.32		Solution treated and aged	11.4	9.6		12.5	10.5		13.6	11.4	
	20.33		Cast or cast and aged	11.8	9.9		12.9	10.8		14.0	11.8	
		Titanium alloys										
	23.1		Commercial pure (99.5% Ti)	4.7	4.0		5.1	4.4		5.5	4.7	
	23.21		α, near α and α+β alloys, annealed	5.1	4.3		5.5	4.7		6.0	5.1	
	23.22		α+β alloys in aged cond. β alloys, annealed or aged	5.1	4.3		5.5	4.7		6.0	5.1	
H	04.1	**Extra hard steel Hard steel**	Hardened and tempered	16.0	13.5		17.4	14.7		19.0	16.0	
	10.1	**Chilled cast iron**	Cast or cast and aged	9.0	7.4		9.9	8.2		10.9	9.0	
K	07.1	**Malleable cast iron**	Ferritic (short chipping)	3.3	2.7	2.2	3.6	3.0	2.4	4.0	3.3	2.7
	07.2		Pearlitic (long chipping)	3.7	3.0	2.5	4.1	3.3	2.8	4.5	3.7	3.0
	08.1	**Grey cast iron**	Low tensile strength	3.7	3.0	2.5	4.1	3.3	2.8	4.5	3.7	3.0
	08.2		High tensile strength	4.5	3.7	3.1	5.0	4.1	3.4	5.5	4.5	3.7
	09.1	**Nodular SG iron**	Ferritic	3.7	3.0	2.5	4.1	3.3	2.8	4.5	3.7	3.0
	09.2		Pearlitic	5.5	4.6		6.1	5.0		6.7	5.5	
N	30.11	**Aluminium alloys**	Wrought or wrought and coldworked, non-aging	1.5	1.3		1.7	1.4		1.8	1.5	
	30.12		Wrought or wrought and aged	2.5	2.1		2.7	2.3		2.9	2.5	
	30.21	**Aluminium alloys**	Cast, non-aging	2.3	1.9		2.5	2.1		2.7	2.3	
	30.22		Cast or cast and aged	2.7	2.2		2.9	2.4		3.2	2.7	
	30.3			1.3	1.1		1.5	1.2		1.6	1.3	
	30.41	**Aluminium**	Cast, 13–15% Si	2.7	2.2		2.9	2.4		3.2	2.7	
	30.42	**alloys**	Cast, 16–22% Si	2.7	2.2		2.9	2.4		3.2	2.7	
	33.1	**Copper and copper**	Free cutting alloys, ≥1% Pb	2.1	1.8		2.3	1.9		2.5	2.1	
	33.2	**alloys**	Brass, leaded bronzes, ≤ 1% Pb	2.1	1.8		2.3	1.9		2.5	2.1	
	33.3		Bronze and non-leaded copper incl. electrolytic copper	5.1	4.3		5.6	4.7		6.1	5.1	

A.10: Materiales de las plaquitas de corte

Uncoated Cemented Carbide - HW

H13A - (N15, S20, K25)
H13A is a fairly fine grained grade with a very good balance between wear resistance and toughness making it a very versatile grade suitable for many materials and applications. Used for milling of heat resistant alloys at moderate cutting speed and feed, milling of aluminum alloys and finishing to medium machining of cast iron. Suitable for machining of nodular cast iron.

Coated Cemented Carbide - HC



GC3020 - (K20, H15)
A hard and very wear resistant cemented carbide with a MT-CVD coating. The thick coating is made of a MT-CVD layer of TiCN giving excellent abrasive wear resistance, followed by a layer of Al_2O_3 giving very good high temperature protection. The total thickness is about 9 microns. Optimized for dry machining of grey cast iron at medium to high speed.