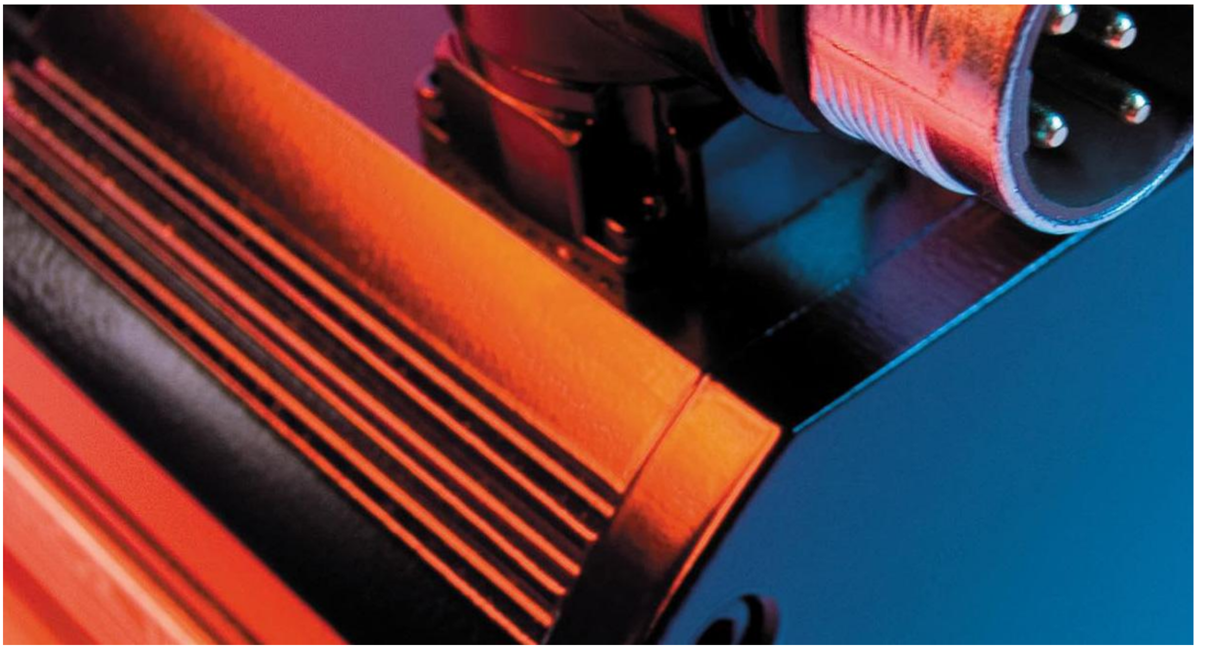


SERVICE MANUAL
XtraforsPrime

Version 11.06

Contents

1.- Introduction to the Product

The XtraforsPrime servomotor is a new product generation that resumes all the knowhow and the new technologies of Mavilor and the group Infranor.

The improvement can be found in the design, in the harmony with the drives, the performances and optional solutions

2. Safety Guidelines

2.1 Appropriate use

Servo motors have been designed, developed and manufactured for conventional use in the industry. They were not designed, developed and manufactured for any use involving serious risks or hazards that could lead to death, injury, serious physical damage, or
loss of any kind without the implementation of exceptionally stringent safety precautions.

Synchronous servomotors are precision motors. They are not intended to be connected directly to a rotary current power supply system. They have to be operated only by a particular electronic power stage. A direct connection to a main supply will lead to the destruction of the motor.

Personnel that in any way uses our products must first read and understand the relevant safety instructions and be familiar with appropriate use.

Do not mount damaged or faulty products or use them in operation.
Make sure that the products have been installed in the manner described in the relevant documentation.

Servo motors can have bare parts with voltages applied (e.g. terminals) or hot surfaces. Additional sources of danger result from moving machine parts. Improperly removing the required covers, inappropriate use, incorrect installation or incorrect operation can result in severe personal injury or damage to property.

2.2.-Explanations

The safety instructions describe the following degrees of hazard seriousness in compliance with ANSI Z535.4. The degree of hazard seriousness informs about the consequences resulting from noncompliance with the safety instructions.

Signal Word	Definition
⚠ DANGER	DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations
⚠ WARNING	WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury
⚠ CAUTION	CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices

2.3 Hazards by Improper Use

DANGER	High voltage and High discharge current! Danger to life or severe bodily harm by electric shock
DANGER	Dangerous movements! Danger to life severe bodily harm or material damage by an unintentional motor movement
WARNING	High electrical voltage due to wrong connections! Danger to life or bodily harm by electric shock
WARNING	Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!
CAUTION	Surface of machine housing could be extremely hot! Danger of injury! Danger of burns!
CAUTION	Risk of injury due to improper handling! Bodily harm caused by crushing, shearing, cutting and mechanical shock

2.4 Transport and Storage

During transport and storage, devices must be protected from excessive stress (mechanical load, temperature, humidity, aggressive atmosphere, etc.).
Servo drives contain components sensitive to electrostatic charges which can be damaged by inappropriate handling. It is therefore necessary to provide the required safety precautions against electrostatic discharges during installation or removal of servo drives.

2.5 Installation

The installation must take place according to the service manual using suitable equipment and tools.
Devices may only be installed without voltage applied and by qualified personnel. Before installation, voltage to the switching cabinet should be switched off and prevented from being switched on again.
The general safety regulations and national accident prevention guidelines (Council Directive 89/391/CEE) must be observed when working with high voltage systems.
Electrical installation must be carried out according to the relevant guidelines (e.g. line cross section, fuse, protective ground connection).

DANGER **High voltage and High discharge current! Danger to life or severe bodily harm by electric shock**

2.6 Protection against Touching Electrical Parts

Before turning on a servo drive, make sure that the housing is properly connected to ground (PE rail). The ground connection must be made, even when testing the servo drive or when operating it for a short time!
Before turning the device on, make sure that all voltage-carrying parts are securely covered.
During operation, all covers and switching cabinet doors must remain closed.
Control and high power contacts can have voltage applied, even when the motor is not turning.
Touching the contacts when the device is switched on is not permitted.
Before working on servo drives, they must be disconnected from the power mains and prevented from being switched on again.
The servo drives are labelled with the following warning:

High electrical voltage due to wrong connections!
Danger to life or bodily harm by electric shock

2.7 Protection against Dangerous Movements

Dangerous movements can be caused by faulty control of the connected motors.
Some common examples are:
- improper or wrong wiring of cable connections
- incorrect operation of the equipment components
- wrong input of parameters before operation
- malfunction of sensors, encoders and monitoring devices
- defective components
- software or firmware errors

Dangerous movements can occur immediately after equipment is switched on or even after an unspecified time of trouble-free operation.
The monitoring in the drive components will normally be sufficient to avoid faulty operation in the connected drives. Regarding personal safety, especially the danger of bodily injury and material damage, this alone cannot be relied upon to ensure complete safety. Until the integrated monitoring functions become effective, it must be assumed in any case that faulty drive movements will occur. The extent of faulty drive movements depends upon the type of control and the state of operation.

Dangerous movements! Danger to life severe bodily harm or material damage by motor unintentional movement

- Ensure personal safety by means of qualified and tested higher-level monitoring devices or measures integrated in the installation. Unintended machine motion is possible if monitoring devices are disabled, bypassed or not activated.
- Pay attention to unintended machine motion or other malfunction in any mode of operation.
- Keep free and clear of the machine's range of motion and moving parts. Possible measures to prevent people from accidentally entering the machine's range
of motion:
- use safety fences

- use safety guards
- use protective coverings
- install light curtains or light barriers
- Fences and coverings must be strong enough to resist maximum possible momentum, especially if there is a possibility of loose parts flying off.
- Mount the emergency stop switch in the immediate reach of the operator. Verify that the emergency stop works before starting up. Do not operate the machine if the emergency stop is not working.
- Isolate the drive power connection by means of an emergency stop circuit or use a starting lockout to prevent unintentional start.
- Make sure that the drives are brought to a safe standstill before accessing or entering the danger zone. Safe standstill can be achieved by switching off the power supply contactor or by safe mechanical locking of moving parts.
- Secure vertical axes against falling or dropping after switching off the motor power by, for example:
- mechanically securing the vertical axes
- adding an external braking/ arrester/ clamping mechanism
- ensuring sufficient equilibration of the vertical axes

The standard equipment motor brake or an external brake controlled directly by the drive controller is not sufficient to guarantee personal safety!

2.8 Protection against Contact with Hot Parts

Surface of machine housing could be extremely hot! Danger of injury! Danger of burns!

- Do not touch housing surfaces near sources of heat!
- After switching off the equipment, wait at least ten (10) minutes to allow it to cool down before touching it.
- Do not touch hot parts of the equipment, such as housings with integrated heat sinks and resistors.

2.9 Protection during Handling and Mounting

Under certain conditions, incorrect handling and mounting of parts and components may cause injuries.

Risk of injury due to improper handling! Bodily harm caused by crushing, shearing, cutting and mechanical shock

- Observe general installation and safety instructions with regard to handling and mounting.
- Use appropriate mounting and transport equipment.
- Take precautions to avoid pinching and crushing.
- Use only appropriate tools. If specified by the product documentation, special tools must be used.

- Use lifting devices and tools correctly and safely.
- For safe protection wear appropriate protective clothing, e.g. safety glasses, safety shoes and safety gloves.
- Never stand under suspended loads.
- Clean up liquids from the floor immediately to prevent slipping.

3.- Technical Data

3.1.- General Description

The three-phase synchronous motors from the XtraforsPrime are permanently excited, electronically commutated synchronous motors for applications that require excellent dynamic characteristics and positioning precision as well as compact size and reduced weight.

- NdFeB permanent magnets
- Sinusoidal commutation with encoder or resolver as feedback unit
- Three-phase winding with star connection
- Compact sizes result in low weight
- High overload capability/peak torque
- 0 Cogging torque due to it's special construction without slots in the stator
- High dynamic torque at high speeds
- Long life-span, all motor parts except for bearings are free of wear
- Direct diversion of lost power generated in the stator over the housing to the flange
- Preloaded, grooved ball bearings which are sealed on both sides and greased
- Complete motor system with stall torque ranging from 0.25 Nm to 75 Nm
- Connection using two circular plugs or cables

3.2.- Definitions

Max speed

The speed limit is fixed by the bus voltage of the drive

The value is given in RPM

Stall torque

The torque is given by the motor at very low speed, with an increment of the winding temperature of 130ºC and mounted with a heat sink plate.

The value is given in Nm

Stall current

The current is required to achieve the stall torque

The value is given in A

Peak torque

The maximum torque is available without iron saturation (torque constant still linear)

The value is given in Nm

EMF constant

Voltage that the motor gives as a generator between two terminals at certain speed, the voltage is measured in rms value and the speed in rad/s

The value is given in Vs/rad

Torque constant

The ratio between the current (in rms value) is supplied to the motor and the torque in the output shaft, measured in Nm

The value is given in Nm/A

Reluctance torque (Cogging)

The maximum torque needed to move the shaft without power. It characterizes the stepping effect of the rotor which should be as low as possible.

The value is given in Nm

Winding resistance

The resistance is measured between two phases at 25ºC T ambient

The values is given in Ω

Winding inductance

The inductance is measured between two phases

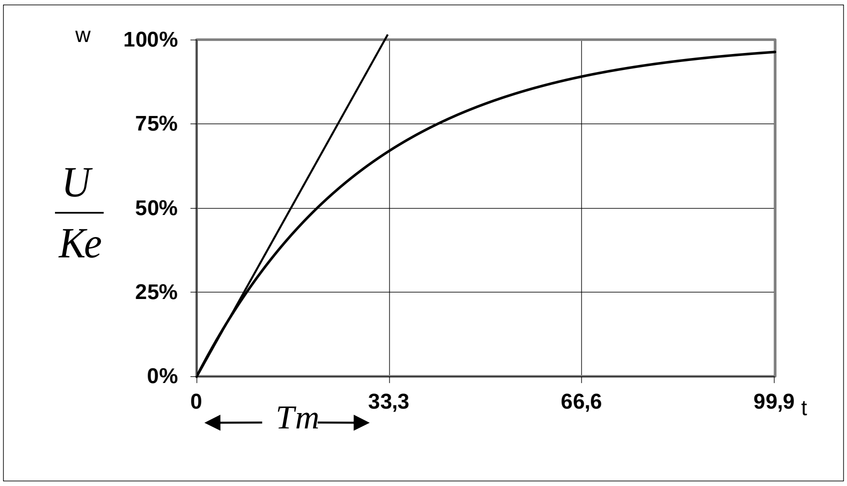
The value is given in mH

Rotor inertia

It is inertia of the rotor without any accessories.
The value is given in kg $m^2 10^{-3}$

Mechanical time constant

It characterizes the speed increase for an input voltage step. The value shows the time to achieve the 63% of the maximum speed for the input voltage.

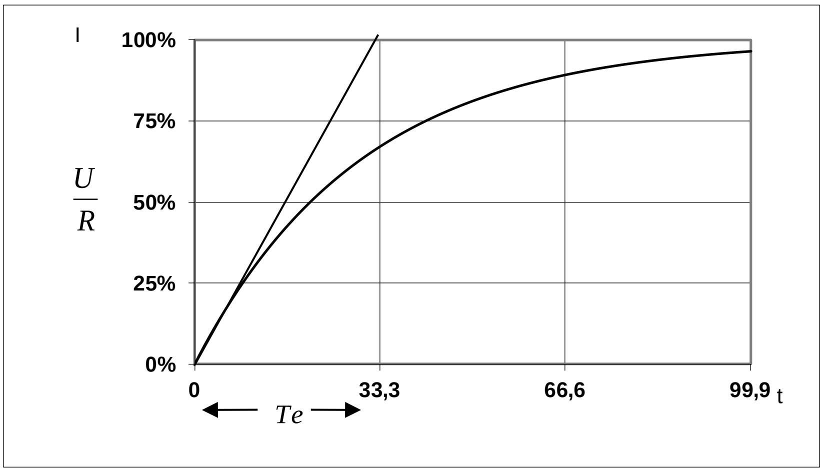


$$Tm = \frac{JxR}{KexKt}$$

The values is given in s

Electrical time constant

It characterizes the current increase in the motor winding for a voltage step



$$Te = \frac{L}{R}$$

The value is given in ms when L is in mH and R in Ω

Thermal resistance

It is the temperature difference across a structure when a unit of heat energy flows through it in unit time

The value is given in ºC/W

Mass

It is the weight of the motor without accessories. The value is given in kg

Radial load

It expresses the shaft radial load applied in the middle of the output shaft, which will give a basic rating life of the bearings of 20000 hours

Axial load

It expresses the shaft axial load which will give a basic rating life of the bearings of 20000 hours

Insulation

It refers to the maximum operation temperature allowed

3.3.- Characteristics

400 VAC

CHARACTERISTICS	SYMBOL	UNITS	FP-0023	FP-0034	FP-0055	FP-0105	FP-0207	FP-0307
Max. Speed at 400V (± 10%)	rpm	nm	36000(1)	30000(1)	22000(2)	15000	9500	8500
Stall Torque (± 10%)	Ms	Nm	0.24	0.40	0.54	1	2	2.7
Stall Current (± 10%)	Is	A	1.40	1.49	2.15	2.51	3.04	3.63
Nominal Torque at 3000rpm (3)	Mn	Nm	0.23	0.38	0.46	0.9	1.85	2.54
Peak Torque (± 10%)	Mj	Nm	1.44	2.4	3.24	6	12	16.2
EMF Constant (±5%)	Ke	Vs/rad	0.099	0.155	0.145	0.23	0.38	0.43
Torque Constant (±5%)	Kt	Nm/A	0.17	0.27	0.25	0.40	0.66	0.74
Cogging Torque	Ct	Nm	0	0	0	0	0	0
Winding Resistance (± 5%)	R	Ω	10	14.7	9.7	9.2	8.2	6.2
Winding Inductance (± 5%)	L	mH	2	4.34	2.5	2.45	3.4	2.6
Rotor Inertia	J	$kgm^2 10^{-3}$	0.0033	0.01	0.02	0.04	0.13	0.19
Mechanical Time Constant	Tm	ms	1.94	3.53	5.33	4.02	4.26	3.68
Electrical Time Constant	Te	ms	0.200	0.295	0.258	0.266	0.415	0.419
Thermal Time Constant (5)	Tth	s	661	712	855	588	980	1126
Thermal Resistance	Rth	ºc/W	2.97	1.78	1.30	1.00	0.77	0.71
Insulation			F	F	F	F	F	F
Max. winding temperature		ºc	155	155	155	155	155	155
Nº of poles			4	4	8	8	8	8
Axial force	Fa	N	40	80	100	100	120	120
Radial force	Fr	N	75	150	230	250	338	367
Weight	M	kg	0.4	0.7	1	1.2	2.1	2.5
Temperature sensor type			PTC	PTC	PTC	PTC	PTC	PTC
With an Aluminium heat sink plate (4)		mm	150x150	300x300	300x300	300x300	300x300	300x300

CHARACTERISTICS	SYMBOL	UNITS	FP-0409	FP-0609	FP-0711	FP-0911	FP-1111	FP-1311
Max. Speed at 400V (± 10%)	rpm	nm	5300	5500	6300	5000	4600	4600
Stall Torque (± 10%)	Ms	Nm	4.2	5.6	6.5	9	11	13.2
Stall Current (± 10%)	Is	A	3.57	4.97	6.82	7.99	8.14	9.77
Nominal Torque at 3000rpm (3)	Mn	Nm	4.15	5.12	6.10	8.20	9.10	10.75
Peak Torque (± 10%)	Mj	Nm	25.2	33.6	39	54	66	79.2
EMF Constant (±5%)	Ke	Vs/rad	0.68	0.65	0.55	0.65	0.78	0.78
Torque Constant (±5%)	Kt	Nm/A	1.18	1.13	0.95	1.13	1.35	1.35
Cogging Torque	Ct	Nm	0	0	0	0	0	0
Winding Resistance (± 5%)	R	Ω	6.5	4.1	2.84	2.4	1.91	1.9
Winding Inductance (± 5%)	L	mH	3.8	2.4	2.4	2.29	2.07	2
Rotor Inertia	J	$kgm^2 10^{-3}$	0.48	0.63	1.16	1.72	2.28	2.85
Mechanical Time Constant	Tm	ms	3.90	3.53	6.29	5.64	4.13	5.14
Electrical Time Constant	Te	ms	0.585	0.585	0.845	0.954	1.084	1.053
Thermal Time Constant (5)	Tth	s	1005	1108	992	1157	1340	1604
Thermal Resistance	Rth	°c/W	0.70	0.57	0.44	0.38	0.46	0.32
Insulation			F	F	F	F	F	F
Max. winding temperature		°c	155	155	155	155	155	155
Nº of poles			8	8	8	8	8	8
Axial force	Fa	N	160	160	200	200	200	200
Radial force	Fr	N	572	606	550	600	650	685
Weight	M	kg	4.2	4.3	5.6	7	8.3	9.6
Temperature sensor type			PTC	PTC	PTC	PTC	PTC	PTC
With an Aluminium heat sink plate (4)		mm	400x400	400x400	500x500	500x500	500x500	500x500

CHARACTERISTICS	SYMBOL	UNITS	FP-1714	FP-3314	FP-5019	FP-8019
Max. Speed at 400V (± 10%)	rpm	nm	3500	2500	2000	2000
Stall Torque (± 10%)	Ms	Nm	18.3	31.5	54.5	75
Stall Current (± 10%)	Is	A	10.67	13.37	19.07	22.79
Nominal Torque at 3000rpm (3)	Mn	Nm	15.50	27.50	46.00	59.00
Peak Torque (± 10%)	Mj	Nm	109.8	189	327	450
EMF Constant (±5%)	Ke	Vs/rad	0.99	1.36	1.65	1.9
Torque Constant (±5%)	Kt	Nm/A	1.71	2.36	2.86	3.29
Cogging Torque	Ct	Nm	0	0	0	0
Winding Resistance (± 5%)	R	Ω	1.23	1.28	0.8	0.83
Winding Inductance (± 5%)	L	mH	2.6	2.1	2	2.1
Rotor Inertia	J	$kgm^2 10^{-3}$	6.02	12.01	28.3	37.7
Mechanical Time Constant	Tm	ms	4.36	4.80	4.80	5.00
Electrical Time Constant	Te	ms	2.114	1.641	2.500	2.530
Thermal Time Constant (5)	Tth	s	2249	2948	2407	2555
Thermal Resistance	Rth	°c/W	0.41	0.25	0.20	0.13
Insulation			F	F	F	F
Max. winding temperature		°c	155	155	155	155
Nº of poles			8	8	12	12
Axial force	Fa	N	360	360	700	700
Radial force	Fr	N	770	950	1500	1600
Weight	M	kg	14.2	23.2	32	41
Temperature sensor type			PTC	PTC	PTC	PTC
With an Aluminium heat sink plate (4)		mm	700x700	700x700	700x700	700x700

230 VAC

CHARACTERISTICS	SYMBOL	UNITS	FP-0023	FP-0034	FP-0055	FP-0105	FP-0207	FP-0307
Max. Speed at 230V (± 10%)	rpm	nm	27000(1)	30000(1)	16300(2)	11400	8700	6600
Stall Torque (± 10%)	Ms	Nm	0.24	0.4	0.54	1	2	2.7
Stall Current (± 10%)	Is	A	1.97	2.98	2.67	3.45	5.28	5.44
Nominal Torque at 3000rpm (3)	Mn	Nm	0.23	0.38	0.46	0.9	1.85	2.54
Peak Torque (± 10%)	Mj	Nm	1.44	2.4	3.24	6	12	16.2
EMF Constant (±5%)	Ke	Vs/rad	0.07	0.077	0.12	0.17	0.22	0.29
Torque Constant (±5%)	Kt	Nm/A	0.12	0.13	0.20	0.29	0.38	0.50
Cogging Torque	Ct	Nm	0	0	0	0	0	0
Winding Resistance (± 5%)	R	W	5.1	3.7	6.2	4.8	2.7	2.8
Winding Inductance (± 5%)	L	mH	1.0	1.1	1.6	1.3	1.1	1.2
Rotor Inertia	J	$kgm^2 10^{-3}$	0.0033	0.01	0.02	0.04	0.13	0.19
Mechanical Time Constant	Tm	ms	1.97	3.53	5.28	3.95	4.27	3.68
Electrical Time Constant	Te	ms	0.197	0.295	0.260	0.271	0.414	0.419
Thermal Time Constant (5)	Tth	s	661	712	855	588	980	1126
Thermal Resistance	Rth	ºc/W	2.93	1.78	1.31	1.02	0.77	0.71
Insulation			F	F	F	F	F	F
Max. winding temperature		ºc	155	155	155	155	155	155
Nº of poles			4	4	8	8	8	8
Axial force	Fa	N	40	80	100	100	120	120
Radial force	Fr	N	75	150	230	250	338	367
Weight	M	kg	0.4	0.7	1	1.2	2.1	2.5
Temperature sensor type			PTC	PTC	PTC	PTC	PTC	PTC
With an Aluminium heat sink plate (4)		mm	150x150	300x300	300x300	300x300	300x300	300x300

CHARACTERISTICS	SYMBOL	UNITS	FP-0409	FP-0609	FP-0711	FP-0911	FP-1111	FP-1311	FP-1714
Max. Speed at 230V (± 10%)	rpm	nm	5000	3800	4800	3800	3500	3200	3100
Stall Torque (± 10%)	Ms	Nm	4.2	5.6	6.5	9	11	13.2	18.3
Stall Current (± 10%)	Is	A	6.46	6.53	9.46	11.63	11.76	13.03	17.34
Nominal Torque at 3000rpm (3)	Mn	Nm	4.15	5.12	6.10	8.20	9.10	10.75	15.50
Peak Torque (± 10%)	Mj	Nm	25.2	33.6	39	54	66	79.2	109.8
EMF Constant (±5%)	Ke	Vs/rad	0.38	0.50	0.39	0.44	0.54	0.59	0.61
Torque Constant (±5%)	Kt	Nm/A	0.65	0.86	0.67	0.77	0.94	1.01	1.06
Cogging Torque	Ct	Nm	0	0	0	0	0	0	0
Winding Resistance (± 5%)	R	W	2.0	2.4	1.5	1.1	0.9	1.1	0.5
Winding Inductance (± 5%)	L	mH	1.2	1.4	1.2	1.1	1.0	1.1	1.0
Rotor Inertia	J	$kgm^2 10^{-3}$	0.48	0.63	1.16	1.72	2.28	2.85	6.02
Mechanical Time Constant	Tm	ms	3.84	3.53	6.42	5.64	4.15	5.10	4.40
Electrical Time Constant	Te	ms	0.593	0.585	0.828	0.955	1.080	1.061	2.097
Thermal Time Constant (5)	Tth	s	1005	1108	992	1157	1340	1604	2249
Thermal Resistance	Rth	ºc/W	0.71	0.57	0.43	0.38	0.46	0.32	0.41
Insulation			F	F	F	F	F	F	F
Max. winding temperature		ºc	155	155	155	155	155	155	155
Nº of poles			8	8	8	8	8	8	8
Axial force	Fa	N	160	160	200	200	200	200	360
Radial force	Fr	N	572	606	550	600	650	685	770
Weight	M	kg	4.2	4.3	5.6	7	8.3	9.6	14.2
Temperature sensor type			PTC	PTC	PTC	PTC	PTC	PTC	PTC
With an Aluminium heat sink plate (4)		mm	400x400	400x400	500x500	500x500	500x500	500x500	700x700

48 VDC

CHARACTERISTICS	SYMBOL	UNITS	FP-0023	FP-0034	FP-0055	FP-0105	FP-0207
Max. Speed at 48VDC (± 10%)	**rpm**	**nm**	6000	6000	4500	3000	3000
Stall Torque (± 10%)	**Ms**	**Nm**	0.24	0.4	0.54	1	2
Stall Current (± 10%)	**Is**	**A**	2.80	3.83	4.64	6.37	12.53
Nominal Torque at 3000rpm (3)	**Mn**	**Nm**	0.23	0.38	0.46	0.9	1.85
Peak Torque (± 10%)	**Mj**	**Nm**	1.44	2.4	3.24	6	12
EMF Constant (±5%)	**Ke**	**Vs/rad**	0.05	0.06	0.07	0.09	0.09
Torque Constant (±5%)	**Kt**	**Nm/A**	0.09	0.10	0.12	0.16	0.16
Cogging Torque	**Ct**	**Nm**	0	0	0	0	0
Winding Resistance (± 5%)	**R**	**W**	2.5	2.2	2.1	1.4	0.5
Winding Inductance (± 5%)	**L**	**mH**	0.5	0.7	0.5	0.4	0.2
Rotor Inertia	**J**	**kgm²10-³**	0.0033	0.01	0.02	0.04	0.13
Mechanical Time Constant	**Tm**	**ms**	1.94	3.48	5.40	4.08	4.36
Electrical Time Constant	**Te**	**ms**	0.200	0.300	0.254	0.262	0.405
Thermal Time Constant (5)	**Tth**	**s**	661	712	855	588	980
Thermal Resistance	**Rth**	**ºc/W**	2.97	1.81	1.28	0.99	0.75
Insulation			F	F	F	F	F
Max. winding temperature		**ºc**	155	155	155	155	155
Nº of poles			4	4	8	8	8
Axial force	**Fa**	**N**	40	80	100	100	120
Radial force	**Fr**	**N**	75	150	230	250	338
Weight	**M**	**kg**	0.4	0.7	1	1.2	2.1
Temperature sensor type			PTC	PTC	PTC	PTC	PTC
With an Aluminium heat sink plate (4)		**mm**	150x150	300x300	300x300	300x300	300x300

(1) 25000 rpm values achievable with GD1 & CD1 Drive (Speed Limit Converter)
(2) 15000 rpm values achievable with GD1 & CD1 Drive (Max. Current Bandwidth, 1KHz)
(3) From FP-1714 to big sized, Nominal Torque at 1500rpm
(4) From FP-1714 to big sized, the width size is 20mm, the rest 10mm.
(5) With heat sink included

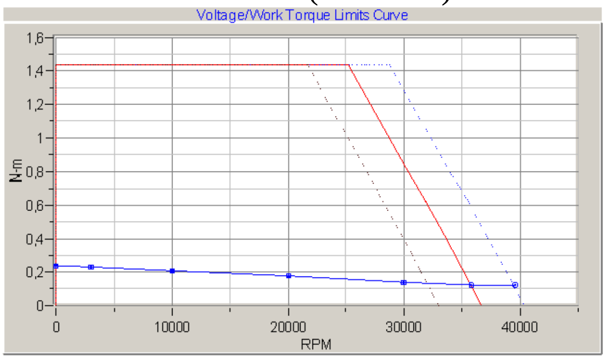
When the motor is mounted with encoder, the performances could be changed because of the temperature or speed limit of the electronics, please ask factory for more details.

3.4.- Functional curves

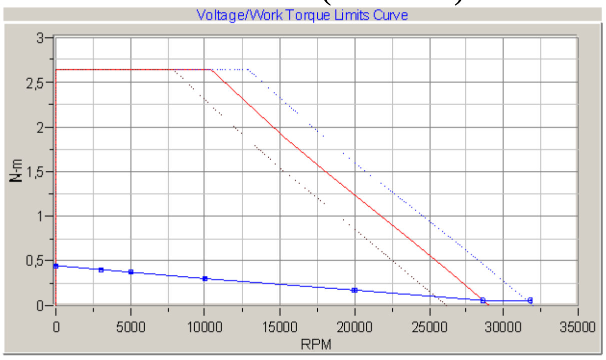
The curves shown here below, have been obtained with a CD1a 400VAC drive. The motors were mounted in a heat sink plate of aluminium see table 4 and with an increment of temperature on the winding of 130º at 25ºC Amb.

Plot 1: Limit +10% Input voltage.
Plot 2: Limit Nominal Input voltage.
Plot 3: Limit -10% Input voltage.
Plot 4: Limit Continuous Operation.

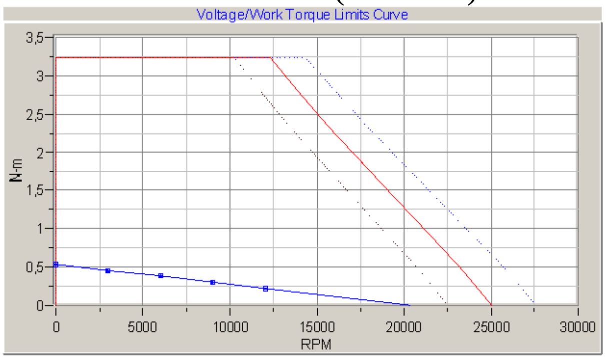
FP-0023 (CD1a 5.1)



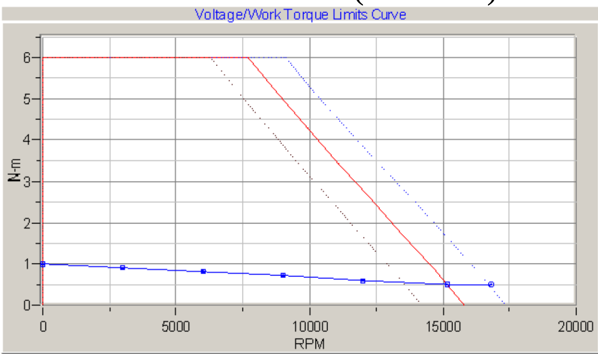
FP-0034 (CD1a 5.1)



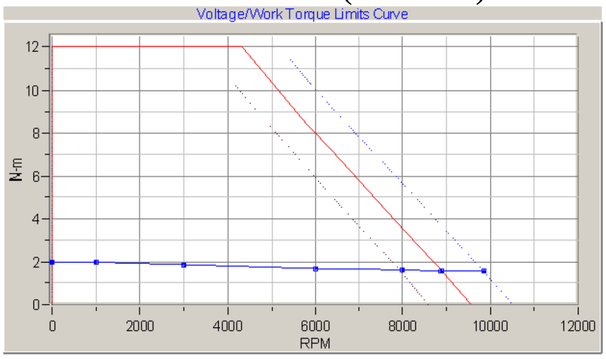
FP-0055 (CD1a 5.1)



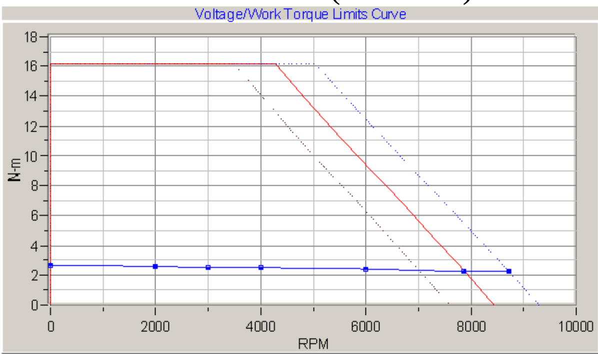
FP-0105 (CD1a 5.1)



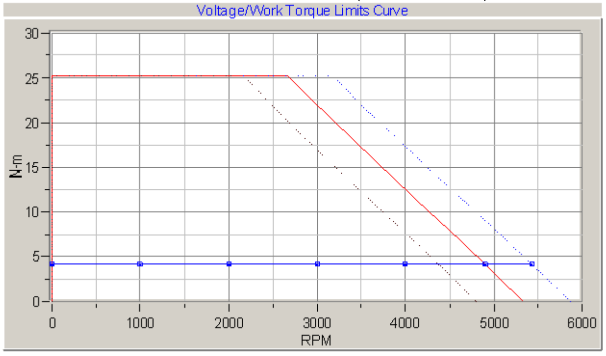
FP-0207 (CD1a 7.2)



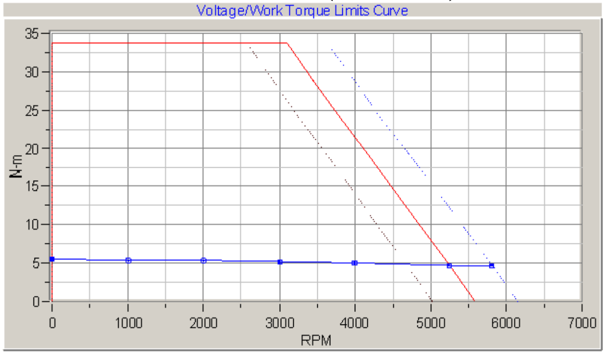
FP-0307 (CD1a 7.2)



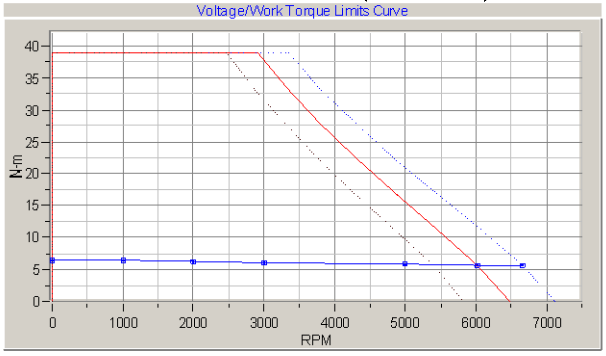
FP-0409 (CD1a 7.2)



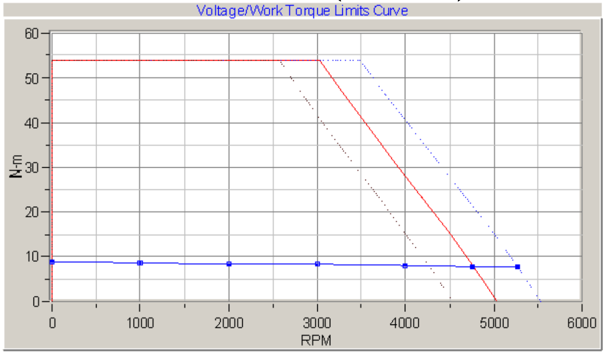
FP-0609 (CD1a 14)



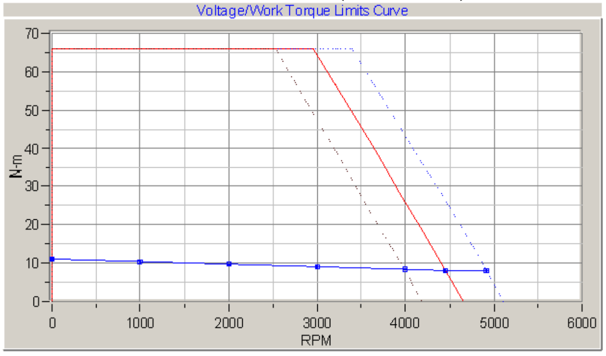
FP-0711 (CD1a 14)



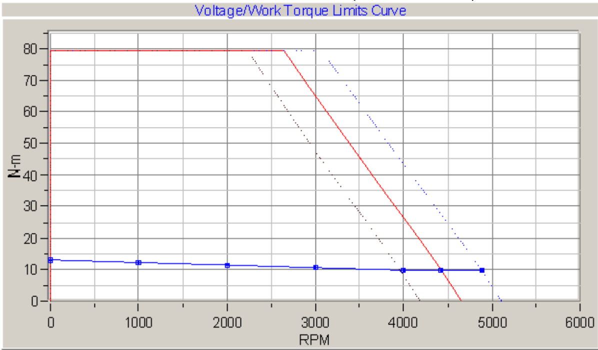
FP-0911 (CD1a 30)



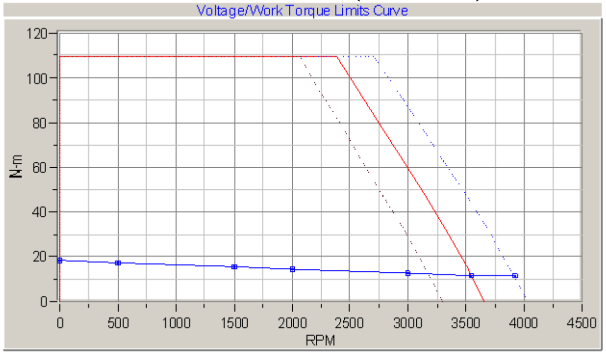
FP-1111 (CD1a 30)



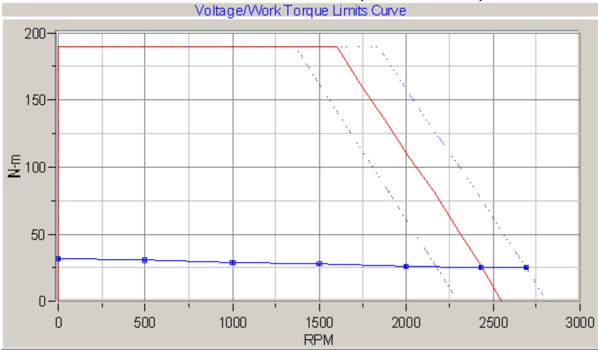
FP-1311 (CD1a 30)



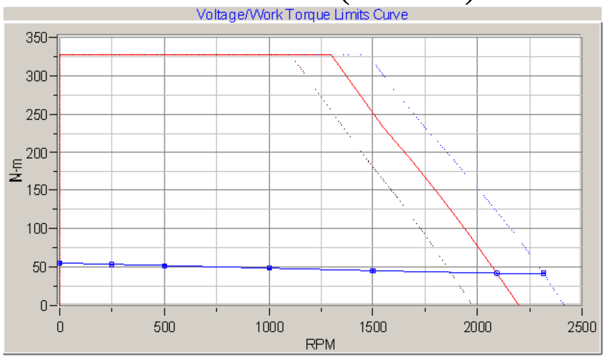
FP-1714 (CD1a 30)



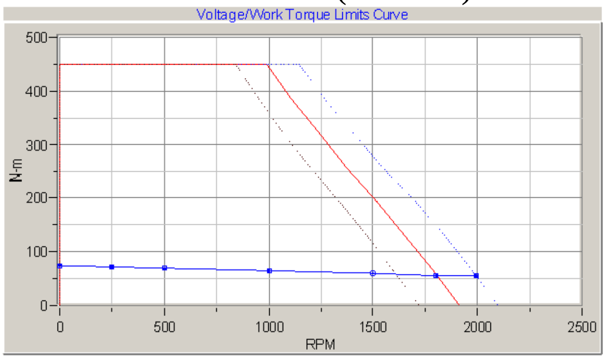
FP-3314 (CD1a 30)



FP-5019 (CD1a 45)



FP-8019 (CD1a 45)



3.5.- Cooling

The XtraforsPrime motor are self-cooling. The motors must be installed on the cooling surface equivalent to the aluminium heat sink according to the following table

.

Motor	FP-0023	FP-0034	FP-0055	FP-0105	FP-0207	FP-0307	FP-0409	FP-0609
Heat Sink Plate	150*150*10	300*300*10	300*300*10	300*300*10	300*300*10	300*300*10	400*400*10	400*400*10

Motor	FP-0711	FP-0911	FP-1111	FP-1311	FP-1714	FP-3314	FP-5019	FP-8019
Heat Sink Plate	500*500*20	500*500*20	500*500*20	500*500*20	700*700*20	700*700*20	700*700*20	700*700*20

Table 4

⚠ CAUTION

Free convection of the motor housing must be guaranteed!

3.6.- Brake functionality

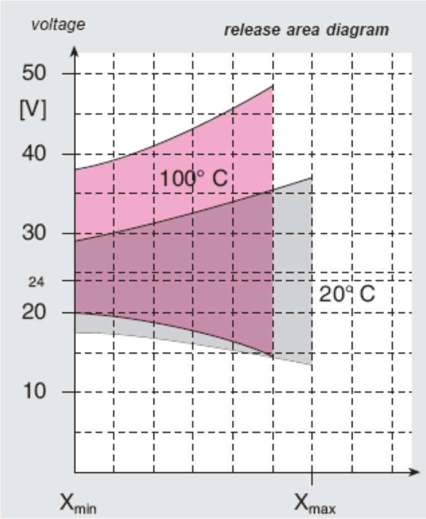
The XtraforsPrime motors can be supplied with a holding brake

Motor	FP-0023	FP-0034	FP-0055	FP-0105	FP-0207	FP-0307	FP-0409	FP-0609
Brake torque Nm	-	-	1	1	2	4,5	4,5	9
Power W			10	10	11	12	12	18
Inertia 10^{-4} kgm^2			0.021	0.021	0.068	0.18	0.18	0.54
Weight kg			0.11	0.11	0.15	0.30	0.30	0.46

Motor	FP-0711	FP-0911	FP-1111	FP-1311	FP-1714	FP-3314	FP-5019	FP-8019
Brake torque Nm	9	9	18	18	18	36	72	72
Power W	18	18	24	24	24	26	40	40
Inertia 10^{-4} kgm^2	0.54	0.54	1.66	1.66	1.66	5.56	11.5	11.5
Weight kg	0.46	0.46	0.9	0.9	0.9	1.6	2.85	2.85

Table 5

Release voltage vs brake air gap and motor temperature



3.7.- Grease life

Test item			Multemp SRL	Test method
Appearance			light brown, buttery	
Thickener			Lithium soap	
Worked penetration			250	ASTM D217
Dropping point ºC			190	ASTM D566
Copper strip corrosion	100ºC, 24h		pass	ASTM D4048
Evaporation loss mass %	99ºC, 22h		0.3	ASTM D972
Oil separation mass%	100ºC, 24h		1.2	ASTM D6184-98 Mod.
Oxidation stability Mpa	99ºC, 100h		0.025	ASTM D942
Foreign particles particles/cm^3	10 um or larger		400	
	25 um or larger		100	
	75 um or larger		0	
	125 um or larger		0	
Working stability			305	
Water washout mass%	38ºC,1h		1.3	ASTM D1264
Low-temperature torque Ncm	-30ºC	Starting torque	7.9	ASTM D1478-63
		Running torque	2.5	
	-40ºC	Starting torque	11	
		Running torque	2.8	
Corrosion preventive properties	52ºC, 48h		#1	ASTM D1743-73
Base oil kinematics viscosity mm^2/s	40ºC		26	ASTM D445

Other greases are available for different temperatures, please ask factory for more information

3.8.- Shaft Load

Axial force

The axial force Fa on the shaft end is made up of the installation forces (e.g. stress caused by installation) and operational forces (e.g. thrust caused by slanted pinions). The maximum axial force Fa depends on the bearing type and the desired lifespan of the bearings.

The fixed bearing is secured on the B flange with a retaining plate. The floating ball bearing is preloaded on the A flange with a spring in the direction of the B flange. Axial forces in the direction of the A flange can cause the spring bias to be overcome and the shaft is shifted by the amount of axial play in the bearing (0.1 to 0.2 mm approx). This shift can cause problems on motors with holding brakes or motors with encoders.

⚠ DANGER

Because of the high axial forces on the motor shaft during installation, the bearings could be damaged and the operation of the motor holding brake could be so heavily influenced that it has no or only a reduced braking effect. Encoder errors could also occur.
Therefore, excessive pressure or shocks to the front of the shaft end or the rear housing cover should be avoided at all costs.
Loads caused by a hammer definitely exceed the permissible values!

Radial force

The radial force Fr on the shaft end is made up of installation forces (e.g. belt tension on pulleys) and operation forces (e.g. load torque on the pinion). The maximum radial force Fr depends on the shaft end type, bearing type, average speed, position where the radial force is applied and the desired lifespan of the bearing. As standard 20000 h when the load indicated on the catalogue is applied in the middle of the output shaft.

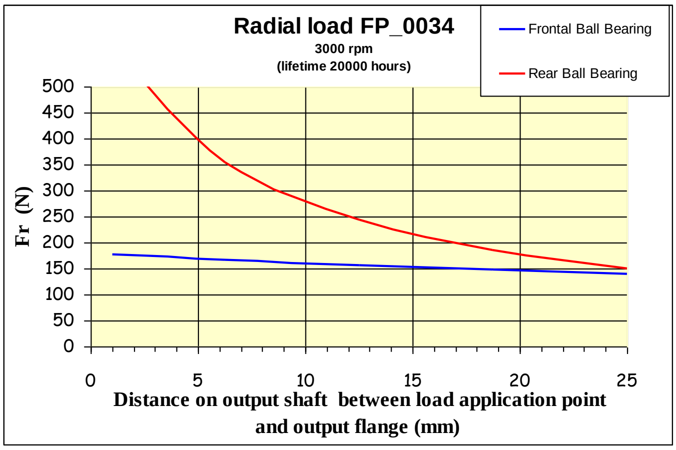
⚠ WARNING

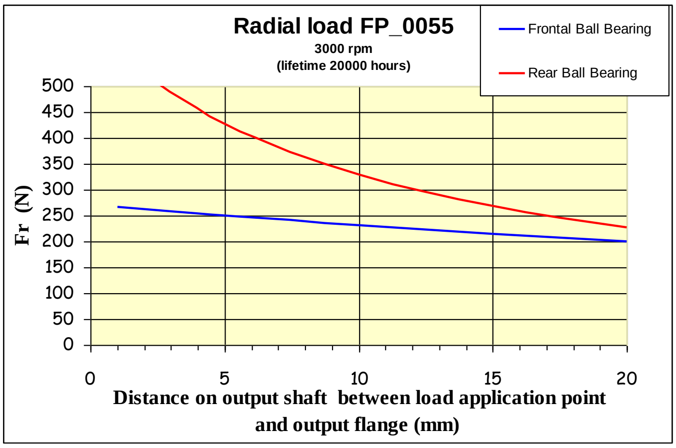
Excessive radial force can cause premature wear on the bearing or, in extreme cases, can cause the output shaft to break

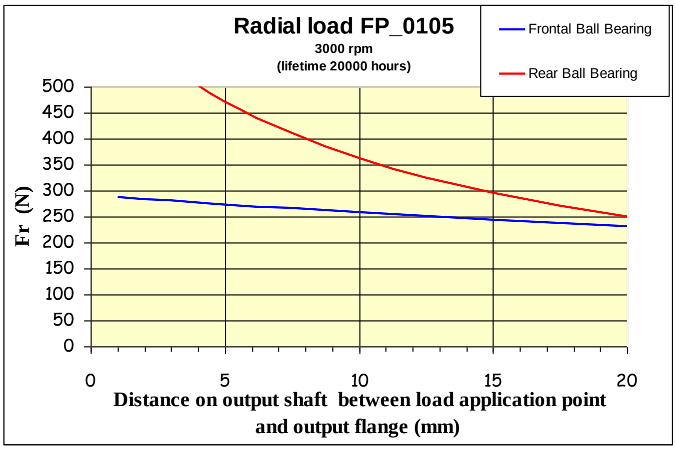
⚠ CAUTION

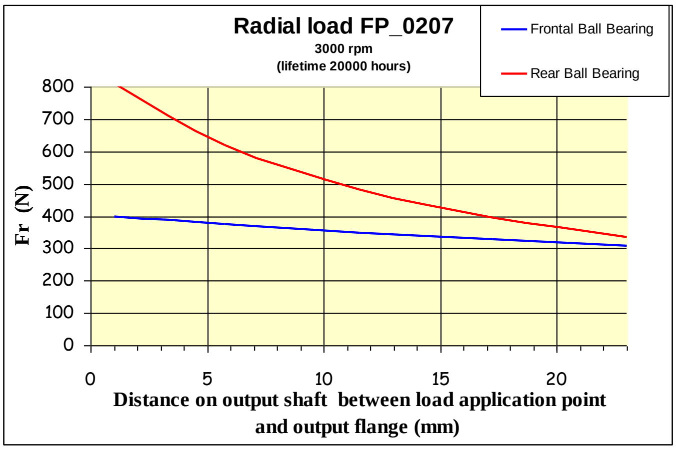
When installing drive elements on the motor shaft avoid hyperstatic arrangements of the motor shaft bearing. The tolerances that occurs cause additional force on the motor shaft bearings
This can significantly reduce the bearing lifespan or damage the bearing.

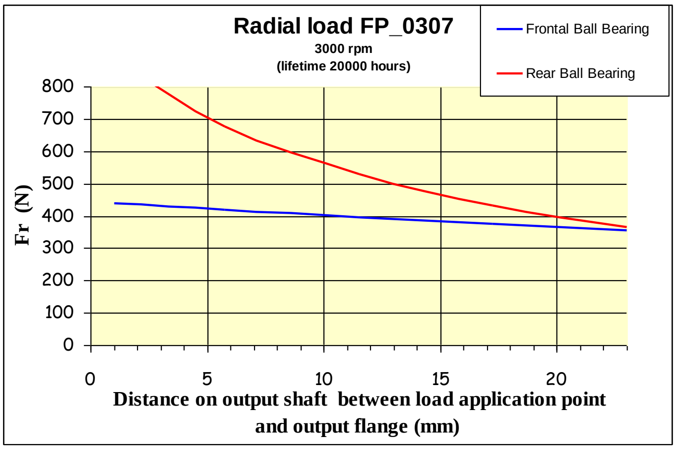
Shaft Load vs position

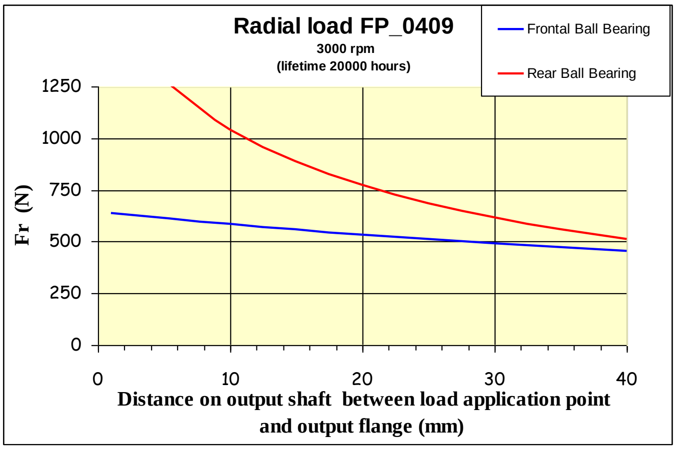


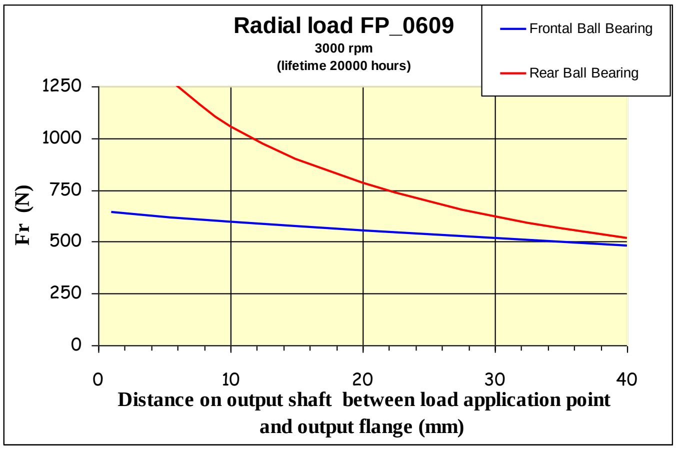


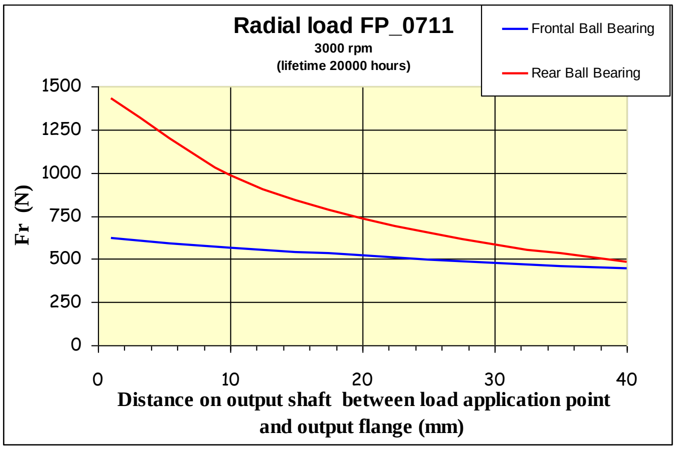


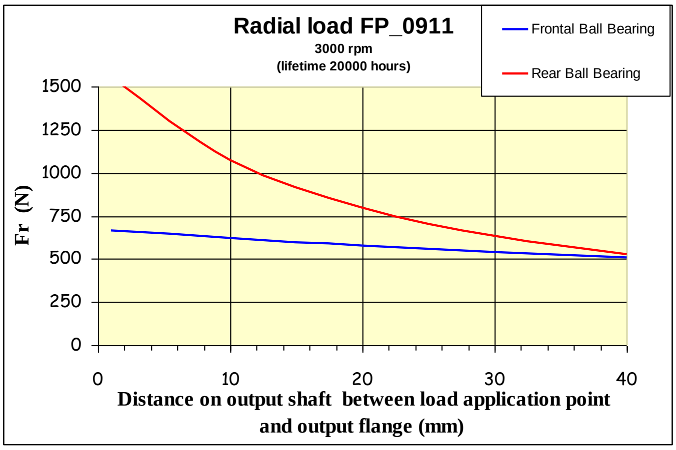


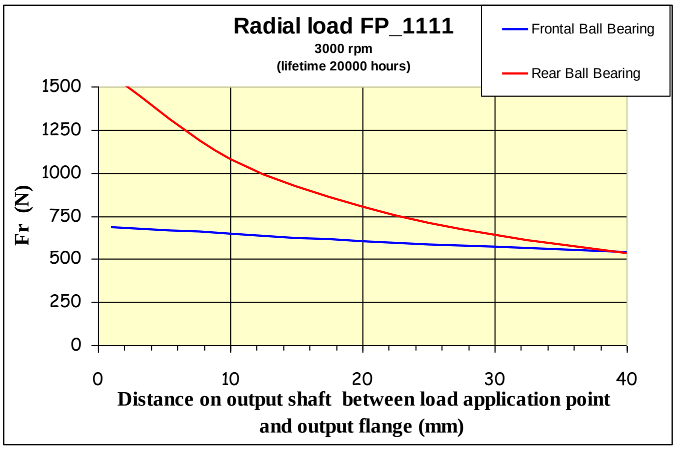

Radial load FP_0307
3000 rpm
(lifetime 20000 hours)
Frontal Ball Bearing
Rear Ball Bearing
Fr (N)
0
100
200
300
400
500
600
700
800
0
5
10
15
20
Distance on output shaft between load application point and output flange (mm)

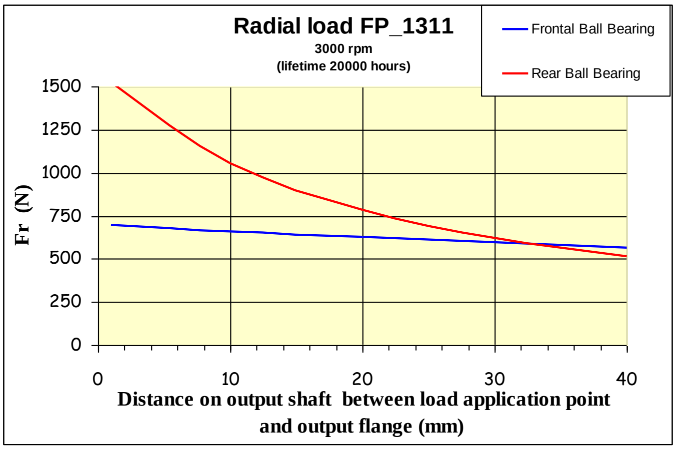

Radial load FP_0409
3000 rpm
(lifetime 20000 hours)
Frontal Ball Bearing
Rear Ball Bearing
Fr (N)
0
250
500
750
1000
1250
0
10
20
30
40
Distance on output shaft between load application point and output flange (mm)

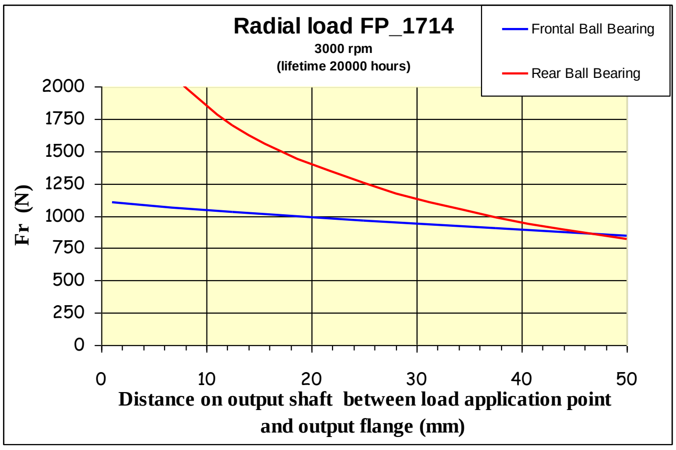

Radial load FP_0609
3000 rpm
(lifetime 20000 hours)
Frontal Ball Bearing
Rear Ball Bearing
Fr (N)
0
250
500
750
1000
1250
0
10
20
30
40
Distance on output shaft between load application point and output flange (mm)

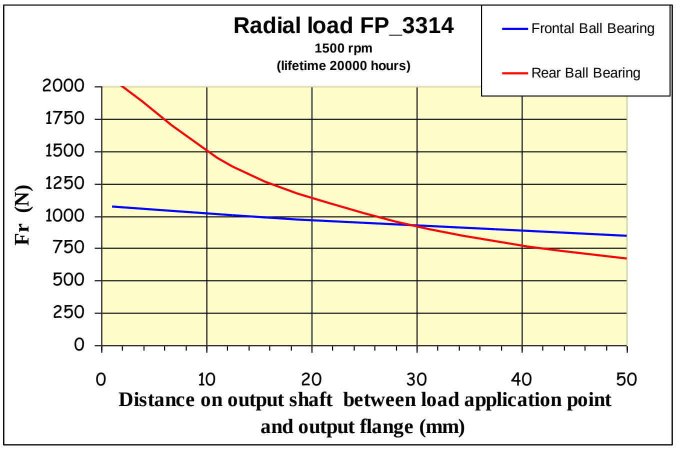

Radial load FP_0711
3000 rpm
(lifetime 20000 hours)
Frontal Ball Bearing
Rear Ball Bearing
Fr (N)
0
250
500
750
1000
1250
1500
0
10
20
30
40
Distance on output shaft between load application point and output flange (mm)

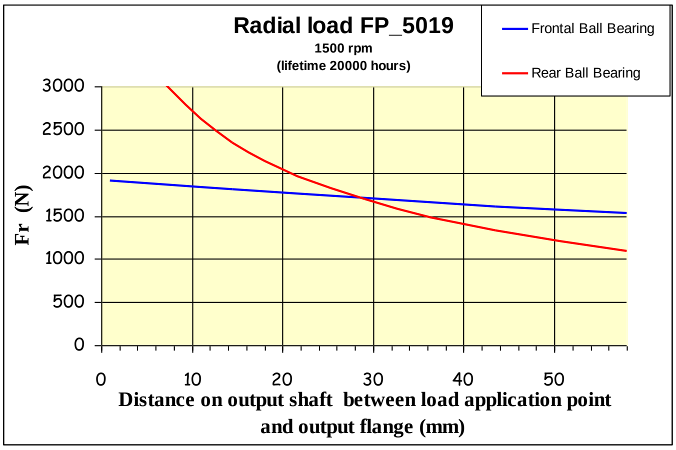

Radial load FP_0911
3000 rpm
(lifetime 20000 hours)
Frontal Ball Bearing
Rear Ball Bearing
Fr (N)
0
250
500
750
1000
1250
1500
0
10
20
30
40
Distance on output shaft between load application point and output flange (mm)

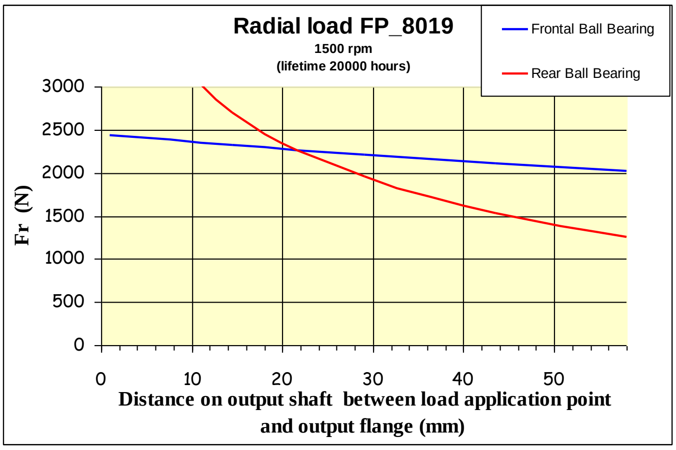

Radial load FP_1111
3000 rpm
(lifetime 20000 hours)
Frontal Ball Bearing
Rear Ball Bearing
Fr (N)
0
250
500
750
1000
1250
1500
0
10
20
30
40
Distance on output shaft between load application point and output flange (mm)


Radial load FP_1311
3000 rpm
(lifetime 20000 hours)
Frontal Ball Bearing
Rear Ball Bearing
Fr (N)
1500
1250
1000
750
500
250
0
0
10
20
30
40
Distance on output shaft between load application point and output flange (mm)


Radial load FP_1714
3000 rpm
(lifetime 20000 hours)
Frontal Ball Bearing
Rear Ball Bearing
Fr (N)
2000
1750
1500
1250
1000
750
500
250
0
0
10
20
30
40
50
Distance on output shaft between load application point and output flange (mm)

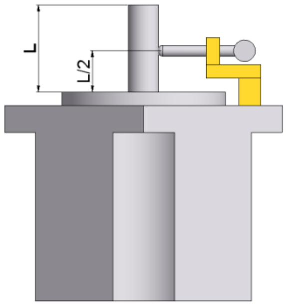

Radial load FP_3314
1500 rpm
(lifetime 20000 hours)
Frontal Ball Bearing
Rear Ball Bearing
Fr (N)
2000
1750
1500
1250
1000
750
500
250
0
0
10
20
30
40
50
Distance on output shaft between load application point and output flange (mm)


Radial load FP_5019
1500 rpm
(lifetime 20000 hours)
Frontal Ball Bearing
Rear Ball Bearing
Fr (N)
3000
2500
2000
1500
1000
500
0
0
10
20
30
40
50
Distance on output shaft between load application point and output flange (mm)


Radial load FP_8019
1500 rpm
(lifetime 20000 hours)
Frontal Ball Bearing
Rear Ball Bearing
Fr (N)
3000
2500
2000
1500
1000
500
0
0
10
20
30
40
50
Distance on output shaft between load application point and output flange (mm)

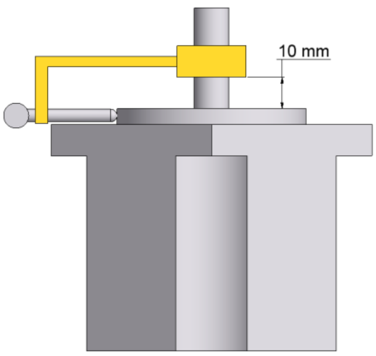
3.9.- Tolerances IEC 60072

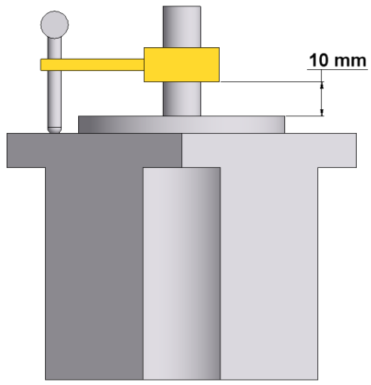
Shaft extension run-out



Shaft diameter	Normal	Reduced
$0 < D \leq 10$	0.030	0.015
$10 < D \leq 18$	0.035	0.018
$18 < D \leq 30$	0.040	0.021

Concentricity and Perpendicularity

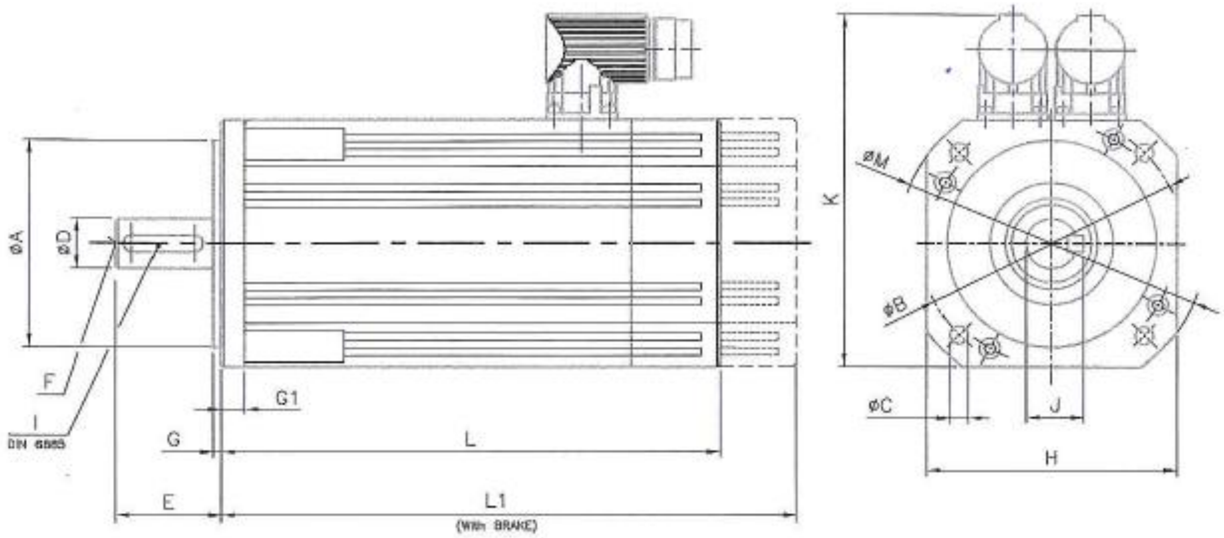




Mounting flange diameter	Normal	Reduced
32	0.08	0.04
40	0.08	0.04
60	0.08	0.04
80	0.08	0.04
95	0.08	0.04
130	0.10	0.05

4.- Dimensions

4.1.- Dimensions sheet



	ØA$_{j6}$	ØB	4xØC	ØD$_{k6}$	E	F	G	G1	□H	I	J$^{0\ +0.1}$	K	L	L1	ØM
FP-0023	28	40	4.5	8j5	25	-	2.5	5	38	-	-	48	125	160	48
FP-0034	32	45	4.5	8j5	25	-	2.5	5	42	-	-	70	140.5	171.5	53
FP-0055	40	65	5.5	9	20	M3x9	2.5	5.5	57	A3x3x12	10.2	107	90	129	74
FP-0105	40	65	5.5	9	20	M3x9	2.5	5.5	57	A3x3x12	10.2	107	110	149	74
FP-0207	60	75	5.5	11	23	M4x10	2.5	7	70	A4x4x14	12.5	112	116.5	142	89
FP-0307	60	75	5.5	11	23	M4x10	2.5	7	70	A4x4x14	12.5	112	137.5	165.5	89
FP-0409	80	100	6.6	19	40	M6x16	3	9	90	A6x6x30	21.5	132	147.5	177	111
FP-0609	80	100	6.6	19	40	M6x16	3	9	90	A6x6x30	21.5	132	165.5	210	111
FP-0711	95	115	9	19	40	M6x16	3	9	110	A6x6x30	21.5	152	149	194	130
FP-0911	95	115	9	19	40	M6x16	3	9	110	A6x6x30	21.5	152	173	218	130
FP-1111	95	115	9	19	40	M6x16	3	9	110	A6x6x30	21.5	152	197	242	130
FP-1311	95	115	9	19	40	M6x16	3	9	110	A6x6x30	21.5	152	221	266	130
FP-1714	130	165	11	24	50	M8x19	3.5	12	140	A8x7x32	27	182	215	258	184
FP-3314	130	165	11	24	50	M8x19	3.5	12	140	A8x7x32	27	182	317	367	184
FP-5019	180	215	16	32	58	M12x28	4	19.5	192	A10x8x50	35	247	297.5	383	240
FP-8019	180	215	16	32	58	M12x28	4	19.5	192	A10x8x50	35	247	348.5	434	240

	FP-0023		FP-0034		FP-0055		FP-0105		FP-0207		FP-0307		FP-0409		FP-0609	
	L	L1	L	L1	L	L1	L	L1	L	L1	L	L1	L	L1	L	L1
INCREMENTAL	(**)	(**)	(**)	(**)	112.5	145	132.5	165	116.5	162	137.5	189	147.5	192	165.5	215
END DAT 2.1	-	-	-	-	123	167	143	187	159	190	180	217	185.5	215	203.5	245
HIPERFACE	-	-	-	-	123	156	143	179	142	173	163	200	158	202.5	176	225.5
SinCos	-	-	-	-	137	172	157	192	159	190	180	217	177	215	195	244.5

	FP-00711		FP-0911		FP-1111		FP-1311		FP-1714		FP-3314		FP-5019		FP-8019	
	L	L1	L	L1	L	L1	L	L1	L	L1	L	L1	L	L1	L	L1
INCREMENTAL	162	197	186	221	210	258	234	282	223	296.5	325	398.5	310.5	363	361.5	414
END DAT 2.1	185.5	220.5	209.5	244.5	233.5	281.5	257.5	305.5	266	322.5	368	424.5	317.5	368	368.5	419
HIPERFACE	172.5	205.5	196.5	229.5	220.5	268.5	244.5	292.5	258	304	360	406	317.5	368	368.5	419
SinCos	181	220.5	205	244.5	229	281.5	253	305.5	265	318.5	367	420.5	322.5	373	373.5	424

4.2.- Type of Output Shaft

All the XtraforsPrime servomotor shafts comply to DIN 748. They can be supplied with a smooth shaft or keyed shaft. The NEMA option is also available.

Smooth shaft

A smooth output shaft is used for a force-fit shaft-hub connection that guarantees a zero –play connection between shaft and hub as well as smooth operation.

For connection of pinion gears, belt disks or similar drive elements, please use suitable clamping sets, pressure sleeves or other fastening elements

Drive elements must be protected against unintentional removal

The output shaft has a threaded centre hole which can be used to remove drive elements

4.3.- Keyed shaft

The keyed shaft can be used for a form-fit torque transfer with low demands on the shaft-hub connection and for handling torques with a constant direction.

The keyways for the XtraforsPrime servomotors conform to keyway form N1 according to DIN 6885-1. Form A Shaft keys used conforms to DIN 6885-4 . Balancing motors with keyways is done using the half-key convention according to ISO 2372

The end of the shaft has a threaded centre hole which can be used to mount drive elements with shaft end disks.

The shaft key can be deflected during heavy reverse operation. In extreme cases, this can cause the output shaft to break!

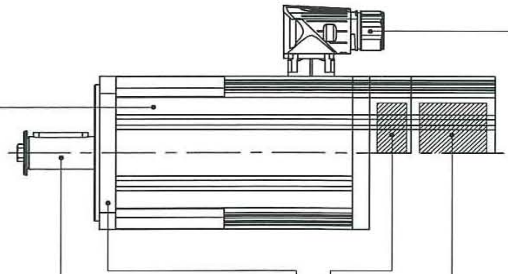
Smooth output shaft should be used preferably

4.4.- Optional flange mounting

The NEMA mounting flange is an option available, for other configuration contact factory.

5.- Codification

XtraforsPrime CODIFICATION



FP _ _ _ _ | _ | _ | _ | _ | _ | _ | _ _

MODEL	TORQUE		FRAME		
FP-23	0,16	002	38	3	FP0023
FP-34	0,30	003	42	4	FP0034
FP-55	0,54	005	57	5	FP0055
FP-105	1,00	01	57	05	FP0105
FP-207	2,00	02	70	07	FP0207
FP-307	2,70	03	70	07	FP0307
FP-409	4,50	04	90	09	FP0409
FP-609	5,60	06	90	09	FP0609
FP-711	6,80	07	110	11	FP0711
FP-911	9,30	09	110	11	FP0911
FP-1111	11,50	11	110	11	FP1111
FP-1311	13,50	13	110	11	FP1311
FP-1714	17,00	17	140	14	FP1714
FP-3314	33,00	33	140	14	FP3314
FP-5019	50,00	50	192	19	FP5019
FP-8019	75,00	80	192	19	FP8019

BUS VOLTAGE

0	400 VAC (560 VDC)
2	230 VAC (320 VDC)
8	34 VAC (48 VDC)
9	SPECIAL

OUTPUT SHAFT

0	STANDARD
2	STANDARD WITHOUT KEYWAY
3	STANDARD + SHAFT SEAL
4	STANDARD WITHOUT KEYWAY + SHAFT SEAL
N	NEMA DIMENSIONS
9	SPECIAL

SPECIFICATION

STANDARD	00
REDUCED TOLERANCES DIN 42955	0R
SPECIAL	TWO ALPHANUMERICS SIGNS PLUS SPECIFICATION SHEETS

ELECTRICAL CONNECTION

TWO ROTATEABLE 90° CONNECTORS (without plugs)	6
BL CONNECTIONING FOR OPTION 6 (without plugs)	B
TWO 90° ANGLE CONNECTOR –NON ROTATEABLE– (without plugs)	N
TWO STRAIGHT CONNECTORS (without plugs)	7
CABLES	1
SPECIAL	9

FEEDBACK SYSTEM

RESOLVER 2T8 (Transmitter Speed 1)		1
ENCODER	INCREMENTAL SinCos (512 ppr)	B
ENCODER	INCREMENTAL SinCos (2048 ppr)	C
ENCODER	ABSOLUTE Endat 2.1 Multiturn	D
ENCODER	ABSOLUTE EnDat 2.1 Singleturn	E
ENCODER	ABSOLUTE Hiperface Multiturn	F
ENCODER	ABSOLUTE Hiperface Singleturn	G
ENCODER	INCREMENTAL + COMMUTATION (1024 ppr)	H
ENCODER	INCREMENTAL + COMMUTACION (2048 ppr)	K
HALL EFFECT SENSOR		5
SPECIAL		9

BRAKE

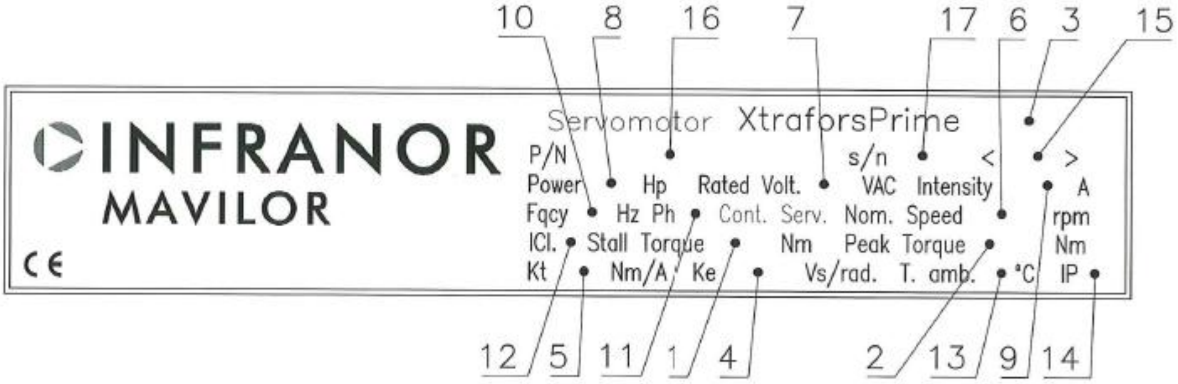
WITHOUT BRAKE	0
WITH BRAKE	3
SPECIAL	9

FRONT FLANGE

STANDARD (B5)	0
NEMA DIMENSIONS	N
SPECIAL	9

CODE: N° FP020700001600

MODEL	TORQUE 2 Nm / FRAME 70	207
BUS VOLTAGE	400 VAC	0
SHAFT	STANDARD	0
FLANGE	STANDARD	0
BRAKE	WITHOUT BRAKE	0
FEEDBACK SYSTEM	WITH RESOLVER TRANSMITTER 2T8	1
ELECTRICAL CONNECTION	ROTABLE 90° CONNECTORS	6
SPECIFICATION	STANDARD	00



1.- Stall Torque
2.-Peak Torque
3.-Motor Type
4.- Voltage constant
5.- Torque constant
6.- Nominal speed
7.- Supply voltage of the drive
8.- Power at nominal speed
9.- Current at nominal power and speed
10.- Frequency of the current at rated speed
11.- Phase number
12.- Insulation class
13.- Ambient temperature
14.- IP protection class
15.- Fabrication date code
16.- Motor code
17.-Serial number

6.- Installation

⚠ WARNING

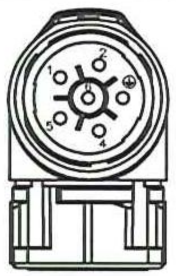
The XtraforsPrime servomotors are not permitted to be connected directly to power mains, they are only permitted to be operated in combination with an Infranor servo drive

⚠ CAUTION

The plugs must be connected and fastened correctly.

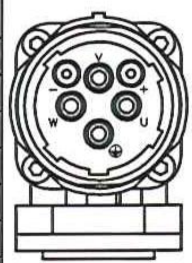
Incorrectly connecting the plugs and tightening the nuts can cause problems and damage the servomotor or servo drive.

6.1.- Power Connection



POWER CONNECTOR

CONTACT	WIRE COLOUR	FUNCTION	CONTACT
1	RED	PHASE 3 W	W
2	BLACK	PHASE 1 U	U
4	BLUE	PHASE 2 V	V
–	YELLOW/GREEN	GROUND ⏚	⏚
5	RED	BRAKE +	+
6	BLACK	BRAKE –	–
FP–55 to FP–3314			FP–5019 and FP–8019



6.2.- Signal Connection

					SIGNAL CONNECTOR						
	RESOLVER				INCREMENTAL				INCREMENTAL Sin Cos		
	TAMAGAWA		LTN		DYNAPAR M15		Quantum Devices		HEIDENHAIN		
	TRANSMITER 2T8				DYNAPAR M21		QR145		ERN 1185		
CONTACT	WIRE COLOUR	FUNCTION	WIRE COLOUR	FUNCTION	WIRE COLOUR	FUNCTION	WIRE COLOUR	FUNCTION	WIRE COLOUR	FUNCTION	W CO
1	YELLOW	S2(SIN+)	BLUE	S2(SIN+)	GREY	HALL1	VIOLET	HALL1	GREEN-BLACK	A+	GREE
2	BLUE	S4(SIN-)	YELLOW	S4(SIN-)	BROWN	HALL2	ORANGE-WHITE	HALL2	YELLOW-BLACK	A-	YE B
3	BLACK	S3(COS+)	BLACK	S3(COS+)	WHITE	HALL3	BROWN-WHITE	HALL3	BLUE-BLACK	B+	BLUE
4	RED	S1(COS-)	RED	S1(COS-)	BLUE	A	BLUE	A	RED-BLACK	B-	RED
5	RED-WHITE	R1(REF+)	RED-WHITE	R1(REF+)	BLUE-BLACK	A'	GREEN	A'	GREY	C+	VI
6	YELLOW-WHITE	R2(REF-)	BLACK-WHITE	R2(REF-)	GREEN	B	BROWN	B	PINK	C-	YE
7					GREEN-BLACK	B'	WHITE	B'	YELLOW	D+	G
8					VIOLET	Z	ORANGE	Z	VIOLET	D-	P
9					VIOLET-BLACK	Z'	YELLOW	Z'	RED	R+	
10					BLACK	GND(Encoder)	BLACK	GND(Encoder)	BLACK	R-	W
11					RED	+5V(Encoder)	RED	+5V(Encoder)	BLUE	+5V(Encoder)	B
12	BLACK	Thermistor	BLACK	Thermistor	BLACK	Thermistor	BLACK	Thermistor	BLACK	Thermistor	B
13	BLUE	Thermistor	BLUE	Thermistor	BLUE	Thermistor	BLUE	Thermistor	BLUE	Thermistor	B
14	RED	+5V(Memory)	RED	+5V(Memory)	RED	+5V(Memory)	RED	+5V(Memory)	RED	+5V(Memory)	
15	GREY	GND(0V Memory)	GREY	GND(0V Memory)	GREY	GND(0V Memory)	GREY	GND(0V Memory)	GREY	GND(0V Memory+ 0V Encoder)	G
16	WHITE	SCL(Memory)	WHITE	SCL(Memory)	WHITE	SCL(Memory)	WHITE	SCL(Memory)	WHITE	SCL(Memory)	W
17	BLUE	SDA(Memory)	BLUE	SDA(Memory)	BLUE	SDA(Memory)	BLUE	SDA(Memory)	BLUE	SDA(Memory)	B

6.3.- Connector position

The XtraforsPrime servomotor mounts a revolving angled connector, this allows different positions.




7.- Conditions of use

7.1.- Ambient temperature

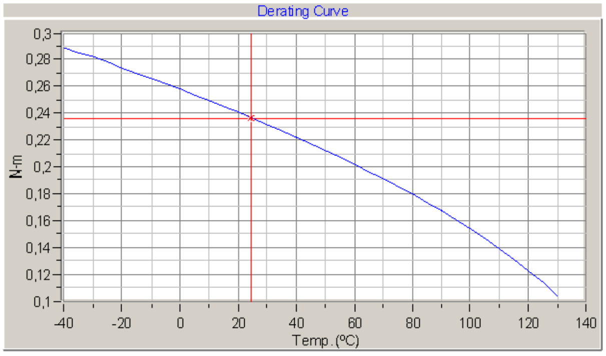
The characteristics specified for the XtraforsPrime servomotor apply in the following conditions

Ambient temperature of 25º   Operating temperature -40 to +70ºC

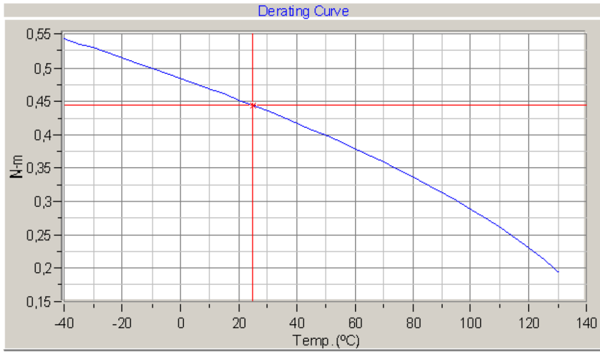
Altitude of o to 1000 m above sea level

For different ambient temperatures, the following derating curves should be used. Other conditions please ask factory

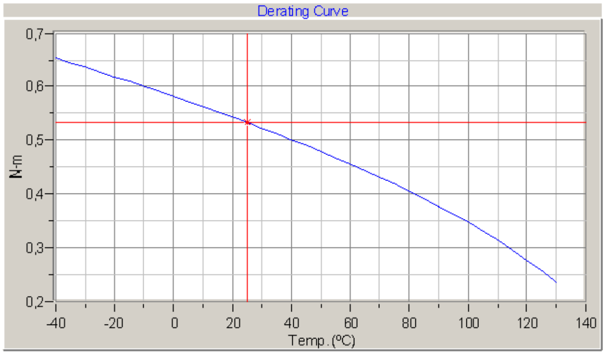
FP-0023



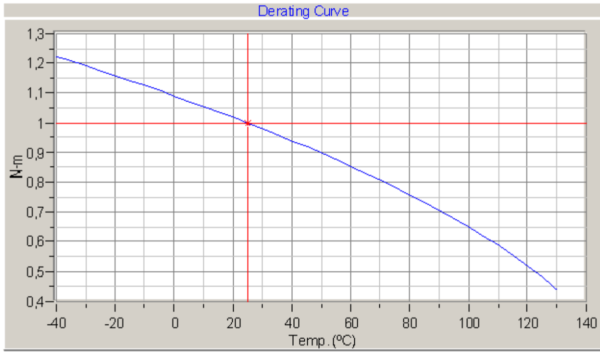
FP-00334



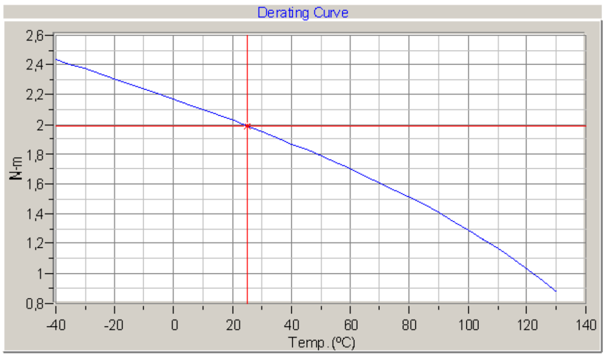
FP-0055



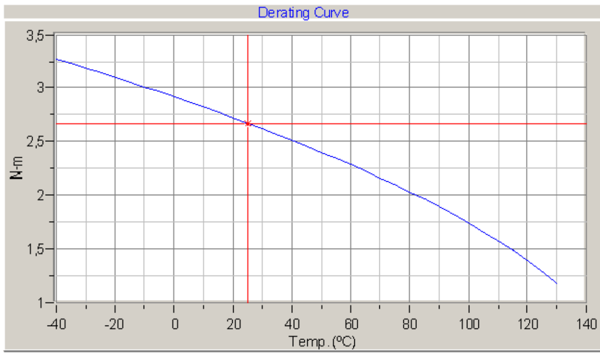
FP-0105



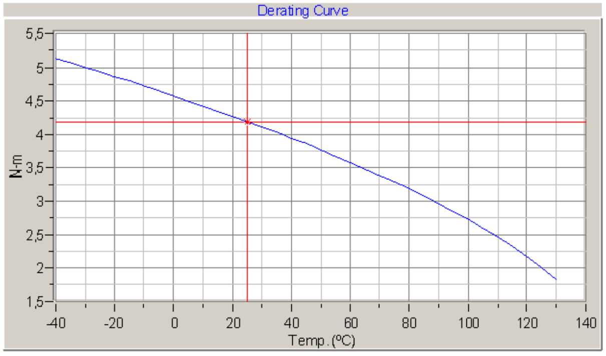
FP-0207



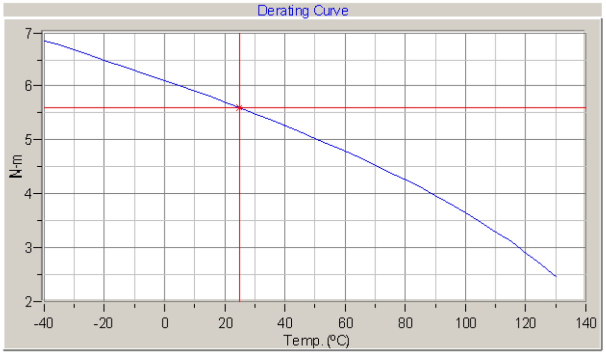
FP-0307



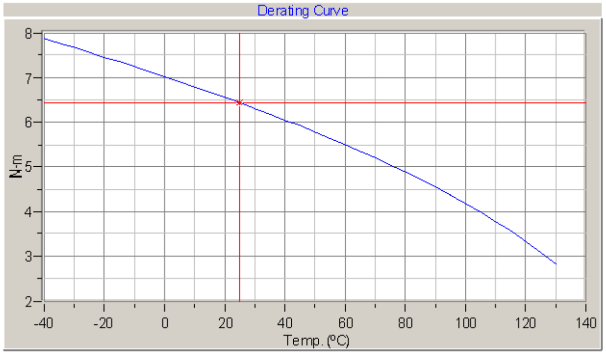
FP-0409



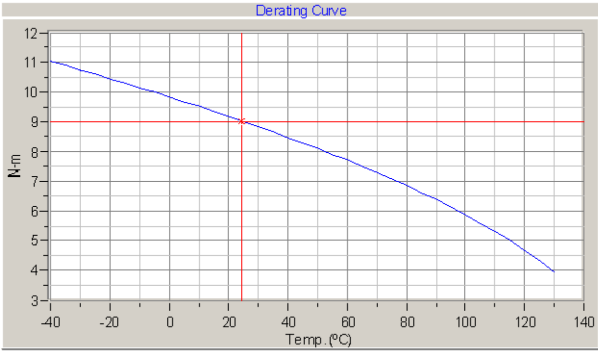
FP-0609



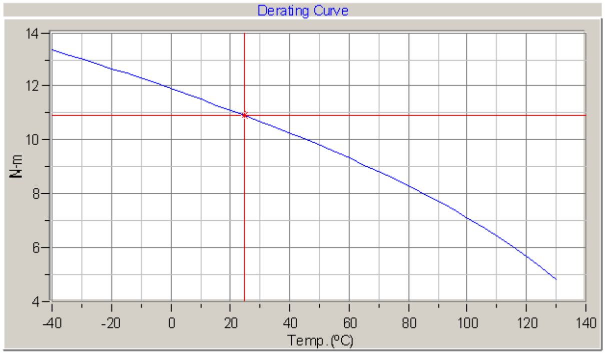
FP-0711



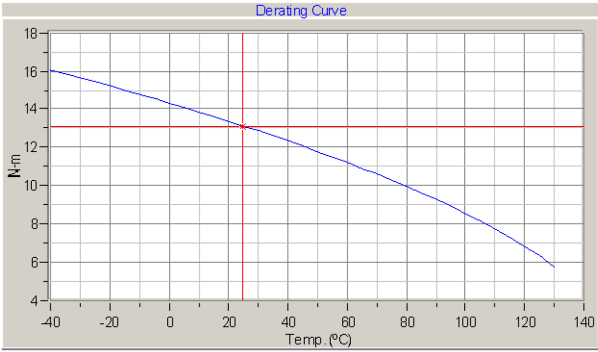
FP-0911



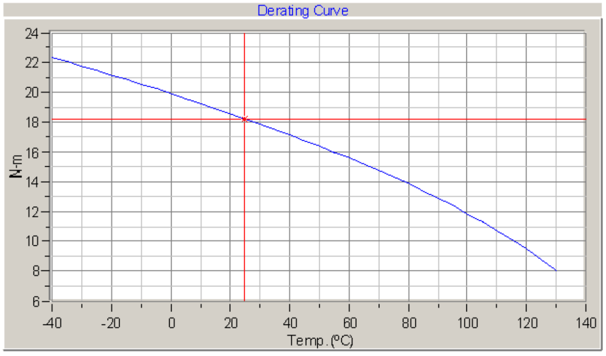
FP-1111



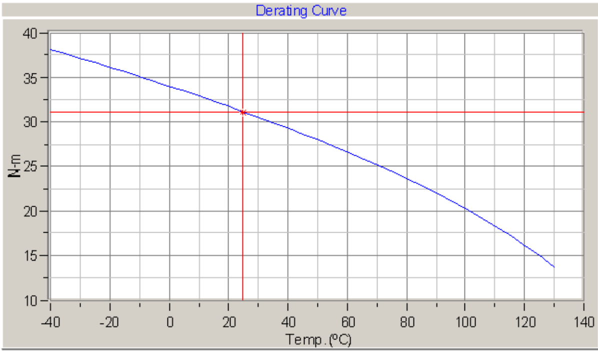
FP-1311



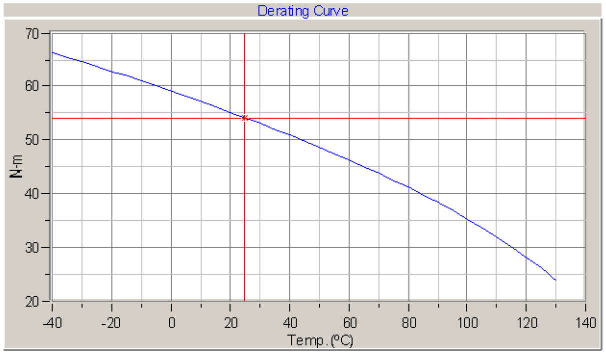
FP-1714



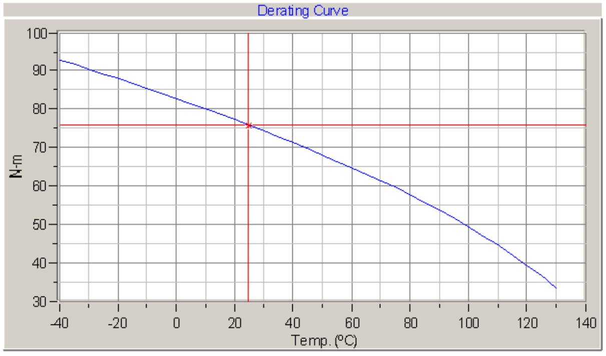
FP-3314



FP-5019



FP-8019



7.2.- Mechanical environmental conditions

According to IEC 68-2-6, the XtraforsPrime servomotors may be operated permanently installed and weather-protected under following conditions:

7.2.1.- Vibration Shock

Sinusoidal vibrations

50 m/s^2 from 10 to 500 Hz (EN 60068-2-6)

Shocks

15 g during 11ms (EN 60068-2-27)

7.2.2.- Enclosure Protection (IP Class)

The type of protection is defined by the identification symbol IP (International Protection) and two code numbers specifying the degree of protection. The first code number defines the degree of protection against contact and penetration of foreign particles. The second code number defines the degree of protection against water.
The protection classes according to IEC 529 apply to XtraforsPrime servomotor.

The degree of protection of the motor is IP-65, the Viton® joint used is to prevent against the most usual fluids (water and cooling fluids), for other type of fluids, contact the manufacturer.

In the case of vertical installation positions (shaft up), dirt and fluids can enter the motor interior more easily, causing malfunctions or failures. In those cases a sealing ring on the shaft is recommended

The installation position and the protection class of the motors should be taken into account when planning the system.

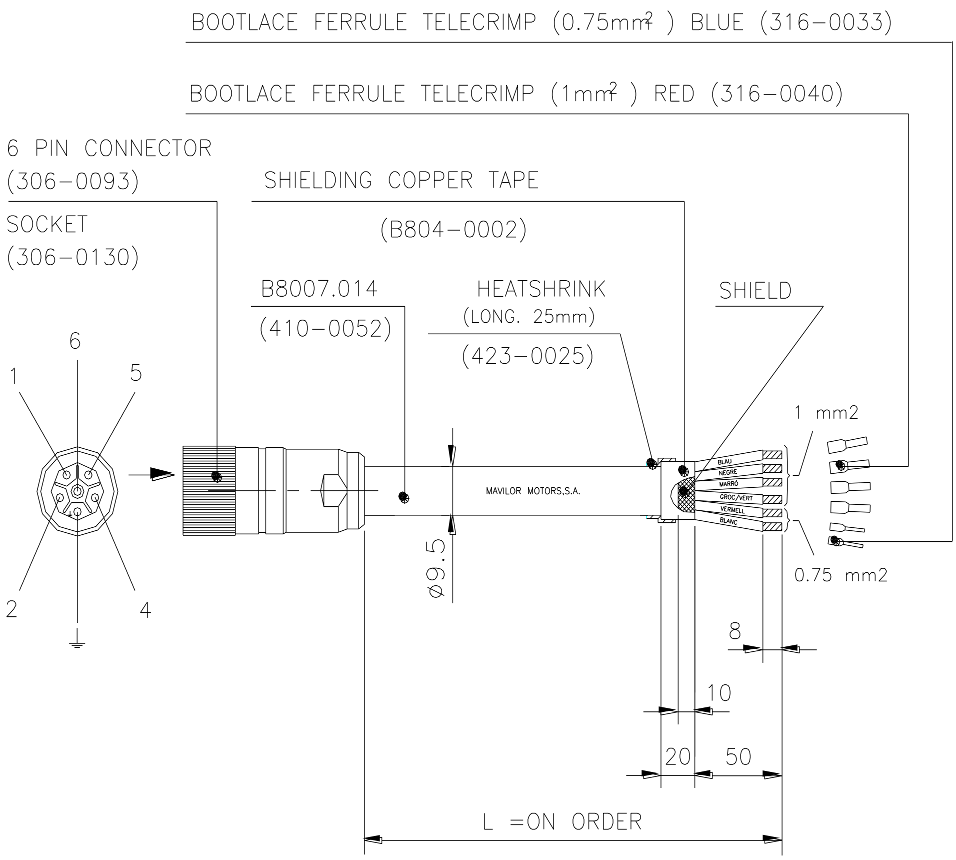
7.3.- Balancing.

XtraforsPrime servomotor motors are dynamically balanced according to DIN ISO 2372, Group K (Veff max 4.5 mm/s)

8.- Accessories

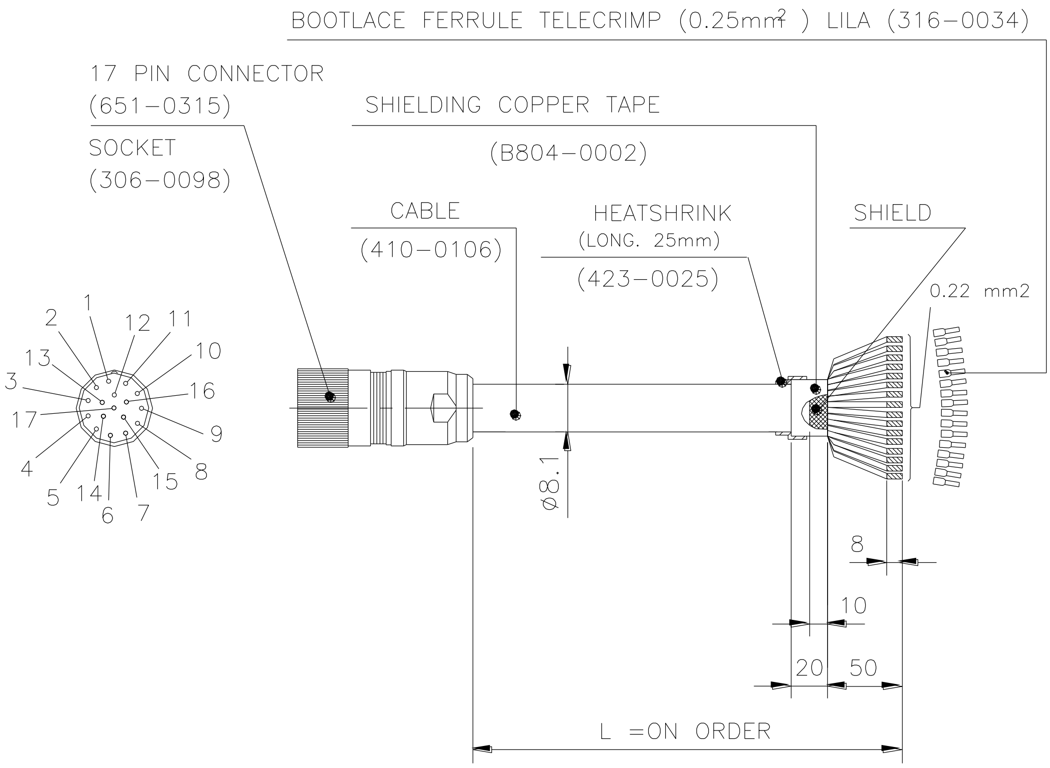
8.1.- Cables

Power cables



CM100-xxxxR Example

Signal cables



	Power cable	Resolver cable	Encoder cable
FP-0055/FP-0105	CM100-xxxxR	CR022-xxxxR	CC022-xxxxR
FP-0207/FP-0307	CM100-xxxxR	CR022-xxxxR	CC022-xxxxR
FP-0409/FP-0609	CM100-xxxxR	CR022-xxxxR	CC022-xxxxR
FP-0711/FP-09011/ FP-1111/FP-1311	CM400-xxxxR	CR022-xxxxR	CC022-xxxxR
FP-1714/FP-3314	CM400-xxxxR	CR022-xxxxR	CC022-xxxxR
FP-5019/FP-8019	CM400-xxxxB	CR022-xxxxR	CC022-xxxxR

xxxx = Required length in centimeters

9.- Applications

9.1.- Process to select the servomotor

1.- CALCULATE

- Inertia of the load $J_E \quad kg\,m^2$

-Acceleration required $\alpha = \frac{\Delta\omega_M}{\Delta t} = \frac{2\pi\Delta n_M}{60\Delta t} \quad \alpha\ rad/s^2 \quad n\ rpm \quad \omega\ rad/s$

-Acceleration torque of the load $M_E = J_E\alpha \quad M_E\ Nm \quad J\ kg\,m^2 \quad \alpha\ rad/s^2$

- Resistant torque $M_c \quad Nm$

-Speed of the motor required $n\ rpm$

2.- SELECT THE MOTOR

-Nominal torque

-Nominal speed

3.- CALCULATE THE TOTAL INERTIA $J_T = J_E + J_M \quad kgm^2$

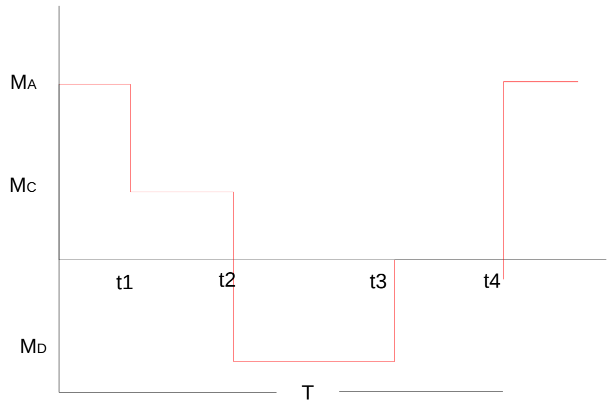
4.- CALCULATE THE ACCELERATION AND DECELERATION TORQUE

$$M_{aT} = J_T.\alpha.1{,}2 \quad M_A = M_T + M_R \quad M_D = M_{aT} - M_R \quad M\ Nm \quad J\ kgm^2 \quad \alpha\ rad/s^2$$

5.- CALCULATE THE TORQUE rms

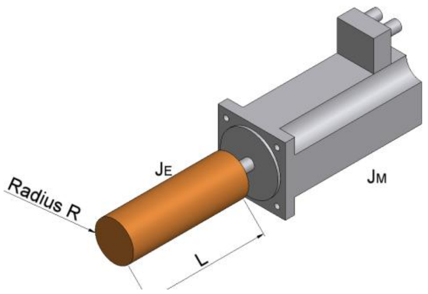
$$M_{RMS} = \sqrt{\frac{M_A^2.t_1 + M_c^2.t_2 + M_D^2.t_3}{T}} \quad M\ Nm \quad t\ s \quad T\ total\ time\ s$$

Duty Cycle



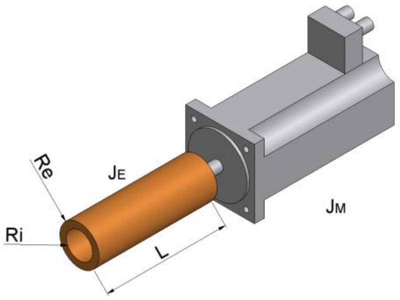
9.2.- Inertia calculations

Direct transmission



$$J_E = \frac{m.R^2}{2}; \quad m = \rho.\pi.R^2.L$$

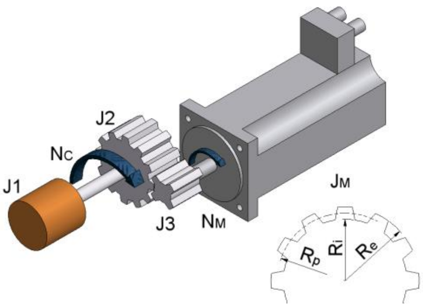
$$J_T = J_E + J_M; \quad \rho = \text{Density}$$



$$J_E = \frac{m.(R_e^2 + R_i^2)}{2}; \quad m = \rho.\pi.(R_e^2 - R_i^2).L$$

$$J_T = J_E + J_M$$

Gear Transmission



$$J_E = \frac{J_1 + J_2}{i^2} + J_3$$

$$J_T = J_E + J_M$$

$$i = \frac{N_M}{N_C} = \frac{R_{P3}}{R_{P4}} = \frac{Z_3}{Z_4}$$

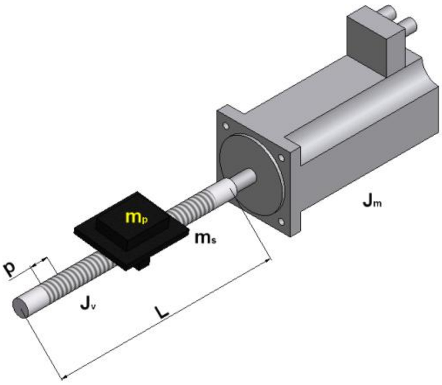
$$R_P = \frac{Z.\overline{m}}{2}; \quad R_e = R_p + \overline{m}$$

$i = \text{reduction ratio} \quad N = \text{speed}$

$R = \text{Pitch radius} \quad Z = \text{n}^{\text{o}} \text{ teeth}$

$\overline{m} = \text{module}$

Lead screw transmission



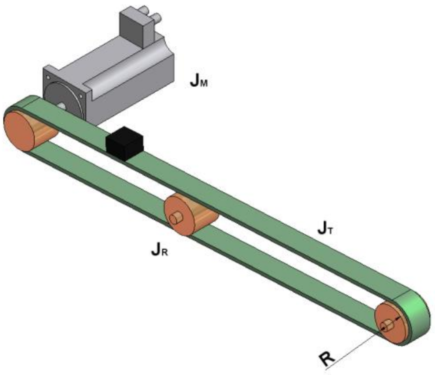
$$J_E = (m_p + m_s).\left(\frac{p}{2\pi}\right)^2 + J_V$$

$$J_T = J_E + J_M$$

$$m = \text{mass of the load} \quad p = \text{pitch}$$

$$Jv = \text{Inertia of the screw}$$

Belt



$$J_E = 3J_R + (m_p + m_t).R^2$$

$$J_T = J_E + J_M$$

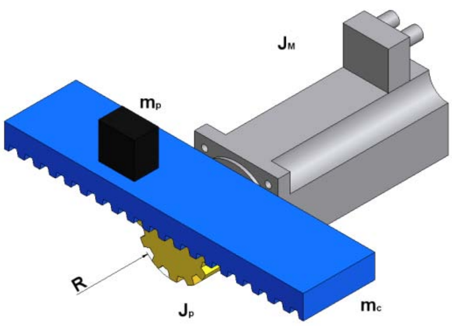
$$J_R = \text{Inertia of the drum}$$

$$m_p = \text{mass of the load}$$

$$m_t = \text{mass of the belt}$$

$$R = \text{Radius of the drum}$$

Pinion



$$J_E = J_P + (m_p + m_c).R^2$$

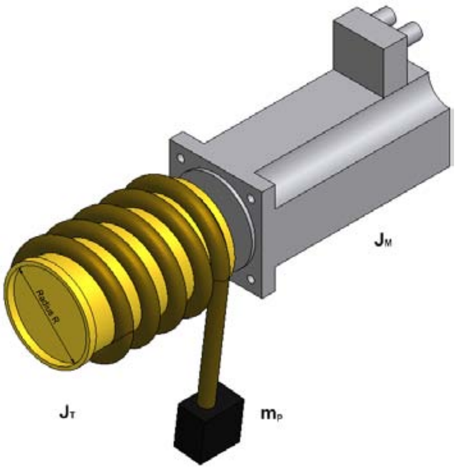
$$J_T = J_E + J_M$$

$$J_p = \text{Inertia of pinion} \quad R = \text{Radius of pinion}$$

$$m_p = \text{mass of the load} \quad m_c = \text{mass of the chariot}$$

$$J_M = \text{Inertia of the motor}$$

Winch

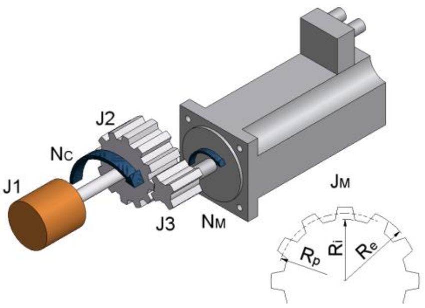


$$J_E = m_p.R^2 + J_1$$

$$J_T = J_E + J_M$$

9.3.- Torque calculations

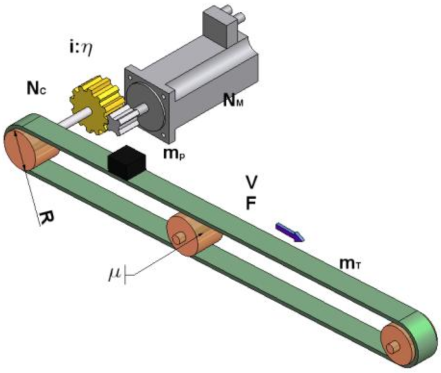
Gear transmission



$$M_C = \frac{M_M}{i.\eta}; \quad i = \frac{N_C}{N_M}$$

$$\eta = 0.6.....0.95$$

Belt transmission

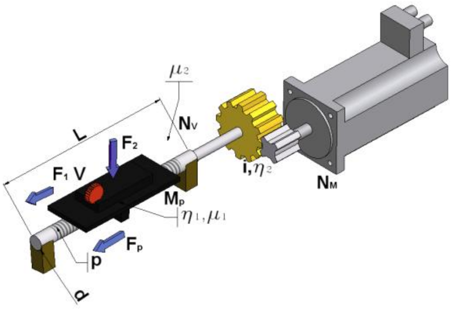


$$N_M = \frac{60.V}{2\pi.R} i$$

$$M_R = \frac{R.\mu.(m_p + m_T).g}{\eta.i}$$

$$M_L = \frac{F.R}{\eta.i} \quad M_C = 1.25 M_R + M_L$$

Screw lead transmission



$$M_{R1} = \mu_1.\frac{p}{2\pi}.[(m_p + m_s).g.F_2]$$

$$M_{R2} = \mu_2.R_c.F_p \quad \mu_1 = 0.15$$

$$\mu_2 = 3_{0/00}..9_{0/00}$$

$$R_c = 0.75...0.9d \quad \eta_1 = 0.8..0.95$$

$$\eta_2 = 0.8..0.95$$

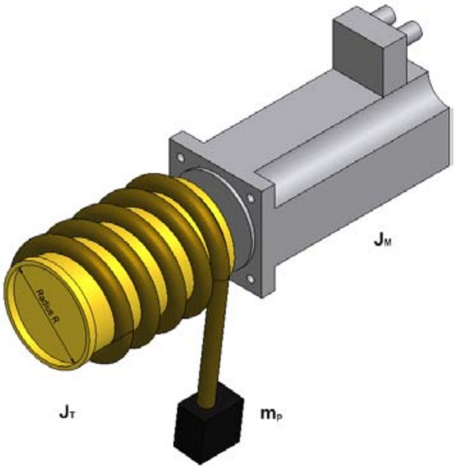
$$N_M = \frac{V}{p} i \quad i = \frac{N_M}{N_V}$$

$$M_R = \frac{\frac{M_{R1}}{\eta_1} + M_{R2}}{\eta_2.i}$$

$$M_L = F_1.\frac{p}{2\pi}\frac{1}{i.\eta_1.\eta_2}$$

$$M_C = 1.1 M_R + M_L$$

Winch



$$M_C = M_L = m_p.g.R$$

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