Small Push-Pull Solenoids

SMALL PUSH-PULL SOLENOIDS

1. Design and Features

The small push-pull solenoids have the same features as the conventional push-pull solenoid. The push-pull solenoid design utilizes a coil with the maximum amount of magnet wire in the smallest amount of space. This coil assembly is then packaged in a metal housing using highly permeable steel to obtain the maximum force in the minimum size and weight. This small size solenoid is a very cost effective solution when small movements are required and/or limited amount of electrical power is available.

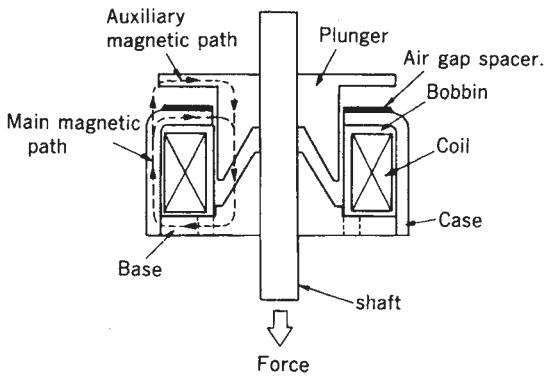


Fig. 1

2. Stroke and Force

The conical pole piece configuration is the standard design for the small push-pull solenoid. For the best performance efficiency, the stroke should be kept to a minimum.

3. Operational Considerations

A) Temperature

The coil data of small push-pull solenoids shows the values at ambient temperature 20° C and without the use of a heat sink. If a solenoid is used at a rating shown in the coil data, it is designed so that the coil temperature rises and reaches equilibrium at approximately 85° C. In applications where the ambient temperature is higher than 20° C possible thermal damage can occur. Temperature rise tests should be performed by the customer to assure that the coil does not reach 120° C. Coils can be constructed to operate at temperatures higher than 120° C without thermal damage. Please consult the factory for details.

B) Air Gap Spacer

The small push-pull solenoid uses an air gap spacer between the armature and the case. This spacer is installed to prevent the armature and base from coming into mechanical contact with each other, which would cause residual magnetism.

C) Return Spring

The small push-pull solenoid does not include a return spring. Therefore, the application must include a return spring.

D) Shaft Modification

It is not recommended that the customer modify the shaft, as the shafts are fabricated before assembly. Any special configuration can be supplied. Please consult factory for details.

E) Installation of Solenoid

The small push-pull solenoid uses tapped holes for mounting in the base.

Caution needs to be observed that the mounting screws used to attach these solenoids are the correct length so as not to damage the coil.

4. General Characteristics

Insulation class	Class E (120° C) Size 110C is class A (105° C) Lead wire class A (105° C)
Dielectric strength	AC 1000V 50/60 Hz 1 min. (at normal temperature and normal humidity)
Insulation resistance	More than 100 Mohm at DC 500V megger (at normal temperature and normal humidity)
Expected life	Standard life : 5 million cycles

(Solenoid cycle life is very dependent upon side load, frequency of use, and environmental conditions. Cycle life tests should be performed by the customer.)

5. How to Select a Solenoid

Before selecting a small push-pull solenoid, the following information must be determined :

A) Force

The actual force required in the application should be increased using a safety factor multiplier of 1.5 to arrive at the force value that should be used in your specification.

B) Duty Cycle

Use the aforementioned formula to calculate duty cycle. Also note the maximum on time. (See page 2)

C) Stroke
Stroke is determined by application requirements.
D) Operating Voltage
Operating DC voltage is determined by the application and voltage available.

After determining these specifications, one can find the correct size solenoid for the application, using the force-stroke characteristic tables and graphs. The coil data is also shown for different sizes of magnet wire. If the exact operating voltages are not in the coil data table, please consult the factory for details.
To determine the force output of the solenoid after temperature rise, please use the amp-turn force graphs (page 60) after calculating the amp-turns.

6. Ordering Information

●When ordering a small push-pull solenoid, the correct part number needs to be determined from the following combination of characteristics (1-3) :
(1) M-Metric Thread
F-SAE Thread
(2) Solenoid Size (example-144C)
(3) Coil voltage from tables (At 100% Duty cycle)

●Example of a complete part number.

(1) (2) (3)
M 144C-6V

This part number is for a solenoid with Metric threads, size 144C, with a 6V coil.

7. Labeling

For small push-pull solenoids the part number labeling is as follows :

A) Standard Solenoid (no modifications).
The solenoid label will have the part number and the date code (which identifies the year and week of manufacture).

Example : M 144C-6V 9401

Metric Thread
Solenoid Size and Coil voltage at 100% duty cycle
Date Code (year and week)

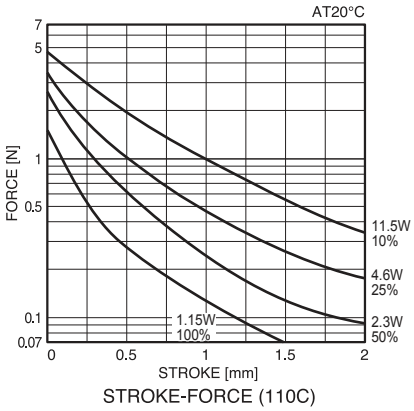
B) Special Configuration (required for any modification to a standard design)
Any change from the standard catalog design requires that a custom part number be assigned, which will also include the date code of manufacture.

Example : F94010P 9401

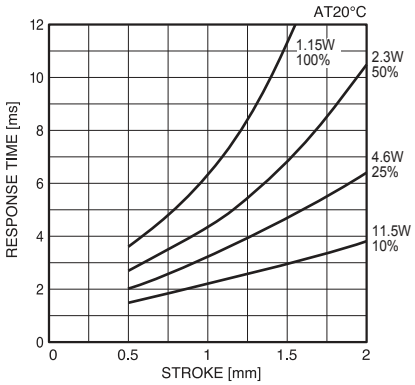
Special Part Number
Date Code (year and week)

SIZE110C SMALL PUSH PULL SOLENOID

UNIT : mm
SHOWN ENERGIZED

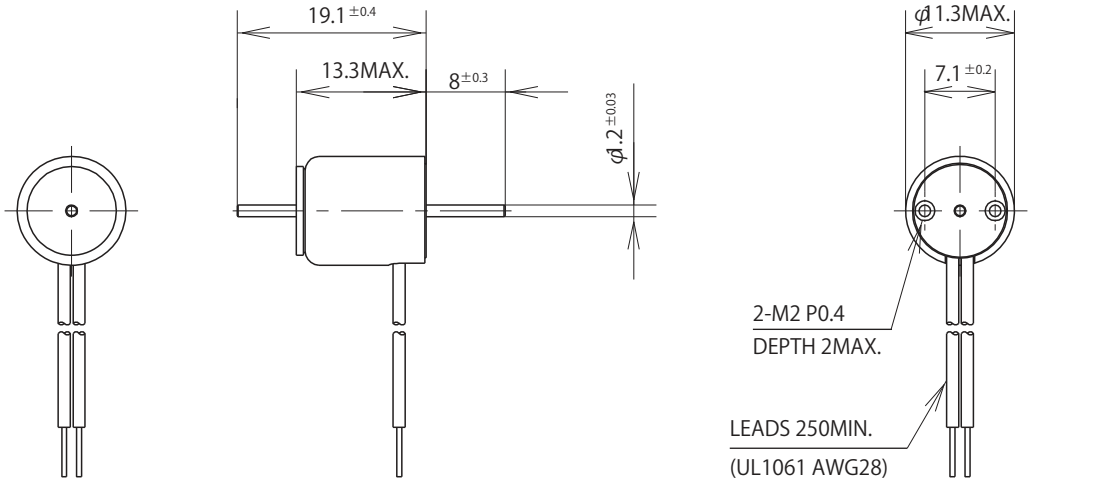


STROKE-FORCE (110C)



STROKE-RESPONSE TIME

WEIGHT : 7g
PLUNGER: 1g



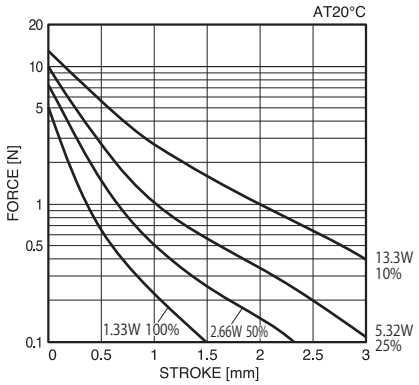
COIL DATA

without heat sink

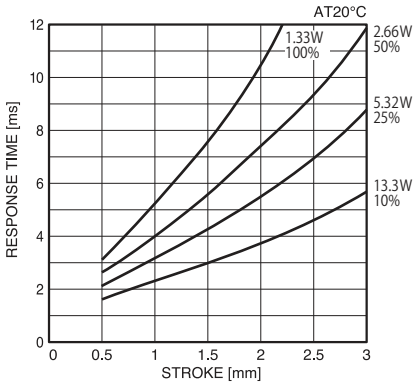
	duty cycle = "on" time / ("on" time + "off" time) ×100%	100% continuous	50% or less	25% or less	10% or less
	MAX. "on" time in seconds	∞	100	36	7
	watts at 20℃	1.15	2.3	4.6	11.5
	ampere-turns at 20℃	105	148	210	332

type no.	resistance Ω±10%(at 20°C)	no. turns	volts DC			
M110C-3V F110C-3V	10.5	390	3	4.2	6	9.5
M110C-6V F110C-6V	31.5	700	6	8.5	12	19
M110C-12V F110C-12V	143	1450	12	17	24	38

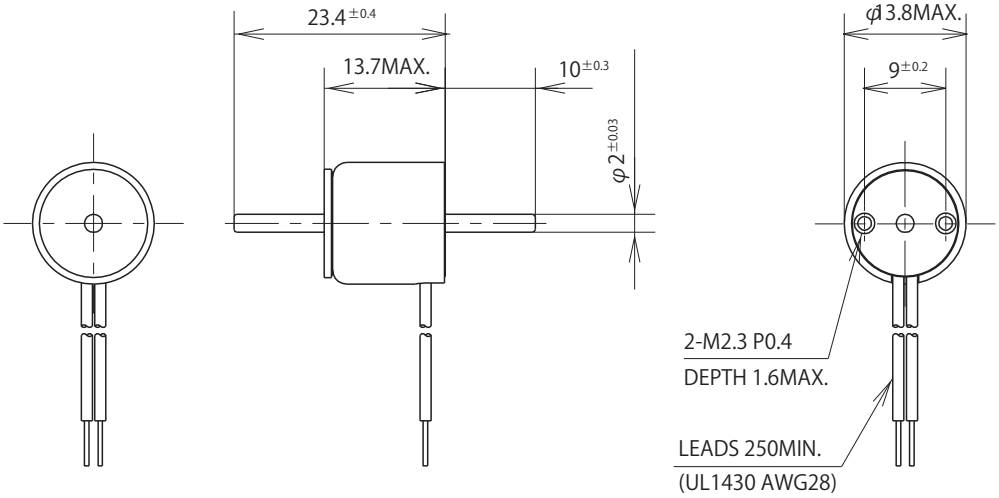
WEIGHT :12g
PLUNGER: 2.5g



STROKE-FORCE (141C)



STROKE-RESPONSE TIME



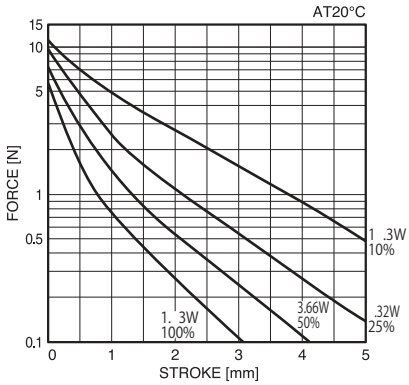
COIL DATA

without heat sink

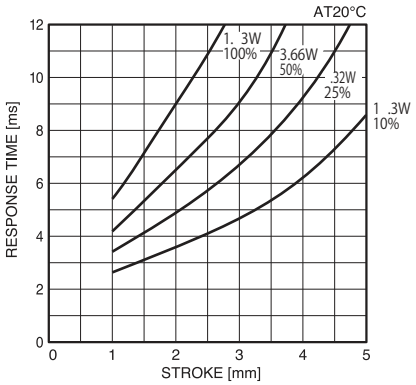
	duty cycle = "on" time / ("on" time + "off" time) ×100%		100% continuous	50% or less	25% or less	10% or less
	MAX. "on" time in seconds		∞	100	36	7
	watts at 20℃		1.33	2.66	5.32	13.3
	ampere-turns at 20℃		133	189	267	422
type no.	resistance Ω±10%(at 20°C)	no. turns	volts DC			
M141C-3V F141C-3V	6.5	330	3	4.2	6	9.5
M141C-6V F141C-6V	30	700	6	8.5	12	19
M141C-12V F141C-12V	97	1200	12	17	24	38
M141C-24V F141C-24V	468	2600	24	34	48	76

SIZE144C SMALL PUSH PULL SOLENOID

UNIT : mm
SHOWN ENERGIZED

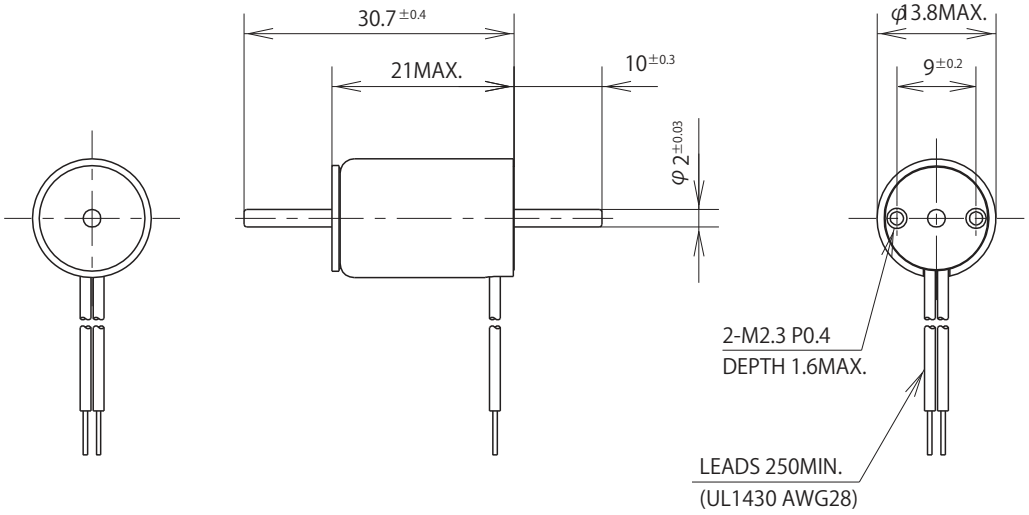


STROKE-FORCE (144C)



STROKE-RESPONSE TIME

WEIGHT : 18g
PLUNGER: 3g

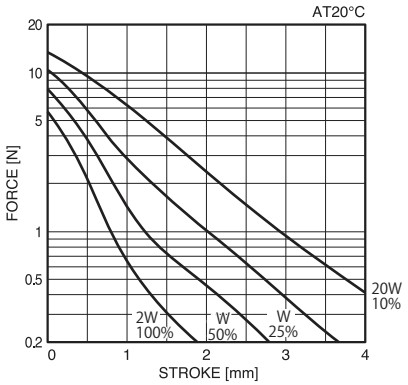


COIL DATA

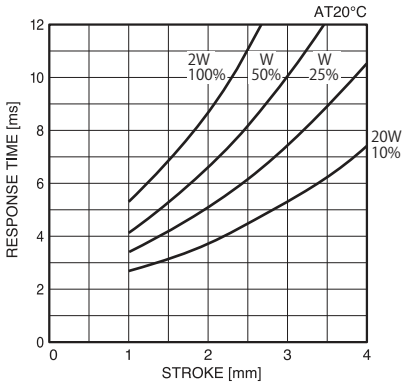
without heat sink

	duty cycle = "on" time / ("on" time + "off" time) ×100%		100% continuous	50% or less	25% or less	10% or less
	MAX. "on" time in seconds		∞	100	36	7
	watts at 20℃		1.83	3.66	7.32	18.3
	ampere-turns at 20℃		236	334	472	746
type no.	resistance Ω ±10%(at 20°C)	no. turns	volts DC			
M144C-3V F144C-3V	5	415	3	4.2	6	9.5
M144C-6V F144C-6V	22.7	910	6	8.5	12	19
M144C-12V F144C-12V	91.5	1750	12	17	24	38
M144C-24V F144C-24V	329	3150	24	34	48	76

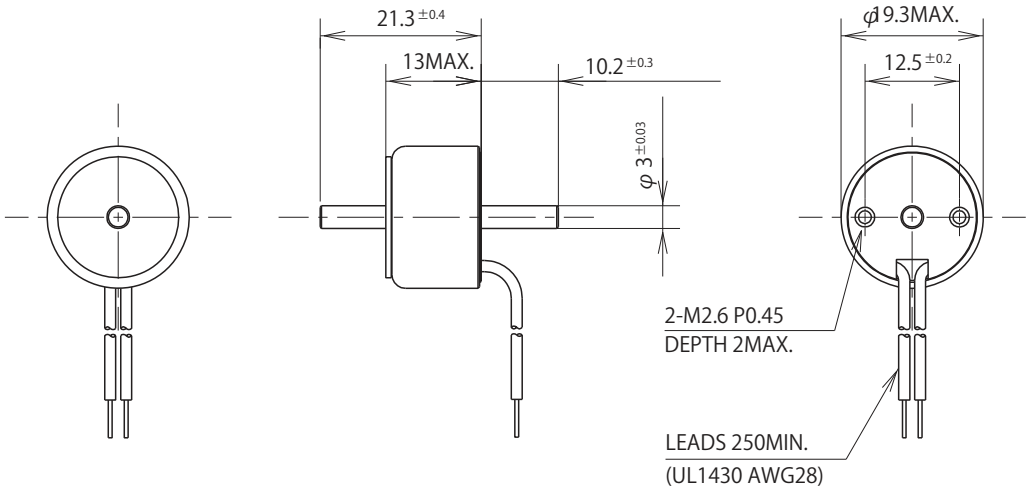
WEIGHT : 20g
PLUNGER: 4g



STROKE-FORCE (190C)



STROKE-RESPONSE TIME



COIL DATA

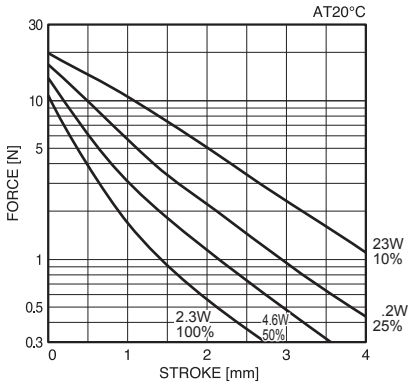
without heat sink

	duty cycle = "on" time / ("on" time + "off" time) ×100%		100% continuous	50% or less	25% or less	10% or less
	MAX. "on" time in seconds		∞	100	36	7
	watts at 20℃		2	4	8	20
	ampere-turns at 20℃		170	240	340	537
type no.	resistance Ω ±10%(at 20°C)	no. turns	volts DC			
M190C-3V F190C-3V	4.9	295	3	4.2	6	9.5
M190C-6V F190C-6V	21.5	620	6	8.5	12	19
M190C-12V F190C-12V	89	1230	12	17	24	38
M190C-24V F190C-24V	307	2120	24	34	48	76

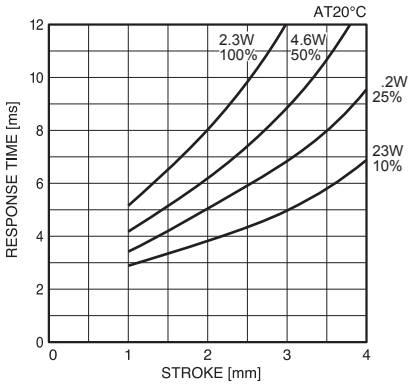
SIZE192C SMALL PUSH PULL SOLENOID

UNIT : mm
SHOWN ENERGIZED

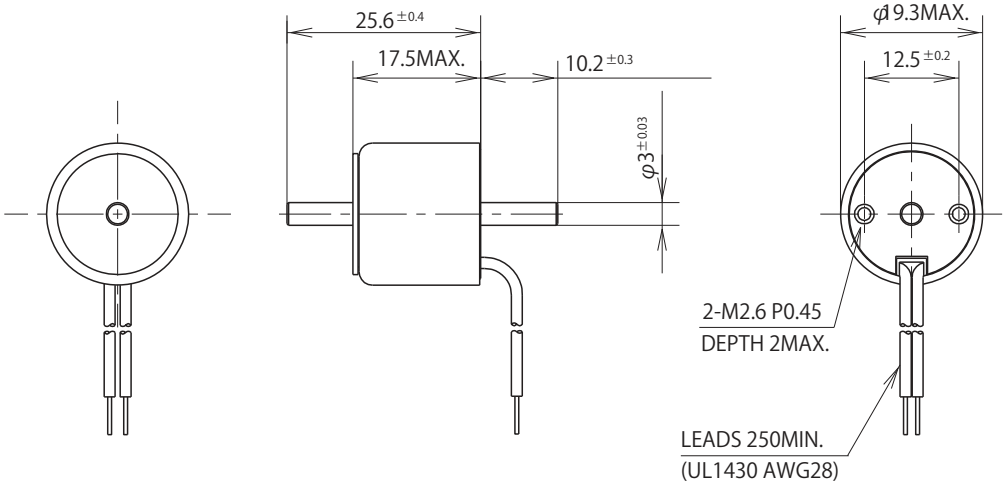
WEIGHT : 27g
PLUNGER: 4.5g



STROKE-FORCE (192C)



STROKE-RESPONSE TIME



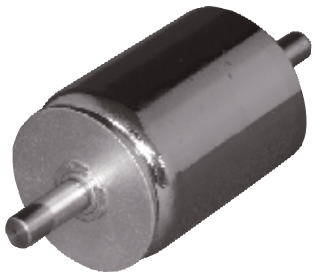
COIL DATA

without heat sink

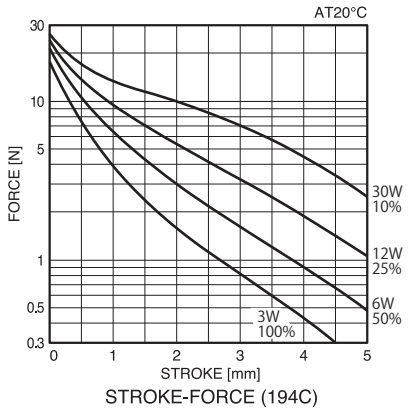
	duty cycle = "on" time / ("on" time + "off" time) ×100%		100% continuous	50% or less	25% or less	10% or less
	MAX. "on" time in seconds		∞	100	36	7
	watts at 20℃		2.3	4.6	9.2	23
	ampere-turns at 20℃		265	374	530	838
type no.	resistance Ω±10%(at 20°C)	no. turns	volts DC			
M192C-3V F192C-3V	4.3	380	3	4.2	6	9.5
M192C-6V F192C-6V	16	735	6	8.5	12	19
M192C-12V F192C-12V	68	1500	12	17	24	38
M192C-24V F192C-24V	242	2770	24	34	48	76

SIZE194C SMALL PUSH PULL SOLENOID

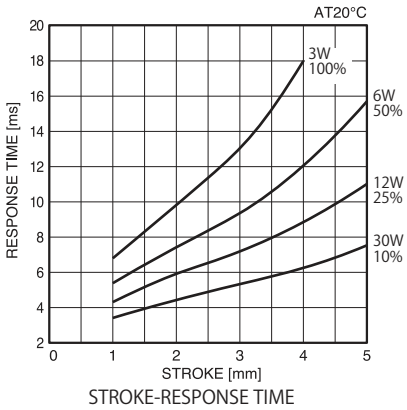
UNIT : mm
SHOWN ENERGIZED



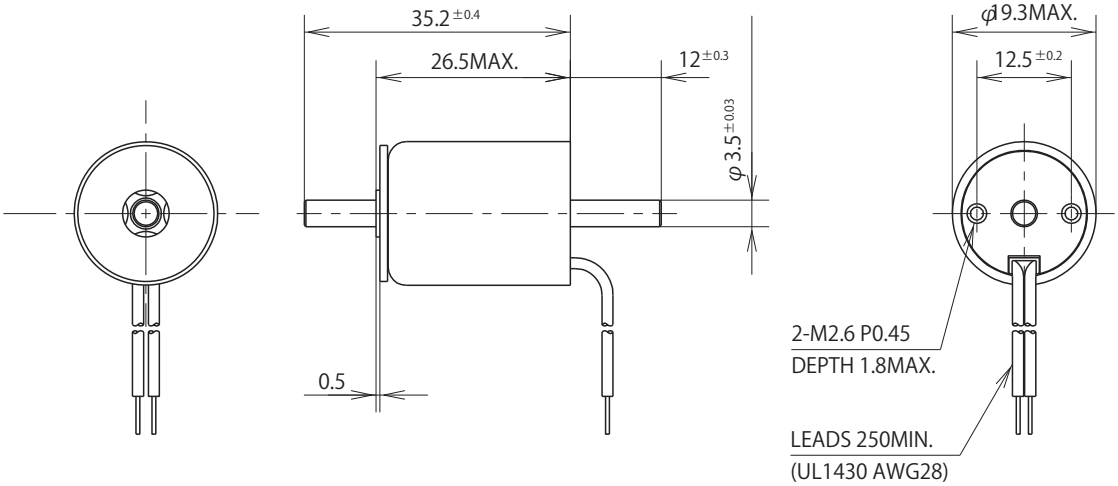
WEIGHT : 44g
PLUNGER: 9g



STROKE-FORCE (194C)



STROKE-RESPONSE TIME



COIL DATA

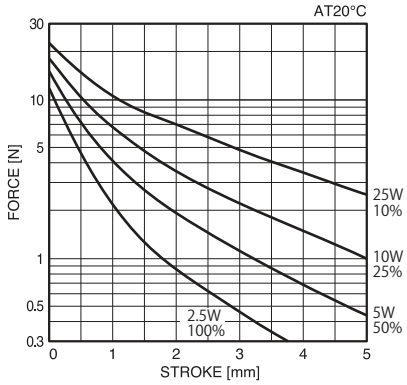
without heat sink

	duty cycle = "on" time / ("on" time + "off" time) ×100%		100% continuous	50% or less	25% or less	10% or less
	MAX. "on" time in seconds		∞	100	36	7
	watts at 20℃		3	6	12	30
	ampere-turns at 20℃		382	542	765	1211
type no.	resistance Ω ±10%(at 20°C)	no. turns	volts DC			
M194C-3V F194C-3V	2.7	360	3	4.2	6	9.5
M194C-6V F194C-6V	11.8	770	6	8.5	12	19
M194C-12V F194C-12V	49.5	1620	12	17	24	38
M194C-24V F194C-24V	185	2950	24	34	48	76

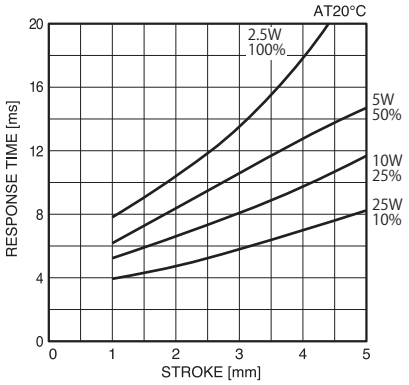
SIZE221C SMALL PUSH PULL SOLENOID

UNIT : mm
SHOWN ENERGIZED

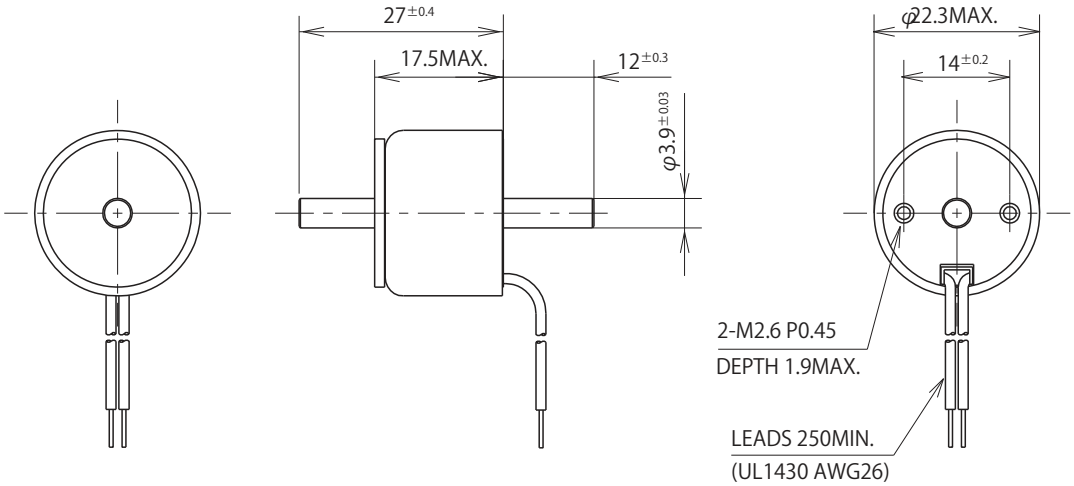
WEIGHT : 39g
PLUNGER: 9g



STROKE-FORCE (221C)



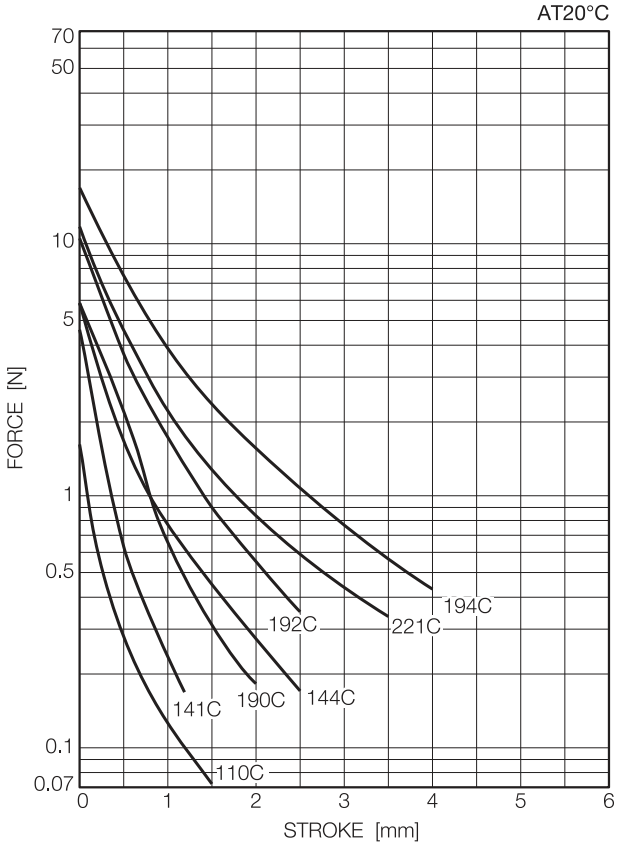
STROKE-RESPONSE TIME



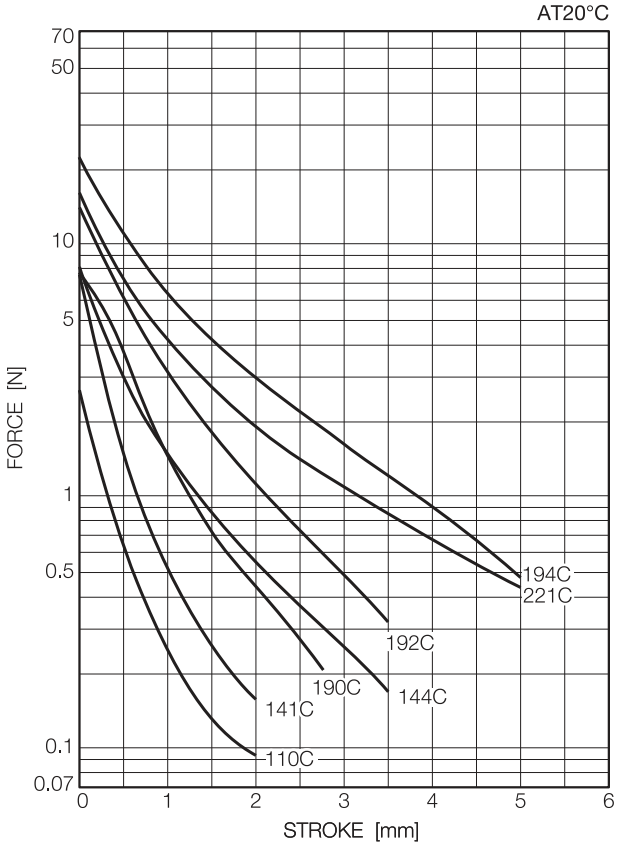
COIL DATA

without heat sink

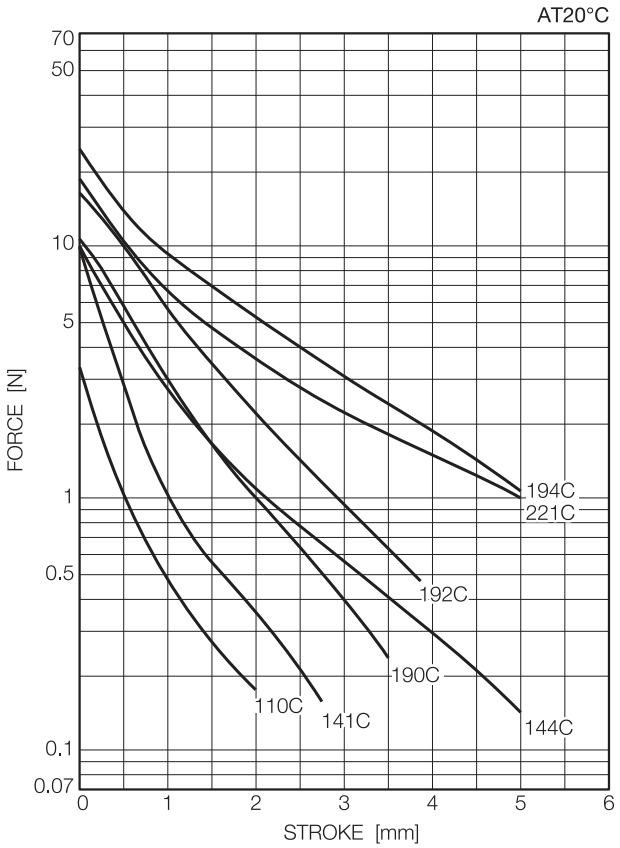
	duty cycle = "on" time / ("on" time + "off" time) ×100%		100% continuous	50% or less	25% or less	10% or less
	MAX. "on" time in seconds		∞	100	36	7
	watts at 20℃		2.5	5	10	25
	ampere-turns at 20℃		253	358	507	803
type no.	resistance Ω±10%(at 20°C)	no. turns	volts DC			
M221C-3V F221C-3V	3.8	325	3	4.2	6	9.5
M221C-6V F221C-6V	13.8	620	6	8.5	12	19
M221C-12V F221C-12V	59	1260	12	17	24	38
M221C-24V F221C-24V	226	2200	24	34	48	76



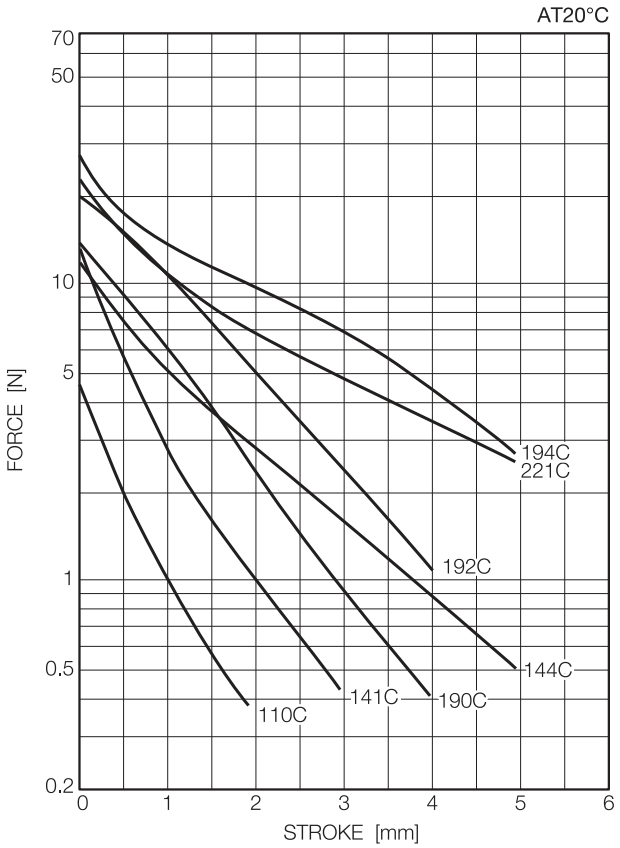
DUTY CYCLE 100%



DUTY CYCLE 50%



DUTY CYCLE 25%

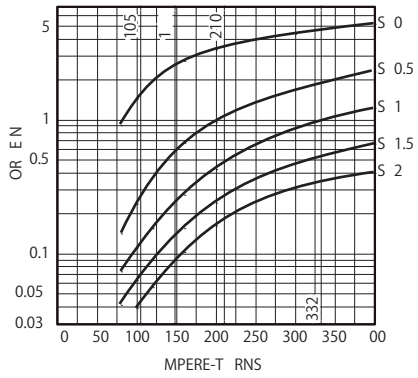


DUTY CYCLE 10%

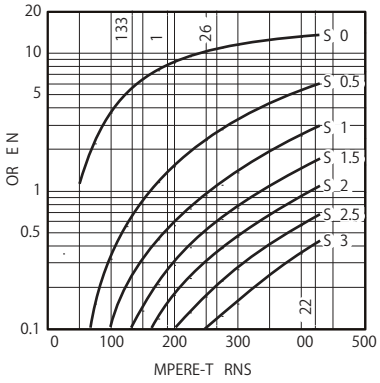
SMALL PUSH PULL SOLENOID AMPERE TURN V.S. FORCE

PERFORMANCE CURVES ARE AT 20˚C

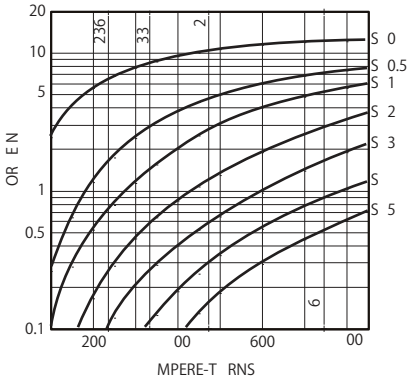
SIZE110C



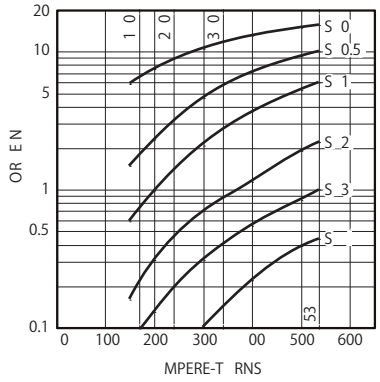
SIZE141C



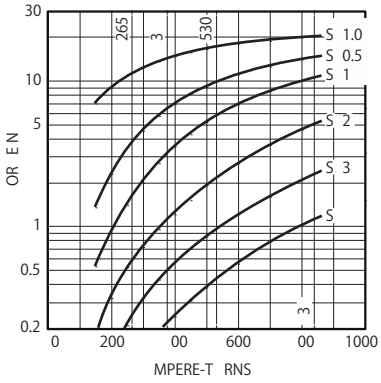
SIZE144C



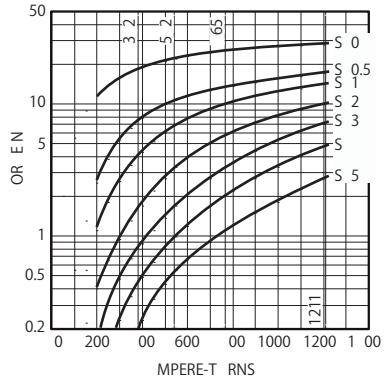
SIZE190C



SIZE192C



SIZE194C



SIZE221C