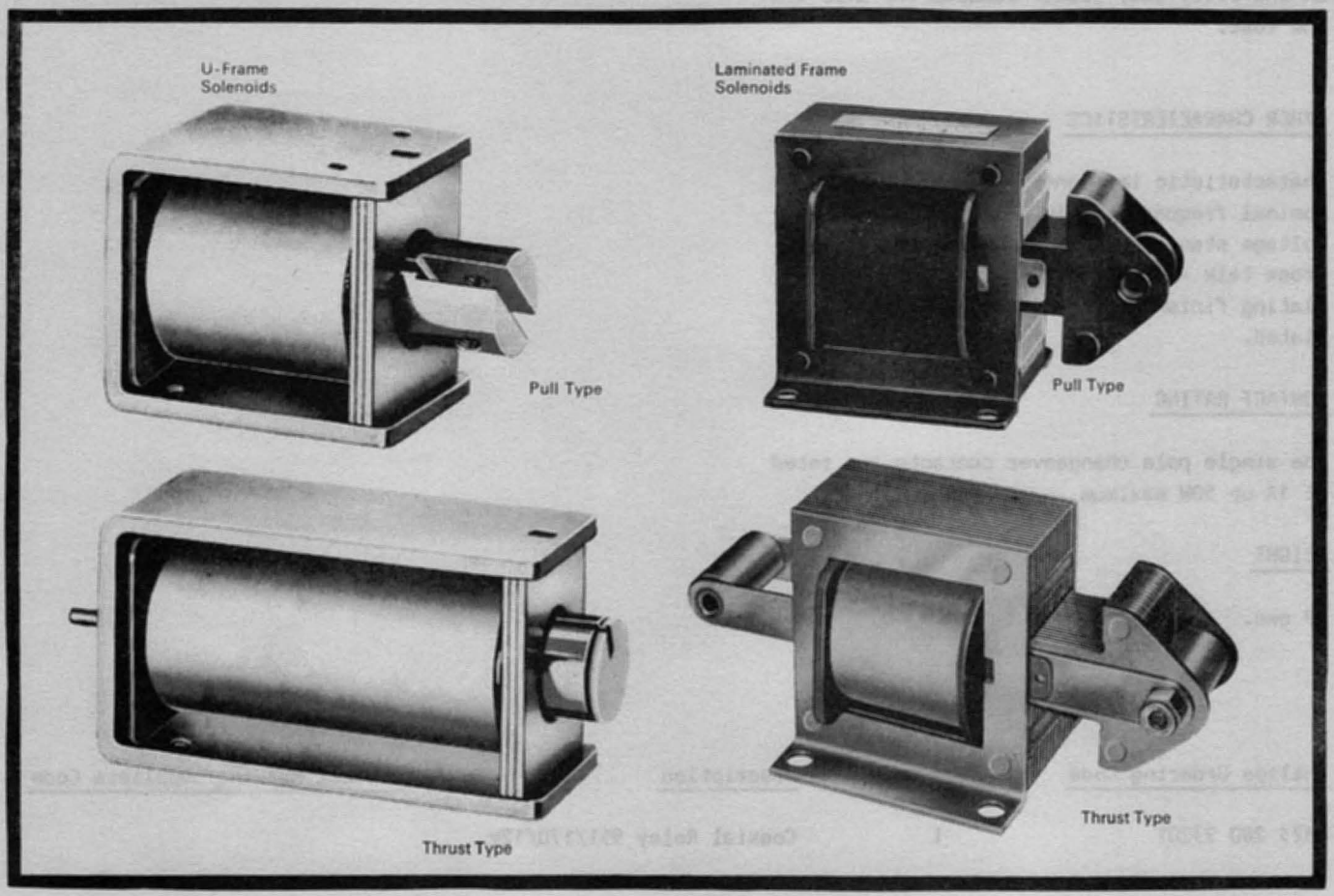
SOLENOIDS

HOW TO SELECT YOUR PYE SOLENOID



DESCRIPTION OF TYPES

Basically a solenoid consists of a coil with an associated iron circuit forming the fixed part. A moving iron plunger is pulled into this coil when it is energised.

The simplest form of solenoid is the SOLID FRAME TYPE. This has a simple iron frame enclosing the coil, and a cylindrical plunger. On AC supplies the iron losses in the solid U-frame restrict the efficiency of this type of solenoid. As the size increases it becomes necessary to go to a LAMINATED FRAME construction to reduce iron losses.

AC OR DC OPERATION

Often the choice is predetermined by the supply available. Where there is a choice these factors should be considered.

1. AC solenoids tend to be more powerful in the fully open position than DC. This is due to 'inrush current', which at maximum stroke can be more than ten times the closed current.

2./

SOLENOIDS (contd)

AC OR DC OPERATION (contd)

2. AC solenoids must close completely so that the inrush current falls to its normal value. If an AC solenoid sticks in the open position a burn-out is likely. DC solenoids take the same current throughout their stroke and cannot overheat through incomplete closing.

3. AC operated solenoids are usually faster than DC, but with a few milliseconds variation in response time, depending on the point of cycle when the solenoid is energised. DC solenoids are slower, but they repeat their closing times accurately against a given load.

4. A good AC solenoid correctly used should be quiet when closed, but only because its fundamental tendency to hum has been overcome by correct design and accurate assembly. Dirt on the mating faces or mechanical overload may make it noisy. A DC solenoid is naturally quiet.

VOLTAGE

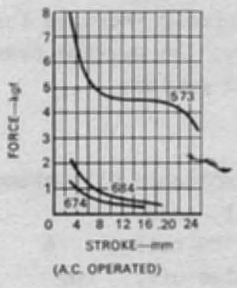
Again this choice will normally be predetermined by the supplies available. A solenoid can be wound for any voltage between the limits of unreasonably fine wire for high voltages and wire too thick to handle for the very low voltages.

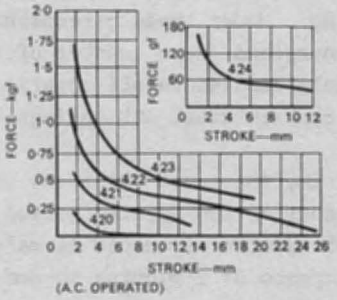
Where a choice is available it should be remembered that a low voltage coil tends to give more power than one for high voltage, and is more robust as it uses heavier wire.

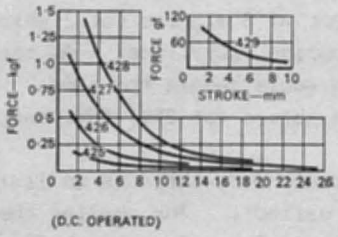
FORCE/STROKE CURVE

When a solenoid is fully opened it has a large air gap. The reluctance of this air gap keeps the magnetic field small and the force correspondingly low. As the plunger closes, the reluctance falls and the magnetic field increases For this reason, the force obtainable from a solenoid increases progressively as the plunger closes. Force/stroke curves are included for all of our solenoids so that you can match the solenoid to your duty.

These curves show the force exerted with the coil at full working temperature. The force exerted by a cold solenoid is always higher. Force variations with temperature are greatest on DC solenoids and least on laminated AC types, where inductance is involved. On DC solenoids the variations may be considerably reduced by condenser discharge operation. This effectively reduces the power in the hold position and consequently reduces the heating effect on the coil.







PULL AND THRUST

Basically a solenoid has a pull action. This pull action can be converted to a pushing action by fitting a suitable thrust pin or plunger extension.

MATCHING SOLENOID TO LOAD

The force/stroke curves give the nominal force that will be available from the plunger at any particular plunger position. There will also be a matching duty cycle which will be the force required by the solenoid's load throughout the stroke. In some cases this may be for practical purposes constant as, for example, when a solenoid lifts a deadweight. In some cases, however, the mechanism may be spring-loaded so that the force taken by the load is progressively greater as the plunger goes in. There may be cases when a solenoid is operating a number of linkages when the main loading is frictional. In this case the force required by the load may be greatest in the fully open position, in that once the static friction

SOLENOIDS (contd)

MATCHING SOLENOID TO LOAD (contd)

The duty cycle of the load should always be matched as far aspossible to the solenoid force curve. In many cases it may be found possible to use a smaller solenoid by altering the load cycle through levers or crank mechanisms.

Our Sales Department will be pleased to advise you of the best solenoid available to meet any particular application requirement.

OPERATE TIME

At any point in the operating stroke the difference between the force available from the solenoid and the force required to drive the load will be the force available to accelerate the load and plunger. This means, of course, that the more excess power there is available from the solenoid the faster the solenoid will operate. The closing time of the solenoid is approximately doubled as its mechanical load is increased from 70% of what it will pull to the maximum. For reasonably fast operation, 25% excess power is advisable. As a general principle the use of excessively large solenoids for the duty is not, however, good practice, as unabsorbed energy must be taken up as impact.

Condenser discharge circuits can be used to provide very fast closing while keeping the power in the hold position to a reasonable value.

RATING

'Continuous Rating' means that the solenoid can be left on continuously without overheating. The force exerted and the power consumed are then the basic continuous rating values to which all other ratings are referred. In the case of an AC solenoid the continuous rating refers to the solenoid in the closed position only. If the solenoid plunger is withdrawn, the 'inrush' current will rise to a high value, and if left energised, will burn out. A continuously rated DC solenoid can be left energised continuously, irrespective of the plunger position.

In many applications a solenoid is energised for only a short period and then left switched off for some time, so that it can cool down. Under these circumstances the solenoid coil can be wound for a much higher power than the continuous rating value. As a result, higher forces can be obtained with the proviso that the solenoid can no longer be continuously energised.

Suppose we have a time cycle of 25%, for instnce, say 2 minutes on, 6 minutes off. This gives 2 minutes energised out of 8 minutes total which is a 25% rating. Under these circumstances we could increase the coil consumption four times. As the coil is only energised for a quarter of the time, the average power consumption would remain the same. The same principle applies to all upratings. We publish performance curves for 25%, 50%, continuous and, in certain cses, 10% ratings.

On intermittent duty there is as limit to the total time energised which any uprated solenoid will stand in one 'on period'. The smaller the solenoid, the shorter the uprated period it will stand continuously. For a large unit 15 minutes on and 15 minutes off could be safe as a 50% rating. A miniature solenoid might well burn out after a few repeats of 2 minutes on and 2 minutes off. Our catalogue pages give the maximum 'on time' for the various duty cycles.

In some cases, solenoid may be required for intermittent operation, but not on a fixed time cycle. To give some guidance on this, we give for each solenoid the maximum 'on time' for the different ratings on a single cycle basis. This is the maximum time this particular solenoid can be left energised when starting from ambient temperature of 20°C

When /

SOLENOIDS (contd)

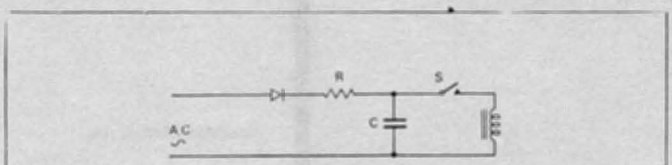
RATING (contd)

When AC solenoids are used on fast cycling 'inrush current' occurs at each closure. With fairly long cycle times where the solenoid closes and then remains energised for some time, the increase in power during the operate period has no significant effect. If the cycle time is fast, so that the solenoid barely has time to close before it is de-energised again, then the inrush current causes considerable extra heating effects. Fast cycling AC solenoids may require the use of continuously rated solenoids for intermittent duties. Special coils can be provided giving very high forces for duty cycles below 10%, where a solenoid is ony momentarily energised. Solenoid coils can also be wound for less than 'continuous rating' force, taking appropriately less power. These reduced ratings may be advisable to prevent abnormal reduction of life where a solenoid operates a mechanical load well below its available power.

On any questions of rating our Sales Department will be pleased to advise you on your application.

CAPACITOR DISCHARGE OPERATIONn

The high force of an instantaneous rating can often be provided by the use of a suitable capacitor/resistor circuit. This arrangement is particularly suitable for small solenoids.



Typical capacitor discharge circuit

AC PULL/DC HOLD

The capacitor discharge circuit referred to above is usually limited to a stroke requirement of 10mm maximum. For improved performance at longer strokes we recommend the AC pull/DC hold arrangement.

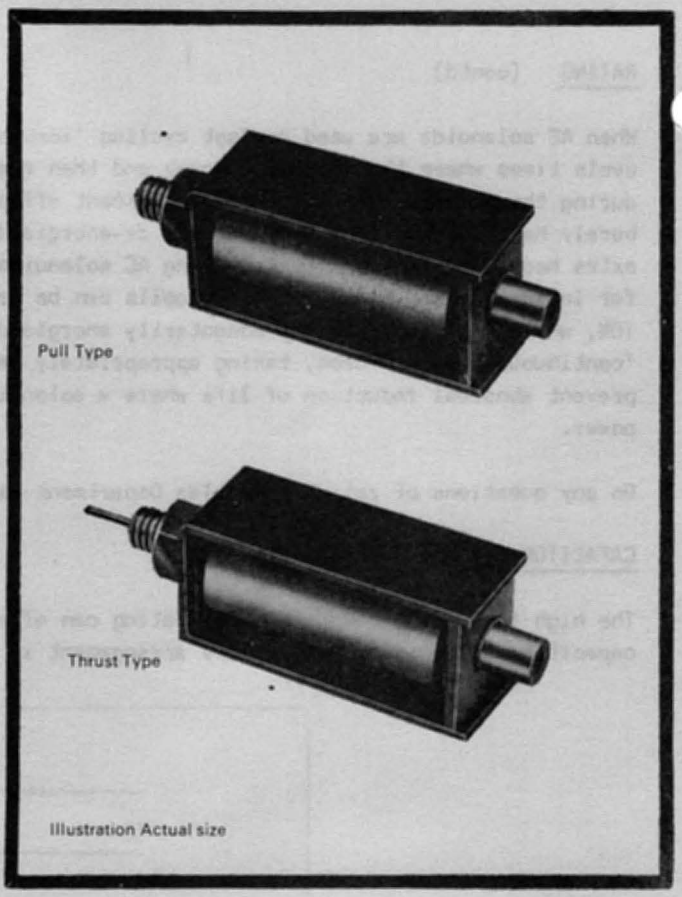
APPROVALS

The following solenoids have CSA aproval.

Series 421, 426. Series 422, 427. Series 423, 428. Series 575. Series 674.

SOLENOID - SERIES 40

OLD SERIES 420 = AC TYPE
425 = DC TYPE



DESCRIPTION

These miniature solenoids are suitable for a wide range of light duty and high speed applications. They are particularly suitable for capacitor discharge circuits. giving very high performance. Both pull and thrust versions can be supplied.

Due to the physical dimensions of the solenoid a shading ring is not fitted.

AMBIENT TEMPERATURE

The information given on this page is based on a room temperature of 20°C, allowing for a nominal 75°C temperature rise in the coil.

MAXIMUM PERMISSIBLE VOLTAGE

Series 420: 250 VAC
Series 425: 150 VDC

INSULATION

All coils proof tested to frame at 1500V RMS 50 Hz.

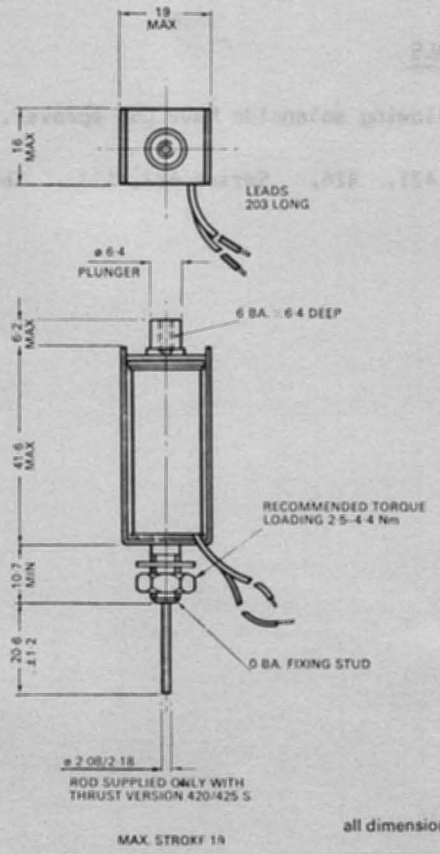
CLOSED POWER (CONTINUOUS RATING)

Series 420: 5.3VA approximately
Series 425: 4.25W

WEIGHT

Total: 56.7 gm.
Plunger: 14 gm

MAXIMUM /



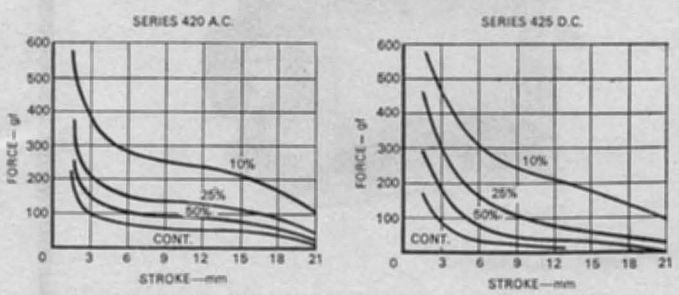
SOLENOID - SERIES 40 (contd.)

MAXIMUM ON TIME

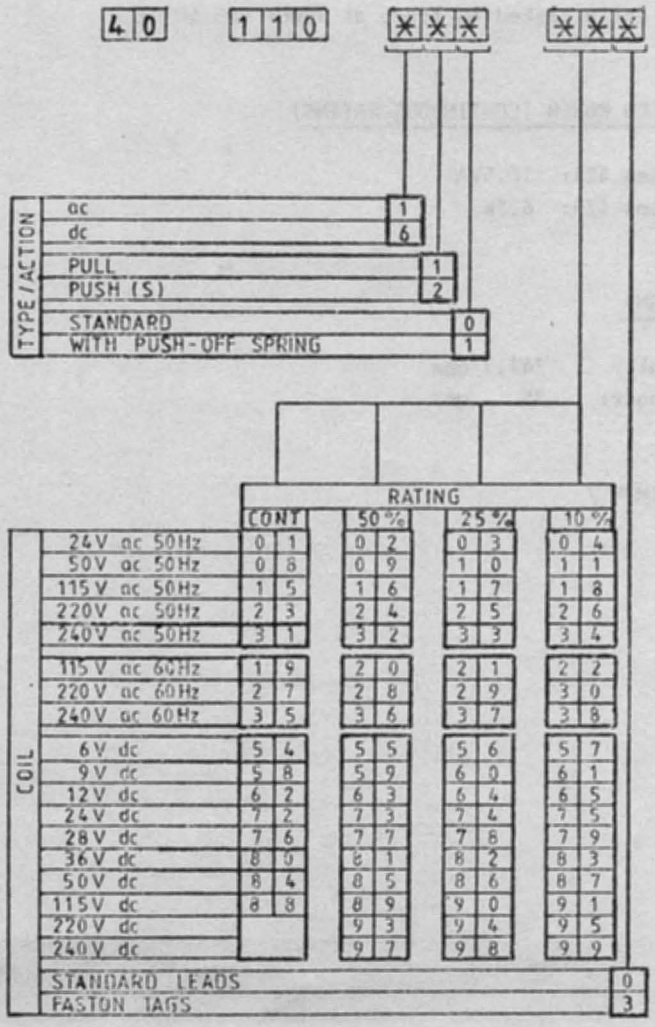
Series No.	10%		25%		50%	
	1 cycle	Cont. cycling	1 cycle	Cont. cycling	1 cycle	Cont cycling
420	14 sec	7 sec	55 sec	40 sec	3 min	2.25 min
425	25 sec	15 sec	55 sec	45 sec	2.75 min	2.25 min

FORCE/STROKE CURVES

These force curves show average performance only. In addition to normal manufacturing tolerances, deviations can be expected at some voltages due to the coil winding tolerances.

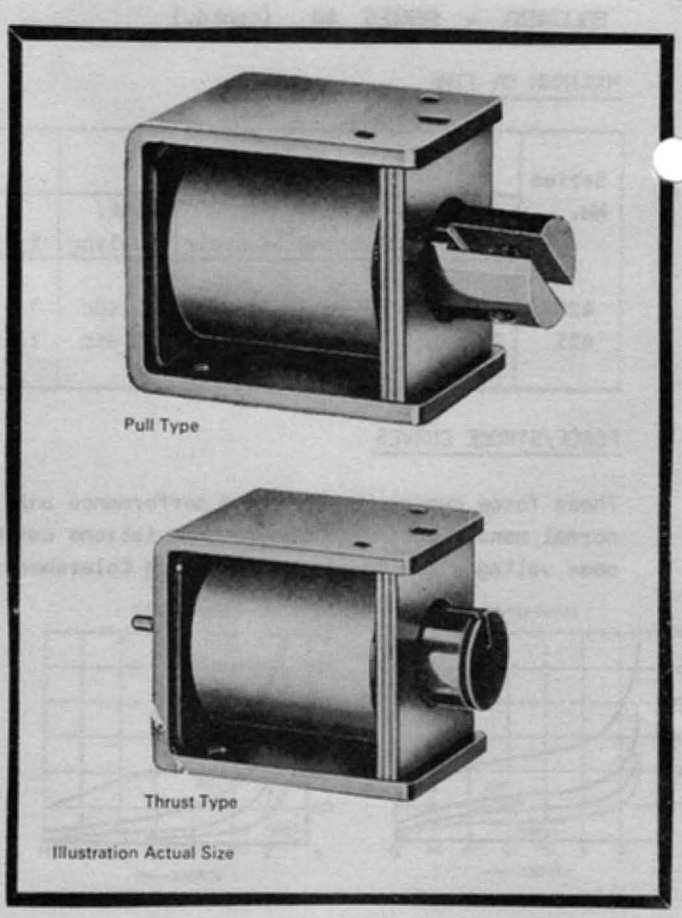


SUPPLIERS CODE



SOLENOID - SERIES 41

OLD SERIES 421 = AC TYPE
426 = DC TYPE



DESCRIPTION

This small solenoid has a very high force/size ratio. AC and DC types are externally identical, but shading rings are fitted on the AC Series 421 solenoid, giving quiet operation.

AMBIENT TEMPERATURE

The information given on this page is based on a room temperature of 20°C, allowing for a nominal 75°C temperature rise in the coil.

MAXIMUM PERMISSIBLE VOLTAGE

Series 421: 250 VAC
Series 426: 250 VDC

INSULATION

All coils tested to frame at 1500V RMS 50 Hz

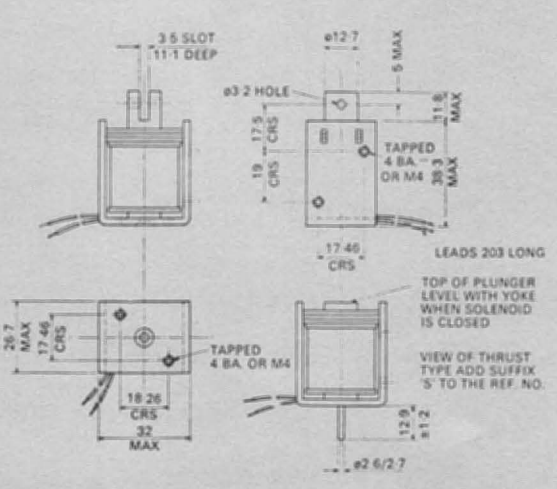
CLOSED POWER (CONTINUOUS RATING)

Series 421: 10.5VA
Series 426: 6.5W

WEIGHT

Total: 141.7 gms
Plunger: 35 gms

MAXIMUM /



all dimensions in mm

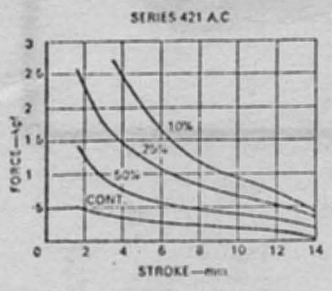
SOLENOID - SERIES 41 (contd.)

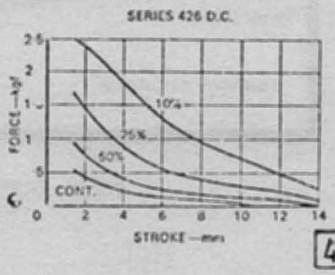
MAXIMUM ON TIME

Series No.	10%		25%		50%	
	1 cycle	Cont. cycling	1 cycle	Cont. cycling	1 cycle	Cont cycling
421	50 sec	30 sec	2.75 min	1.7 min	8 min	6.25 min
426	35 sec	20 sec	1.75 min	1.0 min	4.5 min	3.75 min

FORCE/STROKE CURVES

These force curves show average performance only. In addition to normal manufacturing tolerances, deviations can be expected at some voltages due to the coil winding tolerances.





SUPPLIERS CODE

4 1	1 2 ✱	✱ ✱ ✱	✱ ✱ ✱

BASIC

STANDARD	0
C.S.A. APPROVED (USE COIL ✱✱4 ONLY)	1

TYPE/ACTION

ac		1
dc		6
PULL		1
PUSH (S)		2
STANDARD		0
WITH PUSH-OFF SPRING		1

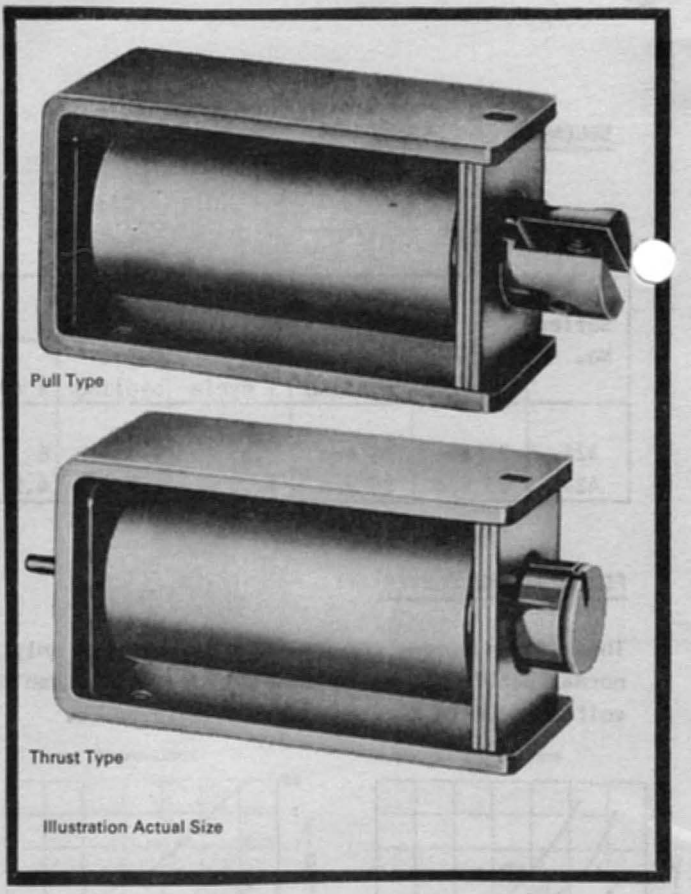
RATING

COIL	CONT	50%	25%	10%
24V ac 50Hz	0 1	0 2	0 3	0 4
50V ac 50Hz	0 8	0 9	1 0	1 1
115V ac 50Hz	1 5	1 6	1 7	1 8
220V ac 50Hz	2 3	2 4	2 5	2 6
240V ac 50Hz	3 1	3 2	3 3	3 4
115V ac 60Hz	1 9	2 0	2 1	2 2
220V ac 60Hz	2 7	2 8	2 9	3 0
240V ac 60Hz	3 5	3 6	3 7	3 8
6V dc	5 4	5 5	5 6	5 7
9V dc	5 8	5 9	6 0	6 1
12V dc	6 2	6 3	6 4	6 5
24V dc	7 2	7 3	7 4	7 5
28V dc	7 6	7 7	7 8	7 9
36V dc	8 0	8 1	8 2	8 3
50V dc	8 4	8 5	8 6	8 7
115V dc	8 8	8 9	9 0	9 1
220V dc	9 2	9 3	9 4	9 5
240V dc	9 6	9 7	9 8	9 9

STANDARD LEADS	0
FASTON TAGS	3
C.S.A. APPROVED	4

SOLENOID - SERIES 42

422 = AC TYPE
427 = DC TYPE



DESCRIPTION

This small solenoid has a very high force/size ratio. AC and DC types are externally identical, but shading rings are fitted on the AC Series 422 solenoid, giving quiet operation.

AMBIENT TEMPERATURE

The information given on this page is based on a room temperature of 20°C allowing for a nominal 75°C temperature rise in the coil.

MAXIMUM PERMISSIBLE VOLTAGE

Series 422: 250 VAC
Series 427: 250 VDC

INSULATION

All coils proof tested to frame at 1500V RMS 50 Hz.

CLOSED POWER (continuous rating)

Series 422: 15VA
Series 427: 10W

WEIGHT

Total: 213 gms
Plunger: 42.5 gms

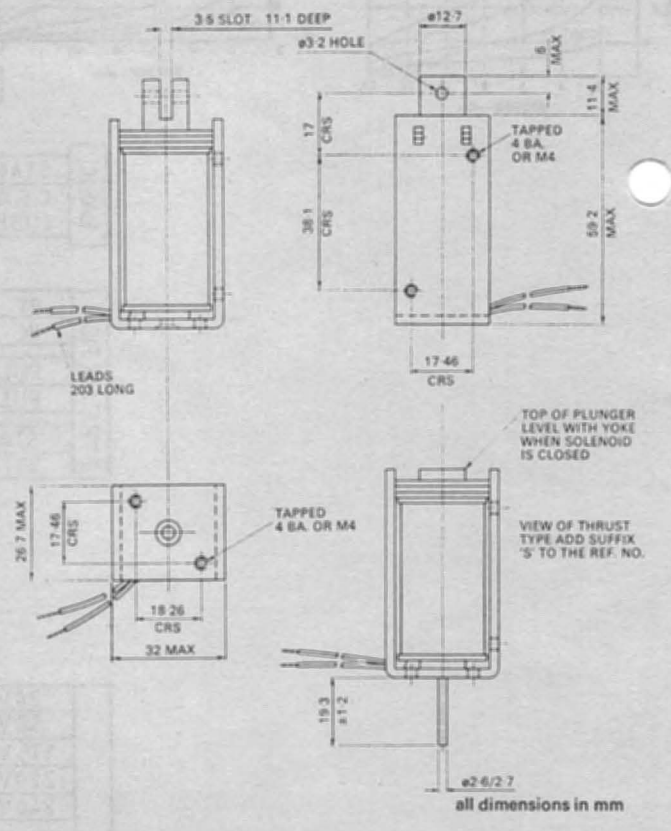
APPROVALS

Solenoids which are approved to the Canadian Standards Association requirements can be supplied if specified.

Maximum on time

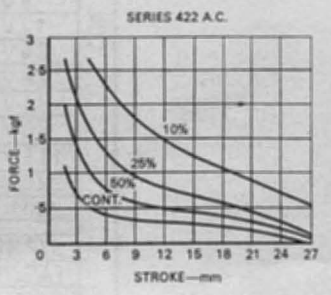
Series No.	10%		25%		50%	
	1 cycle	*Cont. cycling*	*1 cycle*	*Cont. cycling*	*1 cycle*	*Cont. cycling*
422	55 sec	40 sec	3 min	2 min	10 min	7 min
427	50 sec	30 sec	2 min	1.25 min	5.75 min	4 min

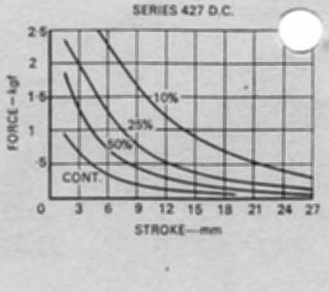
Note: Ex stock types are of the continuous type



Force/stroke curves

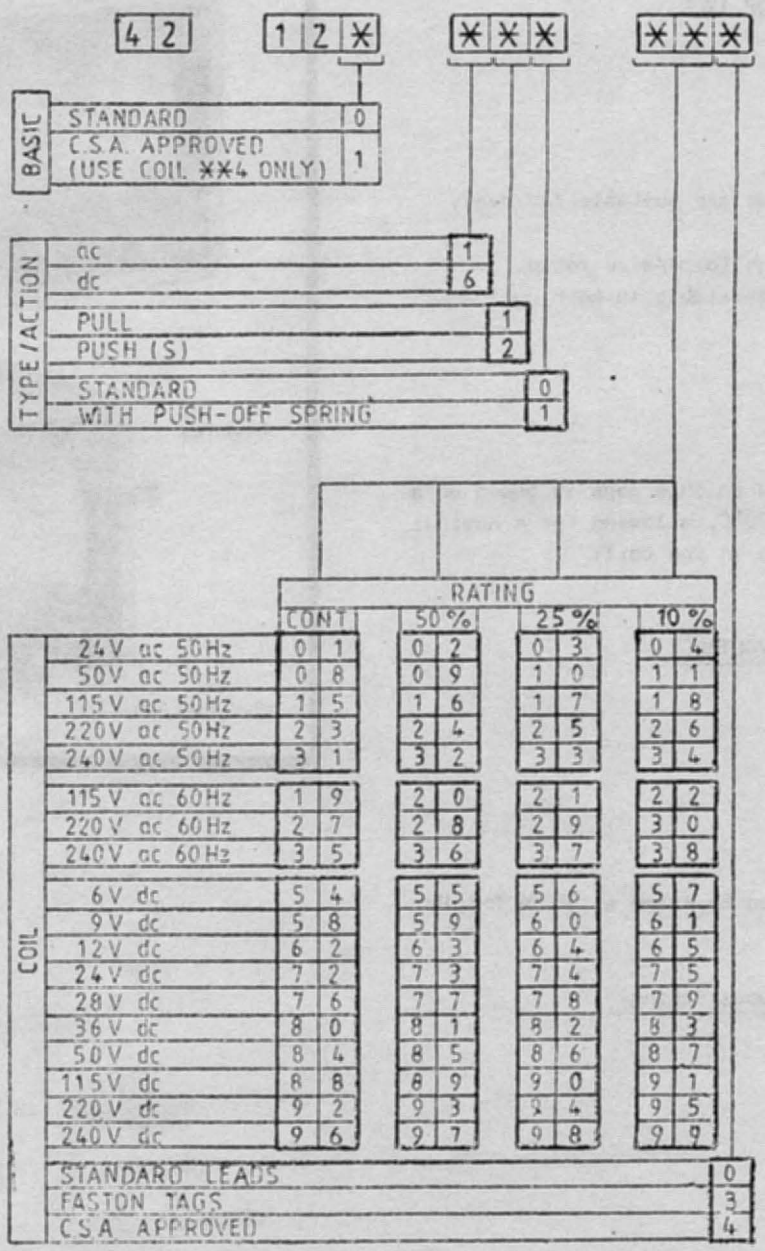
These force curves show average performance only. In addition to normal manufacturing tolerances, deviations can be expected at some voltages due to the coil winding tolerances.





SOLENOID - SERIES 42 (contd)

Suppliers Code

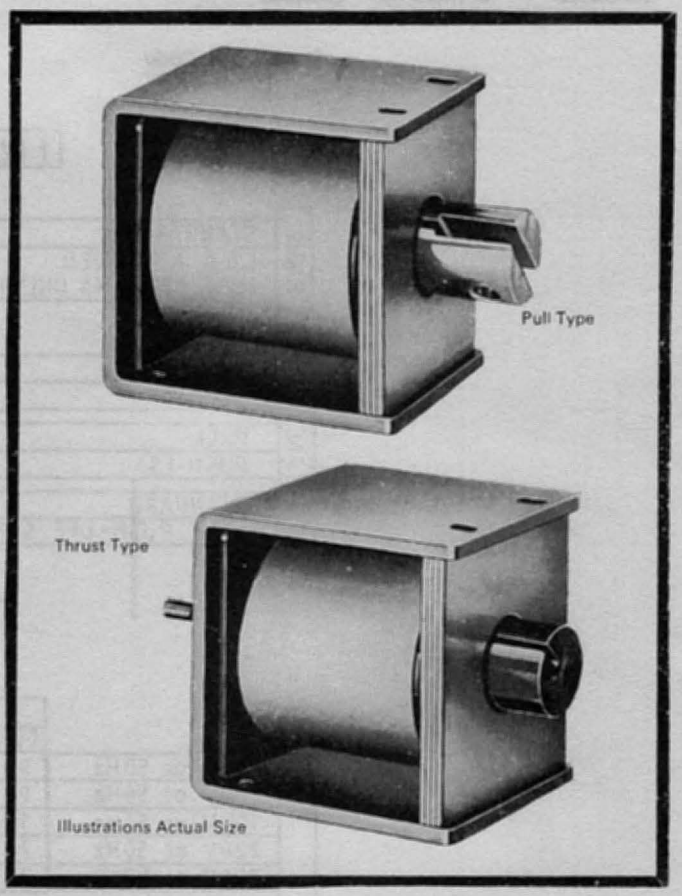


Philips Ordering Code	Category	Product Description	Product Marking	Supplier Ordering Code
4823 281 22101	1	Solenoid 422 230 VAC	42207 230 VAC	42 120 110 310
4823 281 23101	1	Solenoid 427 12 VDC	42717 12 VDC	42 120 610 620
4823 281 23102	1	Solenoid 427 24 VDC	42705 24 VDC	42 120 610 720
4823 281 24101	1	Thurst Bar for 422/427 Series		

* Other types available on indent

SOLENOID SERIES 43

OLD SERIES 423 = AC TYPE
428 = DC TYPE



DESCRIPTION

These robust solenoids are suitable for heavy duty applications.
They offer a very high force/size ratio.
These solenoids are available in both pull and thrust versions.

AMBIENT TEMPERATURE

The information given on this page is based on a room temperature of 20°C, allowing for a nominal 75°C temperature rise in the coil.

MAXIMUM PERMISSIBLE VOLTAGE

Series 423: 250 VAC
Series 428: 250 VDC

INSULATION

All coils proof tested to frame at 1500V RMS Hz.

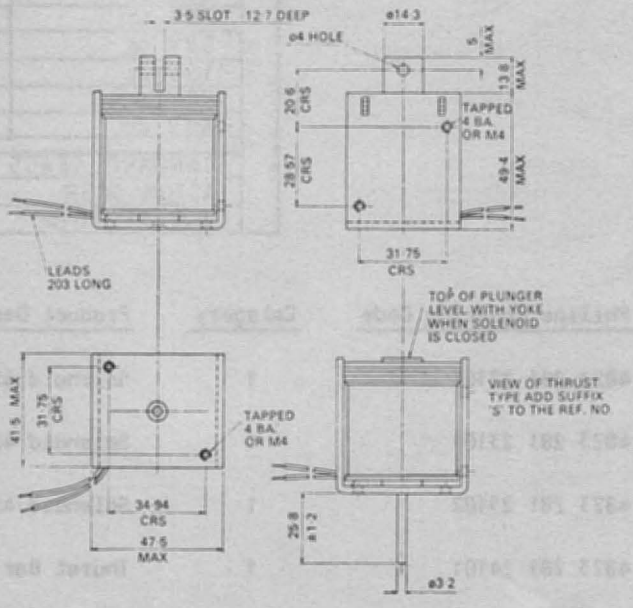
CLOSED POWER (continuous rating)

Series 423: 20VA
Series 428: 12W

WEIGHT

Total: 425 gms
Plunger: 49 gms

MAXIMUM /

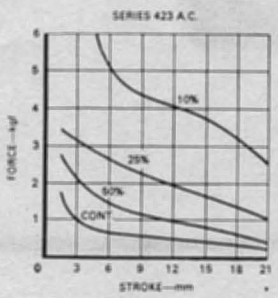


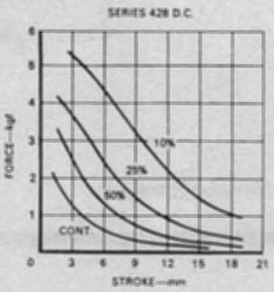
all dimensions in mm

SOLENOID - SERIES 43 (contd.)

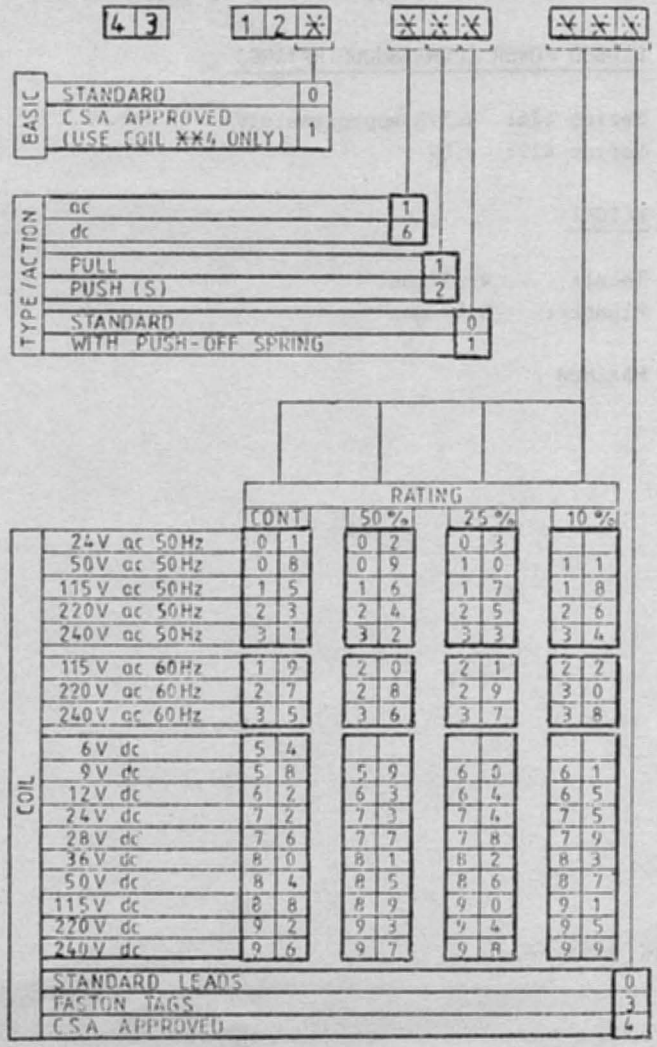
MAXIMUM ON TIME

Series No.	10%		25%		50%	
	1 cycle	Cont. cycling	1 cycle	Cont. cycling	1 cycle	Cont cycling
423	65 sec	5 sec	7.75 min	1.25 min	14.5 min	2 min
428	55 sec	35 sec	3.5 min	2 min	7 min	4.25 min





SUPPLIER CODE



SOLENOID SERIES 44

OLD SERIES 424 = AC TYPE
429 = DC TYPE

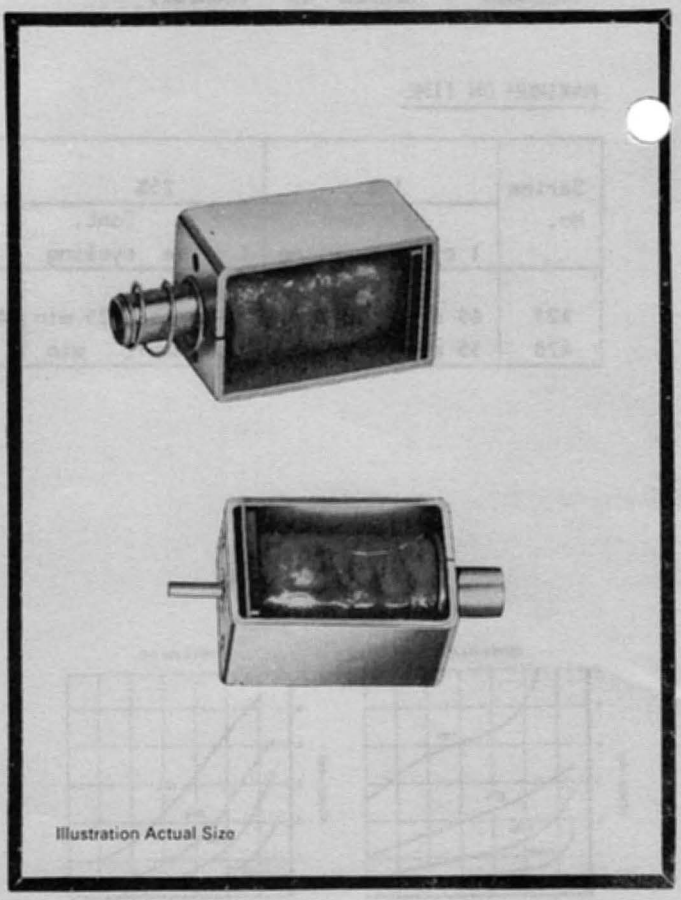


Illustration Actual Size

DESCRIPTION

These miniature solenoids are intended for short stroke high force applications.
Both pull and thrust versions can be supplied.
The 424K solenoid is fitted with a push-off spring and shading ring for quiet operation on AC supplies.

AMBIENT TEMPERATURE

The information given on this page is based on a room temperature of 20°C, allowing for a nominal 75°C temperature rise in the coil.

MAXIMUM PERMISSIBLE VOLTAGE

Series 424: 250 VAC
Series 429: 150 VDC

INSULATION

All coils proof tested to frame at 1500V RMS Hz.

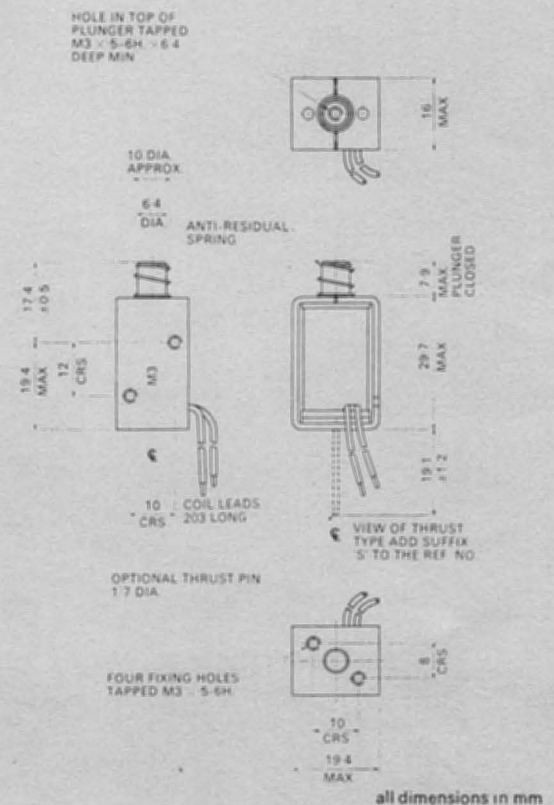
CLOSED POWER (CONTINUOUS RATING)

Series 424: 4.3VA approximately
Series 429: 3.0W

WEIGHT

Total: 47.5 gms
Plunger: 8.5 gms

MAXIMUM /



all dimensions in mm

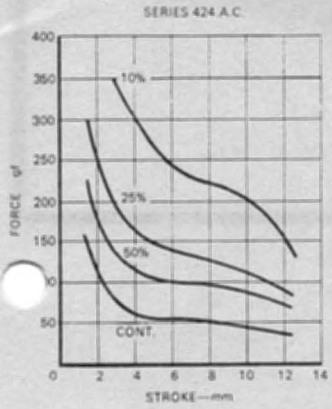
SOLENOID - SERIES 44 (contd.)

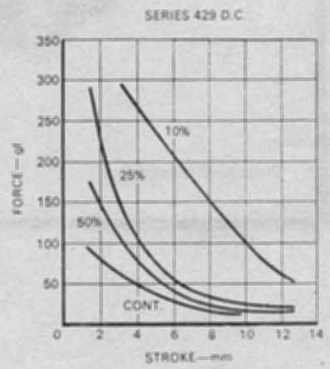
MAXIMUM ON TIME

Series No.	10%		25%		50%	
	1 cycle	Cont. cycling	1 cycle	Cont. cycling	1 cycle	Cont cycling
424	10 sec	6 sec	45 sec	30 sec	2.5 min	1.5 min
429	20 sec	13 sec	45 sec	35 sec	2 min	1.5 min

FORCE/STROKE CURVES

These force curves show average performance only. In addition to normal manufacturing tolerances, deviations can be expected at some voltages due to the coil winding tolerances.





SUPPLIERS CODE

4 4	2 2 0	* * *	* * *

TYPE/ACTION

ac	1
dc	6
PULL	1
PUSH (S)	2
STANDARD	0
WITH PUSH-OFF SPRING	1

COIL

	RATING CONT	50%	25%	10%
24V ac 50Hz	0 1	0 2	0 3	0 4
50V ac 50Hz	0 8	0 9	1 0	1 1
115V ac 50Hz	1 5	1 6	1 7	1 8
220V ac 50Hz	2 3	2 4	2 5	2 6
240V ac 50Hz	3 1	3 2	3 3	3 4
115V ac 60Hz	1 9	2 0	2 1	2 2
220V ac 60Hz	2 7	2 8	2 9	3 0
240V ac 60Hz	3 5	3 6	3 7	3 8
6V dc	5 4	5 5	5 6	5 7
9V dc	5 8	5 9	6 0	6 1
12V dc	6 2	6 3	6 4	6 5
24V dc	7 2	7 3	7 4	7 5
28V dc	7 6	7 7	7 8	7 9
36V dc	8 0	8 1	8 2	8 3
50V dc	8 4	8 5	8 6	8 7
115V dc	8 8	8 9	9 0	9 1
220V dc		9 3	9 4	9 5
240V dc		9 7	9 8	9 9

STANDARD LEADS	0
FASTON TAGS	3

SOLENOID SERIES 46

OLD SERIES 466 = AC TYPE
467 = DC TYPE

Illustration Actual Size

DESCRIPTION

A robust solid state frame solenoid, an extension to our U-Frame range. Both AC (466) and DC (467) versions available.

AMBIENT TEMPERATURE

The information given is based on a room temperature of 20°C, allowing for a nominal 75°C temperature rise in the coil.

MAXIMUM PERMISSIBLE VOLTS

Series 466: 440 VAC
Series 467: 250 VDC

INSULATION

All coils proof tested to frame at 1500V RMS 50 Hz.

CLOSED POWER (CONTINUOUS RATING)

Series 466: 18 VA
Series 467: 9.5W

WEIGHT

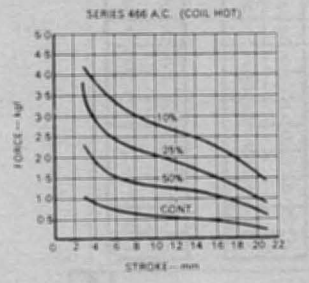
Total: 330 gms
Plunger - Series 466: 35 gms
Plunger - Series 467: 33 gms

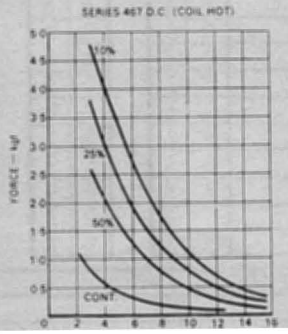
MAXIMUM ON TIME

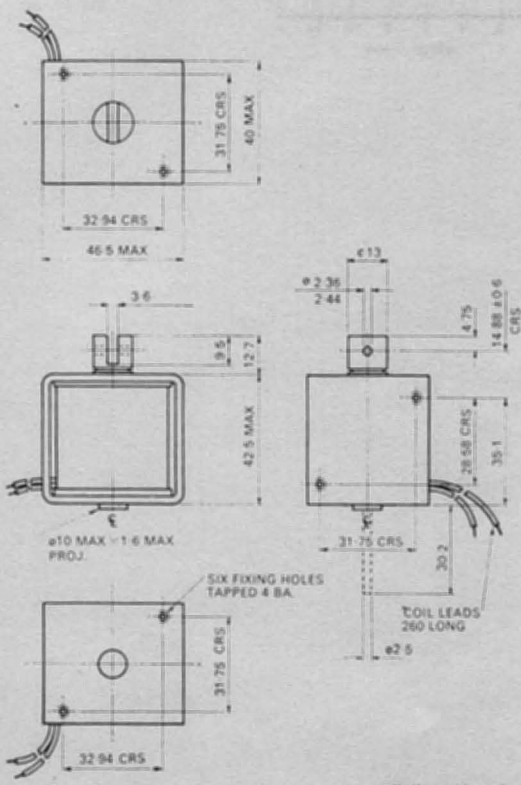
Series No.	10% Impulse	25%	50%	100% Intermittent
466	1.25 min	3 min	7.25 min	continuous
467	50 sec	1.5 min	2.75 min	continuous

FORCE/STROKE CURVE

These force curves show average performance only. In addition to normal manufacturing tolerances, deviations can be expected at some voltages due to the coil winding tolerances.



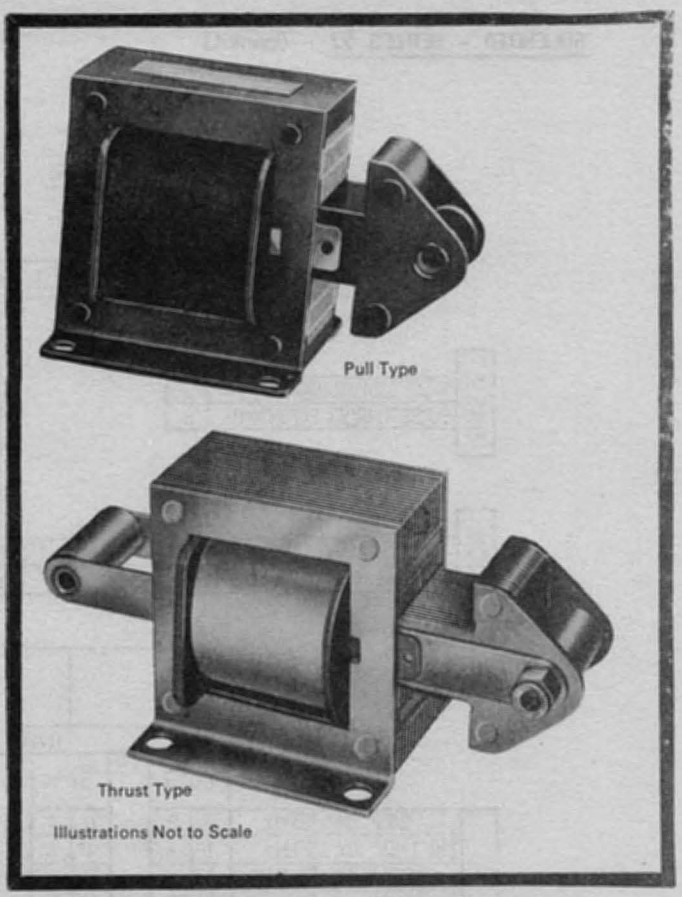




all dimensions in mm

SOLENOID - SERIES 57

SERIES 573 = AC TYPE



DESCRIPTION

A compact AC solenoid of laminated construction. It is available with two frame arrangements, making it suitable for side mounting (Series 573C) or base and throat mounting (Series 573D). Both pull and thrust versions are available. A wide range of vacuum impregnated coils are available for all standard voltages and ratings. Coils are easily interchangeable

AMBIENT TEMPERATURE

The information given on this page is based upon a room temperature of 20°C, allowing for a nominal 75°C temperature rise in the coil.

MAXIMUM PERMISSIBLE VOLTAGE

500 VAC

INSULATION

All coils proof tested to frame at 1500V RMS 50 Hz.

CLOSED VA

80VA (continuous rating).

WEIGHT

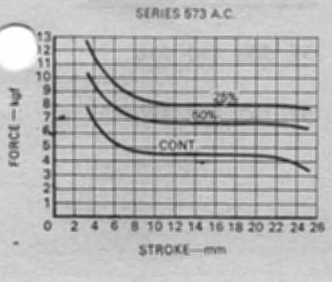
Total: 825 gms
Plunger: 219 gms

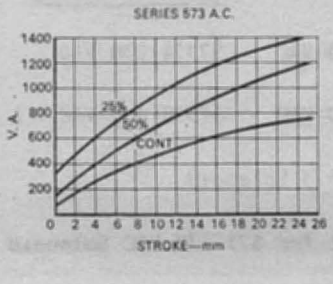
MAXIMUM ON TIME

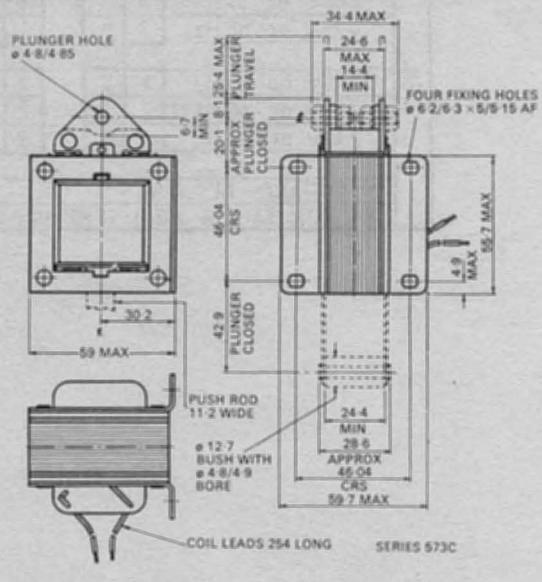
Rating	1 Cycle	Cont. Cycling
25%	1.25 min	0.5 min
50%	7 min	1.75 min

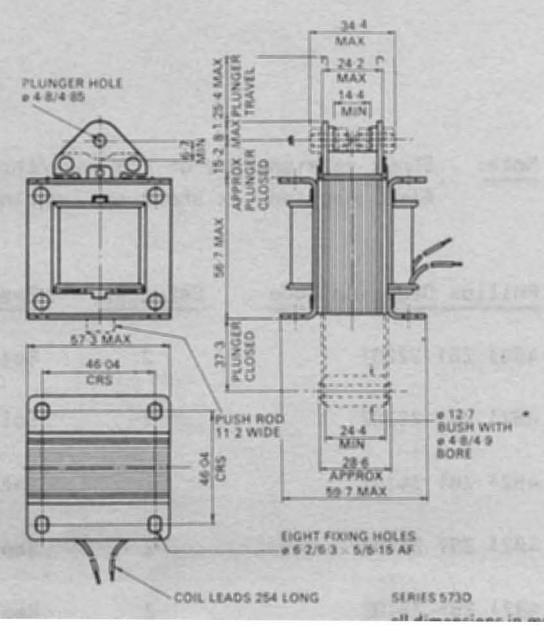
FORCE/STROKE AND VA/STROKE CURVES

These force curves show average performance only. In addition to normal manufacturing tolerances, deviations can be expected at some voltages due to the coil winding tolerances.



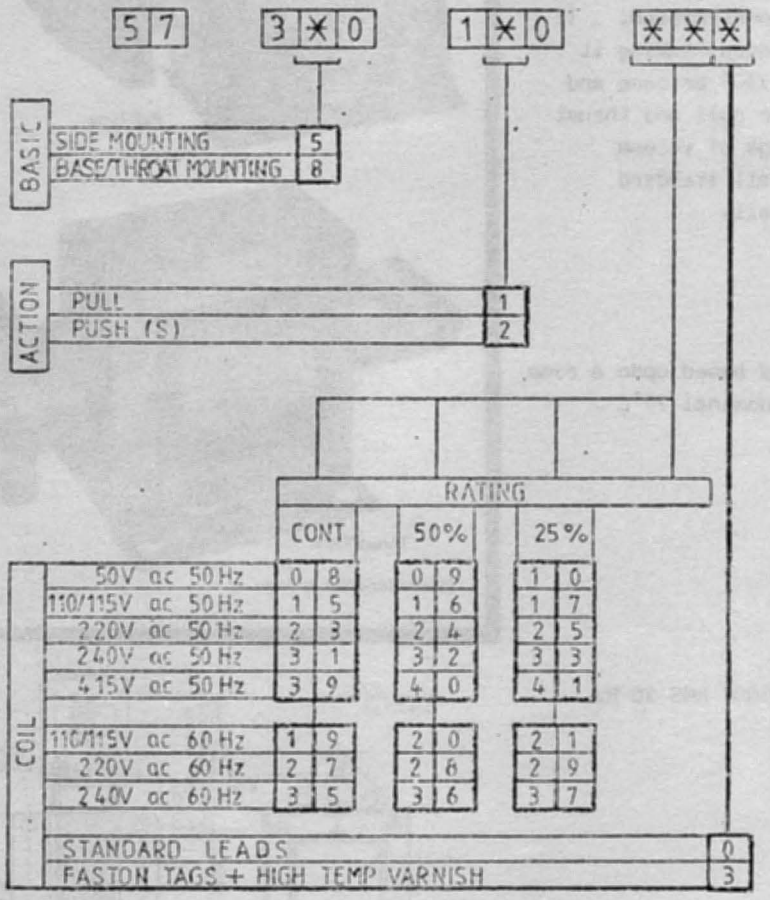






SOLENOID - SERIES 57 (contd)

Suppliers Ordering Code

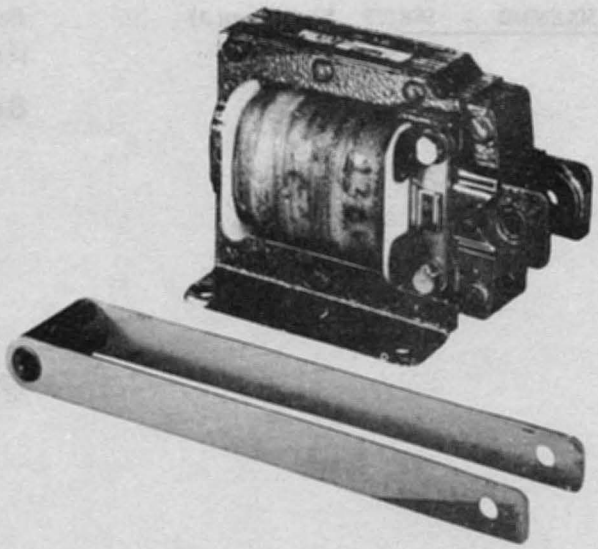


Note: Stock versions are of the base/thrust mounting - see Picture 2.
Also, versions ex stock are continuous types only.

Philips Ordering Code	Category	Description	Product Marking	Suppliers New Code
4823 281 22201	2	Solenoid 573 230 VAC	57374 230 VAC	57 380 110 310
4823 281 22202	2	Solenoid 573 400 VAC	57378 400 VAC	57 380 110 390
4823 281 24102	2	Thrust Bar for 573 Solenoid		
4823 281 25101	2	Replacement Coil for 573 230 VAC Solenoid		
4823 281 25102	2	Replacement Coil for 573 400 VAC Solenoid		

SOLENOID - SERIES 57

SERIES 575



Note Not recommended for new production runs

DESCRIPTION

This is a general purpose heavy duty AC Solenoid of rigid laminated construction. Both pull and thrust versions can be supplied. Coils are readily intechangeable.

AMBIENT TEMPERATURE

The information given on this page is based on a room temperature of 20°C, allowing for a nominal 75°C temperature rise in the coil.

MAXIMUM PERMISSIBLE VOLTAGE

440 volts RMS AC

INSULATION

All coils proof tested to frame at 1500V RMS 50 Hz.

CLOSED VA

65 VA (continuous rating).

WEIGHT

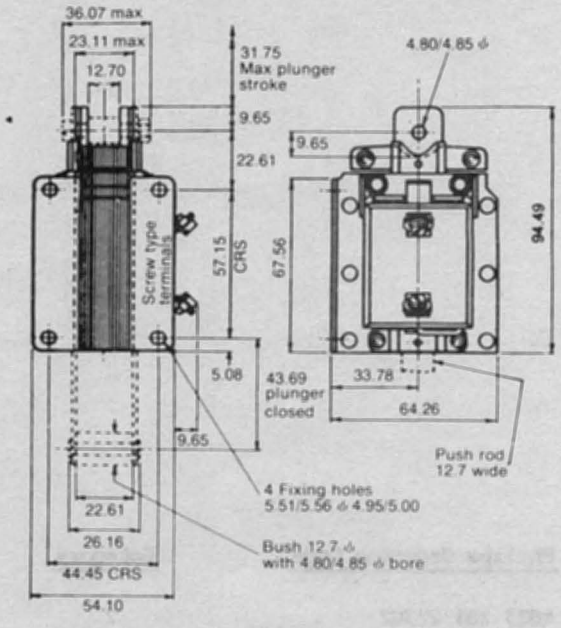
Total: 907.2 gms
Plunger: 276.3 gms

MAXIMUM ON TIME

(See "How to select your solenoid")

Rating	1 Cycle	Cont. cycling
25%	5.5 min	3
50%	17 min	10.5 min

Add letter 'S' after type number for thrust version, i.e. 575S/400 Continuous. Other voltage and rated solenoids to special order.



Thrust type shown dotted

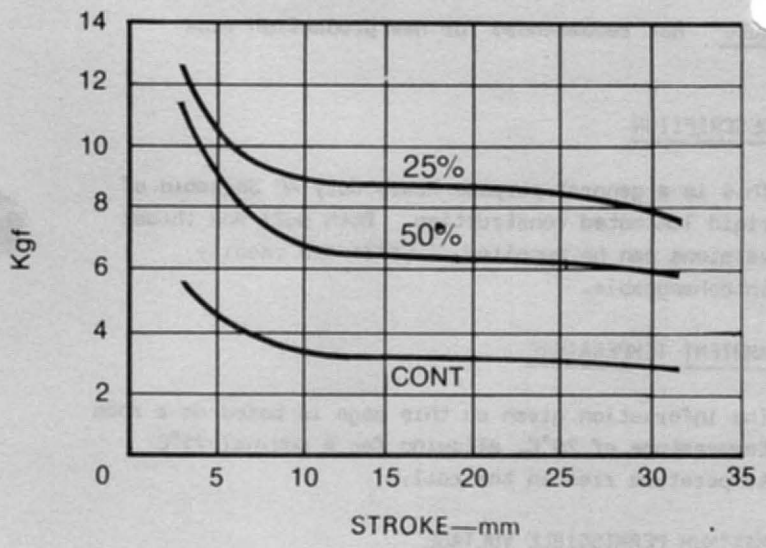
All dimensions in millimetres

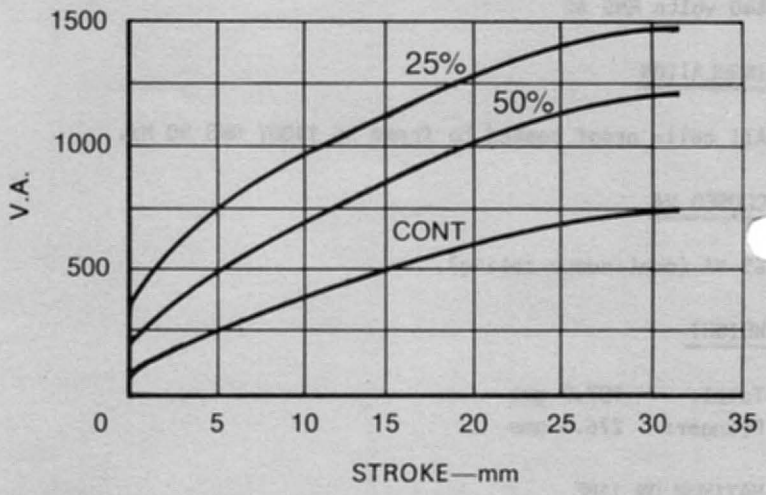
SOLENOID - SERIES 57 (contd)

Force/stroke and VA/stroke curves

(See how to select your solenoid)

Series 575 A.C.





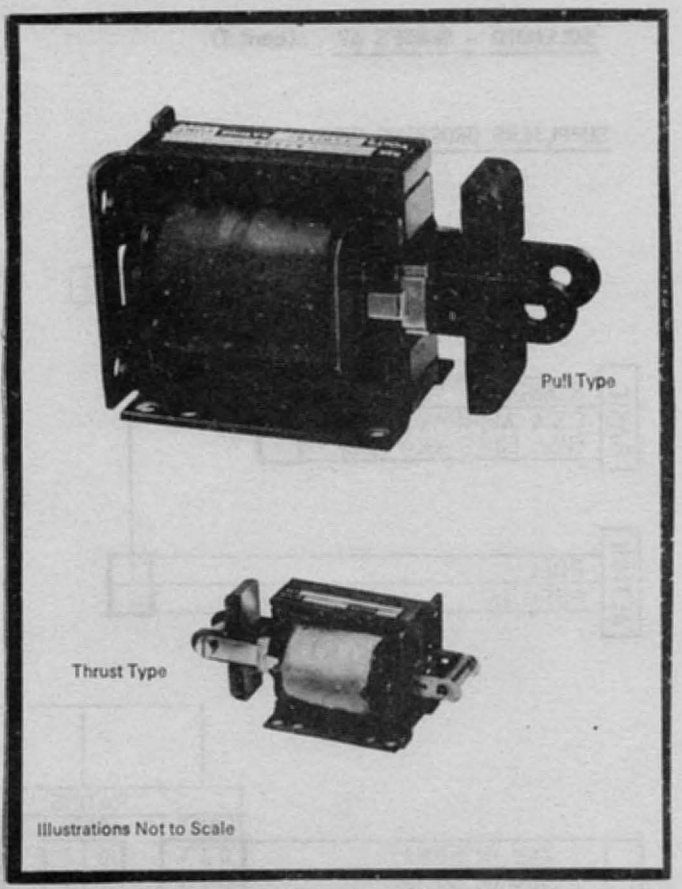
These force curves show average performance only.
In addition to normal manufacturing tolerances, deviations can be expected at some voltages due to the coil winding wire sizes available and their tolerances.

Philips Ordering Code	Category	Description	Product Description
4823 281 22302	2	Solenoid 575 400 VAC	57503 400 VAC
4823 281 24103	2	Thrust Bar for 575 Solenoid	
4823 281 25104	2	Replacement Coil for Solenoid 575 400 VAC	

Note: Ex stock versions are continuous rating only.

SOLENOID - SERIES 67

OLD SERIES 674 = AC TYPE



DESCRIPTION

A small AC solenoid having a high force and silent hold. They are robust and efficient units of laminated construction. Both pull and thrust versions can be supplied. The coils are easily intechangeable.

AMBIENT TEMPERATURE

The information given on this page is based on a room temperature of 20°C, allowing for a nominal 75°C temperature rise in the coil.

MAXIMUM PERMISSIBLE VOLTAGE

440 VAC

INSULATION

All coils proof tested to frame at 1500V RMS 50 Hz.

CLOSED VA

24 VA (continuous rating).

WEIGHT

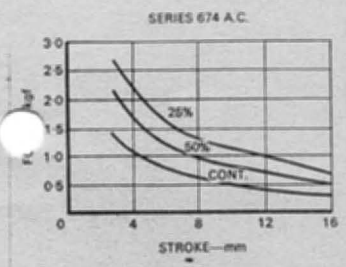
Total: 198 gms
Plunger: 56.7 gms

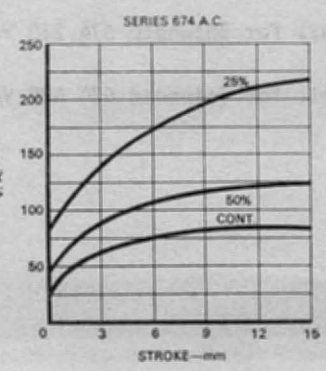
MAXIMUM ON TIME

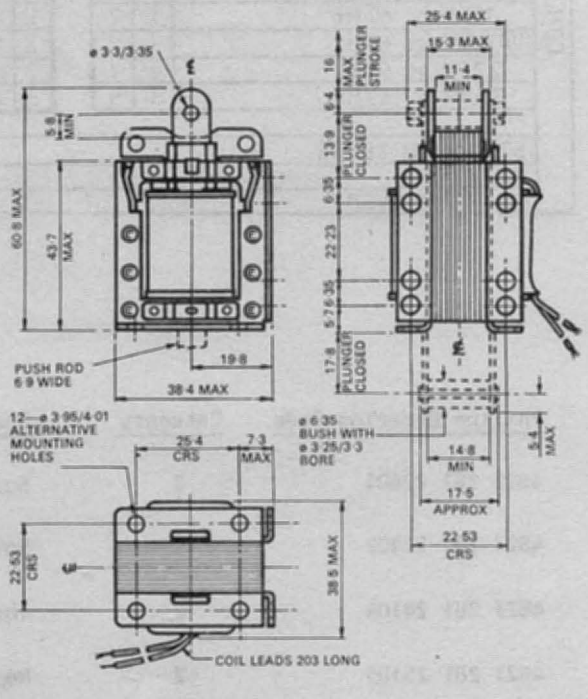
Rating	1 Cycle	Cont. cycling
25%	2 min	1.5 min
50%	6 min	4.75 min

FORCE/STROKE AND VA/STROKE CURVES

These force curves show average performance only. In addition to normal manufacturing tolerances, deviations can be expected at some voltages due to the coil winding tolerances.

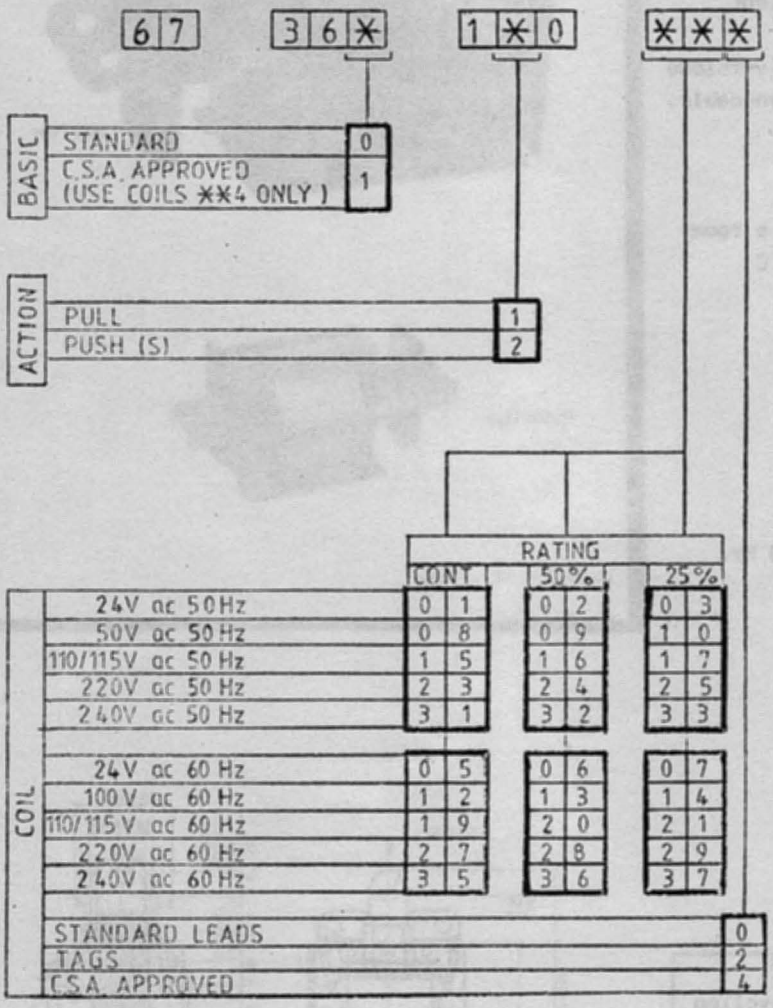






SOLENOID - SERIES 67 (contd)

SUPPLIERS ORDERING CODE

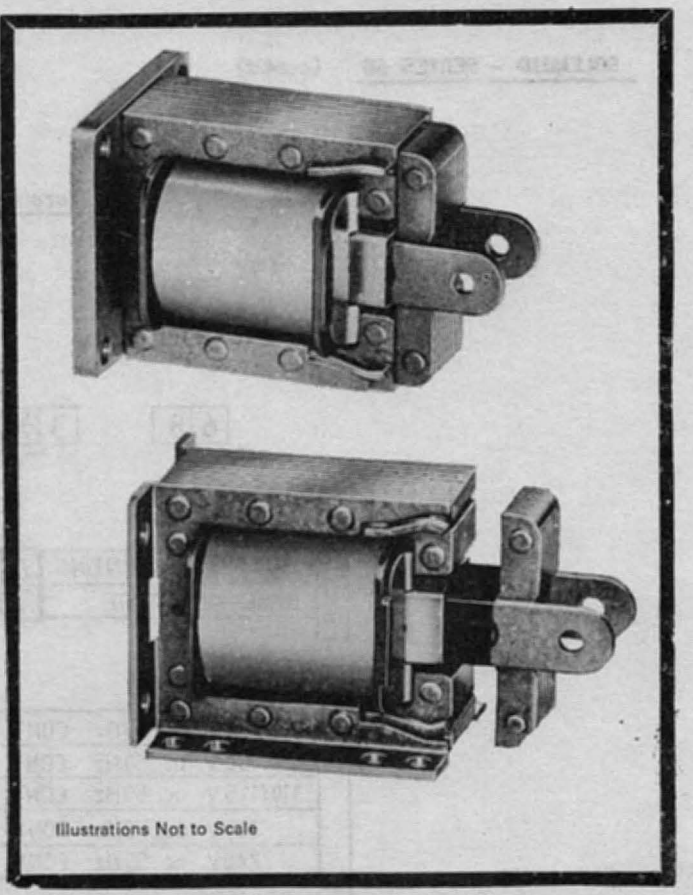


Note: Ex stock versions are all continuous rating types.

Philips Ordering Code	Category	Description	Product Marking	Suppliers Code
4823 281 22401	2	Solenoid 674 230 VAC	67406 230 VAC	67 360 110 310
4823 281 22402	2	Solenoid 674 400 VAC	67403 400 VAC	-
4823 281 24104	2	Thrust Bar for 674 Solenoid		
4823 281 25105	2	Replacement Coil for Solenoid 674 230 VAC		
4823 281 25106	2	Replacement Coil for Solenoid 674 400 VAC		

SOLENOID - SERIES 68

OLD SERIES 684 = AC TYPE



Illustrations Not to Scale

DESCRIPTION

This AC solenoid is for pull operation only and has a high force/size ratio. It is a robust unit of laminated construction. It is available with alternative types of mounting brackets.

AMBIENT TEMPERATURE

The information given on this page is based on a room temperature of 20°C, allowing for a nominal 75°C temperature rise in the coil.

MAXIMUM PERMISSIBLE VOLTAGE

440 VAC

INSULATION

All coils proof tested to frame at 1500V RMS 50 Hz.

CLOSED VA

28 VA (continuous rating).

WEIGHT

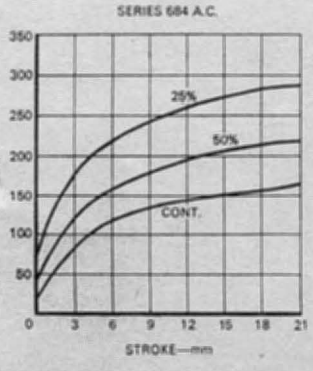
Total: 219 gms
Plunger: 64 gms

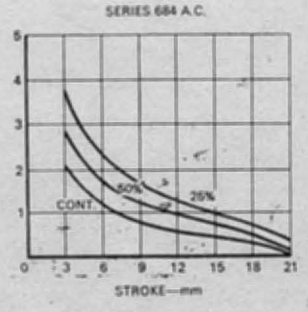
MAXIMUM ON TIME

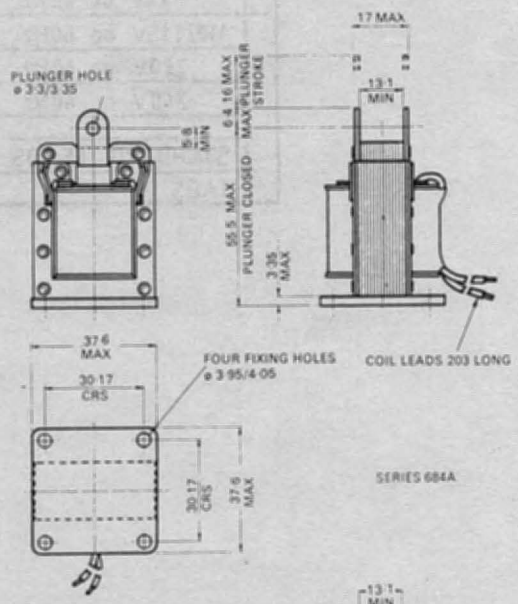
Rating	1 Cycle	Cont. cycling
25%	2 min	1 min
50%	6 min	3 min

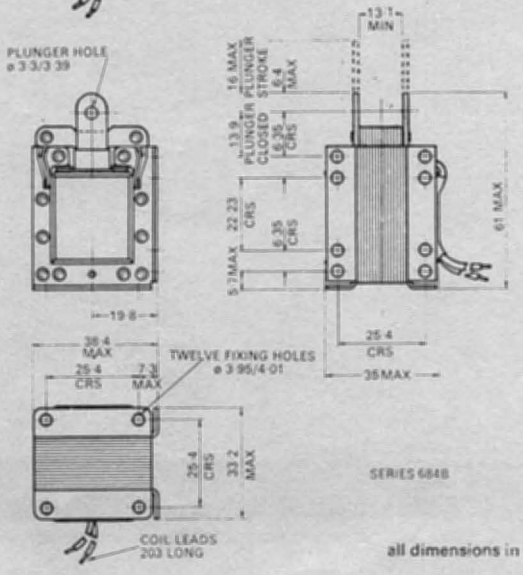
FORCE STROKE AND VA/STROKE CURVES

These force curves show average peformance only. In addition to normal manufacturing tolerances, deviations can be expected at some voltages due to the coil winding tolerances.









all dimensions in mm

SOLENOID - SERIES 68 (contd)

Suppliers Ordering Code