

NPR (Nippon Piston Ring) Piston Rings.

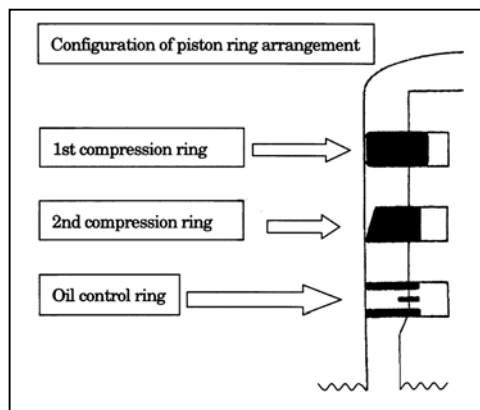
1. The most important functions of NPR Piston Rings.

NPR's most important principles of Piston Rings are:

- a. Function (Reliability).
- b. Reduced Weight.
- c. Low Friction.
- d. Low Production Cost.

Functions of each 1st, 2nd, and Oil Control Rings (please see below figures):

Function \ Type	1st compression ring	2nd compression ring	Oil control ring
Gas seal	⊙	○	—
Oil control	○	⊙	⊙
Heat conduction	⊙	○	—
Bearings	⊙	○	○



1) Gas seal:

The seal must perform during both the compression stroke and expansion stroke to provide maximum performance. This is best achieved with the proper amount of lubricant oil film on the piston ring cylinder contact point and complete contact of the bottom of the piston ring against the piston groove. Therefore, the proper seal improves performance and decreases oil consumption.

2) Oil Control:

The function of the oil control ring is to assure the proper amount of lubricant film. By providing the correct lubricant film for all piston ring contact points on the cylinder, this will prevent scuffing and excessive wear. However, an excessive amount of lubricant film will force too much oil into the combustion chamber resulting in soot in the exhaust.

3) Heat Conduction:

The function of heat conduction is to allow heat to escape from the piston head to cylinder wall and then to cooling water and/or cooling fins. If the heat is not allowed to decrease, oil temperature will increase. This results in reduced oil viscosity and increased oil consumption.

4) Bearing:

Pistons have reciprocation motion in both expansion and compression strokes. Because of this the piston exerts a higher pressure against one side of the cylinder wall during the expansion stroke. The piston ring assures a proper clearance between the piston and the cylinder wall while maintaining complete contact around the entire circumference of the cylinder wall. This prevents both gas blow by and piston scoring.

2. The quality advantages of NPR Steel Rings.

NPR's unrivaled Piston Rings and Pistons will satisfy the needs of today's higher performance engine. All Piston Rings and Pistons listed in this catalog are the results of our hard bench engine tests taking into consideration material composition and surface treatment design. These tests on actual engines were conducted with the cooperation of the automobile manufacturer to assure a proper match to your engine's specifications.

Material – Steel vs. Cast Iron vs. Ductile Iron.

Today's modern engines have higher operating temperatures, higher compression, higher stress and higher restrictions on emissions. These conditions have put greater demands on piston rings. Steel rings outperform their cast iron predecessors in reduced oil consumption, reduced blow by, reduced wear, reduced breakage, and reduced friction.

Oil consumption

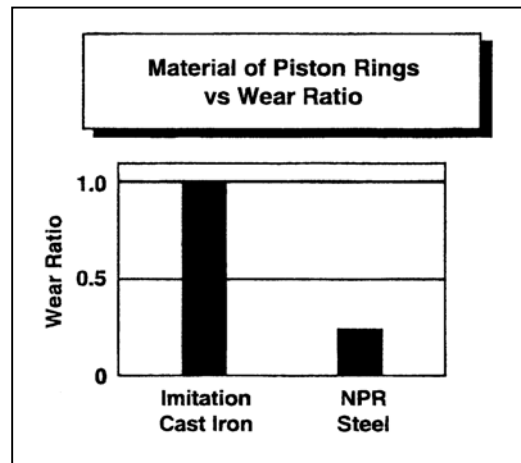
Steel piston rings allow for a reduction in the radial wall thickness. This (thinner) and lighter design seals more completely against the ring groove. Also, the steel ring with greater strength, reduced width conforms better to less than perfect cylinder bores. These two advantages reduce oil consumption by more than 30%.

Durability of Steel

The inherent strength of high alloy steel dramatically reduces the chance of ring breakage. Late model engines have reduced their ring thickness from 2.0 to 1.2 and 1.0 mm. Steel also provides for longer service life because ring wear is reduced by over 60%.

Steel Piston Rings

- Advantages:** Higher tensile strength.
Higher yield strength.
Greater fatigue life.
Greater hardness.
Lower ring mass.
- Benefits:** Better stress resistance.
Reduced rings side wear.
Reduced grooves pound out.
Longer service life.
Better conformability.
Superior oil economy.
Superior blow-by control.
Lower friction.



Surface Treatment

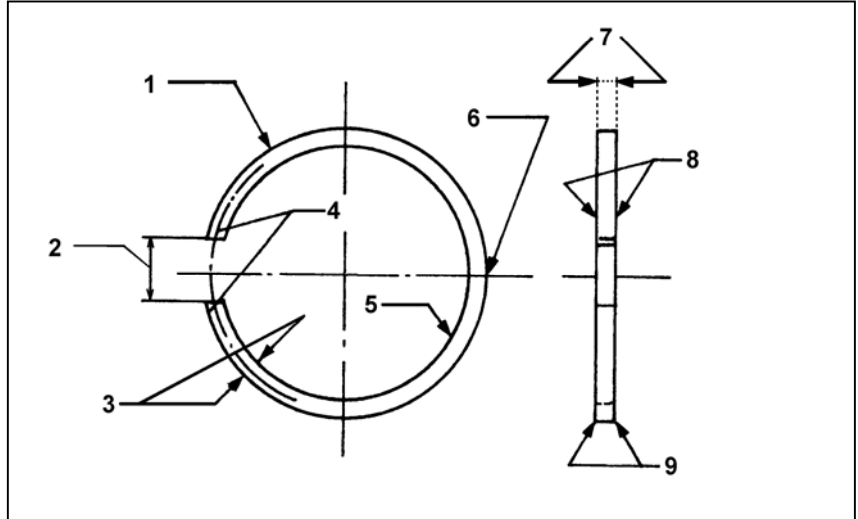
NPR's surface treatment is also very high quality, and the result of our technology. The chart below shows surface treatment comparison.

Surface Treatment	Anti Scuffing	Anti Wearing	Anti Damage to other parts.	Anti Corrosion	Cost
Chrome	Good	Good	Good	Good	Very Good
Moly	Good	Poor	Very Poor	Poor	Good
Gas Nitride	Good	Very Good	Very Good	Very Good	Good
PVD	Excellent	Excellent	Excellent	Excellent	High

3. Piston Ring – Name of Parts

Free (Unstressed) Ring

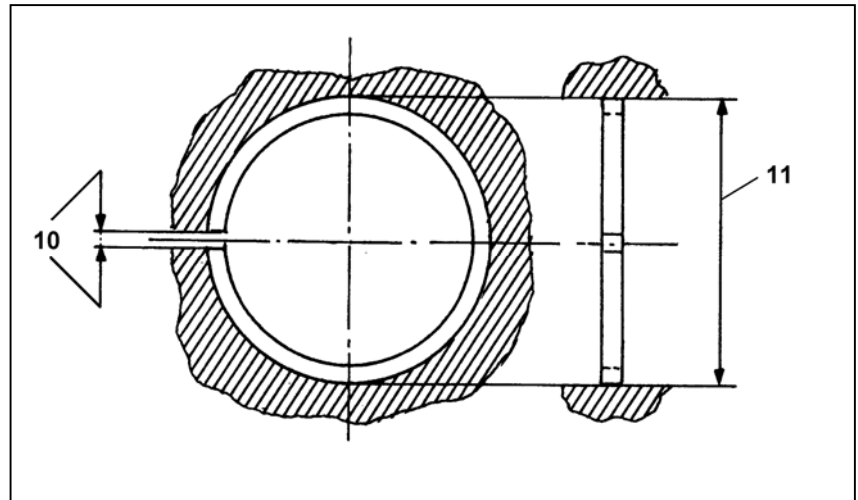
1. Ring face or Periphery.
2. Total free gap (m).
3. **T**: Radial wall thickness (ai).
4. Butt ends.
5. Inside Surface.
6. Back of the ring.
7. **B**: Ring width (h1)
8. Side Face.
9. Peripheral edges.



Closed Gap

10. Closed gap (S1).
11. Cylinder Bore (H).
Nominal ring diameter (d1).

Symbols in () are as given in :
ISO6621/1
SAE J1588
JIS B 8032



Recommended Closed Ring Gap

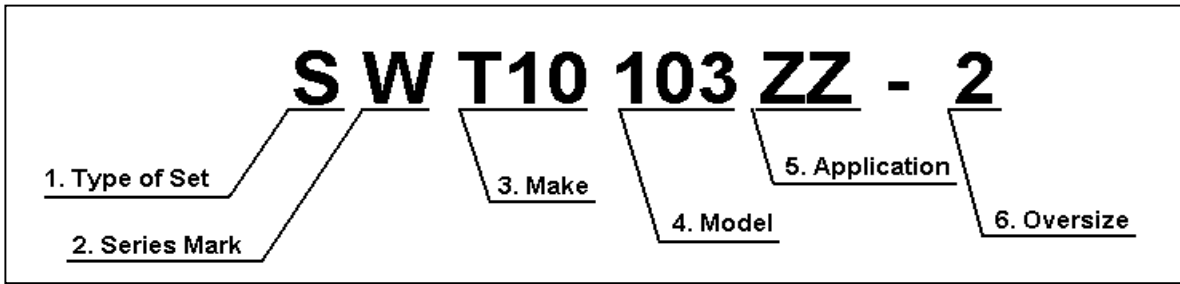
NPR generally manufacturers its rings to meet the JIS (Japanese Industrial Standard) B8032-6-1998. It is import to recognize that some end gaps for individual engines may vary from this standard because of the original engine manufacturer's requirements. The table appearing below is for reference only. All sizes are in millimeters.

Recomendacion De Cierre Del Espacio Final Del Anillo (End Gap)

NPR generalmente fabrica sus anillos para piston siempre siguiendo las normas del FIS (El estandar industrial Japonés) B8032-6-1998. Es importante reconocer que en algunos motores, el espacio final del anillo puede variar del JIS a causa de los requerimientos del fabricante. La tabla que aparece debajo es de referencia solamente. Todas las medidas son en milímetros.

<u>Cylinder Bore Size</u>	<u>Compression Ring Gap</u>	<u>2pc. Oil Ring Gap</u>	<u>3pc. Oil Ring Gap</u>
40.00 ~ 59.00	0.15 ~ 0.35	0.15 ~ 0.35	-
60.00 ~ 74.00	0.20 ~ 0.40	0.20 ~ 0.40	0.20 ~ 0.95
75.00 ~ 89.00	0.25 ~ 0.50	0.25 ~ 0.50	0.25 ~ 1.00
90.00 ~ 109.00	0.30 ~ 0.55	0.30 ~ 0.50	0.30 ~ 1.05
110.00 ~ 120.00	0.35 ~ 0.60	0.35 ~ 0.60	0.35 ~ 1.10

4. Explanation of NPR Ring set Code.



1) Type of Set.

S: Eleven digits code started with S represents a complete set of piston rings for an engine model S assigned by Make and Model codes. For instance, TOYOTA 22RE (4 cylinder) has been assigned as T10103. In this case, SWT10103ZZ-2 represents four sets of each 1st, 2nd, and oil rings.

Y: Eleven digits code started with Y represents only one cylinder set of piston ring. In case of TOYOTA 22RE, YWT10103ZZ-2 represents one set of 1st, 2nd, and oil rings.

Note: NPR has both engine set (S-) and cylinder set (Y-) code in the same Make, Model and Application for some makes (HONDA / ISUZU / SUZUKI / YAMAHA etc.).

Note 2: Since a cylinder set code (Y-) represents a piston ring set for only one cylinder, an engine requires a cylinder set multiplied by the number of cylinders of the engine.

2) Series Marks

Series Mark	Series #	Series Mark	Series #
A	100	L	100X
B	300	M	300X
C	500	N	500X
D	555	R	Mt.100X
F	Mt.100	S	Mt.300X
G	Mt.300	T	Mt.500X
H	Mt.500	W	777
J	Mt.555	X	Mt.777

US Application

Most of Piston Rings for Gas Engine : Mt.777 or 777.

Most of Piston Rings for Diesel Engine : Mt.555 or 555.

Export Piston Rings

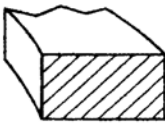
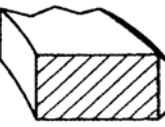
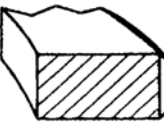
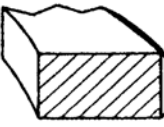
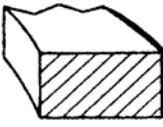
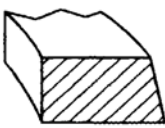
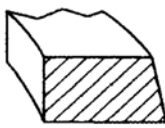
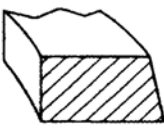
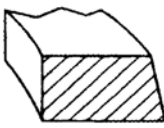
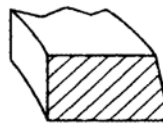
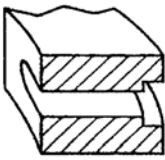
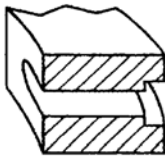
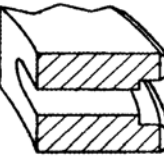
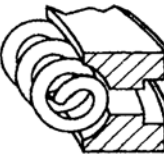
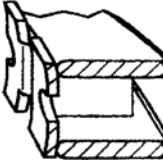
There are varieties of Piston Ring Series. Please see above.

Important Note!

From time to time the surface treatment specifications may be changed. Contact NPR, if you have questions on individual engine applications.

Explanation of Series #

There are various combinations of piston rings to make the set suitable to the engine. Using a ring set containing three rings per cylinder, we explain our basic Series #'s as under:

Series #	100	300	500	555	777
Top Ring					
2nd Ring					
Oil Ring					
Feature	Ring set without Chrome Plating.	1st Ring is Chrome Plated.	1st Ring and Oil Ring are Chrome Plated.	This ring set employs Dieselelex ring (incorporating a coil expander) as the oil control ring.	This ring set employs Nifflex ring (Consisting of combination of three pieces) as the oil control ring.

Mt. : Top and bottom sides of the ring are Chrome Plated.
 X : Plate expander is coupled with oil control ring.

Important Note!

Diesel Ring 555 Series:

Because Diesel Cylinders may have different inside Cylinder wall surfaces, NPR ring surface treatments on Top and Oil Control Ring will change:

Ring Type

Surface Treatment

555

Chrome on outside contact surface.

Mt.555

Chrome on Top, Bottom and Outside contact surface. There may be Chrome on the inside surface depending on individual application.

Mt.555F

Chrome on Top and Bottom surfaces, but no Chrome on outside contact surfaces. Typically used in Chromard Liner applications.

From time to time the surface treatment specifications may be changed. Contact NPR, if you have questions on individual engine applications.

3) **Make**

<u>US Application</u>	<u>Code</u>	<u>Make</u>
	D10	DAIHATSU
	F20	SUBARU
	H30	ACURA, HONDA
	I10	ISUZU, (GM, CHEVROLET, GEO)
	L02	DAEWOO, HYUNDAI, KIA, MAZDA
	M30	MAZDA, MITSUBISHI, (CHRYSLER, DODGE, EAGLE, PLYMOUTH, HYUNDAI)
	M31	MAZDA, MITSUBISHI
	N30	INFINITI, NISSAN, (FORD MERCURY)
	N31	NISSAN DIESEL
	S20	SUZUKI, (GM, CHEVROLET, GEO)
	T10	LEXUS, TOYOTA, (GM, CHEVROLET, GEO)
	T20	MAZDA (FORD, MERCURY)

<u>Export</u>	<u>Code</u>	<u>Make</u>
	D10	DAIHATSU
	F20	SUBARU
	H20	HINO
	H30	HONDA
	I10	ISUZU
	K04	KOMATSU
	L02	DAEWOO, HYUNDAI, KIA, MAZDA
	M30	MITSUBISHI
	M31	HYUNDAI, MITSUBISHI
	N30	NISSAN
	N31	NISSAN DIESEL
	S20	SUZUKI
	T10	TOYOTA
	T20	KIA, MAZDA

NOTE: EXPLANATION OF MAKES IN PARENTHESIS ()
 When engines are out-sourced, you may find some set codes which have a make code assigned for an engine manufacturer other than the vehicle manufacturer (For example: SWM31047 is used for Chrysler engine).

4) **Model**

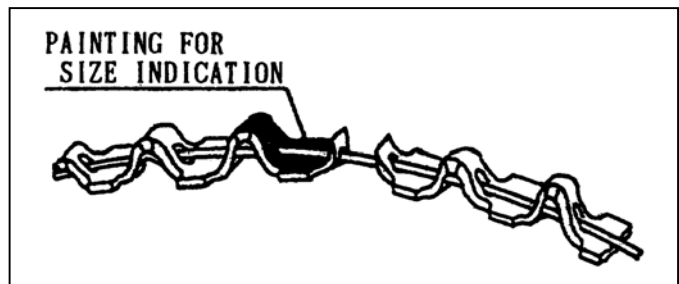
A three digit number is uniquely assigned by an engine model connected with a make code.

5) **Serial Code for Application**

Assigned by engineer.

6) **Oversize Code**

0:	Standard.	No Color
1:	Oversize (0.25mm).	White
2:	Oversize (0.50mm).	Blue
3:	Oversize (0.75mm).	Black
4:	Oversize (1.00mm).	Yellow
5:	Oversize (1.25mm).	Orange
6:	Oversize (1.50mm).	Green



* Indication is only for **Nifflex** type expander rings. *

* Please note that there may be some exceptions for this color code depending on the original manufacturers requirement. *

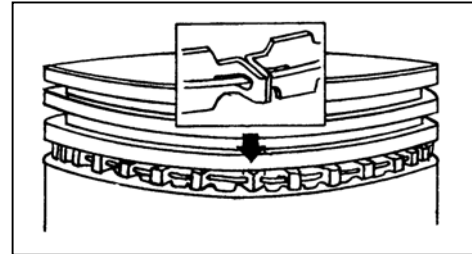
Installation Instruction of Oil Rings. (Instalacion del Anillo de Control de Aceite)



1. Series 777 Oil Rings. (Anillo de Aceite Serie 777)

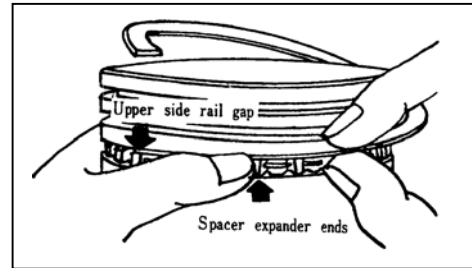
Fit the spacer expander into the ring groove, and ensure that the ends are butting as shown in the illustration.

Acomodar el espaciador dentro de la ranura y asegurarse que las orillas se lleguen a juntar, sin encimarse. Como se muestra en la ilustracion donde las orillas del espaciador se juntan.



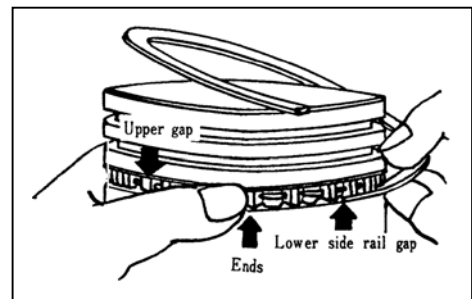
Hold with thumb the spacer expander with its ends completely butting. Install the upper side rail with its gap approximately 45 Degree left of Spacer Expander end.

Con el dedo pulgar sostener el espaciador donde se juntan ambas orillas. Instalar primero la lamina o riel superior con una distancia de una pulgada o 45 grados a la izquierda donde se juntaron las orillas del espaciador.



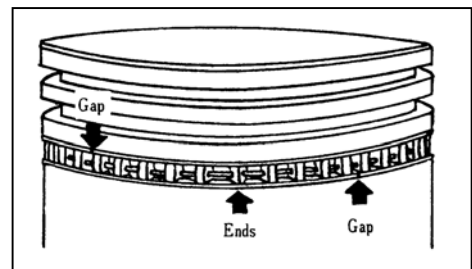
Install the lower side rail with its gap approximately 45 Degree right of the expander ends.

Posteriormente de la misma manera a como se menciono anteriormente se instala la lamina o riel inferior con una distancia de una pulgada o 45 grados hacia la derecha de donde se juntaron las orillas del espaciador.



If you have followed these instructions, this ring will Be installed as illustrated on the right. Make sure each gap is located as illustration to the right demonstrates.

Si usted ha seguido estas instrucciones como la ilustracion que aparece de lado derecho. Tiene que asegurarse que los huecos (Gap) sean colocados como se muestra en el dibujo.



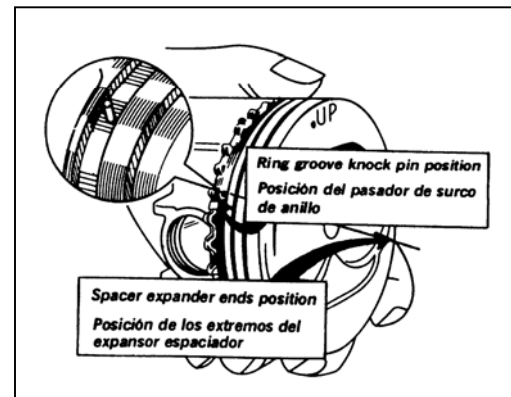
Installation Instruction of Oil Rings. (Instalacion del Anillo de Control de Aceite.)



2. Series 777 Oil Rings for Subaru EA Engine. (Serie 777 Anillo de Control de Aceite para Subaru Tipo de Maquina EA.)

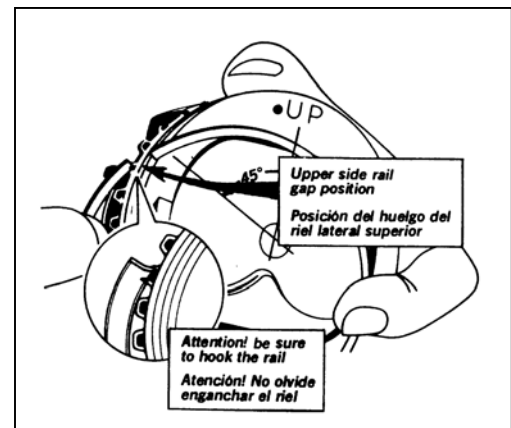
In EA Engine pistons, there is a knock pin in the oil ring groove. Install the spacer expander around the whole piston perimeter, placing its ends approximately 180 Degree from the knock pin.

Los pistones del motor EA tienen un pasador en el Surco del anillo aceitador. Instale el expansor Espaciador alrededor del perimetro total del piston, Ubicando sus extremos a unos 180 Grado de dicho pasador.



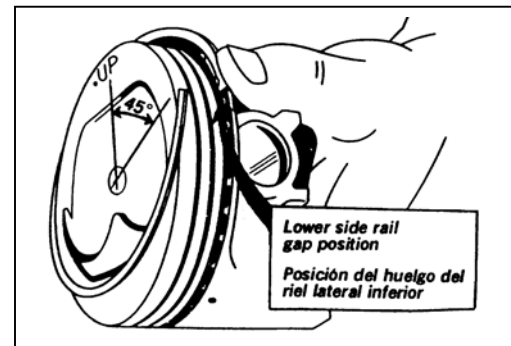
One of the two side rails has one of its ends slightly bent. Hook the bent part into the spacer expander, at a point located approximately 45 Degree left of the piston head “UP” mark, then install the rail around the whole piston perimeter (see figure).

Uno de los dos rieles laterales tiene uno de sus extremos ligeramente doblado. Enganche esta parte doblada en el expansor espaciador, en un punto ubicado a unos 45 Grado a la izquierda de la marca “UP” grabada en la cabeza del piston, e instale el riel alrededor del perimetro total del piston (ver figura).



Install the lower side rail with its gap approximately 45 Degree right of the piston head “UP” mark.

Instale el riel lateral inferior con su hueco ubicado a unos 45 Grado a la derecha de la marca “UP” grabada en la cabeza del piston.

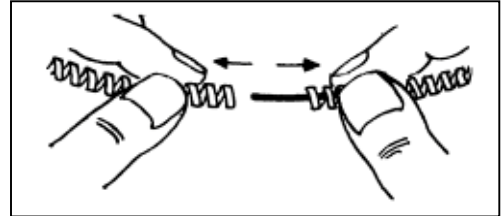


Installation Instruction of Oil Rings. (Instrucciones para Instalar el Anillo De Control de Aceite.)

3. Series 555 Oil Rings. (Anillo de Aceite Serie 555)

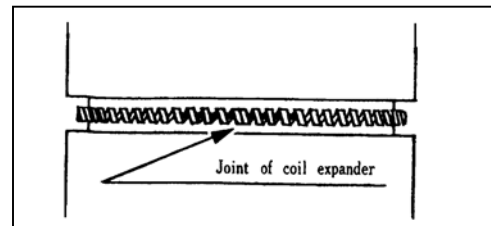
First, disconnect the joint of coil expander.

Primero, desconectar el alambriillo en forma de espiral del espaciador.



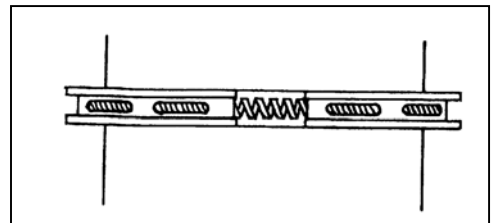
Next, encircle the 1st oil ring groove with coil expander and joint the ends of coil expander again.

Despues, instale el alambriillo en forma de espiral dentro de la ranura del piston en la ranura correspondiente y cerrar el circulo.



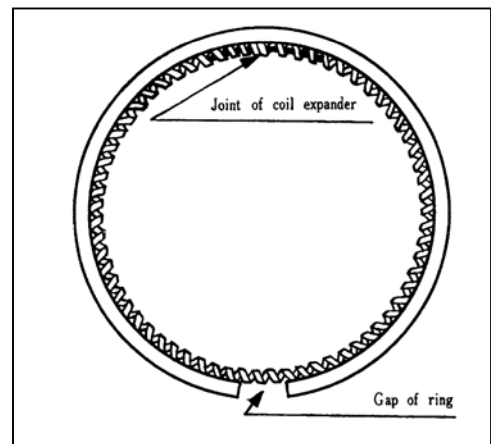
Last, install the ring outside of coil expander.
(Please use Piston Ring Installation Tool).

Finalmente, instalar el espaciador por fuera del alambriillo en forma de espiral.



The end of the ring must be placed on the opposite side of the joint of the coil expander.

Las orillas del anillo deben de ser colocadas del lado opuesto a la union del alambriillo en forma de espiral.

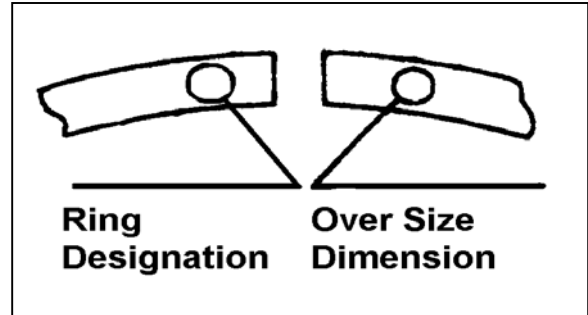




Installation Instruction of Compression Rings.

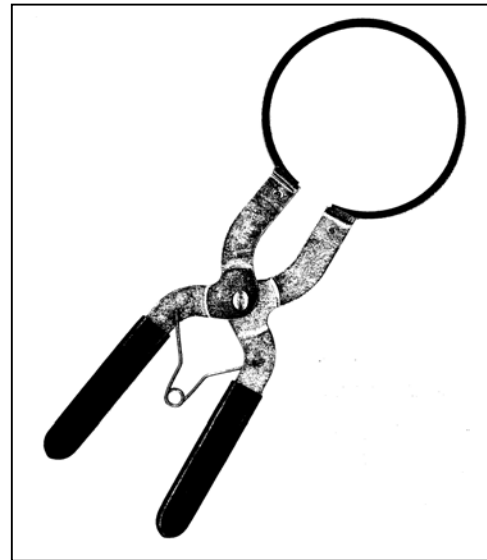
“N” or Number is facing upward when installed on the piston.

Siempre hay que asegurarse que al instalar el anillo de compresion para la primera ranura del piston, este debera notarse que la N y el numero 1 deberan estar siempre hacia arriba dentro la primera ranura del piston.



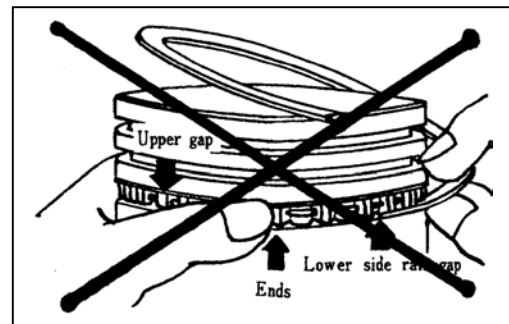
Use Piston Ring tool to expand the end gap. Then install 2nd and Top ring to Piston Ring Groove.

Siempre es recomendable usar herramienta especial, como Ensanchadores del Anillo de Piston. Para el segundo anillo de compresion se usa el mismo procedimiento del primer anillo de compresion, pero en este hay que notar que el numero 2 y la letra N, deberan estar siempre hacia arriba dentro de la segunda ranura del piston.



Do not install compression rings like rail rings.

Nunca hay que instalar los anillos de compresion de la misma manera que se instalan los anillos de control de aceite (rieles o laminas).



RING SPECIFICATIONS AND DEFINITION GUIDE



Cross-section Configuration / Configuration Code

	P CR1		K2	Material Code: Material Name CR : NPR CAST IRON HB : NIPPALOY (Spheroidal graphite Cast Iron) SR : STEEL
	BF CR1-BF		BF-K2 CR1-BF-K2	
	T1 B1-T1		T1-K2	Code: Surface Treatment Fe : Phosphated Cr : Chromium plated on sliding surface 2Cr: Both side faces chromium plated 4Cr: All surfaces Chromium plated GN : Nitrided PVD: PVD Coated JF : UNIFRON coated
	IB		BF-K3	
	BF-IB CR1-BF-IB		BF-K1 CR1-BF-K1	
	T1-IB		T1-K1	
	IC		BF-K1-IC	
	T1-IC		T1-K1-IC	
	T1-RC		C1, BC1, BC2, BC3, BC14, BC-16	
	B1-TUC B-UC		E-C1, E-C2, E-BC1, E-BC3, E-BC16	
	TUC UC		NIFFLEX-S	
	TUH		NIFFLEX-H	
	ES-TUC	Above figures show basic cross-section configuration but not in detail		

B mm : Ring Width

T mm : Ring Rdial Wall Thickness