DIFFERENCES BETWEEN TIGHTENING IN KILOS AND ANGULAR TIGHTENING

TIGHTENING IN KILOS

In this type of tightening, we measure the torque force that is applied to the cylinder head screw used for the closure. The load in kg. appears on the wrench (if it is a dial wrench). In the case of impact wrenches, the load is indicated when the spring jumps up. In electronic wrenches, the load is indicated by a light and an acoustic signal.
The different scales used by different manufacturers might represent a problem in the tightening in kilos. To make things clear, it´s like when we measure distances: there are some countries that use the metric system (km) and others that use the imperial system (miles) England, United States and Australia. The same happens when measuring the torque for a screw, we have three different scales:

As in the three systems we are measuring the torque used for tightening a screw, there is an equivalence between them.
Considering the example of measuring distances again, a distance of 160 km is equivalent to 100 miles aprox.

Something similar happens when tightening:

MEASUREMENT SYSTEM	UNIT OF MEASUREMENT	IT IS FREQUENTLY REFERRED TO AS
METRIC	Kpm (Kilopond per meter)	Tightening in Kilos
ENGLISH	Lb ft (Pound per foot)	Tightening in Pounds
INTERNATIONAL	Nm (Newton per meter)	Tightening in Newtons

TO CONVERT FROM	MATHEMATICAL OPERATION	EXAMPLES
PARA PASSAR DE	OPERAÇÃO A REALIZAR	EXEMPLOS
NEWTONS » KILOS	DIVIDE BY 10	35 Nm = 3,5 Kpm 70 Nm = 7 Kpm 150 Nm = 15 Kpm
KILOS » NEWTONS	MULTIPLY BY 10	3 Kpm = 30 Nm 5 Kpm = 50 Nm 7,5 Kpm = 75 Nm
POUNDS » KILOS	DIVIDE BY 7.23	51 Lb ft / 7,23 = 7,05 » 7 Kpm 80 Lb ft / 7,23 = 11,06 » 11 Kpm
KILOS » POUNDS	MULTIPLY BY 7.23	3 Kpm x 7,23 = 21,69 » 22 Lb ft 5 Kpm x 7,23 = 36,15 » 37 Lb ft

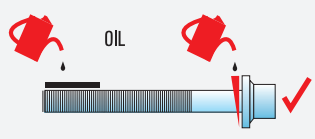
Note:

The conversion of **kpm to Nm** is not exact. It should be multiplied by 9.8 but it´s frequently multiplied by 10 since it´s easier and it has a slight difference.

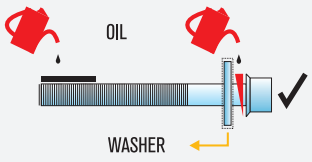
Checkings: Check the screws. In engines where the tightening must be in kilos, check that the length corresponds to the original measure, if the screws are stretched, rusty or the thread surface is damaged, THROW THEM AWAY.
In case you reuse the screws, whisk the thread, lubricate the under head area and the thread with engine oil and let drain for 30 minutes. By doing this, you diminish the loss of torque caused by the friction of the screw thread and avoid oil deposits in the bottom of the hole. If the screw has an integrated washer, you should lubricate within the washer and the screw head.
CAUTION!: Never lubricate the washer face against the head gasket. If the screws are of different lenghts, respect the correct position of each one, if you don´t do this, you could cause a false torque and the cylinder head will not support the block properly. Never use different types of bolts since the materials and designs can be different. In angular tightening engines, it is ESSENTIAL to use new screws and washers.

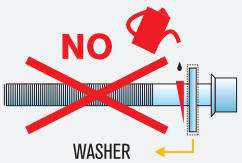
LUBRICATION: LUBRICATE THE UNDER HEAD AREA AND THE THREAD AND LET DRAIN FOR 30 MINUTES.

CYLINDER HEAD FLANGE SCREW



CYLINDER HEAD SCREW WITH WASHER



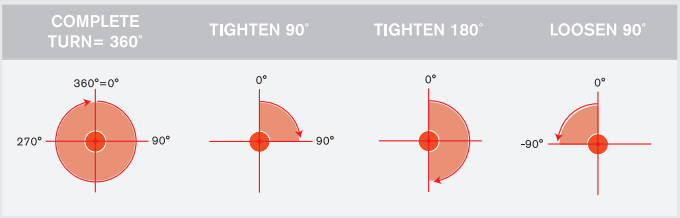


ANGULAR TIGHTENING

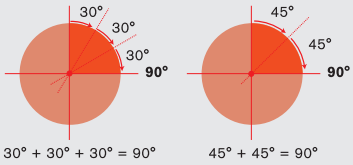
In the angular tightening, you measure the twist performed by the screw (or the force that twists the wrench when tightening). In order to measure the grades, you should use a goniometer or an angle meter. When tightening in grades, you always start by a small tightening in kilos and then apply the tightening grades indicated in the instruction manual. What has to be clear is that when we are measuring in grades, we are measuring the angle while when we measure in kilos we are measuring the force that is being applied. Therefore, there is no equivalence between grades and kilos.

EXAMPLE:
If we tighten two screws and one is harder than the other, we will have to use more force in order to thread the same length (if we are tightening in kilos). If we use the wrench with the same amount of kilos, one will be more threaded than the other (the one that is easier to thread). On the contrary, if we tighten two screws with a 90° angle, although one is harder to put than the other, both screws will be threaded equally therefore having a more precise tightening.

EXAMPLES OF ANGULAR TIGHTENING:



Another thing to have in mind is that grades are cumulative: if we can't turn 90° at once because there is not enough room, we can do it in stages until we reach the 90°. For example: we can have three stages of 30° since 30°+ 30°+ 30°= 90°, or in two of 45° (45°+45°= 90°):

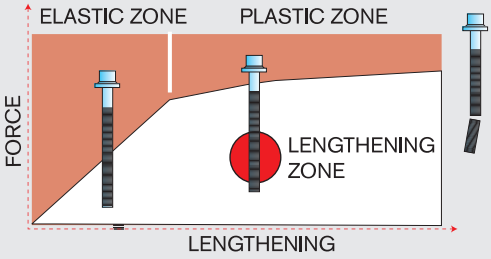


ADVICE: When using the angular method, the tightening must be applied all at once firm and evenly. If you stop the tightening halfway or loose the tautness that is being applied before reaching the final position, it is likely that the applied torque won't have the value specified by the manufacturer.

IMPORTANT:
When using the tightening in kilos, the applied force is within the elastic limits of the screws. This means that when the applied force is taken away, the screw comes back to its initial length.

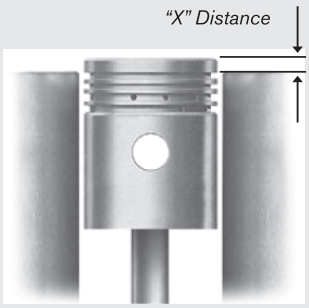
The angular tightening makes the screw work on the plastic zone (see graphic) to make a more effective tightening since the stretching of the zone keeps the force and traction. When you work over a plastic zone, the screw has no way back and forgets its initial length, they end up "stretched". The stretching of the plastic zone is cumulative so it makes it impossible to reuse the screw.

▪ REASONS TO CHANGE CYLINDER HEAD SCREWS



! WHEN CHANGING A DIESEL CYLINDER HEAD GASKET, REMEMBER THE FOLLOWING RECOMMENDATIONS:

When selecting a new gasket, the **"notches"** are not the only thing to consider since each manufacturer has its own marking criteria. In order to keep the compression relation constant, the thickness of the gasket must be determined according to the loosening of the setscrews in reference with the block blueprint **(indicated in the diagram as X Distance)**, measure the projecting of the pistons with a comparator and use the highest as reference.



SELECTION OF THE JOINT THICKNESS (MOTOR DIESEL)*

"X"DISTANCE IN mm.		THICKNESS	PART	
UP TO	0.87 mm	1.40 mm	TC-661	2M
FROM 0.88 TO	1.00 mm	1.50 mm	TC-662	1M
OVER	1.00 mm	1.60 mm	TC-663	3M

* EXAMPLE FOR A RENAULT F8Q ENGINE (DIRECT INJECTION)

In order to have a correct coupling of the parts, bare in mind that the gasket yields between 4%- 8% of its original thickness. This reference varies depending on the applied tightening and the load of material in the product (thickness and notches).