How to make a complicated subject uncomplicated is not easy so I'll try to explain in the best way I can why oils degrade (shear) with use and the easiest way to identify an oil that will "stay in grade" for longer.

Viscosity Index Improvers.

An oils viscosity will decrease as the engine temperature rises. Viscosity Index Improvers are added to reduce this thinning. They are a key addative in the production of multigrade oils.

VI Improvers are heat sensitive long chain, high molecular weight polymers that increase the relative viscosity of the oil at high temperatures. They work like springs, coiled at low temperatures and uncoiling at high temperatures. This makes the molecules larger (at high temps) which increases internal resistance within the thinning oil. They in effect "fight back" against the viscosity loss in the oil.

"Shearing"

The long chain molecules in VI Improvers are prone to "shearing" with use which reduces their ability to prevent the oil from losing viscosity. This "shearing" occurs when shear stress ruptures the long chain molecules and converts them to shorter, lower weight molecules. The shorter, lower weight molecules offer less resistance to flow and their ability to maintain viscosity is reduced.

This shearing not only reduces the viscosity of the oil but can cause piston ring sticking (due to deposits), increased oil consumption and increased engine wear.

Like basestock quality, VI Improvers also vary in quality. The best quality ones are normally found in synthetic oils (Group IV - PAO / Group V - Esters) and it is important to understand that the less of these in the oil the better the oil will stay in grade.

Which oils require more VI Improvers?

There are two scenarios where large amounts of these polymers are required as a rule.

Firstly in "wide viscosity" multigrades. By this I mean that the difference between the lower "W" number and the higher number is large for example 5w-50 (diff 45) and 10w-60 (diff 50) are what is termed as "wide viscosity" oils.

Narrow viscosity oils like 0w-30 (diff 30) or 5w-40 (diff 35) require far less VI Improvers and therefore are less prone to "shearing".

Secondly, mineral and hydrocracked (petroleum synthetic oils) require more VI Improvers than proper PAO/Ester (Group IV or V) synthetic oils as they are less thermally stable to begin with and this is due to the non-uniform molecules in petroleum oils as opposed to the uniformity of synthetics built in laboratories by chemists.

It is a fact that some synthetics require little or no VI Improvers to work as a multigrade due to their superior thermal stability.

How to identify a good "shear stable" oil.

API and ACEA both conduct tests called HTHS (High Temperature/ High Shear) and all oils carrying these specifications are tested and scored.

For all oils, these test results are available however, they are often ommitted from the oils technical data sheet! Oil Companies have a tendency to publish the figures that they want you to see and therefore you often need to dig further or ask for certain information when comparing the performance of various oils.

High-Temperature/High-Shear

This test is a simulation of the shearing effects that would occur within an engine. In fact, it's actually designed to simulate motor oil viscosity in operating crankshaft bearings.

Under high stress conditions where shearing can occur, the VI Improvers (polymers) break down. As they do, the viscosity of the oil decreases. This is what the High Temperature/High Shear test checks for.

The HT/HS test is measured in Centipoise (cP) as the Cold Crank Simulator test is. However, in this case, because you're hoping for the least loss of viscosity with an increase in heat and stress, you want the cP value to remain high.

Each SAE multi-viscosity grade has a specific lower limit for the HT/HS cP value. If a multi-viscosity oil cannot achieve a cP value above that limit, it cannot be classified under that viscosity grade. For instance, according to the SAE specifications, an oil must achieve an HT/HS cP value of 3.7 or higher in order to be classified at the 15w40 viscosity grade.

The thinner the oil the lower the number.

Comparisons of HTHS numbers.

Here for comparison sake are a few numbers that we have compiled from data sheets and requests to the oil companies concerned. These are well known oils and considered to be "quality" synthetics so these comparisons are relevant.

Silkolene PRO S 5w-40
HTHS 4.07

Motul 300V 5w-40
HTHS 4.51

Silkolene PRO S 10w-50
HTHS 5.11

Motul 300V 10w-40
HTHS 4.19

Silkolene PRO R 15w-50
HTHS 5.23

Motul 300V 15w-50
HTHS 5.33

Mobil 1 Motorsport 15w-50
HTHS 5.11

Castrol RS 10w-60
HTHS 3.70

I'm sorry if this is too complicated but making a complicated subject simple is not easy however if I've lost anyone, please feel free to ask questions.

Cheers,
Simon