















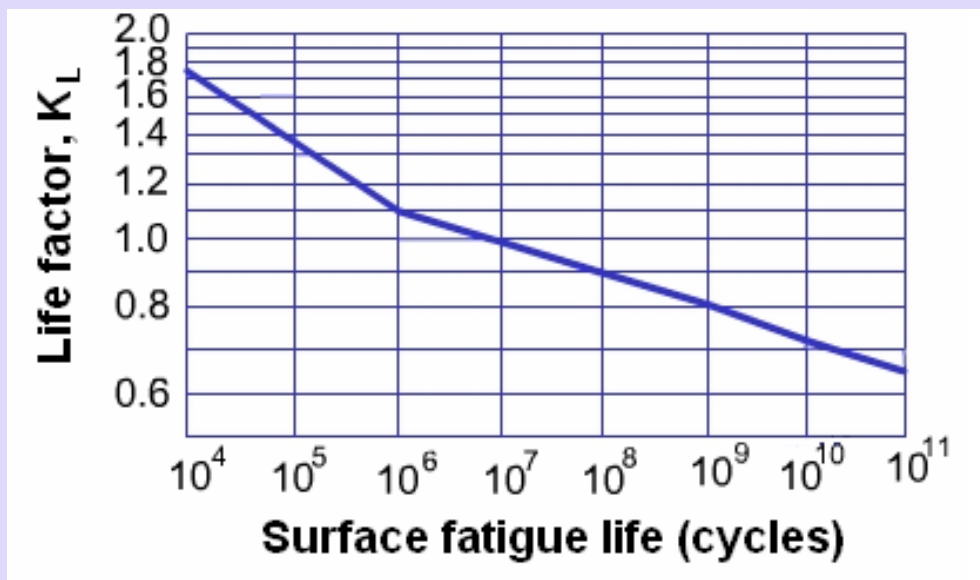


$K_L$  = Life factor given in Fig. 8.4

$K_R$  = Reliability factor, given in Table 8.5

**Table 8.4 Surface fatigue strength  $\sigma_{sf}$  (MPa) for metallic spur gears ( $10^7$  cycle life 99% reliability and temperature  $< 120^0$  C)**

Material	$\sigma_{sf}$ ( MPa )
Steel	2.8 ( Bhn ) – 69 MPa
Nodular iron	0.95 [ 2.8 (Bhn ) – 69 MPa ]
Cast iron, grade 20	379
Cast iron, grade 30	482
Cast iron, grade 40	551
Tin Bronze, AGMA 2C (11% Sn)	207
Aluminium Bronze ( ASTM B 148 – 52 ) (Alloy 9C – H. T )	448



**Fig. 8.4 Life Factor  $K_L$**

**Table 8.5 Reliability factor  $K_R$** 

Reliability (%)	$K_R$
50	1.25
99	1.00
99.9	0.80

$K_T$  = temperature factor,

= 1 for  $T \leq 120^\circ\text{C}$  based on lubricant temperature.

< 1 for  $T > 120^\circ\text{C}$  based on AGMA standards.

Allowable surface fatigue stress for design is given by

$$[\sigma_H] = \sigma_{sf} / s \quad (8.18)$$

Factor of safety  $s = 1.1$  to  $1.5$

Hence Design equation is:

$$\sigma_H \leq [\sigma_H] \quad (8.19)$$

## 8.6 GEAR MATERIALS

Gears are commonly made of cast iron, steel, bronze, phenolic resins, acetal, nylon or other plastics. The selection of material depends on the type of loading and speed of operation, wear life, reliability and application. Cast iron is the least expensive. ASTM / AGMA grade 20 is widely used. Grades 30, 40, 50, 60 are progressively stronger and more expensive. CI gears have greater surface fatigue strength than bending fatigue strength. Better damping properties enable them to run quietly than steel.

Nodular cast iron gears have higher bending strength together with good surface durability. These gears are now a days used in automobile cam shafts. A good combination is often a steel pinion mated against cast iron gear. Steel finds many applications since it combines both high strength and low cost. Plain carbon and alloy steel usage is quite common.

Through hardened plain carbon steel with 0.35 - 0.6% C are used when gears need hardness more than 250 to 350 Bhn. These gears need grinding to overcome heat treatment distortion. When compactness, high impact strength and durability are needed as in automotive and mobile applications, alloy steels are used. These gears are surface or case-hardened by flame hardening, induction hardening, nitriding or case carburizing processes. Steels such as En 353, En36, En24, 17CrNiMo6 widely used for gears.

Bronzes are used when corrosion resistance, low friction and wear under high sliding velocity is needed as in worm-gear applications. AGMA recommends Tin bronzes containing small % of Ni, Pb or Zn. The hardness may range from 70 to 85Bhn. Non metallic gears made of phenolic resin, acetal, nylon and other plastics are used for light load lubrication free quiet operation at reasonable cost. Mating gear in many such applications is made with steel. In order to accommodate high thermal expansion, plastic gears must have higher backlash and undergo stringent prototype testing.

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