Materials of KHK's Stock Gears

You Can Make a Selection of 11 Different Gear Materials According to Your Application.

Materials of KHK's Stock Gears are listed below.

1. SCM415 (SCM21)
Chromium molybdenum steel (JIS G 4105)
(Carburized)

Tensile strength N/mm²	Yield point N/mm²	Elongation %	Core hardness HB	Hardened surface hardness HRC	
830 or more		16 or more	300~320	55~60	**M**

2. SCM440 (SCM4)
Chromium molybdenum steel (JIS G 4105)
(Induction hardened teeth)
(Rack is normalized.) (HB250~285)

Tensile strength N/mm²	Yield point N/mm²	Elongation %	Core hardness HB	Hardened surface hardness HRC	
980 or more	835 or more	12 or more	225~260	50~55	**K**

3. SUS303
Stainless steel (JIS G 4303)

Tensile strength N/mm²	Elongation %	Hardness HB	
520 or more	40 or more	187 or less	**SU**

4. S45C
Machine carbon steel (JIS G 4051)
No normalizing done. Tooth surface hardness of hardened product is HRC48~53.

Tensile strength N/mm²	Yield point N/mm²	Elongation %	
690 or more	490 or more	17 or less	**S**

5. FC200
Gray iron casting, class 3 (JIS G 5501)

Tensile strength N/mm²	Max. deflection load N	Anti—flexure deflection mm	Hardness HB	
200 or more	9000 or more	4.5 or more	223 or less	**C**

6. BC6
Bronze casting, class 6

Tensile strength N/mm²	Elongation %	
195 or more	15 or more	**B**

7. AℓBC2
Aluminum bronze casting, class 2

Tensile strength N/mm²	Elongation %	
490 or more	20 or more	**A**

8. Plastic (MC-601ST nylon)
Spur gears with single hub

Tensile strength N/mm²	Elongation %	Hardness (Rockwell R)	
83~98	10~30	120	**N**

9. Plastic (molded nylon resin) MC901

Tensile strength N/mm²	Elongation %	Hardness (Rockwell R)	
75~96	10~60	110~120	**P**

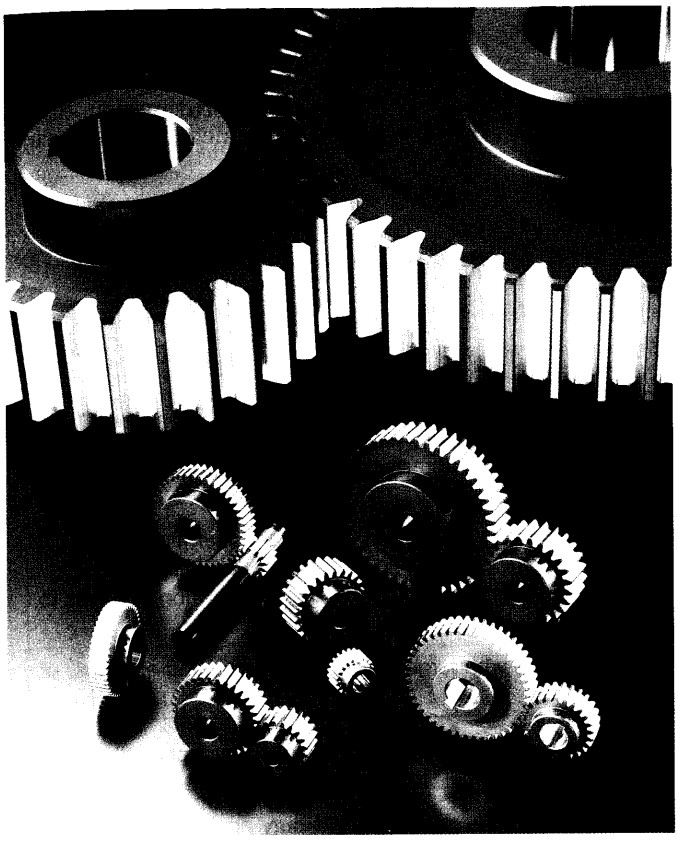
10. Injection molded plastic (Duracon) M90

Tensile strength N/mm²	Elongation %	Hardness (Rockwell R)	
60	20~60	110~120	**D**

11. Free-cutting brass (C3604BD-F)

Tensile strength N/mm²	Elongation %	Hardness Hv (Rockwell R)	
333	—	80	**BS**

1.Spur Gears



〈About Catalog Numbers of KHK Stock Gears〉
Catalog Numbers of KHK stock gears are based on simple principles as follows.
Please order KHK gears by specifying their Catalog Numbers.

(Example)

M SGA 1 - 18

- 18 — No. of teeth (18)
- 1 — Module (1)
- SGA — Type (Ground Spur Gear)
- M — Material (SCM415)

S S 3 - 27

- 27 — No. of teeth (27)
- 3 — Module (3)
- S — Type (Spur Gear)
- S — Material (S45C)

Contents

KHK STOCK GEARS

KHK Stock Spur Gears

With Our Large Selections, You Can Find Suitable Gears for Almost Any Applications!

Characteristics

To meet your requirements, KHK stock gears are made in a variety of types, materials, configurations, modules and numbers of teeth. We also offer products that allow secondary operations to be performed on the bores, shafts, outside diameters, keyways and set screws.

■Main Features of Types of Spur Gears Offered

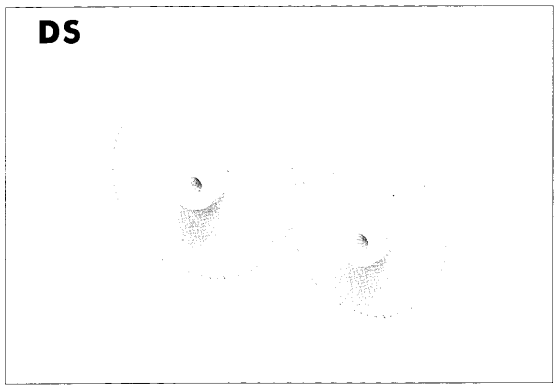
The following table lists the main features:

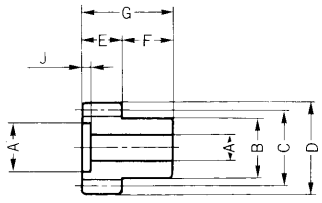
Catalog No.	Module	Material	Heat Treatment	Tooth Surface Finish	Precision	Secondary Operations	Main Characteristics
MSGA(B)	1~4	SCM415	Carburized	Ground	1	×	High strength, abrasion-resistant and compact
SSG	1~4	S45C	Gear teeth induction hardened	Ground	3	△	Allows users to perform secondary operations
SSGS	1.5~3	S45C	Gear teeth induction hardened	Ground	3	△	Ground shaft pinions that allow modification of shafts to fit your bearings
SS	1~10	S45C	—	Cut	4	○	Low cost with large selections of modules and nos. of teeth
SSA	1~5	S45C	—	Cut	4	○	Hubless gears for lighter and more compact applications
SSY	1~1.25	S45C	—	Cut	4	○	Narrower face gears for light-duty applications
SSAY	1~1.25	S45C	—	Cut	4	○	Hubless and narrow faces for even lighter and more compact gears
SUS·SUSA	1~3	SUS303	—	Cut	4	○	Stainless steel gears for more rust-resistant gears
SUSL	0.5~1	SUS303	—	Cut	4	△	Smaller module gears which clamp to the shafts without any keys or set screws
NSU	1~3	MC601ST (S45C)	—	Cut	5	○	Nylon teeth with steel hubs that can have keyways and set screws added
PU	1~3	MC601ST (SUS303)	—	Cut	5	○	Nylon teeth with stainless steel hubs for rust-resistance
PSU	1~2	MC901 (FC200)	—	Cut	5	○	Hubless nylon gears with gray iron core
PS·PSA	1~3	MC901	—	Cut	5	○	Possible to operate without lubrication. Suitable for food processing machines
DS	0.5~1	M90-44	—	Injection Molded	8	△	Low cost, mass-produced products suitable for light-duty office machines
BSS	0.5~0.8	C3604BD-F	—	Cut	4	○	Small module brass spur gears suitable for mating with DS gears
SSR	2~3	S45C	—	Cut	5	○	Allows large gear ratios. Can also be used as segment gears and corner racks

○ Possible △ Partly possible × Not possible

Injection Molded Spur Gears

DS





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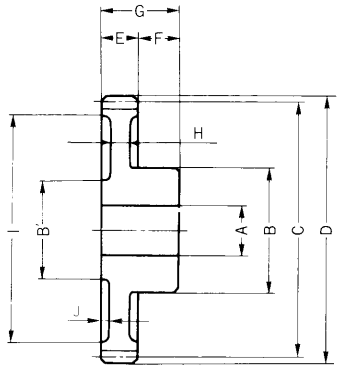

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■Module 0.5

Catalog No.	No. of teeth	Bore	C'bore	Hub dia.	Web I.D.	Pitch dia.	Outside dia.	Face width	Hub width	Total length
	z	A	A'	B	B'	C	D	E	F	G
DSO.5-12	12	2	4	4.5	—	6	7	3	4	7
DSO.5-15	15	2	5	4.5	—	7.5	8.5	3	4	7
DSO.5-16	16	3	6	6	—	8	9	3	4	7
DSO.5-18	18	3	7	6	—	9	10	3	4	7
DSO.5-20	20	4	—	8	5	10	11	3	4	7
DSO.5-24	24	4	—	8	5	12	13	3	4	7
DSO.5-25	25	4	—	8	6	12.5	13.5	3	4	7
DSO.5-28	28	4	—	8	6	14	15	3	4	7
DSO.5-30	30	5	—	10	7	15	16	3	4	7
DSO.5-32	32	5	—	10	7	16	17	3	4	7
DSO.5-35	35	5	—	10	7	17.5	18.5	3	4	7
DSO.5-36	36	5	—	10	7	18	19	3	4	7
DSO.5-40	40	5	—	12	8	20	21	3	4	7
DSO.5-45	45	5	—	12	8	22.5	23.5	3	4	7
DSO.5-48	48	5	—	12	8	24	25	3	4	7
DSO.5-50	50	5	—	12	8	25	26	3	4	7
DSO.5-56	56	6	—	14	10	28	29	3	5	8
DSO.5-60	60	6	—	14	10	30	31	3	5	8
DSO.5-64	64	6	—	14	10	32	33	3	5	8
DSO.5-70	70	6	—	14	10	35	36	3	5	8
DSO.5-72	72	6	—	14	10	36	37	3	5	8
DSO.5-80	80	6	—	14	10	40	41	3	5	8

■Module 0.8

DSO.8-12	12	3	—	6	4	9.6	11.2	4	5	9
DSO.8-15	15	3	—	6	5	12	13.6	4	5	9
DSO.8-16	16	4	—	8	6	12.8	14.4	4	5	9
DSO.8-18	18	4	—	8	6	14.4	16	4	5	9
DSO.8-20	20	5	—	10	8	16	17.6	4	5	9
DSO.8-24	24	5	—	10	8	19.2	20.8	4	5	9
DSO.8-25	25	5	—	10	8	20	21.6	4	5	9
DSO.8-28	28	5	—	10	8	22.4	24	4	5	9
DSO.8-30	30	6	—	12	10	24	25.6	4	5	9
DSO.8-32	32	6	—	12	10	25.6	27.2	4	5	9
DSO.8-35	35	6	—	12	10	28	29.6	4	5	9
DSO.8-36	36	6	—	12	10	28.8	30.4	4	5	9
DSO.8-40	40	6	—	12	10	32	33.6	4	5	9
DSO.8-45	45	6	—	12	10	36	37.6	4	5	9
DSO.8-48	48	6	—	14.5	11.7	38.4	40	4	6	10
DSO.8-50	50	6	—	14.5	11.7	40	41.6	4	6	10
DSO.8-56	56	6	—	14.5	11.7	44.8	46.4	4	6	10
DSO.8-60	60	6	—	14.5	11.7	48	49.6	4	6	10
DSO.8-64	64	6	—	15.5	11.7	51.2	52.8	4	6	10
DSO.8-70	70	6	—	15.5	11.7	56	57.6	4	6	10
DSO.8-72	72	6	—	15.5	11.7	57.6	59.2	4	6	10
DSO.8-80	80	6	—	15.5	11.7	64	65.6	4	6	10

CAUTION: The bore tolerance is generally -0.05 to -0.1 but may be +values at the central portion of the hole.
CAUTION: Remachining the bore is not recommended since reworking material may expose voids.

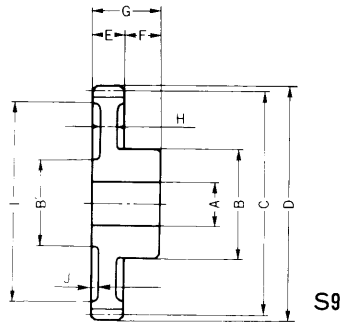
Specifications			
Precision grade	JIS B 1702 grade 8	Core hardness	HRR110～120
Gear teeth	Standard full depth	Surface hardness	
Pressure angle	20°	Surface treatment	—
Material	DURACON(M90-44)	Surface finish	Injection molded
Heat treatment	—	Datum reference surface for teeth cutting	Bore

Web thickness H	Web O.D. I	Depth of counterbore J	Shape	Allowable torque (kgf·m) Bending strength	Allowable torque (N·m) Bending strength	Backlash (mm)	Weight (kgf)	Catalog No.
—	—	0.6	S8	0.0096	0.0941	0.06～0.18	1	**DSO.5-12**
—	—	0.6	S8	0.014	0.1373	0.06～0.18	1	**DSO.5-15**
—	—	0.6	S8	0.0155	0.152	0.06～0.18	1	**DSO.5-16**
—	—	0.6	S8	0.0181	0.1775	0.06～0.18	1	**DSO.5-18**
2.4	8	0.6	S9	0.0209	0.205	0.06～0.18	1	**DSO.5-20**
1.8	9.5	0.6	S9	0.0264	0.2589	0.06～0.18	1	**DSO.5-24**
1.8	10	0.6	S9	0.0278	0.2726	0.06～0.18	1	**DSO.5-25**
1.8	12	0.6	S9	0.0321	0.3148	0.06～0.18	1	**DSO.5-28**
1.8	12	0.6	S9	0.0349	0.3422	0.06～0.18	1	**DSO.5-30**
1.8	13	0.6	S9	0.0379	0.3717	0.06～0.18	1	**DSO.5-32**
1.8	14.5	0.6	S9	0.0426	0.4178	0.06～0.18	1	**DSO.5-35**
1.8	15	0.6	S9	0.0442	0.4334	0.06～0.18	1	**DSO.5-36**
1.8	17	0.6	S9	0.0504	0.4943	0.06～0.18	2	**DSO.5-40**
1.8	19	0.6	S9	0.0583	0.5717	0.08～0.22	2	**DSO.5-45**
1.8	21	0.6	S9	0.0632	0.6198	0.08～0.22	2	**DSO.5-48**
1.8	22	0.6	S9	0.0666	0.6531	0.08～0.22	2	**DSO.5-50**
1.8	24.5	0.6	S9	0.0757	0.7424	0.08～0.22	3	**DSO.5-56**
1.8	26.5	0.6	S9	0.082	0.8041	0.08～0.22	4	**DSO.5-60**
1.8	28.5	0.6	S9	0.0882	0.8649	0.08～0.22	4	**DSO.5-64**
1.8	31.5	0.6	S9	0.0976	0.9571	0.08～0.22	5	**DSO.5-70**
1.8	32.5	0.6	S9	0.1008	0.9885	0.08～0.22	5	**DSO.5-72**
1.8	36.5	0.6	S9	0.1133	1.111	0.08～0.22	6	**DSO.5-80**
2	6.7	1	S9	0.029	0.2844	0.08～0.22	1	**DSO.8-12**
2	8.8	1	S9	0.0424	0.4158	0.08～0.22	1	**DSO.8-15**
2	9.2	1	S9	0.0469	0.4599	0.08～0.22	1	**DSO.8-16**
2	10.7	1	S9	0.0547	0.5364	0.08～0.22	1	**DSO.8-18**
2	12.7	1	S9	0.0634	0.6217	0.08～0.22	2	**DSO.8-20**
2	15.5	1	S9	0.0799	0.7835	0.08～0.22	2	**DSO.8-24**
2	15.5	1	S9	0.0844	0.8277	0.08～0.22	2	**DSO.8-25**
2	19	1	S9	0.0973	0.9542	0.1 ～0.24	3	**DSO.8-28**
2	20	1	S9	0.1058	1.038	0.1 ～0.24	3	**DSO.8-30**
2	21.7	1	S9	0.1149	1.127	0.1 ～0.24	3	**DSO.8-32**
2	24	1	S9	0.129	1.265	0.1 ～0.24	4	**DSO.8-35**
2	25	1	S9	0.1339	1.313	0.1 ～0.24	4	**DSO.8-36**
2	28.3	1	S9	0.1528	1.498	0.1 ～0.24	5	**DSO.8-40**
2	32	1	S9	0.1767	1.733	0.1 ～0.24	6	**DSO.8-45**
2	34.3	1	S9	0.1915	1.878	0.1 ～0.24	7	**DSO.8-48**
2	36	1	S9	0.2016	1.977	0.1 ～0.24	8	**DSO.8-50**
2	41	1	S9	0.2294	2.25	0.1 ～0.24	10	**DSO.8-56**
2	44	1	S9	0.2484	2.436	0.1 ～0.24	11	**DSO.8-60**
2	47.5	1	S9	0.267	2.618	0.12～0.26	12	**DSO.8-64**
2	52	1	S9	0.2955	2.898	0.12～0.26	15	**DSO.8-70**
2	54	1	S9	0.3051	2.992	0.12～0.26	16	**DSO.8-72**
2	60	1	S9	0.3428	3.362	0.12～0.26	19	**DSO.8-80**

NOTE: Allowable torques shown in the table are calculated using the Lewis formula.The backlash values shown are the theoretical values of a pair of identical gears in mesh.

Injection Molded Spur Gears

DS



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■Module 1

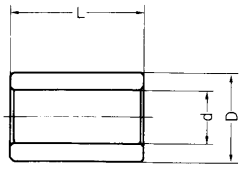
Catalog No.	No. of teeth	Bore	C'bore	Hub dia.	Web I.D.	Pitch dia.	Outside dia.	Face width	Hub width	Total length
	z	A	A'	B	B'	C	D	E	F	G
DS1-12	12	4	—	8	6	12	14	6	6	12
DS1-15	15	4	—	8	7	15	17	6	6	12
DS1-16	16	5	—	10	8	16	18	6	6	12
DS1-18	18	5	—	10	8	18	20	6	6	12
DS1-20	20	5	—	11.7	9	20	22	6	6	12
DS1-24	24	5	—	11.7	9	24	26	6	6	12
DS1-25	25	5	—	11.7	9	25	27	6	6	12
DS1-28	28	5	—	11.7	9	28	30	6	6	12
DS1-30	30	6	—	14	12	30	32	6	6	12
DS1-32	32	6	—	14	12	32	34	6	6	12
DS1-35	35	6	—	14	12	35	37	6	6	12
DS1-36	36	6	—	14	12	36	38	6	6	12
DS1-40	40	8	—	16	14	40	42	6	6	12
DS1-45	45	8	—	16	14	45	47	6	6	12
DS1-48	48	8	—	16	14	48	50	6	8	14
DS1-50	50	8	—	16	14	50	52	6	8	14
DS1-56	56	8	—	18	15.6	56	58	6	8	14
DS1-60	60	8	—	18	15.6	60	62	6	8	14
DS1-64	64	8	—	18	15.6	64	66	6	8	14
DS1-70	70	8	—	18	15.6	70	72	6	8	14
DS1-72	72	8	—	18	15.6	72	74	6	8	14
DS1-80	80	8	—	18	15.6	80	82	6	8	14

CAUTION: The bore tolerance is generally -0.05 to -0.1 but may be +values at the central portion of the hole.
CAUTION: Remachining the bore is not recommended since reworking material may expose voids.

Sintered Metal Bushings

The table below shows a series of standard metal bushings that can be pressed into standard injection molded gears.

BB



Catalog No.	O.D. of bushing $d_0^{+0.02}$	I.D. of bushing $D^{+0.02}_{-0.01}$	Length $L^{+0}_{-0.3}$	Products that can use the bushing
BB30507	3	5	7	DS0.5、DM0.8、DB0.8
BB30608	3	6	8	DS0.5、DS0.8、DM1
BB40609	4	6	9	DS0.8、DM1
BB40612	4	6	12	DS1、DB1
BB50812	5	8	12	DS1
BB50814	5	8	14	DS1、DM1.5

Material: Oil impregnated sintered bronze

5. DESIGN OF PLASTIC GEARS

5.1 The Properties of Nylon MC901 and Duracon M90

The symbol "MC" represents Mono Cast. It belongs to No. 6 Nylon (Polyamide resin). It is also called MC Nylon.

Duracon M90 is one of acetal copolymer resins. It belongs to the thermal-setting crystallized industrial plastic family.

The common properties of plastic gears are:

* They are self-lubricating and can be operated without lubricant if needed.
* They have a rather low noise level.
* They are lightweight and have antichemical corrosion properties.

Besides the advantages listed above, there are limitations to plastic materials, especially with regard to high temperature and moisture absorption.

Designers wanting to use plastic gears must consider additional factors.

(1) Mechanical Properties:

Table 5.1 denotes chemical properties of plastic gear materials under certain standard conditions.

Table 5.1 Mechanical Properties of Nylon MC901 and Duracon M90

Properties	Testing Method ASTM	Unit	Nylon MC 901	Duracon M90
Tensile Strength	D-638	kgf/cm²	800—980	620
Elongation	D—638	%	10—50	60
Modules of Elasticity (Tensile)	D-638	10^3kgf/cm²	30—35	28.8
Yield Point (Compression)	D-695	kgf/cm²	940—1050	——
5% Deformation Point	D—695	kgf/cm²	940—970	——
Modules of Elasticity (Compression)	D—695	10^3kgf/cm²	33—36	——
Shearing Strength	D-732	kgf/cm²	735—805	540
Rockwell Hardness	D-785	R scale	115—120	80
Bending Strength	D—790	kgf/cm²	980—1120	980
Density (23°C)	D-792	——	1.15—1.17	1.41
Poisson's Ratio	——	——	0.40	0.35

These mechanical properties tend to deteriorate as the temperature rises.

(2) Thermal Characteristic:

Table 5.2 shows thermal properties of nylon MC901 and Duracon M90.

(3) Moisture Absorption:

All plastics have the problem of moisture absorption. It will reduce some mechanical properties especially the antiabrasive characteristic.

Table 5.2 Thermal Properties of Nylon MC901 and Duracon M90

Properties	Testing Method ASTM	Unit	Nylon MC 901	Duracon M90
Thermal Conductivity	C—177	10^{-4}Kcal/mhr°C	2	2
Coefficient of Linear Thermal Expansion	D—696	10^{-5}cm/cm/°C	9	9—13
Specified Heat		cal/°Cgrf	0.4	0.35
Thermal Deformation Temperature (18.5kgf/cm²)	D—648	°C	160—200	110
Thermal Deformation Temperature (4.6kgf/cm²)	D—648	°C	200—215	158
Long Term Thermal Resistance Temperature		°C	120—150	——
Deformation Rate Under Load (140kgf/cm², 50°C)	D—621	%	0.65	——
Melting Point		°C	220—223	165

Table 5.3 Water and Moisture Absorption Properties of Nylon MC901 and Duracon M90

Conditions	Testing Method ASTM	Unit	Nylon MC 901	Duracon M90
Rate of Water Absorption (at room temp, in water, 24 Hrs.)	D—570	%	0.5—1.0	0.22
Saturation Absorption Value (in water)		%	5.5—7.0	0.80
Saturation Absorption Value (at room temp, in air)		%	2.5—3.5	0.16

Duracon M90 has less water absorption than Nylon MC901.

(4) Antichemical Corrosion Property:

Nylon MC901

Nylon MC901 has almost the same level of antichemical corrosion property as Nylon resins. In general, it has a better antiorganic solvent property, but has a weaker antiacid property. The properties are as follows:

* For many nonorganic acids, even at low concentration at normal temperature, it should not be used without further tests.
* For nonorganic alkali at room temperature, it can be used to a certain level of concentration.
* For the solutions of nonorganic salts, we may apply them to a fairly high level of temperature and concentration.
* MC901 has better antiacid ability and stability in organic acids than in nonorganic acids, except for formic acid.
* MC901 is stable at room temperature in organic compounds of ester series and ketone series.
* It is also stable in mineral oil, vegetable oil and animal fat, at room temperature.

Duracon M90

This plastic has outstanding antiorganic properties. However, it has the disadvantage of having limited suitable adhesives. Its main properties are:

* Good resistance against nonorganic chemicals, but may still be corroded by strong acids such as nitric, sulfuric and chloric acids.
* Household chemicals, such as synthetic detergents, have almost no effect on M90.
* M90 does not deteriorate even under long term operation in high temperature lubricating oil, except for some additives in high grade lubricants.
* With grease, M90 behaves the same as with oil lubricants.

Gear designers interested in using this material should be aware of the properties regarding individual chemicals. Plastic manufacturers' technical information manuals should be consulted prior to making gear design decisions.

5.2 The Strength of Plastic Gears

(1) Bending Strength of Spur Gears: Nylon MC901

The allowable tangential force F (kgf) at the pitch circle of a Nylon MC901 spur gear can be obtained from the Lewis formula.

$$F = myb\sigma_b f \text{ (kgf)} \tag{5.1}$$

where:

m = Module (mm)
y = Form factor at pitch point (see Table 5.4)
b = Blank width (mm)
σ_b = Allowable bending stress (kgf/mm²) (see Fig. 5.1)
f = Speed factor (see Table 5.5)

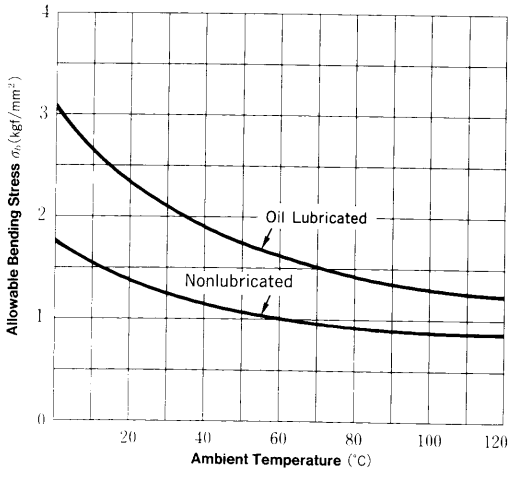


Fig. 5.1 Allowable Beam Strength, σ_b

Table 5.4 Form Factor, y

No. of teeth	Form factor y		
	14½°	20° Standard tooth	20° Stub tooth
12	0.355	0.415	0.496
14	0.399	0.468	0.540
16	0.430	0.503	0.578
18	0.458	0.522	0.603
20	0.480	0.544	0.628
22	0.496	0.559	0.648
24	0.509	0.572	0.664
26	0.522	0.588	0.678
28	0.535	0.597	0.688
30	0.540	0.606	0.698
34	0.553	0.628	0.714
38	0.565	0.651	0.729
40	0.569	0.657	0.733
50	0.588	0.694	0.757
60	0.604	0.713	0.774
75	0.613	0.735	0.792
100	0.622	0.757	0.808
150	0.635	0.779	0.830
300	0.650	0.801	0.855
Rack	0.660	0.823	0.881

Table 5.5 Speed Factor, f

Lubrication	Tangential Speed	Factor
Lubricated	Under 12	1.0
	Over 12	0.85
Nonlubricated	Under 5	1.0
	Over 5	0.7

Duracon M90

The allowable tangential force F (kgf) at the pitch circle of a Duracon M90 spur gear can also be obtained from the Lewis formula.

$$F = myb\sigma_b \tag{5.2}$$

where:

m = Module (mm)
y = Form factor at pitch point (see Table 5.4)
b = Blank width (mm)
σ_b = Allowable bending stress (kgf/mm²)

The allowable bending stress can be calculated by Formula 5.3.

$$\sigma_b = \sigma_b' \frac{K_V K_T K_L K_M}{C_S} \tag{5.3}$$

where:

σ_b' = Maximum allowable bending stress under standard conditions (kgf/mm²) (see Fig. 5.2)
C_S = Working factor (see Table 5.6)
K_V = Speed factor (see Fig. 5.3)
K_T = Temperature factor (see Fig. 5.4)
K_L = Lubrication factor (see Table 5.7)
K_M = Material factor (see Table 5.8)

Fig. 5.2 Maximum Allowable Bending Stress under Standard Conditions, σ_b'

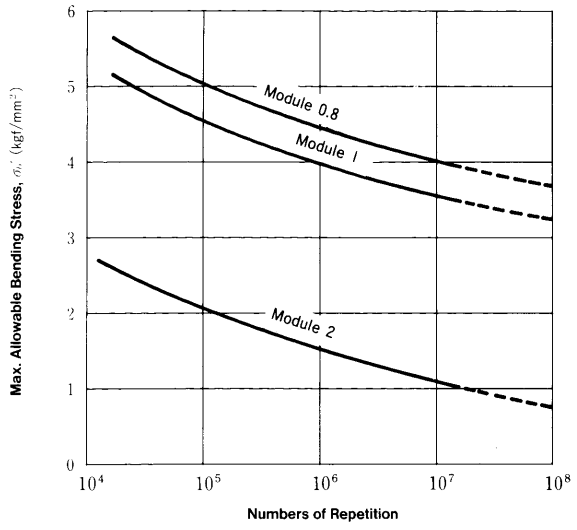


Fig. 5.3 Speed Factor, K_V

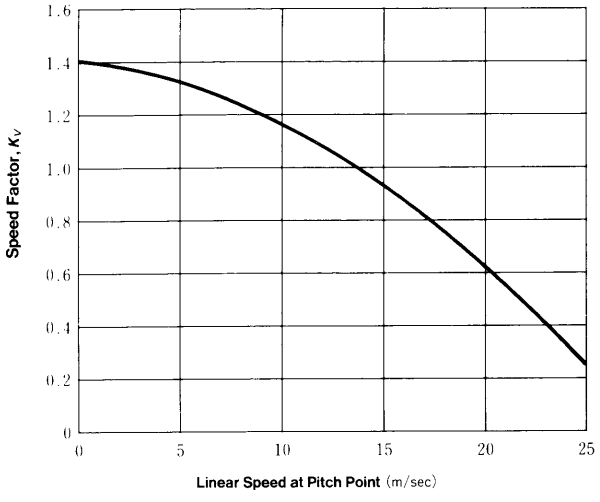


Fig. 5.4 Temperature Factor, K_T

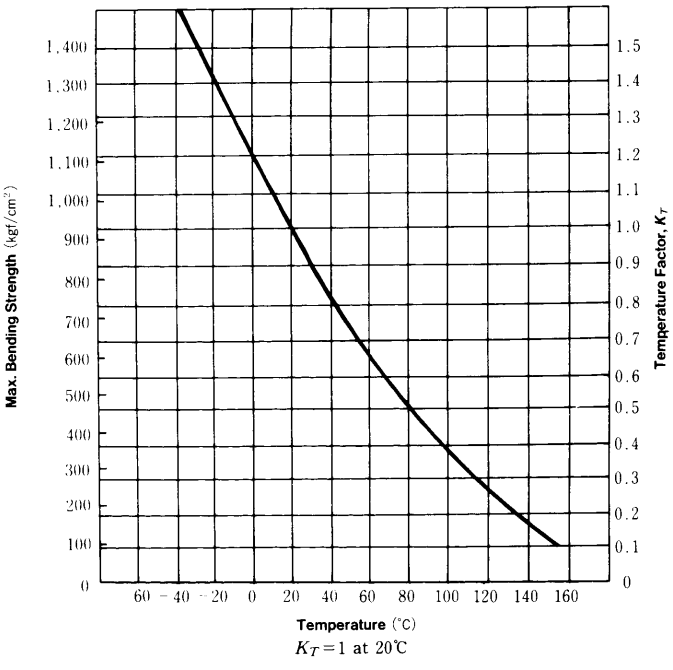


Table 5.6 Working Factor, C_S

Types of Load	Working Hours per Day			
	24hr/day	8-10hr/day	3hr/day	0.5hr/day
Uniform Load	1.25	1.00	0.80	0.50
Light Impact	1.50	1.25	1.00	0.80
Medium Impact	1.75	1.50	1.25	1.00
Heavy Impact	2.00	1.75	1.50	1.25

Table 5.7 Lubrication Factor, K_L

Lubrication	K_L
Grease (initial lubrication)	1
Oil Bath (continuous)	1.5—3.0

Table 5.8 Material Factor, K_M

Material Combination	K_M
Duracon vs. Metal	1
Duracon vs. Duracon	0.75

Application Notes:

In designing plastic gears, the effects of heat and moisture must be given careful consideration. The related problems are:

① Backlash

Plastic gears have larger coefficients of thermal expansion. Also, they have an affinity to absorb moisture and swell. Good design requires allowance for a greater amount of backlash than for metal gears.

② Lubrication

Most plastic gears do not require lubrication. However, temperature rise due to meshing may be controlled by the cooling effect of a lubricant. Often, in the case of high-speed rotational speeds, it is critical.

③ Plastic gear with metal mate

If one of the gears of a mated pair is metal, there will be a heat sink that combats a high temperature rise. The effectiveness depends upon the particular metal, amount of metal mass, and rotational speed.