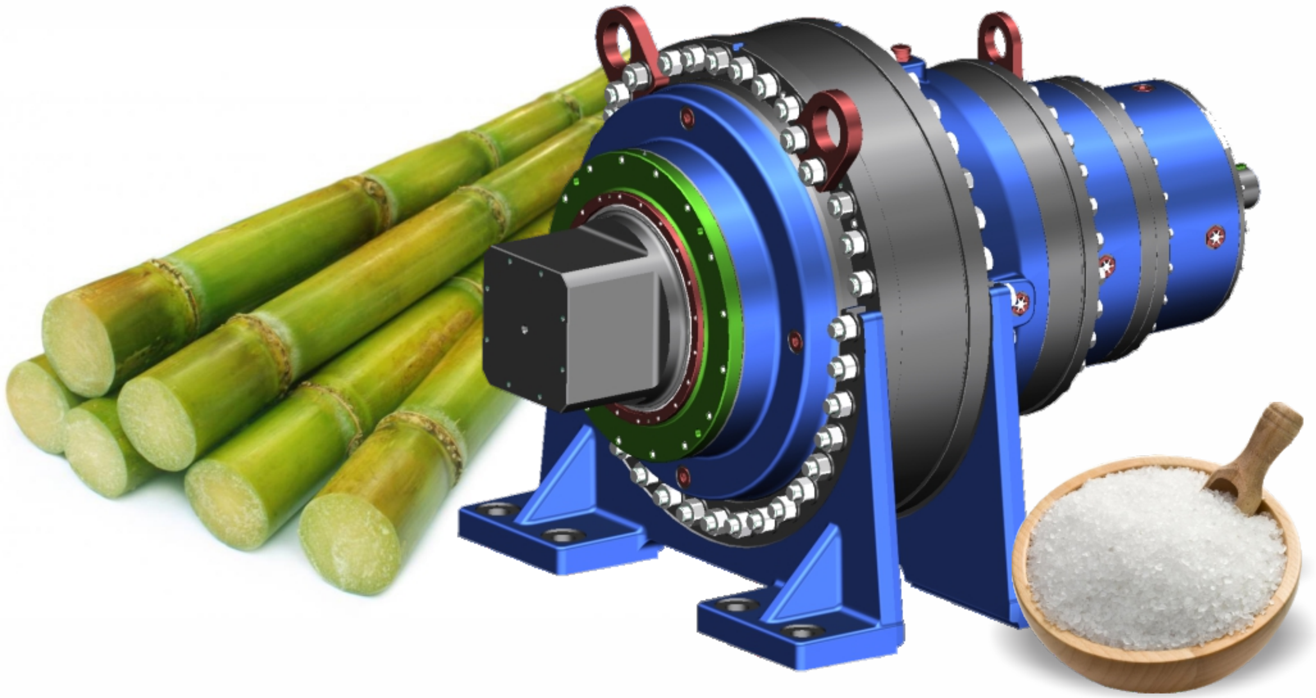
MILL GEARS®
Pvt. Ltd.



Technological innovation...
enhancing your strength

Cane Mill Planetary Gear Box

Mill Gears Private Limited is a family Company.

Since 2000, we have been in the trading business! We used to buy Planetary Gearbox from Europe (Italy) and re-sell it in India as well outside India. So, starting from the year 2000 till the year 2016, we have sold more than 100 Planetary Gearboxes for the Cane Mill application & GRPF application in India as well outside India.

With sixteen years of experience in Cane Mill application in 2016, we started detail engineering on making our own high-quality Planetary Gearbox, especially for the Cane Mill & GRPF application. This was explicitly engineered/designed to compete with French, German & Japanese quality standards. And finally, we designed a high-quality, unique Planetary Gearbox for the Cane Mill Application & GRPF Application. In December 2018, we formed a new Company, "Mill Gears Private Limited", where we started manufacturing our own Planetary Gearboxes in India.

We have a range starting from 550000 Nm till 5500000 Nm (T_{2Hlim}/Tiso/Nominal Torque) especially engineered and developed for the Cane Mill & GRPF applications. This range of specialized Planetary Gearboxes has been designed by a renowned European Engineer with over 45 years of experience designing Planetary Gearboxes for various applications. The best part of our design is it is available in three stages up to a 291:1 Ratio (All stages are 100% Planetary stages). The Design & Quality standards of our gearboxes are based on ISO DP 6336 / ISO 281 standards. The gearboxes are designed with Infinite gear life (Satellite Gears, Pinion & Ring Gear), and bearings were selected having minimum life of 150000 hours. All our Gearboxes have FIVE years standard warranty.

Note: - We do not manufacture components in-house because we believe that – an experienced manufacturer should manufacture it to ensure the highest quality standard without any deviations. So most of our components are manufactured by renowned European companies with a minimum of 40 years of experience.

***First time in the history of Gearbox market, Mill Gears Private Limited is happy to announce 5 years of warranty on their supplied gearboxes from the date of invoice. However certain terms & conditions may apply.**

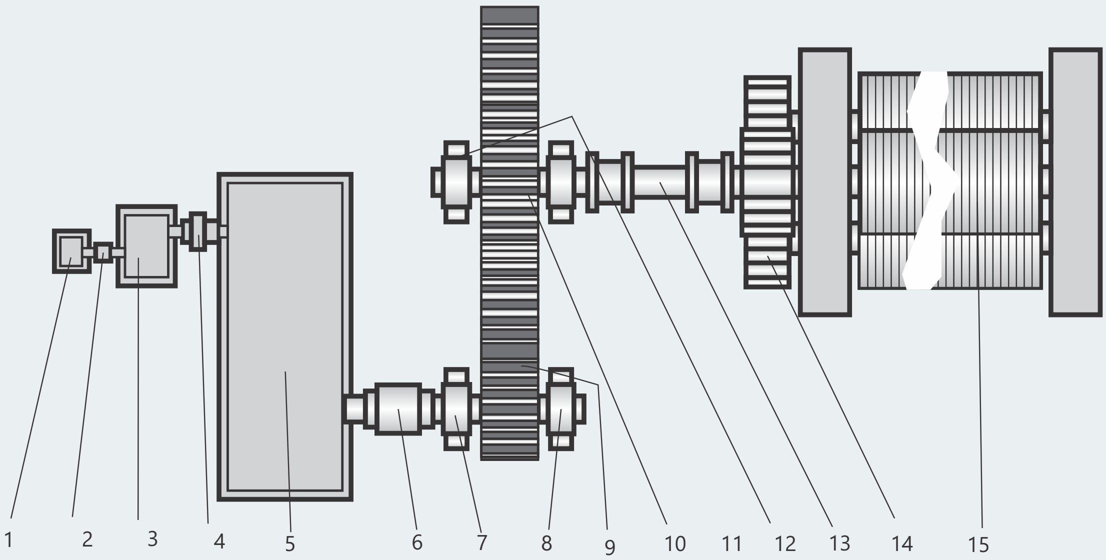
CONVENTIONAL vs PLANETARY CANE MILL DRIVE

Conventional System

The Conventional Sugar Cane Mill Drive consists of Steam turbine, high-speed coupling, high-speed gearbox, coupling, gear reducer, coupling, pinion shaft, two pinion shaft pedestal bearings, output gear, two output shaft, pedestal bearings, square coupling, coupling gears, mill rolls (15 components).

Old Conventional Sugar Cane Mill Drive

1. Steam turbine
2. High speed coupling
3. High speed gearbox
4. Coupling
5. Gearbox
6. Coupling
7. Bearing
8. Bearing
9. Pinion
10. Gear wheel
11. Bearing
12. Bearing
13. Square coupling
14. Crown Pinion
15. Cane Mill

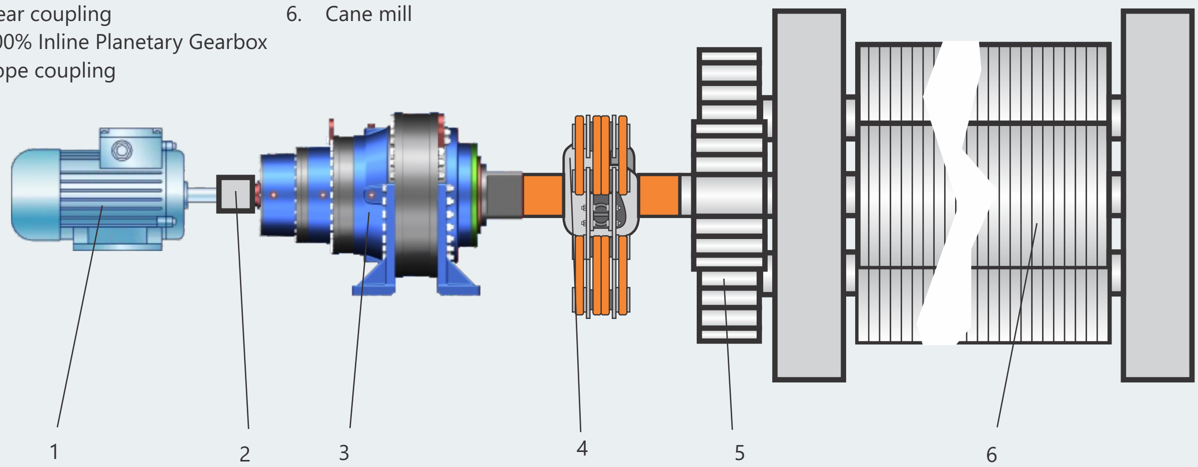


Alternative 1

Compare with a conventional drive unit, Modern Cane Mill Drive consists of Electric motor, Gear Coupling, Hydraulic motor, (or Steam turbine), 100% Inline Planetary Gearbox, Rope coupling and Mill Roller.

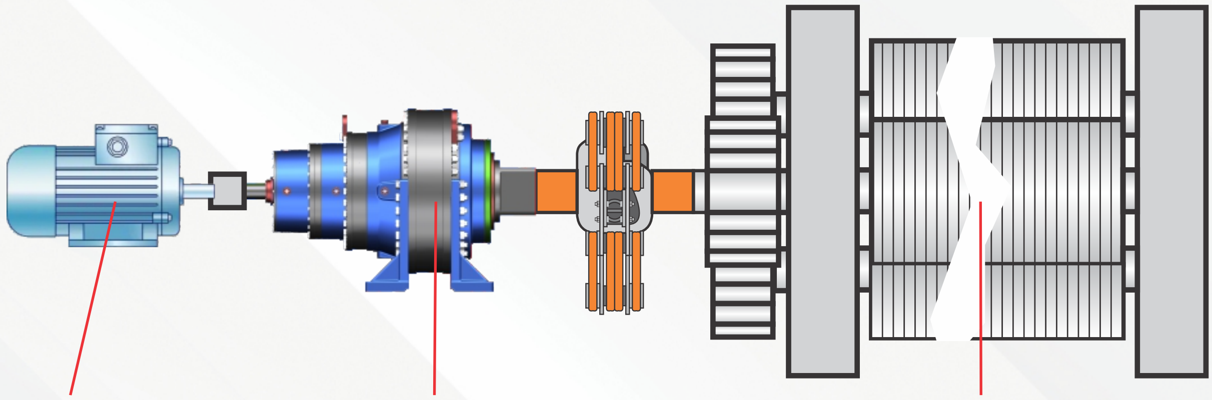
Modern Cane Mill Drive

1. Electric motor (AC drive)
2. Gear coupling
3. 100% Inline Planetary Gearbox
4. Rope coupling
5. Crown Pinion
6. Cane mill



In-line Foot Mounted Planetary Gearbox

Let's understand the basic working fundamentals of Cane Mill Application



1). Cane Mill [Demand]

These are the two processes used for extracting juice from Cane:

- Milling
- Diffusion

Both applications require a high power supply to extract juice from cane fiber. Power is the product of two dimensions (torque and speed) and is supplied by the electric motor. Since the speed requested by the applications is low, the torque is always very high.

2). Most Modern Planetary Gearbox [Mediator between Demand & Supply]

The power supplied by the electric motor is delivered to the mill through the gearbox (the Mediator). Since a Cane Mill requires a high torque and a low speed, modern planetary gearboxes are used to do the job. The motor's shaft is connected to the input shaft of the gearbox that, through a series of internal gearing, provides a mechanical advantage reducing speed and increasing torque.

Working fundamental of Gearbox

- The distinguishing feature is the gearbox ratio = input speed / output speed. So once we know the gearbox ratio and the motor's features in terms of torque and speed we can calculate the gearbox's mechanical advantage.
- Motor Torque x Gearbox ratio = Gearbox Output Torque
- Motor Speed / Gearbox ratio = Gearbox Output Speed

The Gearbox is the Power Mediator between Demand (Mill) and Supply (Motor) and represents the most critical and important equipment whose reliability must be out of question.

3). AC Electric Motor with Variable Frequency Drive [Supply]

Motor is the main element which provides torque to the input shaft of the gearbox that will deliver it to the cane Mill to fulfill its demand of torque to extract juice from the cane.

- From Motor Power (kW) and Motor speed (rpm), we can calculate Motor torque in (kgm) or (Nm)
- Motor torque (kgm) = (constant factor) 974 x Motor (kW) divided by Motor (rpm)
- Motor torque (Nm) = (constant factor) 9550 x Motor (kW) divided by Motor (rpm)

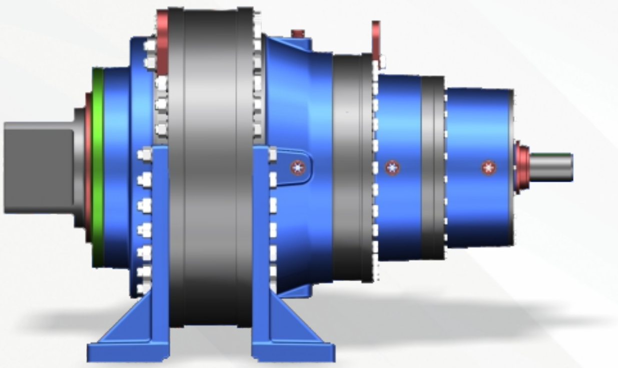
EXAMPLE: Motor 800 kW/6 poles (running speed 994 rpm)

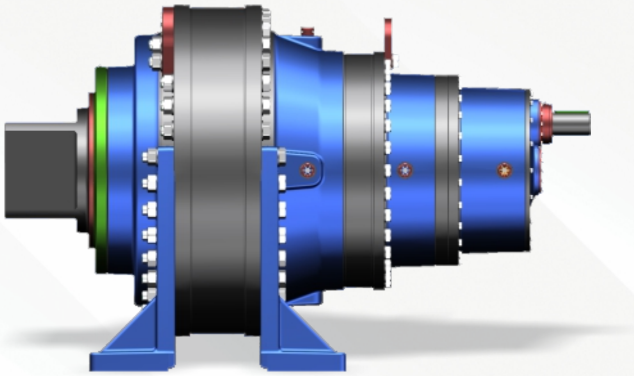
- Motor torque (kgm) = 974 x 800 / 994 = 783.9 (kgm)
- Motor torque (Nm) = 9550 x 800 / 994 = 7686.1 (Nm)

This is the value of the torque that the motor will transfer to the gearbox input shaft.

NOTE: Motors are produced with many different speed that can vary from 1788 (rpm) to 745 (rpm) and with many different features that must be taken into account when calculating the gearbox selection / dimensions.

Mill Gears Planetary Gearbox for Cane Mill Application





AK planetary gearboxes manufactured by Mill Gears have been designed according to ISO 6336 and ISO 281 Standard. They use only reliable components selected from the main suppliers available world wide. Gears and castings are manufactured in Europe by professional suppliers specialized in gears and casting machining. Thanks to its modular design, many basic components have been standardized in each sizes to reduce complexity. General engineering has been developed to produce gearboxes dedicated to the Sugar Mills industry.

General Description

Sizes and transmission types

- AK planetary gearboxes are produced in a wide range of sizes having Nominal Output Torques from 1.3 MNm to 4.8 MNm. Each size is available in 3 or 4 stages combinations offering a complete choice of 18 different ratios specifically dedicated to Sugar Mills requirements. Special ratios can be developed on request.

Housing

- Housings and all cast components are made out of spheroidal cast iron.

Gears

- Spur planetary gears are case hardened and ground. Annulus gears are quenched, tempered and nitrided. Input parallel stage gears have helical teeth case hardened and ground.

Bearings

- All shafts and gears are supported by large and very strong bearings calculated for a basic life higher than 100,000 hours if the gear box is implemented correctly according to the directions supplied. This goal was achieved because Mill Gears is not producing general purpose transmissions but gearboxes dedicated to Cane Mills Applications.

Output shaft

- The output shaft is realized using quenched and tempered high capacity steel. The general shape is squared with dimensions suitable to mount the most modern rope joints. The internal engineering is likely to supply any different shaft shape on request.

Seals

- Input and output shafts have double rubber seals with retention lips reinforced with a PTV lining (virgin PTFE or Teflon) that, among its outstanding chemical properties, grants a very low friction coefficient at temperatures over 200°C. Extra protection from ambient pollution is supplied by means of a greasing cavity between seals and by an additional external V-seal.

Lubrication

- Easy lubrication and oil external circulation is granted by very large 2″ GAS threaded ports available on each housing, together with oversized internal openings that allow a large unobstructed oil passage and supply.

Gearbox Basic Performance Identification

Even if calculation engineers have many calculation Standard available (ISO, DIN, AGMA the most important), gearbox manufacturers, that produce general purpose gearboxes, have always the problem of identifying a basic performance associated with each gearbox size on their catalogues.

Speaking of gear life, since catalogue gearboxes are not finalized regarding the final application, the normal way to solve the problem of size identification is to use a specific feature allowed by the gear calculation Standard ISO 6336.

In practice, using a general purpose ISO stress value of 1,500 N/mm² it is possible to calculate an output torque related to a specific number of 50 million cycles. This torque value is called in many different ways by different manufacturers:

- T_{2N} Nominal
- T_2 Reference
- $T_{2\,ISO}$
- $T_{2\,Hlim}$
- other

When the gearboxes on a catalogue are listed using this method, it's not possible to calculate the gearbox life in real working conditions for two main reason. First of all, the life in hours corresponding to 50 million cycle is generally too short for an industrial application. In the second place it's evident that bearing's life cannot be calculated. This torque value can be used only according to a previous experience or to compare different catalogues.

During its entire work life, the gearbox, is likely to suffer torque peaks for a very short time. The dimensions of the gearbox components (like gears, shafts, splines, bolted connections) are calculated to bear instantaneous peak loads that are much higher than work loads. T2 max can be defined as the value of the static torque that the gearbox can withstand for a very short time without damaging any component.

Gearbox Life Calculation

Gearbox life in real working conditions depends from gear's and bearing's life, whichever is less.

GEAR LIFE

Gear life can be calculated in two ways:

- Duty Cycle available: In this case it's possible to represent the whole work life of the gearbox in "power segments" having the same torque and speed for a certain time . Using an adequate software it's possible to calculate the life of gears and bearings using the theory of "cumulated damage". It is a sophisticated method that can be implemented only by the gearbox manufacturer, using a dedicated software, and implies a deep knowledge of the application.

- Duty Cycle Not Available: This is the case of many applications whose behavior is not easily predictable. In this case it's a normal practice to identify, according to personal experience, a "Service factor fs" (some catalogues call it "Application Factor") that is a fixed value, higher than one associated with the application. The gearbox Nominal Torque, divided by fs, is called "Work Torque" that, using the output speed, allows the calculation of the Work Power that is the motor power. It is normally an approximate method that can lead to many mistakes when dealing with general purpose gearboxes.

BEARING'S LIFE

Bearing's life is always calculated according to the Standard ISO 281 using the calculated force on the bearing, its dynamic factor (from supplier catalogue) and the rotational speed. Since the life curve of the bearings (relationship between stress and hours) is different from the life curve of the gears, a selection based only on gear's life can lead to premature breakdown.

Planetary Gearbox for Cane Mill Application

Planetry Gearbox is the best solution to use for Mill drive application: If the gearbox has been selected properly it will last for a minimum 15 to 20 years without any problem

However nowadays (in India) we are observing many breakdowns of Planetry Gearboxes used in Sugar industries for various types of applications that includes Cane Mill application, GRPF Application, TRPF Application, Cane Carrier, Rack Carrier, Inter Carrier, Main Bagasse Carrier, Return Bagasse Carrier etc.

So we studied this issue and we found the following reasons:

- Gearbox are not selected based on connected power vs. output rpm. This means that, once the Mill power requirement is fixed, people don't take enough care of the output torque that depends from gearbox ratio.
- Catalogues offer general purpose gearboxes and it's not possible to know if the bearings can grant a reliable performance throughout the requested Mill life. A broken bearing can destroy the gearbox very quickly.
- General purpose gearboxes realize the different ratios using available stages that, sometime, have not the same reliability. Thus, since the Nominal Torque is referred to the output stage, the gearbox can fail due to other stages.
- We also observed that many gearbox suppliers apply the Service Factor to T2 max value.
- Since ISO 6336 is allowing the possibility of doing the calculation of the Nominal Torque using different values of the Reference Stress, some gearbox suppliers use a value higher than the advisable 1,500 N/mm^2 . In this way they justify Nominal Torque values which are dangerously high.

Due to the above reasons it's very difficult for a consultant or or the ultimate customer to evaluate if the gearbox manufacturer has selected and offered the proper gearbox for their Cane Mill application

The consequence is that you don't know what you are buying !!

Now, how to calculate the correct torque needed by Cane Mill to extract juice from cane?

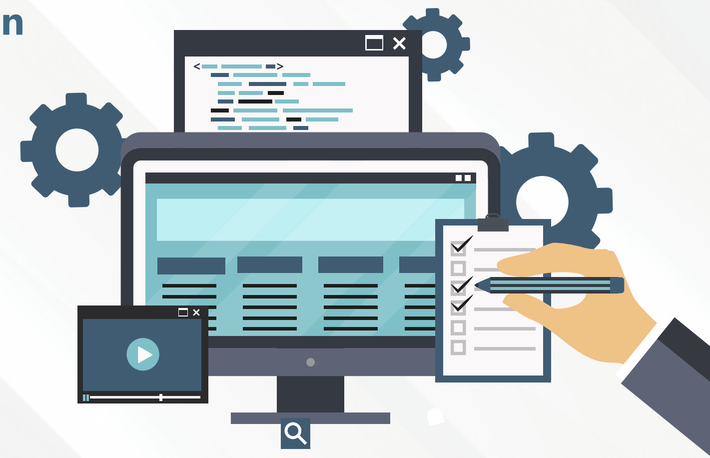
Question:

Can anyone say what will be the Torque Demand from your Cane Mill? Means how much Torque Cane Mill will demand to Gearbox to extract Juice from Cane ?

Answer:

Today there is a software in which if we enter inputs like TCD, Fibre % Cane, Roll Diameter, Roll length, Prime Mover, Mill Ratios, Trash Plate Ratio, working Mill speed etc. the software will give you theoretical calculation / figure of Torque needed by Milling Rolls. So you can easily select Electric Motor.

However this software cannot calculate the following conditions into consideration



- Accumulation of bagasse at mill mouth portion and Donnelly chute buffer can cause heavy jamming and therefore, to clear this jamming you require a number of starts and stops, reverse and forward or else at times you cannot run the Mill, so you to first remove the bagasse manually.
- Some times when such jamming happens the bagasse falls into the Mill rollers.
- Some foreign material comes with the fibre.
- Failure of hydraulic system leads to solid milling demanding exceptionally high power.
- Also, the condition of rollers due to wear and tear makes rollers polish and slippage accrues leads to heavy power requirement.
- So many other accidental issue might take place during crushing
- So there is no software available which can define these Torque values (resistance torque needed by Mill)

From the software you can only calculate the required figures to operate Mills (when it is running smoothly). Accordingly you can select Electric Motor keeping some higher margins based on general load study. But when it comes to the selection of gearbox, most of the people are not much aware about a number of factors involved in the selection of a proper Planetary Gearbox for Cane Mill application.

Let’s understand:
Mill Gears Planetary Gearboxes Selection Criteria

Since a reliable duty cycle for a Cane Mill is not predictable, the only correct selection criteria is based on Service Factor.

The main difference between Mill Gears gearboxes and other available products using this selection criteria is that Mill Gears has developed a dedicated design engineering instead of using general purpose components.

Main features related to gears are:

- The Nominal output torque (that we will call T_2Hlim) has been calculated according to ISO Standard 6336 using a safe allowable contact stress number of 1,500 N/mm^2 and a Life Factor related to 50 million Cycles.
- The Nominal output torque is related to the output planetary stage. All other stages have been dimensioned accordingly to grant a longer life in the same working conditions, which is not always true using general purpose available stages.
- Since the Nominal output torque depends only by the output stage, its value is the same for all ratios making performance calculation much easier.

Using the output torque T_2Hlim for more than 50 Million cycles, ANY gearbox is likely to suffer early damaging fatigue on teeth surface. The solution is to use a Service Factor. Mill Gears has fixed: fs = 1.5 (This choice is not casual).

If T_2Hlim is too strong to grant a long life to the gears, the Work output torque must be lower. Due to a specific feature allowed by the life curve given by ISO 6336, the Nominal torque must be divided by 1.4 to allow infinite life to the gears

$$\boxed{\text{ISO } T_2 \text{ infinite} = T_2\text{Hlim} / 1.4}$$

Using a Service Factor fs = 1.5 (bigger than 1.4) we grant infinite life to the gears providing extra safety when Class V Electric Motor is being used.

$$\boxed{\text{Work Torque} > T_2 \text{ infinite} = T_2\text{Hlim} / 1.5}$$

Since T_2Hlim is the same for all ratios of each gearbox size, also the Work torque is the same and can easily be calculated using the upper equation. Using the Work Torque, the Work Power can be calculated using the gearbox output speed

$$\boxed{\text{Work Power} = (T_2\text{Hlim} / 1.5) \times n_2/9550}$$

Work Power is the safe power of the connected motor. This method is very easy and the examples in the next pages will clarify the simplicity of this method that can be implemented only by the accurate engineering of Mill Gears.

Bearings behavior related to stress is similar but different from gear’s. Each bearing dimension, on the supplier’s catalogue, is associated with a so called “Dynamic Factor”. The force insisting on the bearing, the running speed and the Dynamic Factor are used into a specific formula according to ISO Standard 281 to calculate the “basic life” of the bearing called L10H. The two main features related to this value are:

- The number “10” means that only 90% of the bearings calculated in specific working conditions will reach the calculated life. That is, 10% of the bearings may fail earlier.
- The basic life can be considered reliable only if the bearings are perfectly lubricated (good oil viscosity related to speed and temperature) and work in very good cleanliness conditions.

What is Mill Gears's answer to the above problems?

- Unlikely most competitors, using a Service Factor fs = 1.5 on T2Hlim and an output speed ⩽ 7 rpm, Mill Gears has selected all bearings in order to achieve a basic life over 100,000 hours. This feature is allowed by the dedicated engineering of all stages. The beneficial effects of this extremely long basic life of over (that is unusual in standard gearboxes) are evident if we consider the following example related to a possible request for a total life of 50,000 hours with a specific output torque and speed:

  - Standard gearbox calculated with a bearing's basic life L10H = 50,000 hours (as requested). In this case bearing's reliability is 90%

  - Mill Gears gearboxes calculated with a bearing's basic life L10H > 100,000 hours. In this case, bearing's reliability at 50,000 is 97-98 %

- The basic life variation, due to lubrication oil parameters, can be highly complicated to calculate and to fulfill. Stages don't run at the same speed thus oil's best viscosity demand can be different from stage to stage. Moreover, viscosity changes with temperature and oil are never as clean as requested by the bearing's suppliers. The answer to these problem can be provided by an external oil circulation system with cooling and filtering capability. Oil is also an important factor. Good quality PAO oil with Anti Wear / Extreme pressure additives is advisable. Evidence must be given to oil cooling because this feature is not only important to control oil viscosity but it is also important to keep the oil temperature below 80°C since AW/EP additives can be detrimental to bearing's life if temperature is higher.

MGPL's Planetary Gearbox for Cane Mill Application

According to the information supplied in the previous page, the Work Torque related to each ratio of each size is:

Work Torque T_2 = T_2Hlim / 1.4 | **Work Torque T_2 = T_2Hlim / 1.4**

1). Using the value of Work Torque and Work Speed, it's possible to calculate the maximum Work Power allowed by each ratio of each size.

2). The Work Power is the continuous power that allows infinite gear life of the gears and more than 100,000 hours of the bearings.

3). Work Power is the maximum power of the electric motor connected to the gearbox and it can be selected using the tables in the following page.

Motor Power Selection

Once you know the Mill speed and the motor speed, the selection of the gearbox ratio and the maximum allowed power is immediately available. See below Table for the same:-

Series AK 130

$Pmax = (T_2Hlim/1.708) \times n_2 / 9550$

		745 (rpm)		890 (rpm)		994 (rpm)		1190 (rpm)	
	GEARBOX RATIO	n2 (rpm)	Pmax (kW)	n2 (rpm)	Pmax (kW)	n2 (rpm)	Pmax (kW)	n2 (rpm)	Pmax (kW)
3 STAGE	146.50	5.09	495	6.08	591	6.79	660	8.12	790
	156.53	4.76	463	5.69	553	6.35	618	7.60	740
	168.44	4.42	430	5.28	514	5.90	574	7.06	687
	182.82	4.08	396	4.87	474	5.44	529	6.51	633
	200.52	3.72	362	4.44	432	4.96	482	5.93	577
	222.83	3.34	325	3.99	389	4.46	434	5.34	520
	251.84	2.96	288	3.53	344	3.95	384	4.73	460
	291.08	2.56	249	3.06	298	3.41	332	4.09	398
4 STAGE	282.98	2.63	256	3.15	306	3.51	342	4.21	409
	307.14	2.43	236	2.90	282	3.24	315	3.87	377
	336.87	2.21	215	2.64	257	2.95	287	3.53	344
	374.35	1.99	194	2.38	231	2.66	258	3.18	309
	423.09	1.76	171	2.10	205	2.35	229	2.81	274

Series AK 160

$Pmax = (T_2Hlim/1.708) \times n_2 / 9550$

		745 (rpm)		890 (rpm)		994 (rpm)		1190 (rpm)	
	GEARBOX RATIO	n2 (rpm)	Pmax (kW)	n2 (rpm)	Pmax (kW)	n2 (rpm)	Pmax (kW)	n2 (rpm)	Pmax (kW)
3 STAGE	146.50	5.09	618	6.08	739	6.79	825	8.12	988
	156.53	4.76	579	5.69	691	6.35	772	7.60	924
	168.44	4.42	538	5.28	642	5.90	718	7.06	859
	182.82	4.08	496	4.87	592	5.44	661	6.51	792
	200.52	3.72	452	4.44	540	4.96	603	5.93	722
	222.83	3.34	407	3.99	486	4.46	542	5.34	649
	251.84	2.96	360	3.53	430	3.95	480	4.73	575
	291.08	2.56	311	3.06	372	3.41	415	4.09	497
4 STAGE	282.98	2.63	320	3.15	382	3.51	427	4.21	511
	307.14	2.43	295	2.90	352	3.24	394	3.87	471
	336.87	2.21	269	2.64	321	2.95	359	3.53	430
	374.35	1.99	242	2.38	289	2.66	323	3.18	387
	423.09	1.76	214	2.10	256	2.35	286	2.81	342

Series AK 190

Pmax = (T_2Hlim/1.952) x n_2 / 9550

		745 (rpm)		890 (rpm)		994 (rpm)		1190 (rpm)	
	GEARBOX RATIO	n2 (rpm)	Pmax (kW)	n2 (rpm)	Pmax (kW)	n2 (rpm)	Pmax (kW)	n2 (rpm)	Pmax (kW)
3 STAGE	136.78	5.45	696	6.51	831	7.27	929	8.70	1,112
	146.14	5.10	651	6.09	778	6.80	869	8.14	1,040
	157.27	4.74	605	5.66	723	6.32	808	7.57	967
	170.69	4.36	558	5.21	666	5.82	744	6.97	891
	187.21	3.98	508	4.75	607	5.31	678	6.36	812
	208.04	3.58	458	4.28	547	4.78	610	5.72	731
	235.12	3.17	405	3.79	484	4.23	540	5.06	647
	271.76	2.74	350	3.27	418	3.66	467	4.38	559
4 STAGE	229.78	3.24	414	3.87	495	4.33	553	5.18	662
	245.52	3.03	388	3.62	463	4.05	517	4.85	619
	264.21	2.82	360	3.37	430	3.76	481	4.50	575
	286.76	2.60	332	3.10	397	3.47	443	4.15	530
	314.52	2.37	303	2.83	362	3.16	404	3.78	483
	349.51	2.13	272	2.55	325	2.84	363	3.40	435
	395.01	1.89	241	2.25	288	2.52	322	3.01	385

Series AK 200

Pmax = (T_2Hlim/1.708) x n_2 / 9550

		745 (rpm)		890 (rpm)		994 (rpm)		1190 (rpm)	
	GEARBOX RATIO	n2 (rpm)	Pmax (kW)	n2 (rpm)	Pmax (kW)	n2 (rpm)	Pmax (kW)	n2 (rpm)	Pmax (kW)
3 STAGE	146.50	5.09	778	6.08	930	6.79	1,038	8.12	1,243
	156.53	4.76	728	5.69	870	6.35	972	7.60	1,163
	168.44	4.42	677	5.28	808	5.90	903	7.06	1,081
	182.82	4.08	623	4.87	745	5.44	832	6.51	996
	200.52	3.72	568	4.44	679	4.96	758	5.93	908
	222.83	3.34	512	3.99	611	4.46	683	5.34	817
	251.84	2.96	453	3.53	541	3.95	604	4.73	723
	291.08	2.56	392	3.06	468	3.41	522	4.09	625
4 STAGE	282.98	2.63	403	3.15	481	3.51	537	4.21	643
	307.14	2.43	371	2.90	443	3.24	495	3.87	593
	336.87	2.21	338	2.64	404	2.95	451	3.53	540
	374.35	1.99	304	2.38	364	2.66	406	3.18	486
	423.09	1.76	269	2.10	322	2.35	359	2.81	430

Series AK 250

$Pmax = (T_2Hlim/1.708) \times n_2 / 9550$

	GEARBOX RATIO	745 (rpm) n2 (rpm)	745 (rpm) Pmax (kW)	890 (rpm) n2 (rpm)	890 (rpm) Pmax (kW)	994 (rpm) n2 (rpm)	994 (rpm) Pmax (kW)	1190 (rpm) n2 (rpm)	1190 (rpm) Pmax (kW)
3 STAGE	146.50	5.09	987	6.08	1,179	6.79	1,316	8.12	1,576
	156.53	4.76	923	5.69	1,103	6.35	1,232	7.60	1,475
	168.44	4.42	858	5.28	1,025	5.90	1,145	7.06	1,371
	182.82	4.08	791	4.87	944	5.44	1,055	6.51	1,263
	200.52	3.72	721	4.44	861	4.96	962	5.93	1,151
	222.83	3.34	649	3.99	775	4.46	865	5.34	1,036
	251.84	2.96	574	3.53	686	3.95	766	4.73	917
	291.08	2.56	497	3.06	593	3.41	662	4.09	793
4 STAGE	282.98	2.63	511	3.15	610	3.51	681	4.21	816
	307.14	2.43	471	2.90	562	3.24	628	3.87	752
	336.87	2.21	429	2.64	513	2.95	572	3.53	685
	374.35	1.99	386	2.38	461	2.66	515	3.18	617
	423.09	1.76	342	2.10	408	2.35	456	2.81	546

Series AK 330L

$Pmax = (T_2Hlim/1.952) \times n_2 / 9550$

	GEARBOX RATIO	745 (rpm) n2 (rpm)	745 (rpm) Pmax (kW)	890 (rpm) n2 (rpm)	890 (rpm) Pmax (kW)	994 (rpm) n2 (rpm)	994 (rpm) Pmax (kW)	1190 (rpm) n2 (rpm)	1190 (rpm) Pmax (kW)
3 STAGE	136.78	5.45	1,181	6.51	1,411	7.27	1,575	8.70	1,886
	146.14	5.10	1,105	6.09	1,320	6.80	1,474	8.14	1,765
	157.27	4.74	1,027	5.66	1,227	6.32	1,370	7.57	1,640
	170.69	4.36	946	5.21	1,130	5.82	1,262	6.97	1,511
	187.21	3.98	863	4.75	1,031	5.31	1,151	6.36	1,378
	208.04	3.58	776	4.28	927	4.78	1,036	5.72	1,240
	235.12	3.17	687	3.79	821	4.23	916	5.06	1,097
	271.76	2.74	594	3.27	710	3.66	793	4.38	949
4 STAGE	229.78	3.24	703	3.87	840	4.33	938	5.18	1,123
	245.52	3.03	658	3.62	786	4.05	878	4.85	1,051
	264.21	2.82	611	3.37	730	3.76	816	4.50	976
	286.76	2.60	563	3.10	673	3.47	751	4.15	900
	314.52	2.37	513	2.83	613	3.16	685	3.78	820
	349.51	2.13	462	2.55	552	2.84	617	3.40	738
	395.01	1.89	409	2.25	488	2.52	546	3.01	653

Series AK 330

Pmax = (T_2Hlim/1.708) x n_2 / 9550

		745 (rpm)		890 (rpm)		994 (rpm)		1190 (rpm)	
	GEARBOX RATIO	n2 (rpm)	Pmax (kW)	n2 (rpm)	Pmax (kW)	n2 (rpm)	Pmax (kW)	n2 (rpm)	Pmax (kW)
3 STAGE	144.82	5.14	1,274	6.15	1,523	6.86	1,700	8.22	2,036
	154.74	4.81	1,193	5.75	1,425	6.42	1,591	7.69	1,905
	166.52	4.47	1,108	5.34	1,324	5.97	1,479	7.15	1,771
	180.73	4.12	1,021	4.92	1,220	5.50	1,363	6.58	1,631
	198.22	3.76	931	4.49	1,112	5.01	1,242	6.00	1,487
	220.28	3.38	838	4.04	1,001	4.51	1,118	5.40	1,338
	248.96	2.99	741	3.57	886	3.99	989	4.78	1,184
	287.75	2.59	641	3.09	766	3.45	856	4.14	1,025
4 STAGE	266.47	2.80	693	3.34	827	3.73	924	4.47	1,106
	284.72	2.62	648	3.13	774	3.49	865	4.18	1,035
	306.39	2.43	602	2.90	720	3.24	804	3.88	962
	332.54	2.24	555	2.68	663	2.99	741	3.58	887
	364.73	2.04	506	2.44	605	2.73	675	3.26	808
	405.32	1.84	455	2.20	544	2.45	608	2.94	727
	458.08	1.63	403	1.94	481	2.17	538	2.60	644

Series AK 390

Pmax = (T_2Hlim/1.708) x n_2 / 9550

		745 (rpm)		890 (rpm)		994 (rpm)		1190 (rpm)	
	GEARBOX RATIO	n2 (rpm)	Pmax (kW)	n2 (rpm)	Pmax (kW)	n2 (rpm)	Pmax (kW)	n2 (rpm)	Pmax (kW)
3 STAGE	145.83	5.11	1,527	6.10	1,825	6.82	2,038	8.16	2,440
	155.82	4.78	1,430	5.71	1,708	6.38	1,907	7.64	2,283
	167.68	4.44	1,328	5.31	1,587	5.93	1,772	7.10	2,122
	181.99	4.09	1,224	4.89	1,462	5.46	1,633	6.54	1,955
	199.61	3.73	1,116	4.46	1,333	4.98	1,489	5.96	1,783
	221.82	3.36	1,004	4.01	1,200	4.48	1,340	5.36	1,604
	250.70	2.97	889	3.55	1,061	3.96	1,186	4.75	1,419
	289.76	2.57	769	3.07	918	3.43	1,026	4.11	1,228
4 STAGE	268.34	2.78	830	3.32	992	3.70	1,108	4.43	1,326
	286.71	2.60	777	3.10	928	3.47	1,037	4.15	1,241
	308.53	2.41	722	2.88	863	3.22	963	3.86	1,153
	334.87	2.22	665	2.66	795	2.97	888	3.55	1,063
	367.28	2.03	606	2.42	725	2.71	809	3.24	969
	408.50	1.82	545	2.18	651	2.43	728	2.91	871
	461.28	1.62	483	1.93	577	2.15	644	2.58	771

Series AK 480

$P_{max} = (T_2Hlim/1.708) \times n_2 / 9550$

		745 (rpm)		890 (rpm)		994 (rpm)		1190 (rpm)	
	GEARBOX RATIO	n2 (rpm)	Pmax (kW)	n2 (rpm)	Pmax (kW)	n2 (rpm)	Pmax (kW)	n2 (rpm)	Pmax (kW)
3 STAGE	145.83	5.11	1,860	6.10	2,221	6.82	2,481	8.16	2,970
	155.82	4.78	1,740	5.71	2,079	6.38	2,322	7.64	2,780
	167.68	4.44	1,617	5.31	1,932	5.93	2,158	7.10	2,583
	181.99	4.09	1,490	4.89	1,780	5.46	1,988	6.54	2,380
	199.61	3.73	1,359	4.46	1,623	4.98	1,813	5.96	2,170
	221.82	3.36	1,223	4.01	1,460	4.48	1,631	5.36	1,953
	250.70	2.97	1,082	3.55	1,292	3.96	1,443	4.75	1,728
	289.76	2.57	936	3.07	1,118	3.43	1,249	4.11	1,495
4 STAGE	268.34	2.78	1,011	3.32	1,207	3.70	1,348	4.43	1,614
	286.71	2.60	946	3.10	1,130	3.47	1,262	4.15	1,511
	308.53	2.41	879	2.88	1,050	3.22	1,173	3.86	1,404
	334.87	2.22	810	2.66	967	2.97	1,080	3.55	1,294
	367.28	2.03	738	2.42	882	2.71	985	3.24	1,179
	408.15	1.83	664	2.18	794	2.44	886	2.92	1,061
	461.28	1.62	588	1.93	702	2.15	784	2.58	939

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MEMORY