INTER PLANT STANDARD – STEEL INDUSTRY		
IPSS	**CODE OF PRACTICE FOR SELECTION OF GEAR BOXES**	**IPSS: 1-01-024-18 (First Revision)**
	Corresponding IS does not exist	Formerly IPSS: 1-01-024-86

0. FOREWORD

0.1 Interplant standardization in steel industry has been initiated under the aegis of the Indian Standards Institution (ISI) and the Steel Authority of India Limited (SAIL). The Interplant Standards prepared by the Standards Committee on Mechanical Drives, IPSS 1:1, with the active participation of the representatives of all the steel plants was adopted by the Approval Committee on Consumable Stores and General Equipment, IPSS 1, on 25 March 1986. Lastly, this standard has been revised with first revision by the standard committee in **November, 2018** with the active participation of the representatives from major Indian steel plants and leading consultants.

0.2 Interplant Standards for steel industry primarily aim at achieving rationalization and unification of parts and sub-assemblies used in steel plant equipment and accessories and provide guidance in indenting stores or equipment for existing or new installations by individual steel plants. For exercising effective control or inventories, it is advisable to select a fewer number of sizes (or /types) from among those mentioned in this standard for the purpose of company standards of individual steel plants. It is not desirable to make deviations in technical requirements.

1. SCOPE

This Interplant Standard is intended to give guidelines for the selection of the suitable gear box.

2. DATA FOR PROPER SELECTION

The following data are essential to select correct type and size of gear box.

2.1 Prime Mover

2.1.1 Type – Electric Motor

2.1.2 Rated Power, kW

2.1.3 Speed, rev / min (if variable, indicate speed range and frequency of variation).

2.2 **Driven Machine:**

a) Type (such as kiln, conveyor, etc):

b) Actual power or torque necessary to drive the machine at desired speed of capacity of prime mover;

c) Speed, rev / min; and

d) Operating conditions, such as hours of operation per day, whether continuous or intermittent ambient temperature, frequency of starting, reversibility, number of reversals per hours, over-hung loads, back-stops, brakes and any other special requirement.

3. LOAD CHARACTRISTICS OF THE DRIVEN MACHINE

The driven machines are divided into three groups as per their load characteristics. The load may be uniform, moderate shock or heavy shock. Tables given below gives the load characteristics of different machines. If the required driven machine is not listed, use the one most similar.

4. SERVICE FACTOR

4.1 A gear box is rated to a specific application by the use of service factor. Service factor (S) is the ratio of maximum power rating of a particular size of gear box to the power required for driving the machine or equipment to which the gear box is coupled:

$$S = \frac{\text{Maximum rated power}}{\text{Actual power required}}$$

4.2 Each application has its own conditions and operating requirements, Tables given below gives the service factors for worm gear boxes and another Table gives the service factors for helical and spiral bevel and helical gear boxes. If the required driven machine is not listed, use the one most similar.

5. STARTING AND PEAK LOADS OF DRIVEN MACHINES

5.1 For infrequent starting (less than five starts per hour), the maximum momentary or starting load should not exceed 275 percent of rated load (175 percent overload). When peak load exceeds this rating divide peak power by 2.75 and use the result as resultant power rating. For frequent starting (More than five starts per hour), actual momentary or staring load shall not exceed 200 percent of the rated load (100 percent overload). When peak loads exceeds this rating, divide peak power by two and use the result as resultant power rating.

6. OUTPUT TORQUE RATINGS OF WORM GEAR BOXES

6.1 For all worm wheel speeds of 100 rev/min. or less, it has been found advantageous to use output torque ratings in preference to kW rating. Since at these low speeds static conditions are approximated, it is not necessary to apply service factors.

7. OVERHUNG LOAD

7.1 If a sprocket, pulley or spur pinion is mounted on the output shaft, overhung load is imposed on the shaft. The equivalent overhung load in kg. is calculated as under:

$$P = \frac{A \times 97\,500 \times K}{N \times R}$$

Where

P = equivalent overhung load in kg:

A = Actual power in kW;

N = Shaft speed in rev/min;

R = Pitch radius of sprocket, pulley or spur pinion in centimetres; and

K = load factor.

The load factors are as under:

Overhung Member	K Factor
Sprocket	1.00
Spur pinion	1.25
V-belt sheave	1.50
Flat belt Pulley	3.00

7.2 The calculated overhung load shall be specified while purchasing the gear box. If this is more than the permissible overhung load on the gear box, additional leasing will have to be provided.

8. STEPS FOR SELECTION

8.1 Determine service factor (S) by referring to Tables given below

8.2 Calculate equivalent power by the following equation :

Equivalent Power = Selected Motor KW X S

8.3 Determine Speed Ratio (i) by the following equation:

$$i = \frac{\text{Rev / min of input shaft}}{\text{Rev/min of output shaft}}$$

If the exact speed ratio is not particularly important, select the ratio from the standard very near to the calculated speed ratio.

8.4 Refer Interplant Standard on gear boxes and select a gear box of required rating. The ratings given in the Interplant Standards are only mechanical ratings and are based on service factor one (1) (10-12 hours duty with uniform load).

8.5 Auxiliary cooling of the gear box should be provided if the temperature oil is likely to exceed 70 ^{o}C.

8.6 Further, check for frequency of starting, momentary peak load, brake torque overhung load, back stops etc., as per 5 to 7.2. IF necessary, select a gear box of next higher size based on the above operating conditions.

Service Factor Section

Application service factors are used to adjust the SE Encore selection process to compensate for various loads that may be applied to the worm gear reducer during normal operation. Service factors are applied only to the mechanical rating and not the thermal rating of a worm gear reducer. The charts in this section have been expanded to include typical power transmission applications and their normal load rating. These charts are per AGMA standards. The ratings section of this catalog includes gear reducer rating tables for UNIFORM (1.00) load and service factored rating tables for MODERATE (1.25) and HEAVY (1.50) shock load applications.

Important Terms

APPLIED HP or TORQUE – This is the actual power applied to the input of the worm gear reducer by a drive or motor.

SERVICE FACTOR – Represents the adjustment needed in the APPLIED HP or TORQUE to insure the original design life of the SE Encore speed reducer is maintained in the application.

DESIGN HP or TORQUE – Include the appropriate service factor that accounts for the conditions under which the reducer will be used. Example: 1 HP APPLIED motor input times 1.25 SERVICE FACTOR results in a 1.25 DESIGN HP.

Load classifications are momentary changes in the applied load without changing direction or starting and stopping:

UNIFORM LOAD – Recurring shock loads that do not exceed the specified input or prime mover power.

MODERATE SHOCK LOAD – Recurring shock loads that do not exceed 125% of the specified input or prime mover power.

HEAVY SHOCK LOAD – Recurring shock loads that do not exceed 150% of the specified input or prime mover power.

EXTREME SHOCK LOAD – Recurring shock loads that do not exceed 175% of the specified input or prime mover power.

APPLICATION	SERVICE FACTORS		
	UP TO 3 HRS. DAY	3-10 HRS. DAY	OVER 10 HRS. DAY
AGITATORS (Mixers)			
Pure Liquids	–	1.00	1.25
Liquids and Solids	1.00	1.25	1.50
Liquids–Variable Density	1.00	1.25	1.50
BLOWERS			
Centrifugal	1.00	1.00	–
Lobe	1.00	1.25	1.50
Vane	–	1.00	1.25
BREWING AND DISTILLING			
Bottling Machinery	–	1.00	1.25
Brew Kettles, Continuous Duty	–	1.00	1.25
Cookers–Continuous Duty	–	1.00	1.25
Mash Tubs–Continuous Duty	–	1.00	1.25
Scale Hopper, Frequent Starts	1.00	1.25	1.50
CAN FILLING MACHINES	–	1.00	1.25
CAR DUMPERS	1.25	1.50	1.75
CAR PULLERS	1.00	1.25	1.50
CLARIFIERS	–	1.00	1.25
CLASSIFIERS	1.00	1.25	1.50
CLAY WORKING MACHINERY			
Brick Press	1.25	1.50	1.75
Briquette Machine	1.25	1.50	1.75
Pug Mill	1.00	1.25	1.50
COMPACTORS	1.50	1.75	2.00
COMPRESSORS			
Centrifugal	–	1.00	1.25
Lobe	1.00	1.25	1.50
Reciprocating, Multi-Cylinder	1.00	1.25	1.50
Reciprocating, Single-Cylinder	1.25	1.50	1.75

APPLICATION	SERVICE FACTORS		
	UP TO 3 HRS. DAY	3-10 HRS. DAY	OVER 10 HRS. DAY
CONVEYORS–GENERAL PURPOSE			
Uniformly loaded or fed	–	1.00	1.25
Not uniformly fed	1.00	1.25	1.50
Reciprocating or shaker	1.25	1.50	1.75
CRANES			
Dry Dock			
Main Hoist	1.25	1.50	1.75
Auxiliary Hoist	1.25	1.50	1.75
Boom Hoist	1.25	1.50	1.75
Slewing Drive	1.25	1.50	1.75
Traction Drive	1.50	1.50	1.50
Container			
Main Hoist Boom Hoist Trolley Drive (Gantry or Traction Drive)	Contact Winsmith		
Mill Duty			
Main Hoist Auxiliary Bridge and Trolley Travel	Contact Winsmith		
Industrial Duty			
Main	1.00	1.25	1.50
Auxiliary Bridge and Trolley Travel	Contact Winsmith		
CRUSHER			
Stone or Ore	1.50	1.75	2.00
DREDGES			
Cable Reels	1.00	1.25	1.50
Conveyors	1.00	1.25	1.50

Service Factor Section

APPLICATION	SERVICE FACTORS		
	UP TO 3 HRS. DAY	3-10 HRS. DAY	OVER 10 HRS. DAY
DREDGES (Continued)			
Cutter Head Drives	1.25	1.50	1.75
Pumps	1.00	1.25	1.50
Screen Drives	1.25	1.50	1.75
Stackers	1.00	1.25	1.50
Winches	1.00	1.25	1.50
ELEVATORS			
Bucket	1.00	1.25	1.50
Centrifugal Discharge	–	1.00	1.25
Escalators	Contact Winsmith		
Freight			
Gravity Discharge	–	1.00	1.25
EXTRUDERS			
General	1.25	1.25	1.25
Plastics			
Variable Speed Drive	1.50	1.50	1.50
Fixed Speed Drive	1.75	1.75	1.75
Rubber			
Continuous Screw Operations	1.50	1.50	1.50
Intermittent Screw Operations	1.75	1.75	1.75
FANS			
Centrifugal	–	1.00	1.25
Cooling Towers	Contact Winsmith		
Forced Draft	1.25	1.25	1.25
Induced Draft	1.00	1.25	1.50
Industrial & Mine	1.00	1.25	1.50
FEEDERS			
Apron	–	1.25	1.50
Belt	1.00	1.25	1.50
Disc	–	1.00	1.25
Reciprocating	1.25	1.50	1.75
Screw	1.00	1.25	1.50
FOOD INDUSTRY			
Cereal Cooker	–	1.00	1.25
Dough Mixer	1.00	1.25	1.50
Meat Grinders	1.00	1.25	1.50
Slicers	1.00	1.25	1.50
GENERATORS AND EXCITERS			
HAMMER MILLS			
HOISTS			
Heavy Duty	1.25	1.50	1.75
Medium Duty	1.00	1.25	1.50
Skip Hoist	1.00	1.25	1.50
LAUNDRY TUMBLERS			
LAUNDRY WASHERS			
LUMBER INDUSTRY			
Barkers			
Spindle Feet	1.25	1.25	1.50
Main Drive	1.50	1.50	1.50
Conveyors			
Burner	1.25	1.25	1.50
Main or Heavy Duty	1.50	1.50	1.50
Main Log	1.50	1.50	1.75
Re-Saw, Merry-Go-Round	1.25	1.25	1.50
Slab	1.50	1.50	1.75
Transfer	1.25	1.25	1.50
Chains			
Floor	1.50	1.50	1.50
Green	1.50	1.50	1.50

APPLICATION	SERVICE FACTORS		
	UP TO 3 HRS. DAY	3-10 HRS. DAY	OVER 10 HRS. DAY
LUMBER INDUSTRY (Continued)			
Cut-off Saws			
Chain	1.50	1.50	1.50
Drag	1.50	1.50	1.75
Debarking Drums	1.50	1.50	1.75
Feeds			
Edger	1.25	1.25	1.50
Gang	1.50	1.50	1.50
Trimmer	1.25	1.25	1.50
Log Deck	1.50	1.50	1.50
Log Hauls–Incline–Well Type	1.50	1.50	1.50
Log Turning Devices	1.50	1.50	1.50
Planer Feed	1.25	1.25	1.25
Planer Tilting Hoists	1.50	1.50	1.50
Rolls–Live-off brg.–Roll Cases	1.50	1.50	1.50
Sorting Table	1.25	1.25	1.50
Tipple Hoist	1.25	1.25	1.50
Transfers			
Chain	1.50	1.50	1.50
Craneway	1.50	1.50	1.50
Tray Drives	1.25	1.25	1.50
Veneer Lathe Drives	Contact Winsmith		
METAL MILLS			
Draw Bench Carriage and Main Drive	1.00	1.25	1.50
Runout Tables, Non-reversing			
Group Drives	1.00	1.25	1.50
Individual Drives	1.50	1.50	1.75
Reversing	1.50	1.50	1.75
Slab Pushers	1.25	1.25	1.50
Shears	1.50	1.50	1.75
Wire Drawing	1.00	1.25	1.50
Wire Winding Machine	1.00	1.25	1.50
METAL STRIP PROCESSING MACHINERY			
Bridles	1.25	1.25	1.50
Coilers & Uncoilers	1.00	1.00	1.25
Edge Trimmers	1.00	1.25	1.50
Flatteners	1.00	1.25	1.50
Loopers (Accumulators)	1.00	1.00	1.00
Pinch Rolls	1.00	1.25	1.50
Scrap Choppers	1.00	1.25	1.50
Shears	1.50	1.50	1.75
Slitters	1.00	1.25	1.50
MILLS, ROTARY TYPE			
Ball & Rod			
Spur Ring Gear	1.50	1.50	1.75
Helical Ring Gear	1.50	1.50	1.50
Direct Connected	1.50	1.50	1.75
Cement Kilns	1.50	1.50	1.50
Dryers & Coolers'	1.50	1.50	1.50
MIXERS, CONCRETE	1.00	1.25	1.50
PAPER MILLS			
Agitator (Mixer)	1.50	1.50	1.50
Agitator for Pure Liquors	1.25	1.25	1.25
Barking Drums	1.75	1.75	1.75
Barkers–Mechanical	1.75	1.75	1.75
Beater	1.50	1.50	1.50
Breaker Stack	1.25	1.25	1.25
Calender (anti-friction bearings only)	1.25	1.25	1.25
Chipper	1.75	1.75	1.75

Service Factor Section

APPLICATION	SERVICE FACTORS		
	UP TO 3 HRS. DAY	3-10 HRS. DAY	OVER 10 HRS. DAY
PAPER MILLS (Continued)			
Chip Feeder	1.50	1.50	1.50
Coating Rolls	1.25	1.25	1.25
Conveyors			
Chip, Bark, Chemical	1.25	1.25	1.25
Log (including Slab)	1.75	1.75	1.75
Couch Rolls	1.25	1.25	1.25
Cutter	1.75	1.75	1.75
Cylinder Molds	1.25	1.25	1.25
Dryers (anti-friction bearings only)			
Paper Machine	1.25	1.25	1.25
Conveyor Type	1.25	1.25	1.25
Embosser	1.25	1.25	1.25
Extruder	1.50	1.50	1.50
Fourdriner Rolls (Includes Lumpbreaker, dandy roll, wire turning, and return rolls)	1.25	1.25	1.25
Jordan	1.25	1.25	1.25
Kiln Drive	1.50	1.50	1.50
Mt. Hope Rolls	1.25	1.25	1.25
Paper Rolls	1.25	1.25	1.25
Platter	1.50	1.50	1.50
Presses–Felt & Suction	1.25	1.25	1.25
Pulper	1.50	1.50	1.75
Pumps–Vacuum	1.50	1.50	1.50
Reel (Surface Type)	1.25	1.25	1.50
Screens			
Chip	1.50	1.50	1.50
Rotary	1.50	1.50	1.50
Vibrating	1.75	1.75	1.75
Size Press	1.25	1.25	1.25
Thickener (AC Motor)	1.50	1.50	1.50
(DC Motor)	1.25	1.25	1.25
Washer (AC Motor)	1.50	1.50	1.50
(DC Motor)	1.25	1.25	1.25
Wind & Unwind Stand	1.00	1.00	1.00
Winders (Surface Type)	1.25	1.25	1.25
Yankee Dryers (anti-friction bearings only)	1.25	1.25	1.25
PLASTICS INDUSTRY–PRIMARY PROCESSING			
Intensive Internal Mixers			
Batch Mixers	1.75	1.75	1.75
Continuous Mixers	1.50	1.50	1.50
Batch Drop Mill–2 smooth rolls	1.25	1.25	1.25
Continuous Feed, Holding & Blend Mill	1.25	1.25	1.25
Compounding Mills	1.25	1.25	1.25
Calenders	1.50	1.50	1.50
PLASTICS INDUSTRY–SECONDARY PROCESSING			
Blow Molders	1.50	1.50	1.50
Coating	1.25	1.25	1.25
Film1.25	1.25	1.25	-
Pipe	1.25	1.25	1.25
Pre-plasticizers	1.50	1.50	1.50
Rods	1.25	1.25	1.25
Sheet	1.25	1.25	1.25
Tubing	1.25	1.25	1.50
PULLERS–BARGE HAUL	1.00	1.50	1.75
PUMPS			
Centrifugal	–	1.00	1.25
Proportioning	1.00	1.25	1.50

APPLICATION	SERVICE FACTORS		
	UP TO 3 HRS. DAY	3-10 HRS. DAY	OVER 10 HRS. DAY
PUMPS (Continued)			
Recriprocating			
Single Acting, 3 or more cylinders	1.00	1.25	1.50
Double Acting, 2 or more cylinders	1.00	1.25	1.50
Rotary			
Gear Type	–	1.00	1.25
Lobe	–	1.00	1.25
Vane	–	1.00	1.25
RUBBER INDUSTRY			
Intensive Internal Mixers			
Batch Mixers	1.50	1.75	1.75
Continuous Mixers	1.25	1.50	1.50
Mixing Mill–2 smooth rolls–(If corrugated rolls are used, then use the same service factors that are used for a Cracker Warmer.)	1.50	1.50	1.50
Batch Drop Mill–2 smooth rolls	1.50	1.50	1.50
Cracker Warmer–2 roll; 1 corrugated roll	1.75	1.75	1.75
Cracker Warmer–2 corrugated rolls	1.75	1.75	1.75
Holding, Feed & Blend Mill–2 rolls	1.25	1.25	1.25
Refiner–2 rolls	1.50	1.50	1.50
Calenders	1.50	1.50	1.50
SAND MILLER			
SEWAGE DISPOSAL EQUIPMENT			
Bar Screens	–	1.00	1.25
Chemical Feeders	–	1.00	1.25
Dewatering Screens	1.00	1.25	1.50
Scum Breakers	1.00	1.25	1.50
Slow or Rapid Mixers	1.00	1.25	1.50
Sludge Collectors	1.00	1.00	1.25
Thickeners	1.00	1.25	1.50
Vacuum Filters	1.00	1.25	1.50
SCREENS			
Air Washing	–	1.00	1.25
Rotary-Stone or Gravel	1.00	1.25	1.50
Traveling Water Intake	–	1.00	1.25
SUGAR INDUSTRY			
Beet Slicer	1.50	1.50	1.75
Cane Knives	1.50	1.50	1.50
Crushers	1.50	1.50	1.50
Mills low speed end	1.50	1.50	1.50
TEXTILE INDUSTRY			
Batchers	1.00	1.25	1.50
Calenders	1.00	1.25	1.50
Cards	1.00	1.25	1.50
Dry Cans	1.00	1.25	1.50
Dryers	1.00	1.25	1.50
Dyeing Machinery	1.00	1.25	1.50
Looms	1.00	1.25	1.50
Mangles	1.00	1.25	1.50
Nappers	1.00	1.25	1.50
Pads	1.00	1.25	1.50
Slashers	1.00	1.25	1.50
Soapers	1.00	1.25	1.50
Spinners	1.00	1.25	1.50
Tenter Frames	1.00	1.25	1.50
Washers	1.00	1.25	1.50
Winders	1.00	1.25	1.50

Appendix

Service Factor Section

Momentary Overloads And Frequent Starts And Stops

Normal starting , or occasional momentary peak loads up to 300% of catalog rating at 1750 RPM (maximum of 2 seconds each occurrence) and that occur two or three times per day are permissible when using a service factor of 1.0. If either of these values is exceeded, a service factor of 1.5 should be used. Heavy starting loads may be encountered when the output shaft of the reducer is directly coupled to larger gears or heavy masses. In these cases, a service factor of 2.0 should be used. Reversing drives and those subjected to quickly repeated shock loads of unusual or unpredictable intensity and stalling loads, drives that are overrunning, or that "wind up" due to quick power stoppage and storage of energy are not covered by the service factors above. In these cases, a service factor of at least 3.0 is recommended. Applications with frequent starts and stops should be evaluated using Winsmith's Full Duty Cycle selection method that is detailed in the Motion Control Products catalog, available at www.WINSMITH.com.

CONVERSION TABLE

To Find Equivalent Service Factor When Using Single or Multi-Cylinder Engines.

For Hydraulic or Electric Motor Service Factor of:	Use this Service Factor for Single Cylinder Engines	Use this Service Factor for Multi-Cylinder Engines
1.00	1.50	1.25
1.25	1.75	1.50
1.50	2.00	1.75
1.75	2.25	2.00
2.00	2.50	2.25

AGMA SERVICE FACTOR CHART BASED ON LOAD CLASSIFICATION

Prime Mover	Duration of Service Per Day	Uniform	Driven Machine Load Classifications		
			Moderate Shock	Heavy Shock	Extreme Shock
Electric and	Occasional 1/2 hour	1.00	1.00	1.00	1.25
Hydraulic Motors	Less than 3 hours	1.00	1.00	1.25	1.50
(See above chart for	3-10 hours	1.00	1.25	1.50	1.75
internal combustion engines)	Over 10 hours	1.25	1.50	1.75	2.00

FOLLOWING SERVICE FACTORS APPLY FOR APPLICATIONS INVOLVING FREQUENT STARTS AND STOPS

Prime Mover	Duration of Service Per Day	Uniform	Driven Machine Load Classifications		
			Moderate Shock	Heavy Shock	Extreme Shock
Electric and	Occasional 1/2 hour	1.00	1.00	1.25	1.50
Hydraulic	Less than 3 hours	1.00	1.25	1.50	1.75
Motors	3-10 hours	1.25	1.50	1.75	2.00
	Over 10 hours	1.50	1.75	2.00	2.25