

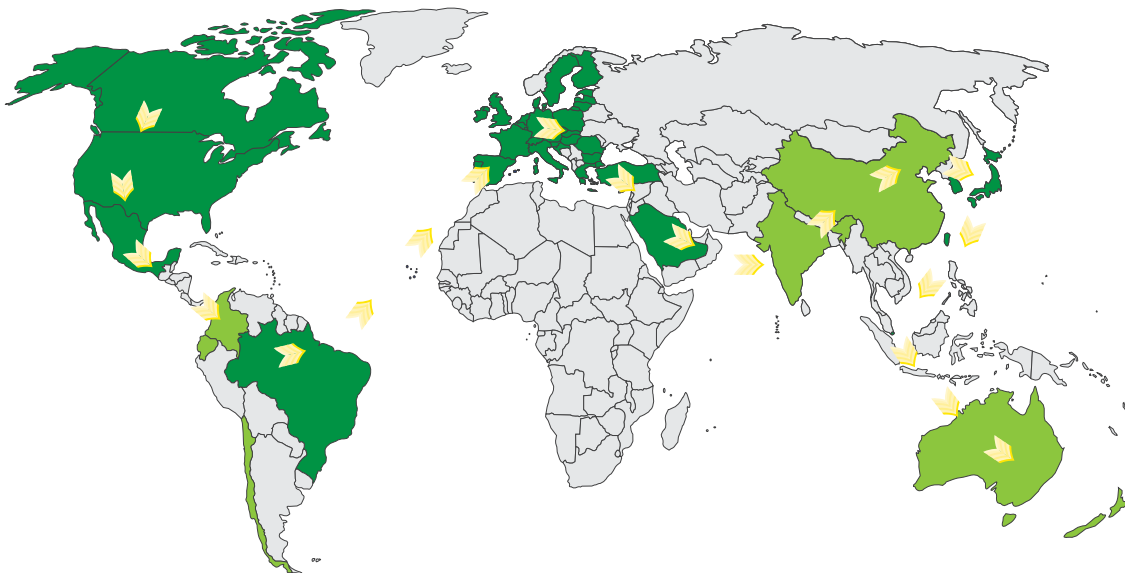


**International
Efficiency
Regulations
for Electric
Motors**

Global efficiency classes

IEC 60034-30-1	NEMA MG-1	GB 18613	NBR 17094-1	AS/NZS 1359.5	IS 12615	SASO 2893	KS C IEC 60034	JIS C 4034-30
IE1	Standard			IE1	IE1	IE1	IE1	IE1
IE2	High	Grade 3	IR2	IE2	IE2	IE2	IE2	IE2
IE3	Premium	Grade 2	IR3	IE3	IE3	IE3	IE3	IE3
IE4	Super Premium	Grade 1			IE4	IE4	IE4	IE4

Binding energy efficiency regulations



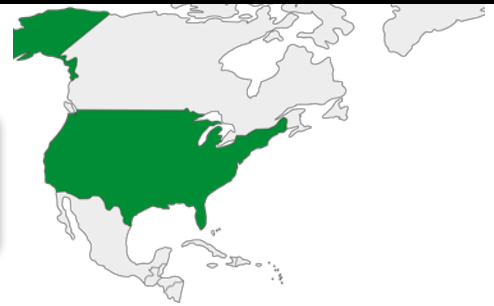
Countries with IE3		Countries with IE2	Countries with IE1
Brazil	Switzerland	Australia/New Zealand	Rest of the World
European Union	Singapore	Chile	
Japan	South Korea	China	
Canada	Taiwan	Ecuador	
Mexico	Turkey	India	
Saudi Arabia	USA	Columbia	



Canada



USA



Efficiency Standard	NEMA MG-1
Efficiency Regulation	EER 2016
Valid since	28/06/2017
Efficiency Requirement	Premium (IE3)
Applicable for	<ul style="list-style-type: none"> • Single-speed, three-phase, 50 Hz, 50/60 Hz, 60 Hz cage induction motors • 2-pole, 4-pole, 6-pole and 8-pole motors • Nominal rated output power between 0.75 kW (1 HP) and 375 kW (500 HP) • Nominal rated voltage U_N up to 600 V • Designed for continuous operation (MG1) or S1 (IEC) • Ambient temperature range: – 15° C up to + 40° C • Geared motors • Brake motors
Exceptions	<ul style="list-style-type: none"> • Motors which are designed in such a way that they can be operated submerged in a fluid • At altitudes exceeding 1000 metres above sea level • At ambient temperatures above + 40° C • At ambient temperatures below – 15° C • Motors with external cooling via third-party cooling which is not an integral component of the motor itself • Motors especially designed for inverter operation • Pole-changing motors • Motors designed for operating modes other than S1 • Single-phase motor • PMSM • Fixtures (stator + rotor) as component

Efficiency Standard	NEMA MG-1
Efficiency Regulation	DOE 10 CFR Part 431
Valid since	01/06/2016
Efficiency Requirement	Premium (IE3)
Applicable for	<ul style="list-style-type: none"> • Single-speed, three-phase, 60 Hz cage induction motors • Operated with sinusoidal voltage supply • 2-pole, 4-pole, 6-pole and 8-pole motors • Nominal rated output power between 0.75 kW (1 HP) and 375 kW (500 HP) • Nominal rated voltage U_N up to 600 V • Designed for continuous operation (MG1) or S1 (IEC) • Ambient temperature range: – 15° C up to + 40° C • Geared motors • Brake motors
Exceptions	<ul style="list-style-type: none"> • Motors which are designed in such a way that they can be operated submerged in a fluid • At altitudes exceeding 1000 metres above sea level • At ambient temperatures above + 40° C • At ambient temperatures below – 15° C • Motors which are cooled via IC418 ambient air • Motors which are cooled via fluids • Motors especially designed for inverter operation • Pole-changing motors • Motors designed for operating modes other than S1 • Single-phase motor • PMSM



Mexico



Columbia



Efficiency Standard	NEMA MG-1
Efficiency Regulation	NOM-016-ENER-2016
Valid since	13/01/2017
Efficiency Requirement	Premium (IE3)
Applicable for	<ul style="list-style-type: none"> • Single-speed, three-phase, 60 Hz cage induction motors • 2-pole, 4-pole, 6-pole and 8-pole motors • Nominal rated output power between 0.746 kW (1 HP) and 373 kW (500 HP) • Nominal rated voltage U_N up to 600 V • Designed for continuous operation (MG1) or S1 (IEC) • Ambient temperature range: -15°C up to $+40^{\circ}\text{C}$ • Geared motors • Brake motors
Exceptions	<ul style="list-style-type: none"> • Motors which are designed in such a way that they can be operated submerged in a fluid • At altitudes exceeding 1000 metres above sea level • At ambient temperatures above $+40^{\circ}\text{C}$ • At ambient temperatures below -15°C • Motors which are cooled via IC418 ambient air • Motors which are cooled via fluids • Motors especially designed for inverter operation • Pole-changing motors • Motors designed for operating modes other than S1 • Single-phase motor • PMSM

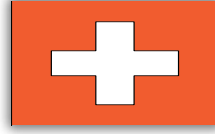
Efficiency Standard	Resolución no4 1012:2015	
Efficiency Regulation	Resolución no4 1012:2015	
Valid since	31/08/2018	
Efficiency Requirement	IE2	
Applicable for	<ul style="list-style-type: none">• Single-speed, three-phase, 60 Hz cage induction motors• 2-pole, 4-pole, 6-pole and 8-pole motors• Nominal rated output power between 0.12 kW and 370 kW• Nominal rated voltage U_N up to 1000 V• Continuous operation (S1 Mode) and $S3 \geq 80\%$• Brake motors• Geared motors	
Exceptions	<ul style="list-style-type: none">• At altitudes > 1000 metres above sea level• At ambient temperatures above $+ 40^{\circ} \text{C}$• At ambient temperatures below $- 15^{\circ} \text{C}$• Ex-Motors• Motors especially designed for inverter operation• Pole-changing motors• Motors designed for operating modes other than S1 and $< S3-80\%$• Single-phase motors• PMSM	
Pending energy efficiency regulation		
Valid from	31/08/2020	
Efficiency Requirement	$< 7.5\text{kW}$ $\geq 7.5\text{kW}$ for VSD	IE2 IE3 IE2
Valid from	31/08/2021	
Efficiency Requirement	$< 0.75\text{kW}$ $\geq 0.75\text{kW}$ for VSD	IE2 IE3 IE2



Brazil



Efficiency Standard	ABNT NBR 17094-1
Efficiency Regulation	Portaria Interministerial N° 1
Valid since	01/08/2019
Efficiency Requirement	IR3 (IE3)
Applicable for	<ul style="list-style-type: none"> • Single-speed, three-phase, 60 Hz cage induction motors • 2-pole, 4-pole, 6-pole and 8-pole motors • Nominal rated output power between 0.12 kW and 370 kW • Nominal rated voltage U_N up to 1000 V • Continuous operation (S1 Mode) and $S3 \geq 80\%$ • Brake motors • Geared motors
Exceptions	<ul style="list-style-type: none"> • At altitudes exceeding 1000 metres above sea level • At ambient temperatures above $+40^\circ\text{C}$ • At ambient temperatures below -15°C • Ex-Motors • Motors especially designed for inverter operation • Pole-changing motors • Motors designed for operating modes other than S1 and $< S3-80\%$ • Single-phase motors • PMSM



Switzerland




Efficiency Standard	IEC 60034-30
Efficiency Regulation	EnV 730.02
Valid since	01/01/2017
Efficiency Requirement	IE3 + IE2 for inverter duty
Applicable for	<ul style="list-style-type: none"> • Single-speed, three-phase, 50 Hz and 50/60 Hz cage induction motors • 2-pole, 4-pole or 6-pole motors • Nominal rated output power between 0.75 kW and 375 kW • Nominal rated voltage U_N up to 1000 V • Continuous operation
Exceptions	<ul style="list-style-type: none"> • Motors which are designed in such a way that they can be operated submerged in a fluid • Motors which are completely built into a product (e.g. a gearbox, a pump, a fan or a compressor), and where the energy efficiency of which cannot be recorded independently of that product • At altitudes exceeding 1000 metres above sea level • At ambient temperatures above $+40^\circ\text{C}$ • At ambient temperatures below -15°C (any motor) and/or at ambient temperatures below 0°C (air-cooled motor) • In potentially explosive atmospheres within the meaning of Directive 94/9/EC of the European Parliament and of the Council • Brake motors



Europe

Efficiency Standard	IEC 60034-30
Efficiency Regulation	(EC) 640/2009 + (EU) 4/2014
Valid since	01/01/2017
Efficiency Requirement	IE3 + IE2 for inverter duty
Applicable for	<ul style="list-style-type: none"> • Single-speed, three-phase, 50 Hz and 50/60 Hz cage induction motors • 2-pole, 4-pole or 6-pole motors • Nominal rated output power between 0.75kW and 375 kW • Nominal rated voltage U_N up to 1000 V • Continuous operation
Exceptions	<ul style="list-style-type: none"> • Motors which are designed in such a way that they can be operated submerged in a fluid • Motors which are completely built into a product (e.g. a gearbox, a pump, a fan or a compressor), and where the energy efficiency of which cannot be recorded independently of that product • At altitudes exceeding 4000 metres above sea level • At ambient temperatures above 60° C • At ambient temperatures below - 30° C (any motor) and/or at ambient temperatures below 0° C (air-cooled motor) • In potentially explosive atmospheres within the meaning of Directive 94/9/EC of the European Parliament and of the Council • Brake motors

Pending energy efficiency regulations (EU) 2019/1781	
Valid from	01/07/2021
Applicable for	<ul style="list-style-type: none"> • VSD frequency inverter 0.12 – 1,000 kW : IE2 • 3-phase motors 0,12 kW to <0,75 kW/ 2-pole, 4-pole, 6-pole or 8-pole: IE2 (except for: Ex eb (DXE)) • 3-Phase motors 0.75 – 1,000 kW / 2-pole, 4-pole, 6-pole or 8-pole: IE3 (except for: Ex eb (DXE)) <p> Brake motors are no longer excluded</p>
Valid from	01/07/2023
Applicable for	<ul style="list-style-type: none"> • 1-phase motors ≥ 0.12 kW: IE2 • Ex eb (DXE) motors ≥ 0.12 kW: IE2 • 3-phase motors 75 kW – 200 kW / 2-pole, 4-pole or 6-pole: IE4 (except for: Brake motors and all explosion-protected motors)
Scope of validity	<p>Induction motors without carbon brushes, commutators, slip rings or electrical rotor connections which are designed to be operated on a sinusoidal voltage of 50 Hz, 60 Hz or 50/60 Hz and which have the following characteristics:</p> <ul style="list-style-type: none"> ◇ 2-pole, 4-pole, 6-pole and 8-pole motors ◇ Nominal rated power P_N between 0.12 kW and 1000 kW ◇ Nominal rated voltage U_N above 50 V up to, and including, 1000 V ◇ Which are designed for continuous mode (S1, S3 $\geq 80\%$ ED, S6 $\geq 80\%$ ED) and ◇ which are intended for direct mains operation



Turkey

Pending energy efficiency regulations (EU) 2019/1781

Exceptions

- Motors with integrated frequency inverters (compact drive units) whose energy efficiency cannot be tested independently of the frequency inverter
- Specially designed and specified motors which are exclusively for the following operating conditions:
 - ◊ At altitudes exceeding 4000 m above sea level
 - ◊ At ambient temperatures above + 60° C
 - ◊ At ambient temperatures below – 30° C
- Motors with an integrated brake which is an integral part of the internal motor design and cannot be removed or powered from a separate power source when testing motor efficiency.
- Motors which are specially designed for the safety of nuclear installations in accordance with Article 3 of Council Directive 2009/71/EURATOM
- Motors with mechanical commutators
- Totally enclosed self-cooled motors (TENV)
- Motors placed on the market before 01/07/2029 which are intended to replace identical motors integrated into products placed on the market before 01/07/2022 and marketed specifically for that purpose
- Multiple-speed motors i.e. Pole-changing motors
- Motors which are specially developed for electric conveyor vehicles
- Motors in portable devices whose weight will be carried by hand during operation.
- Motors in hand-held mobile devices which will be moved during operation
- Motors in wireless or battery-powered devices
- Motors for underground mining work (mines) are excluded

Efficiency Standard	IEC 60034-30
Efficiency Regulation	SGM-2012/2 SGM-2015/15
Valid since	01/01/2017
Efficiency Requirement	IE3 + IE2 for inverter duty
Applicable for	<ul style="list-style-type: none"> • Single-speed, three-phase, 50 Hz and 50/60 Hz cage induction motors • 2-pole, 4-pole or 6-pole motors • Nominal rated output power between 0.75 kW and 375 kW • Nominal rated voltage U_N up to 1000 V • Continuous operation
Exceptions	<ul style="list-style-type: none"> • Motors which are designed in such a way that they can be operated submerged in a fluid • Motors which are completely built into a product (e.g. a gearbox, a pump, a fan or a compressor), and where the energy efficiency of which cannot be recorded independently of that product • Specially designed and specified motors which are exclusively for the following operating conditions: <ul style="list-style-type: none"> ◊ At altitudes exceeding 4000 m above sea level ◊ At ambient temperatures above + 60° C ◊ At ambient temperatures below – 30° C (any motor) and/or at ambient temperatures below 0° C (air-cooled motor) ◊ In potentially explosive atmospheres within the meaning of Directive 94/9/EC of the European Parliament and of the Council • Brake motors



Saudi Arabia



India



Efficiency Standard	IEC 60034-30-1:2014
Efficiency Regulation	SASO-2893:2018
Valid since	16/08/2018
Efficiency Requirement	IE3
Applicable for	<ul style="list-style-type: none"> • Single-speed, three-phase, 60 Hz, induction motors • 2-pole, 4-pole, 6-pole and 8-pole motors • Nominal rated output power between 0.75 kW and 375 kW • Nominal rated voltage U_N 50 V up to 1000 V • Continuous operation (S1 Mode) • Geared motors • Brake motors
Exceptions	<ul style="list-style-type: none"> • Motors with mechanical commutators • Motors which are designed in such a way that they can be operated submerged in a fluid • Motors which are completely built into a product (e.g. a gearbox, a pump, a fan or a compressor), and where the energy efficiency of which cannot be recorded independently of that product • At altitudes exceeding 4000 metres above sea level • At ambient temperatures above + 60° C • At ambient temperatures below – 20° C • Motors with integrated frequency inverter • Motors specially designed for inverter duty • Motors for Ex-areas according to IEC 60079-0 • Motors with special designs such as for heavy ramp up, special torque rigidity, high switching frequencies, very low rotor inertia • Motors for mains operation differing from IEC 60034 with limited ramp up current, increased voltage and/or frequency tolerances

Efficiency Standard	IS 12615: 2018
Efficiency Regulation	Gazette of India No. 3144/2018
Valid since	04/08/2018
Efficiency Requirement	IE2
Applicable for	<ul style="list-style-type: none"> • Single-speed, three-phase, 50 Hz cage induction motors • 2-pole, 4-pole, 6-pole and 8-pole motors • Nominal rated output power between 0.12 kW and 1000 kW • Nominal rated voltage U_N up to 1000 V • Continuous operation (S1 Mode) • Ambient temperature range – 20° C up to + 60° C • At altitudes up to 4000 metres above sea level • Geared motors • Brake motors
Exceptions	<ul style="list-style-type: none"> • Motors with mechanical commutators • Motors which are designed in such a way that they can be operated submerged in a fluid • Motors which are completely built into a product (e.g. a gearbox, a pump, a fan or a compressor), and where the energy efficiency of which cannot be recorded independently of that product • At altitudes exceeding 4000 metres above sea level • At ambient temperatures above + 60° C • At ambient temperatures below – 20° C (any motor) and/or at ambient temperatures below 0° C (air-cooled motor) • Slip-ring induction motors



China



South Korea



Efficiency Standard	GB 18613-2012
Efficiency Regulation	GB 18613-2012
Valid since	01/10/2016
Efficiency Requirement	IE2
Applicable for	<ul style="list-style-type: none"> • Single-speed, three-phase, 50 Hz cage induction motors • 2-pole, 4-pole, 6-pole motors • Nominal rated output power between 0.75 kW and 375 kW • Nominal rated voltage U_N up to 1000 V • Continuous operation (S1) and S3 – 80% • Geared motors • Brake motors
Exceptions	<ul style="list-style-type: none"> • Motors with mechanical commutators • Motors which are designed in such a way that they can be operated submerged in a fluid • Motors which are completely built into a product (e.g. a gearbox, a pump, a fan or a compressor), and where the energy efficiency of which cannot be recorded independently of that product • At altitudes exceeding 1000 metres above sea level • At ambient temperatures above + 40° C • At ambient temperatures below – 15° C (any motor) and/or at ambient temperatures below 0° C (air-cooled motor) • Pole-changing motors • Motors especially designed for inverter duty

Efficiency Standard	KS C IEC 60034
Efficiency Regulation	MKE 2015-28
Valid since	01/10/2018
Efficiency Requirement	IE3
Applicable for	<ul style="list-style-type: none"> • Single-speed, three-phase, 60 Hz, induction motors • 2-pole, 4-pole, 6-pole and 8-pole motors • Nominal rated output power between 0.75 kW and 200 kW • 4-pole and 6-pole motors up to 375 kW • Nominal rated voltage U_N up to 600 V • Constant speed • Standard power/design size assignment • Torque curve according to NEMA A or B
Exceptions	<ul style="list-style-type: none"> • Motors with mechanical commutators • Motors which are designed in such a way that they can be operated submerged in a fluid • Operating Mode S2 • At ambient temperatures above + 40° C • At ambient temperatures below – 15° C • Motors with integrated frequency inverter • Mains motor on frequency inverter when this is not implemented on a pump, fan or blower • Motors specially designed for inverter duty • Motors for explosion hazardous areas • Brake motors • Non-ventilated motors • Pole-changing motors



Japan



Taiwan

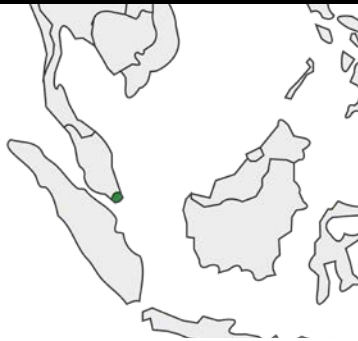


Efficiency Standard	JIS C IEC 4034-30
Efficiency Regulation	JIS C 4213:2014
Valid since	01/04/2015
Efficiency Requirement	IE3
Applicable for	<ul style="list-style-type: none"> • Single-speed, three-phase, 50 Hz, 60 Hz, induction motors • 2-pole, 4-pole, 6-pole motors • Nominal rated output power between 0.75 kW and 375 kW • Nominal rated voltage U_N up to 1000 V • Continuous operation S1 or S3 $\geq 80\%$ • Designed for mains operation • Geared motors • Brake motors
Exceptions	<ul style="list-style-type: none"> • Number of poles ≥ 8 • Insulation Class H and higher • Motors with mechanical commutators • Motors which are designed in such a way that they can be operated submerged in a fluid • At altitudes exceeding 1000 metres above sea level • At ambient temperatures above $+40^\circ\text{C}$ • At ambient temperatures below -20°C • Motors with integrated frequency inverter • Motors specially designed for inverter duty (motor with third-party ventilation) • Motors for explosion hazardous areas • Pole-changing motors

Efficiency Standard	IEC 60034-2-1
Efficiency Regulation	CNS 14400
Valid since	01/07/2016
Efficiency Requirement	IE3
Applicable for	<ul style="list-style-type: none"> • Single-speed, three-phase, 60 Hz, 50/60 Hz, induction motors • 2-pole, 4-pole, 6-pole motors • Nominal rated output power between 0.75 kW and 200 kW • Nominal rated voltage U_N up to 600 V
Exceptions	<ul style="list-style-type: none"> • Motors with mechanical commutators • Motors which are designed in such a way that they can be operated submerged in a fluid • Motors specially designed for inverter duty • Motors for explosion hazardous areas • Pole-changing motors • At ambient temperatures above $+40^\circ\text{C}$ • At ambient temperatures below -15°C



Singapore



Australia / New Zealand

Efficiency Standard	Energy Conservation Order 2017
Efficiency Regulation	S602:2018
Valid since	01/10/2018
Efficiency Requirement	IE3
Applicable for	<ul style="list-style-type: none"> • Single-speed, three-phase, 50 Hz, 50/60 Hz, induction motors • 2-pole, 4-pole, 6-pole motors • Nominal rated output power between 0.75 kW and 375 kW • Nominal rated voltage U_N up to 1000 V • Continuous operation S1, S3 \geq 80%, S6 and S9
Exceptions	<ul style="list-style-type: none"> • Motors with mechanical commutators • Motors which are designed in such a way that they can be operated submerged in a fluid • Motors which are completely built into a product (e.g. a gearbox, a pump, a fan or a compressor), and where the energy efficiency of which cannot be recorded independently of that product • At altitudes exceeding 4000 metres above sea level • At ambient temperatures above + 60° C • At ambient temperatures below – 30° C • Brake motors • Motors for explosion hazardous areas • Motors which will be exported again • Pole-changing motors

Efficiency Standard	IEC 60034-30-1
Efficiency Regulation	GEMS Act of 2018
Valid since	15/05/2019
Efficiency Requirement	IE2
Applicable for	<ul style="list-style-type: none"> • Single-speed, three-phase, 50 Hz, 60 Hz, induction motors • 2-pole, 4-pole, 6-pole, 8-pole motors • Nominal rated output power between 0.73 kW and 185 kW • Nominal rated voltage U_N up to 1100 V • All operating modes except S2 • Designed for mains operation • Geared motors • Brake motors
Exceptions	<ul style="list-style-type: none"> • Motors with mechanical commutators • Motors which are designed in such a way that they can be operated submerged in a fluid • At altitudes exceeding 4000 metres above sea level • At ambient temperatures above + 60° C • At ambient temperatures below – 20° C • Rotary field magnets and torque motors • Motors which are specially designed for inverter duty and for which only torques are specified on the rating plate • Motors which are intended for export • Pole-changing motors

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Geared Cam Limit Switches

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Electric Clutches & Brakes

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Belted Drives

TB Wood's
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Heavy Duty Clutches & Brakes

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Stromag
www.stromag.com

Svendborg Brakes
www.svendborg-brakes.com

Wichita Clutch
www.wichitaclutch.com

Gearing & Specialty Components

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www.bauergears.com

Boston Gear
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Delevan
www.delevan.com

Delroyd Worm Gear
www.delroyd.com

Nuttall Gear
www.nuttallgear.com

Engine Braking Systems

Jacobs Vehicle Systems
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Precision Motors & Automation

Kollmorgen
www.kollmorgen.com

Miniature Motors

Portescap
www.portescap.com

Overrunning Clutches

Formsprag Clutch
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Marland Clutch
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Stieber
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