Automation & Power World 2011

April 18-21, 2011 in Orlando, Florida

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Automation & Power World 2011

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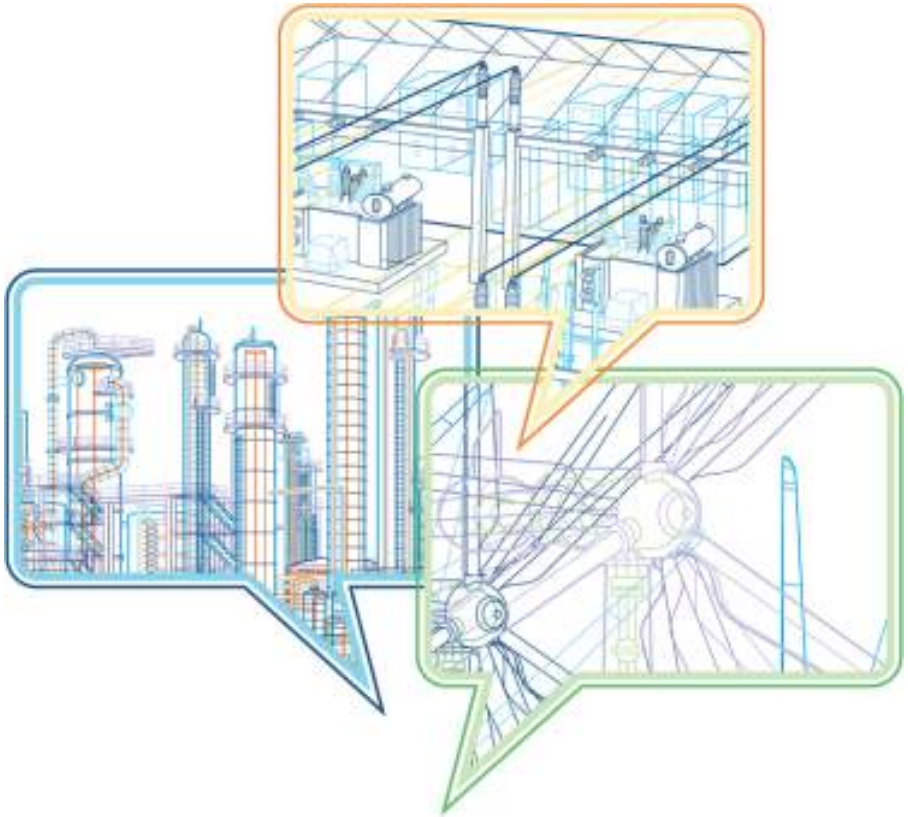

- Save the date for this "must attend" event!
- April 18-21, 2011
- Orlando World Center Marriott, Florida
- Over 400 hours of educational training
  - Business forum
  - Customer case studies
  - Hands-on training
  - Panel discussions
  - Technical workshops
- Earn PDHs and CEUs
- Technology & Solution Center
  - Over 70,000 sq. ft. of exhibits
- Network with your peers
- www.abb.com/a&pworld

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ABB Automation & Power World

At-a-glance

400+

Educational workshops

Automation & Power World offers over 400 hours of educational workshops specifically designed to make engineers, maintenance and management more valuable to their companies.

70K

Technology & Solution Center

Over 1 ½ acres (70,000 ft²) of with nearly100 tons of electrical gear and 100's of experts ready to answer any of your questions and share the future of Automation & Power Solutions.

4,000

Connect with peers

With over 4,000 of your peers in attendance, this is a powerful opportunity to network and learn from the industry. In addition, over 45 customers will be sharing their own case studies.

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Educational workshops developed for all audiences

Just a few examples

- **Roles**
  - **Engineering**
  - **Management**
  - **Maintenance**
- **Company types**
  - **Industrials**
  - **EPCs**
  - **Utilities**
  - **OEMs**

- The coming wave of process safety system migration
- Implementing an alarm management strategy for a 100,000 I/O system - Case study
- Replacement and retrofit of large motors: Challenges and solutions
- Dynamic studies for large scale renewable energy integration at a Texas CREZ - Case study
- Secure commissioning of your process plant - Case study
- New arc flash mitigation technologies and techniques for a safer working environment
- Robotics 101
- A better approach to non-revenue water loss
- Electric vehicles: Are they real this time?
- Why is SIL more important than architecture?

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Past attendees input

“I am impressed with the different parts of the program, the workshops and also the exhibit set-up... there is a lot of information to pick up.”
Duane Souers, Georgia Pacific
“It’s a great opportunity to get a lot of exposure to people and products in one week.”
Pardeep Gill, Alcoa

“It is well worth the time given the opportunities to: learn from industry experts, network with peers in the same industry, learn about emerging technologies, and build excellent supplier relationships.”
Sanjin Osmancevic, National Grid

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Critical Steps to Improve Mechanical Drive Systems Efficiency

Speaker:	William Livoti
Title:	Senior Principal Engineer
Company:	Baldor, A Member of the ABB Group
Location:	Greenville, SC
Email:	wclivoti@baldor.com

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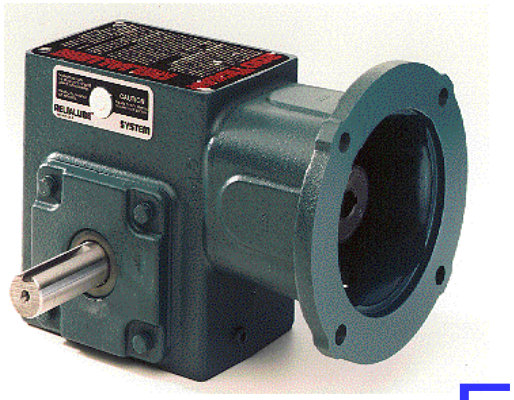
Critical Steps to Improve Mechanical Drive Systems Efficiency



Energy Savings

through the selection and application of gearing

William C. Livoti
Senior Principal Engineer
Baldor Electric Company
Greenville, SC

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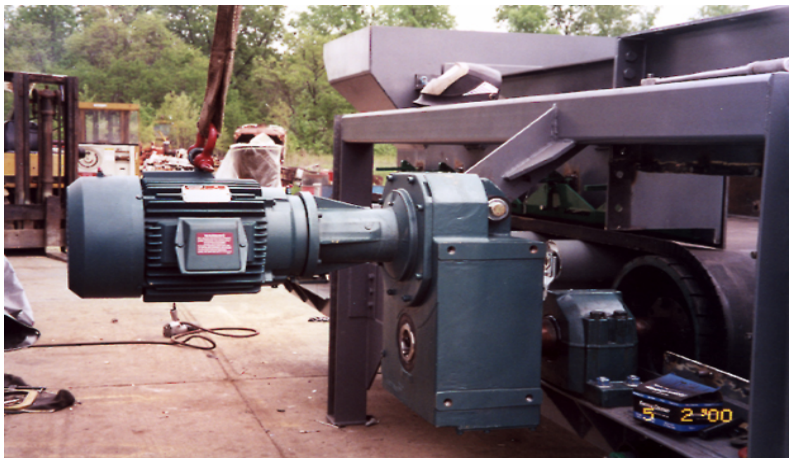
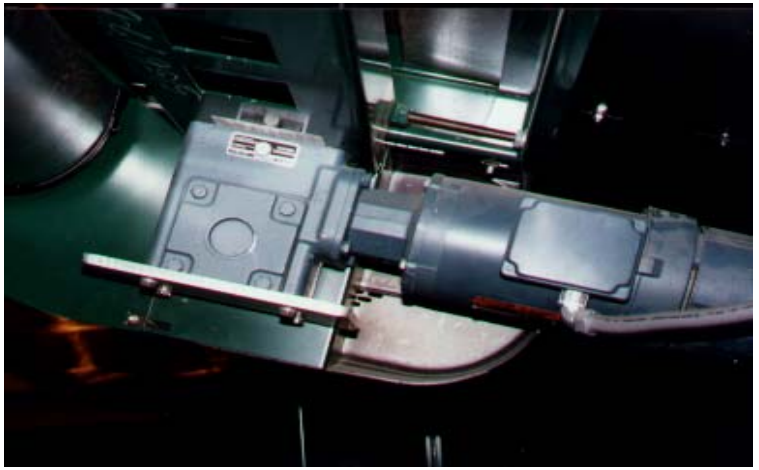
Agenda

Steps to Improve Mechanical Drive Efficiency



- **Interest in Energy Savings**
- **Definitions – losses**
- **The System Approach**
- **Gearing types**
- **Calculating losses and energy savings**
- **Other Factors to Consider**



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Interest in Gearing Efficiency?

- **Electricity costs are increasing exponentially.**
- **Power cost now exceeds the product labor content in some industries.**
- **Initiatives are under way by Government and the Utility Industry to encourage reduced energy consumption.**
- **Motors convert over 60% of power generated in the U.S. - most are applied to pumps and fans - many remaining applications require gear speed reduction.**
- **There can be significant efficiency differences based on selection of gearing type.**

Think Overall System Efficiency

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Steps to Improve Drive System Efficiency

1. **Screen and prioritize your systems to identify good performance improvement candidates**
2. **Get management support for improving the highest priority systems**
3. **Work with appropriate system specialist and / or in-house team to gather and analyze additional data**
4. **Identify, economically validate, and implement performance improvement opportunities**
5. **Document actions and report results to management**
6. **Repeat *Action Plan* process for other good candidate systems**

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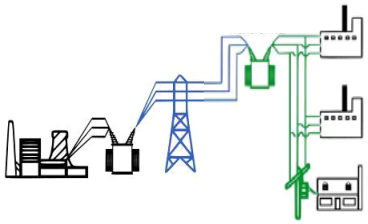
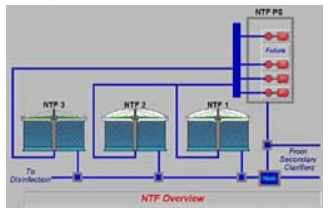
The System Optimization Solution



Component Optimization involves segregating components and analyzing in isolation.

System Optimization involves looking at how the whole group functions together and how changing one can help improve the value of the entire application solution.

At each interface, there are inefficiencies. The primary objective should be to maximize the overall cost effectiveness of the entire system, or simply stated…"how much output energy is delivered per unit of input energy."



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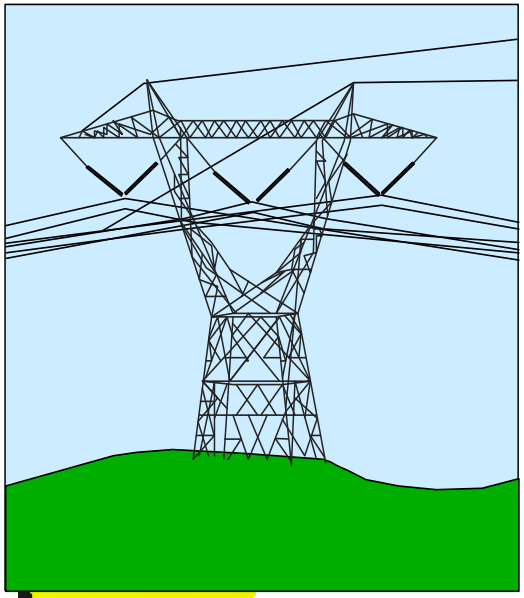
Defining Losses

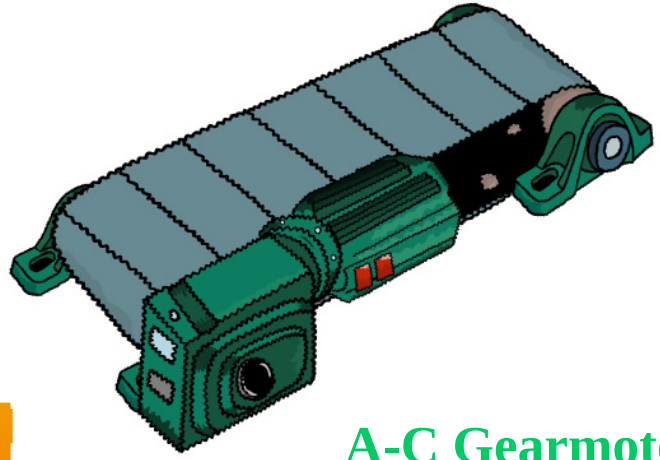
A gearmotor "consumes" a certain percentage of power when driving a given load. This is defined as "Watt Losses".



Watt Losses

Load
(Output power 1 HP = 746 Watts)

Input Power
(Watts)



A-C Gearmotor
(Some power lost during conversion)

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Gearing Losses

- **Gearing is a common method of speed reduction and torque multiplication.**
- **During this transformation - the gear "consumes" a certain percentage of power - this power is termed losses and measured in watts.**
- **Losses can be measured by subtracting the power out from the input power.**

or

power losses (watts) = input power (watts) - output power (watts)

- **Efficiency is the ratio (expressed as a percentage) of the output power/input power.**

or

$$\text{efficiency} = \frac{\text{output}}{\text{input}} = \frac{\text{input - losses}}{\text{input}}$$

- **As losses are reduced or minimized - efficiency improves.**

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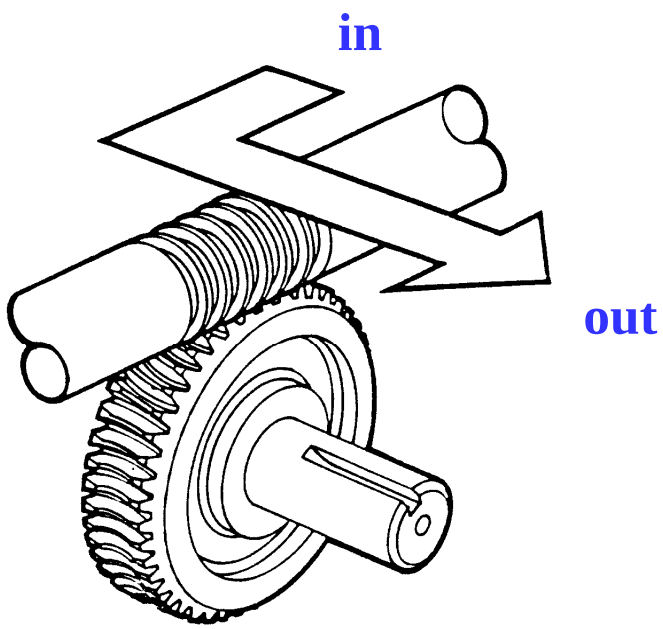
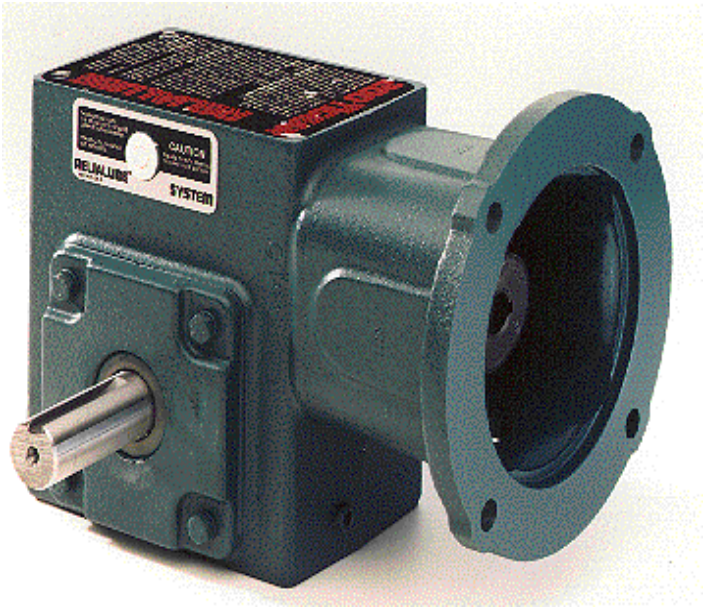
Gearing Types

Right Angle-Worm

- Transmits motion through steel worm running over a bronze gear
- High reductions available in single stage - compact - cost efficient
- Losses are primarily frictional due to “sliding” friction from the worm set





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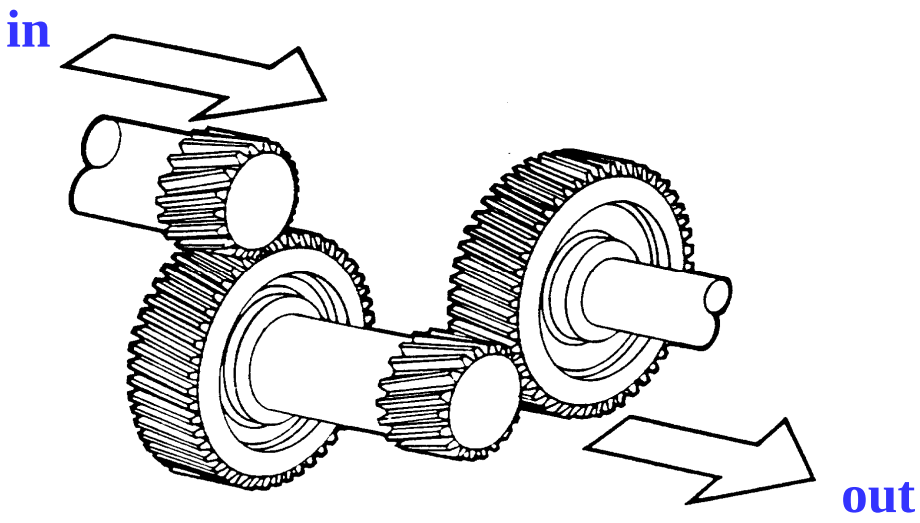
Gearing Types

Parallel - Helical

- Transmit motion through adjacent steel gears
- Losses are primarily frictional due to “rolling contact” between the gears
- Highest efficiency - losses at 2% per gear set



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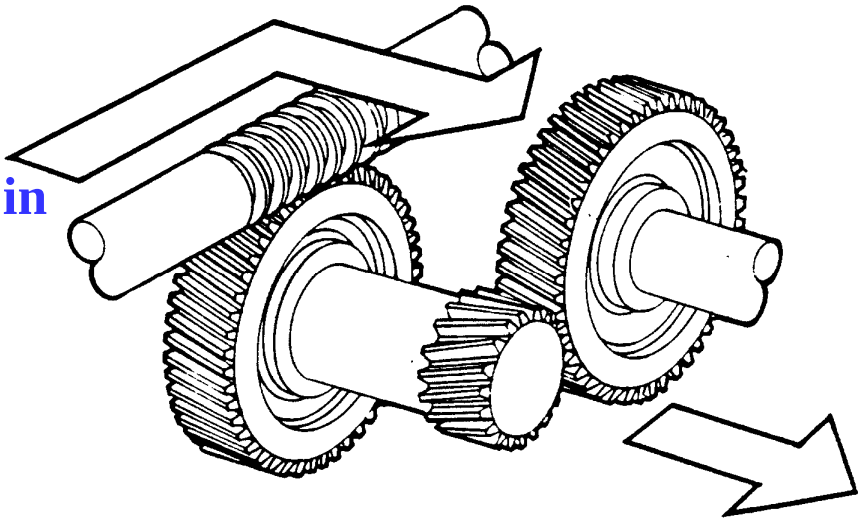
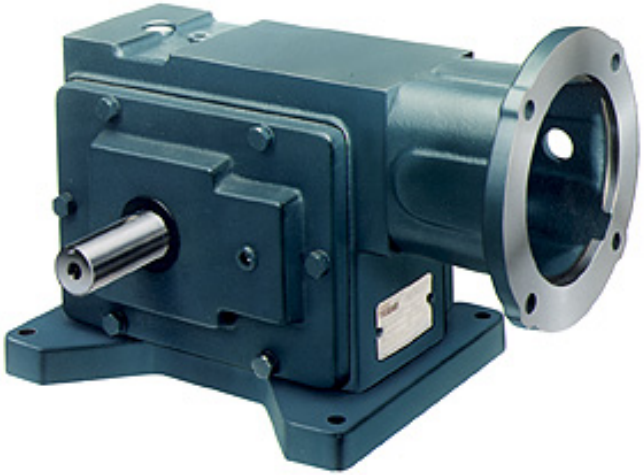
Gearing Types

Right Angle - Worm/Helical

- Combines features of worm and helical - 1st stage or high speed is worm set - 2nd stage or low speed is helical set
- Allows for cost efficient higher reductions
- Losses are minimized utilizing minimum “sliding” losses of the worm at high speed combined with low “rolling” losses of the helical in the 2nd stage





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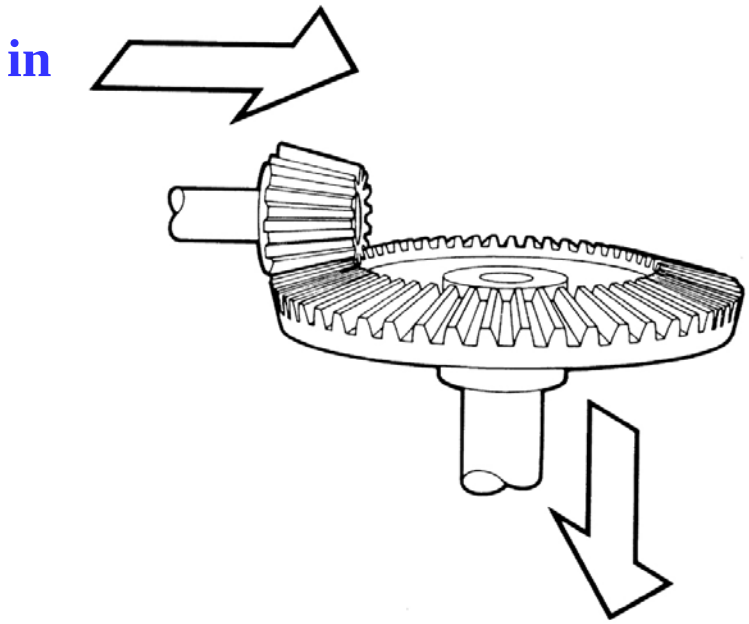
Gearing Types

Right Angle - Helical Bevel

- Transmit motion through adjacent gears
- Losses are primarily frictional due to “rolling contact” between the gear set
- Highest efficiency - losses at 2% per gear set



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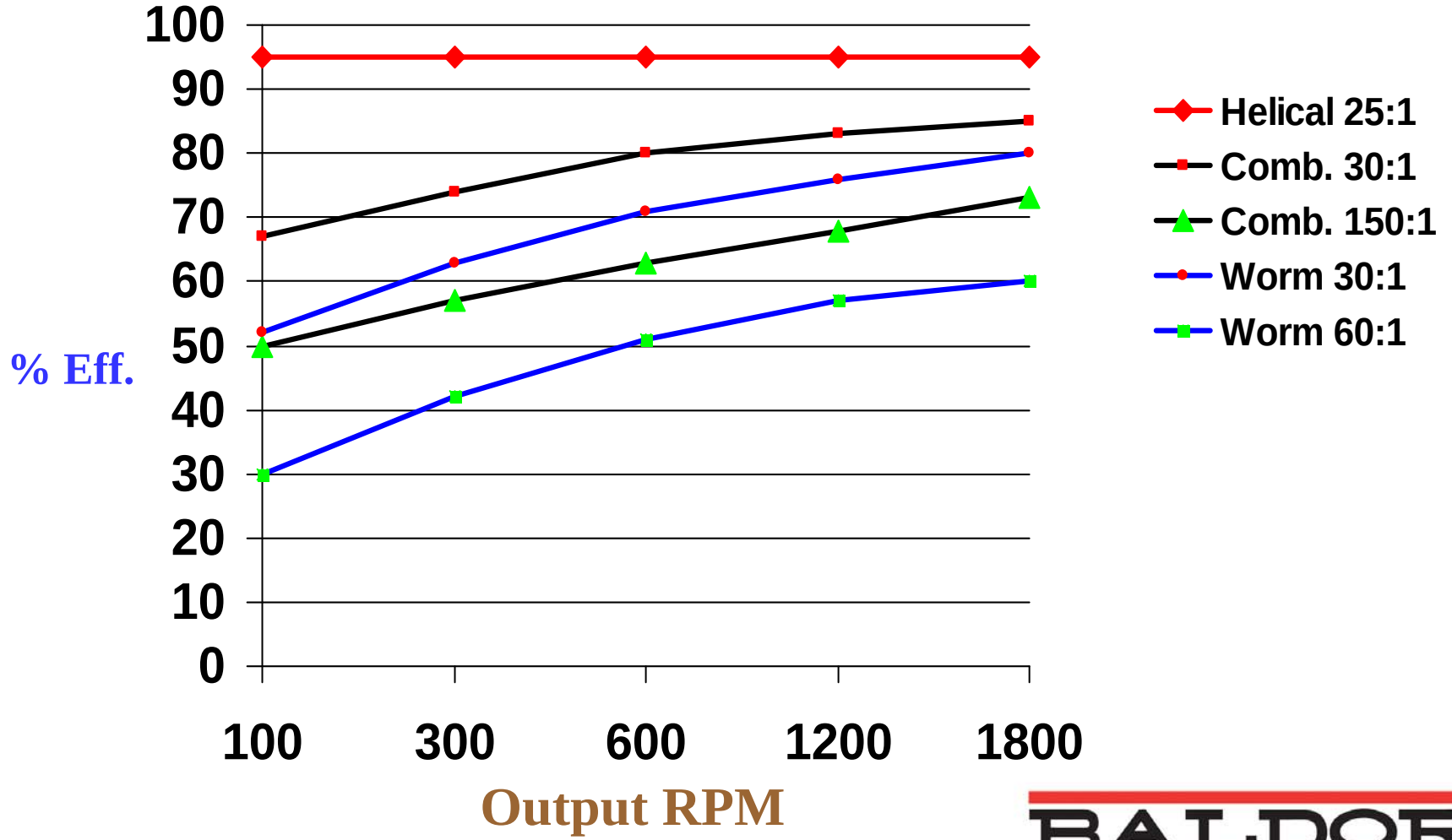
Gearing Types - Efficiencies



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Calculating Gearing losses and Energy Savings

1) **Losses can be measured by subtracting the power out from the input power.**

   power losses (watts) = input power (watts) - output power (watts)

2) **Comparing 2 choices of gearing for an application, the power savings is the difference in the power losses or the difference in the input power required.**

   power saved (watts) = input power choice 1 - input power choice 2

3) **If the data is available, a conversion from HP to watts yields the savings directly. If the data is not available, estimated savings can be determined using this formula and the following table established for worm or helical worm vs helical bevel. This formula assumes that the lower efficiency gear was sized properly for the application initially.**

$$Power\ saved\ (watts) = 746 \times HP_{in} [\ 1 - eff_{lower}/eff_{higher}\ ]$$

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Calculating Gearing Losses and Energy Savings

HP	Gear Ratio	efficiency RHB - HELICAL BEVEL	efficiency WORM or HELICAL WORM	HP	Gear Ratio	efficiency RHB - HELICAL BEVEL	efficiency WORM or HELICAL WORM	HP	Gear Ratio	efficiency RHB - HELICAL BEVEL	efficiency WORM or HELICAL WORM
1/2	10:1	95%	81%	1 1/2	10:1	95%	86%	5	10:1	95%	90%
@	20:1	95%	71%	@	20:1	95%	84%	@	20:1	95%	84%
1750	30:1	95%	68%	1750	30:1	95%	78%	1750	30:1	95%	87%
rpm	40:1	95%	65%	rpm	40:1	95%	72%	rpm	40:1	95%	86%
	50:1	95%	62%		50:1	95%	68%		50:1	95%	86%
	100:1	95%	62%		100:1	95%	67%		100:1	95%	75%
	150:1	95%	61%		150:1	95%	70%		150:1	95%	76%
3/4	10:1	95%	81%	2	10:1	95%	87%	7 1/2	10:1	95%	90%
@	20:1	95%	77%	@	20:1	95%	83%	@	20:1	95%	90%
1750	30:1	95%	68%	1750	30:1	95%	78%	1750	30:1	95%	87%
rpm	40:1	95%	68%	rpm	40:1	95%	72%	rpm	40:1	95%	88%
	50:1	95%	66%		50:1	95%	82%		50:1	95%	87%
	100:1	95%	65%		100:1	95%	73%		100:1	95%	77%
	150:1	95%	64%		150:1	95%	70%		150:1	95%	76%
1	10:1	95%	83%	3	10:1	95%	88%	10	10:1	95%	92%
@	20:1	95%	77%	@	20:1	95%	83%	@	20:1	95%	91%
1750	30:1	95%	76%	1750	30:1	95%	82%	1750	30:1	95%	89%
rpm	40:1	95%	69%	rpm	40:1	95%	82%	rpm	40:1	95%	88%
	50:1	95%	66%		50:1	95%	82%		50:1	95%	89%
	100:1	95%	65%		100:1	95%	73%		100:1	95%	77%
	150:1	95%	64%		150:1	95%	74%		150:1	95%	76%

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Calculating Gearing Losses and Energy Savings

4) **To calculate annual energy savings, cost of energy in $/kW and estimated hours of operation per year.**

Savings / year = Power saved (watts) x Cost of Energy ($/kW) x hours of operation

5) **To determine whether the cost premium of the alternative gearing selection is justified or "pays back", a simple payback can be calculated. This will determine the number of years required to pay off the initial investment.**

Simple Payback = Initial Cost Difference / Savings / year

6) **Typically paybacks within a 2 year time are very acceptable - more detailed financial analysis accounting for the cost of money may also be applied to this justification.**

7) **Generally speaking, long - near continuous operation and or areas with high energy costs are very good candidates for analysis.**

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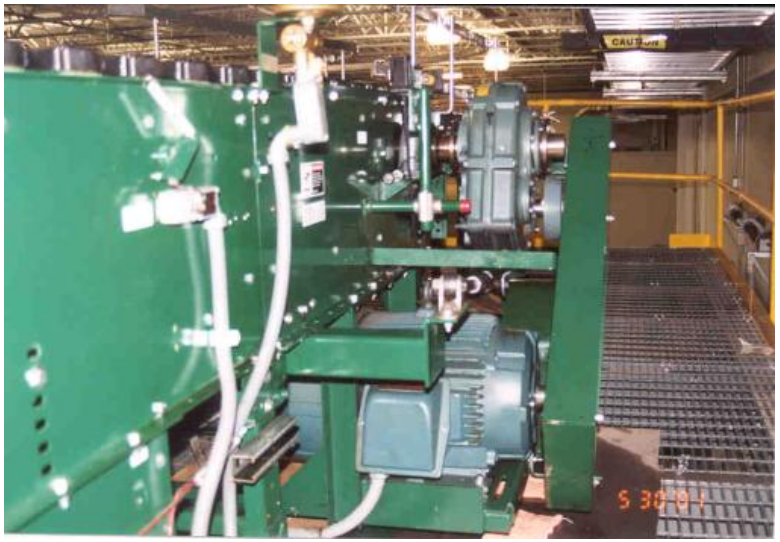
Case Study: Sorters



Existing System:

50HP Standard-E Motor: 93.0%
Belt Drive: 90.0%
25:1 Ratio: 95%

Energy cost / Year = $18,020 per year

High Efficient System:

50HP Premium Efficient Motor: 95.0%
RHB: 23.19:1 Ratio: 95.0%

Energy cost / Year = $17,123 per year

Payback Period = 1.4 years

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Calculating System Efficiency

Process Requirements	Flow required			1000	gpm	1000	gpm	1000	gpm	1000	gpm
	Head required			150	feet	150	feet	150	feet	150	feet
Piping elements	Additional system friction loss			60	ft	30	ft	60	ft	60	ft
Component Efficiencies	Motor eff			94%		94%		94%		96%	
	VFD efficiency factor			95%		95%		95%		95%	
	Mechanical drive eff			90%		90%		90%		90%	
	Pump eff			78%		78%		83%		78%	
Electrical	Energy cost per kWh			$0.07		$0.07		$0.07		$0.07	
	Operating hours per year			6800		6800		6800		6800	
	Factor			Base		Reduce friction by 30 feet.		Increase pump efficiency by 5 points.		Increase motor efficiency by 2 points.	
Output	System efficiency			45%		52%		48%		46%	
	System input power required for process			60.4	bhp	60.4	bhp	56.8	bhp	59.2	bhp
	Power required for additional friction			24.2	bhp	12.1	bhp	22.7	bhp	23.7	bhp
	Total power required			84.6	bhp	72.5	bhp	79.5	bhp	82.8	bhp
	Total cost per year			$30,039		$25,747		$28,229		$29,413	
	Cost Savings					$4,291		$1,810		$626	

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Other Factors to consider in saving energy

- **Avoid over powering the application. Proper selection of gear and motor to meet the application requirements will provide energy as well as equipment cost savings. If the application is less than 25% loaded reduce prime mover size (motor).**
- **Gearing should be applied based on output capability….not on the input power required. A 2 HP motor on a 70% efficient gear will provide 1.4 HP to the application - the same power as a 1 1/2 HP motor on a 95% efficient gear.**
- **During idle periods where production or the process is not required - consider turning off equipment - consider application of variable frequency drives to reduce speeds and for controlled starting.**
- **Proper installation of equipment - alignment of mechanical transmission equipment will reduce energy losses and extend equipment life.**
- **Proper maintenance will assure that equipment performs to like new specifications.**

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Maintenance Cost

- **More-durable gearboxes reduce maintenance and replacement costs.**
- **Lubrication**
  - **Oil churning**
  - **Viscosity**
  - **Additive package**
  - **Synthetics**
  - **Grease Vs Oil**

Conclusions

- **There continues to be a growing need for energy efficient products to counter the effects of rising energy costs.**
- **Choices of gearing types can offer cost, reliability and efficiency alternatives from worm to helical.**
- **Payback periods can justify initial cost investment in application of continuous usage and or high energy costs.**
- **Proper selection, installation and maintenance will save energy costs and assure successful, long term, reliable operation.**
- **Efficiency and reliability go hand in hand, look beyond energy savings.**
- **Think system**

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The development of *sustainable* energy efficient value solutions is vital for the long term success of industry end users and for helping utilities defer major capital expenditures for new generation.

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QUESTION

Where is your company, state, our country going to be with twice the energy foot print of others?

As companies, if we do not take environment and energy conservation seriously we won't be around.

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Workshop statistics
Over 400 hours of training

- ~45 customer presented case studies
- 87 sessions in the Technology and Solution Center
- 11 hours of panel discussions consisting of customers, industry experts and ABB executives
- Nearly 50 hours of hands on technical training

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Registration options

	Full Conference	Courtesy Registration
Access to ABB product developers and application experts in the 70,000 ft² (over 1.5 acre) Technology & Solution Center		
Access to a series of complimentary and educational workshops.		
Free Lunch and Tuesday Evening Reception		
Access to over 300 additional educational workshops – Including ARC Analysts presentations		
Up to $1,500 off a future ABB purchase*		
Complimentary ARC report valued at $2,500!*		
Evening Events (Monday and Wednesday)		
Cost	$300 per day or $800 for all three days.	Free!

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Top ten reasons to attend

- Become more valuable, choose from over 400 educational workshops and hands-on training sessions
- Connect with thousands of peers and industry experts from 40 countries
- Ask questions of, and give feedback to, ABB product developers and executive management
- Get up to date with new and emerging technologies and industry trends
- Learn how to maximize the value from your existing assets
- Discover how to improve grid reliability, energy efficiency and industrial productivity
- Apply lessons learned from over 45 customer-presented case studies
- Focus on critical non-technical issues facing your company in the business forums
- Succeed professionally by earning CEUs on select workshops and PDHs for every workshop you attend
- See the widest range of technologies from one company at one conference!

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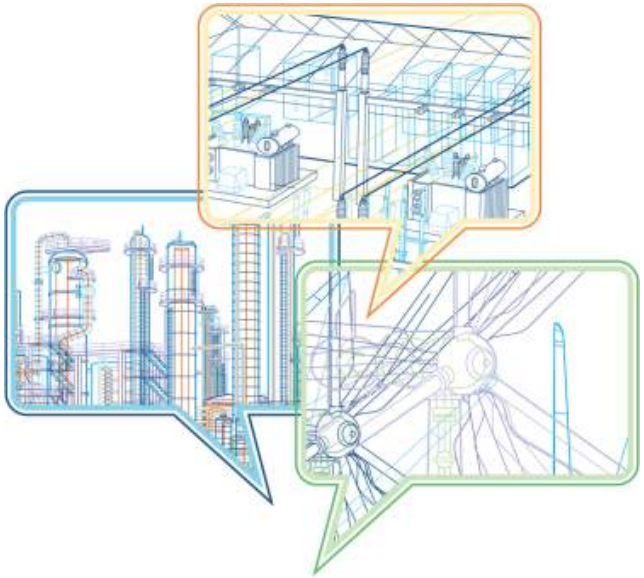

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