



CHAIN VS. SYNCHRONOUS BELTS

C2B
TECHNICAL
TRAINING





CHAIN INTRODUCTION





COMMON CHAIN TYPES

■ Average roller chain (Normally referred to by name brand)

- Diamond chain
- Tsubaki chain
- Morse chain
- Self lubricating chain

■ High performance chain

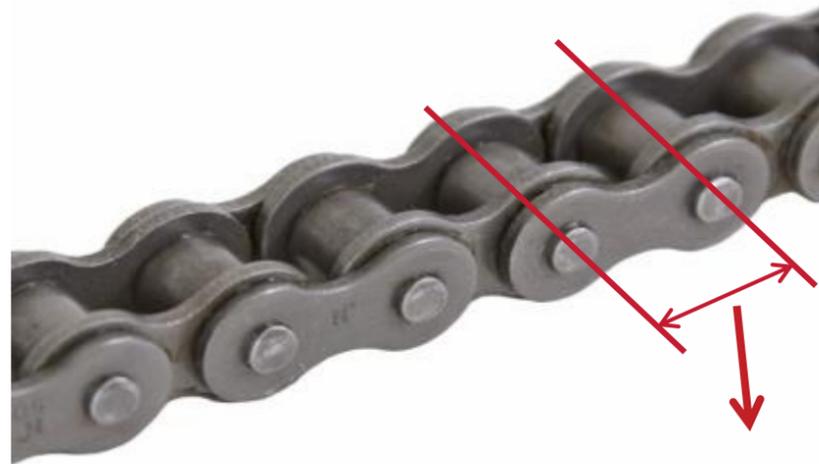
- Silent chain
- Corrosion resistant chain (Stainless steel or cadmium/nickel plated)
- Double pitched chain

■ Low cost imported chain

- Made with low quality steel



Sizing Nomenclature



#60 Chain

First digit denotes the pitch in $(\frac{1}{8})''$
 $(\frac{6}{8})'' = (\frac{3}{4})''$ pitch

Second digit denotes the type of roller chain

- 0 – roller chain
- 1 – lightweight chain
- 5 – rollerless chain (small pitch)

- **Example: #60-2** Number 60 - standard - double strand chain
- **Example: #80H-3** Number 80 – heavy weight - triple strand chain

Chain connection

- Only MTO chains are truly endless
- Single and multiple “box” chains all need connection
- Connecting links reduce power ratings by 15%
- Half links reduce power ratings even further
- Connecting links are the “weak link” of chain

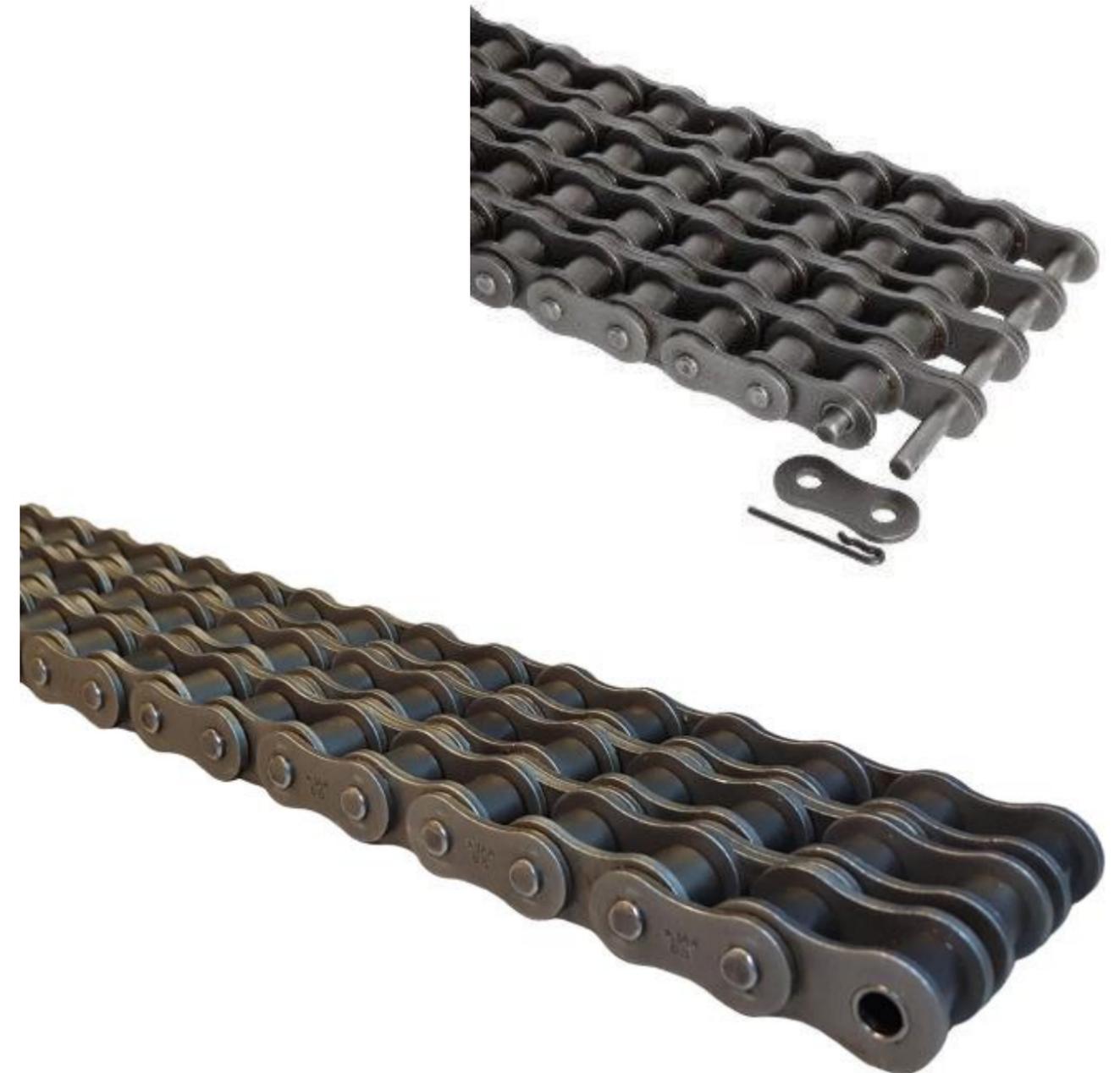




Multiple-Strand Chain

- Consists of two or more strands joined
- Available in up to 8 strands
- Capacity loss due to inner side bars not being press fit
- Lose 15% capacity per strand

Number Of Strands	Strand Factor
2	1.7
3	2.5
4	3.3
5	3.9
6	4.6
8	6.0

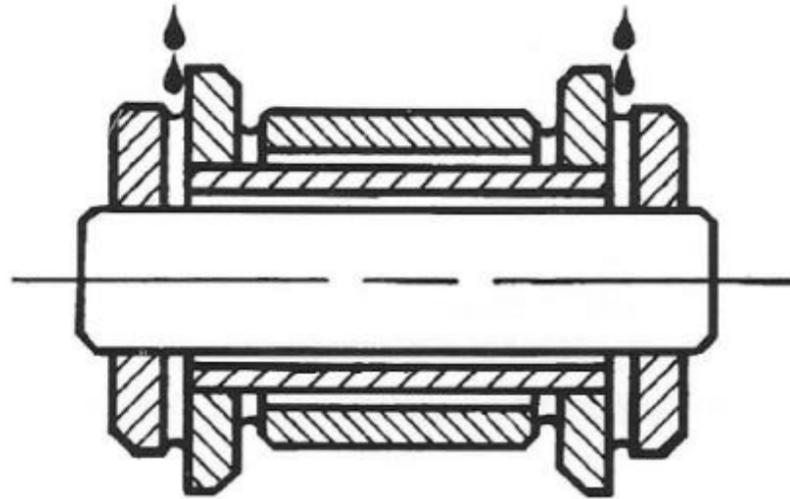




ROLLER CHAIN LUBRICATION TYPES

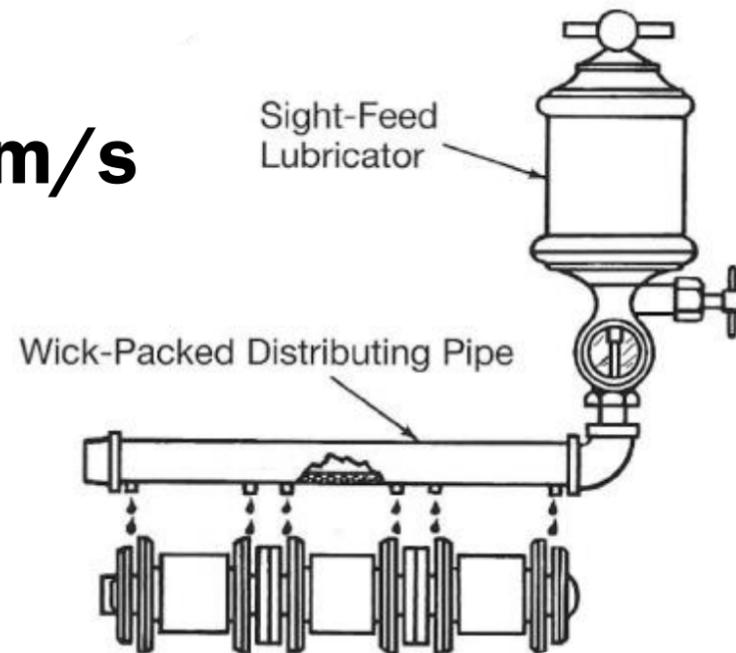
Manual lubrication:

- Up to 1 m/s



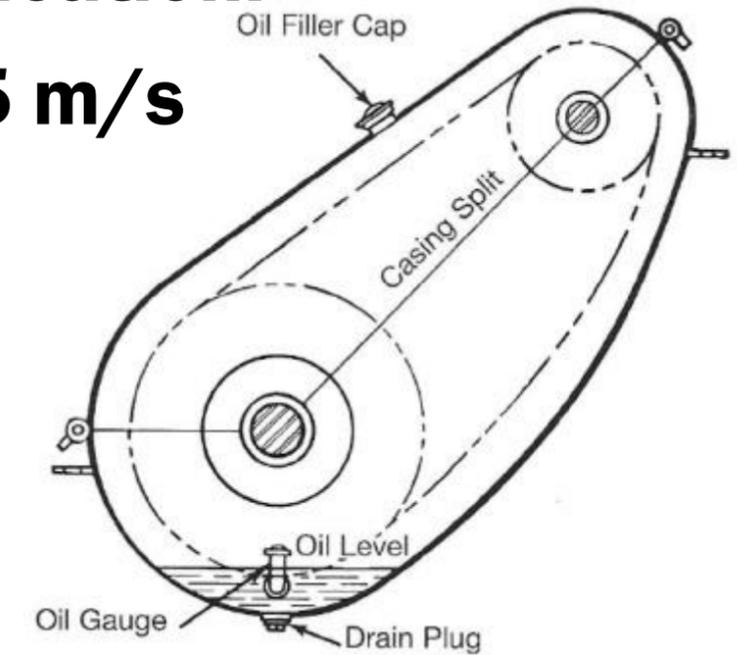
Drip lubrication:

- 1 m/s to 2,5 m/s



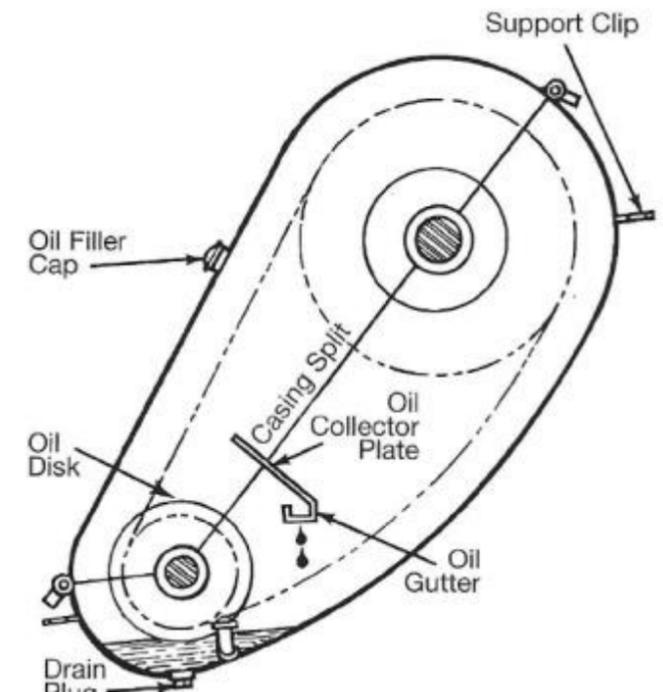
Disk/Oil bath lubrication:

- 2,5 m/s to 12,5 m/s



Spray lubrication:

- > 12,5 m/s





WHAT IS SILENT CHAIN?

Involute shaped teeth and sprocket grooves

- Similar to gears

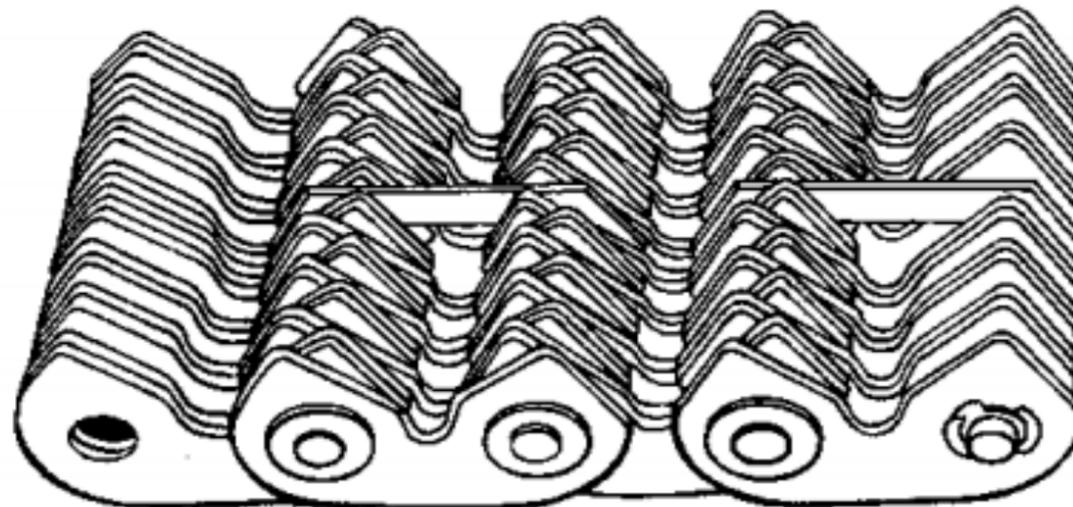
Designed for high speed applications

Has a higher capacity than roller chain (per width)

Not truly silent

Better cyclic variation properties

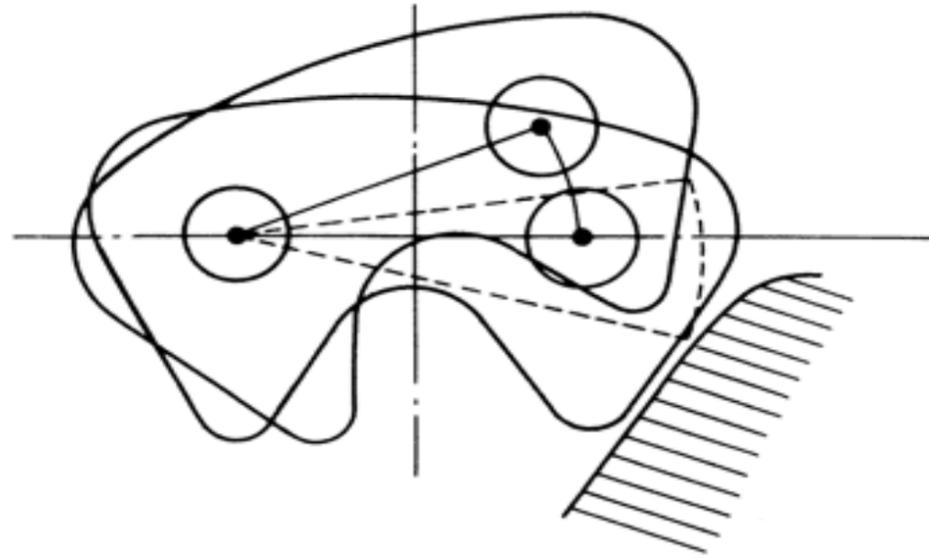
Also known as High Velocity Chain



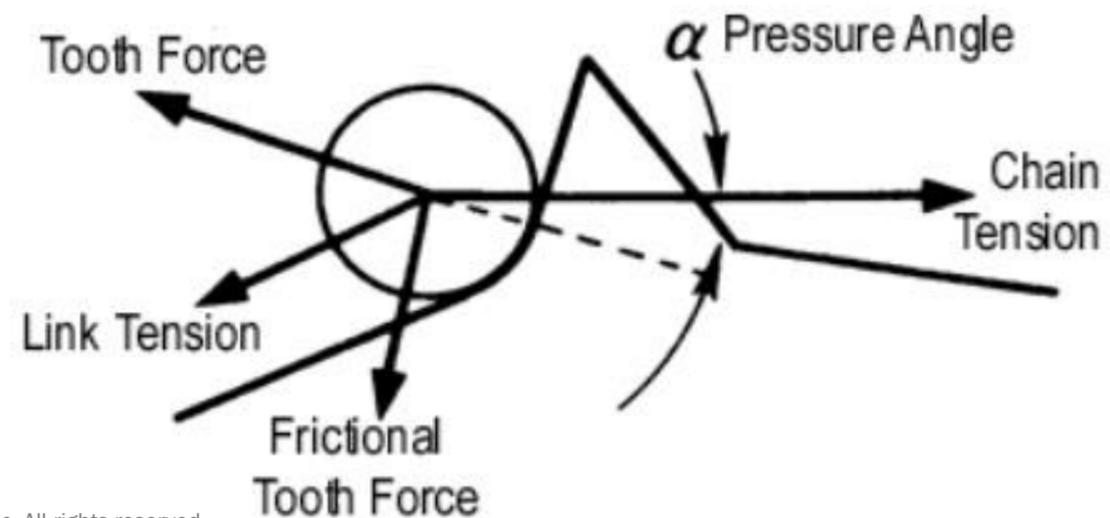


WHY IS IT SILENT?

The shape of the chain mimics the shape of the sprocket or the chain strikes the sprocket angle, reducing noise and minimizing wear.



Roller chain engages at a much harsher angle.





COMPARISON

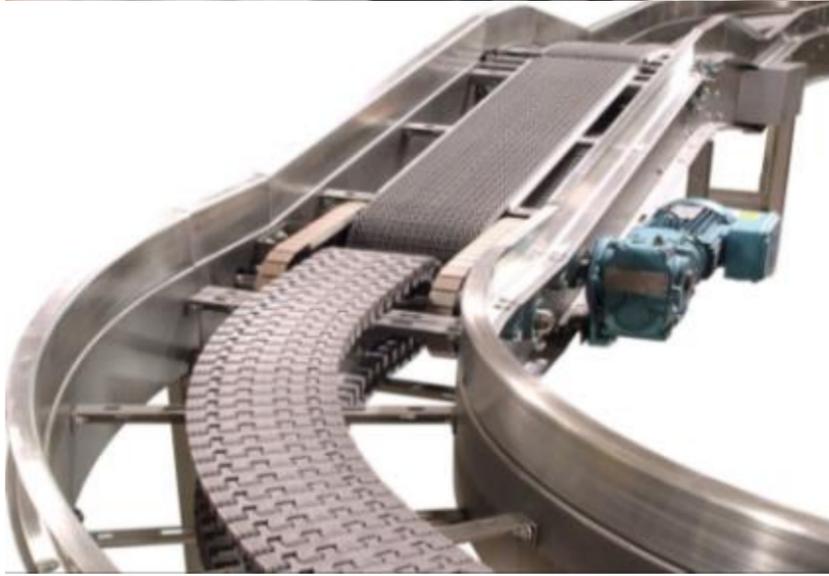
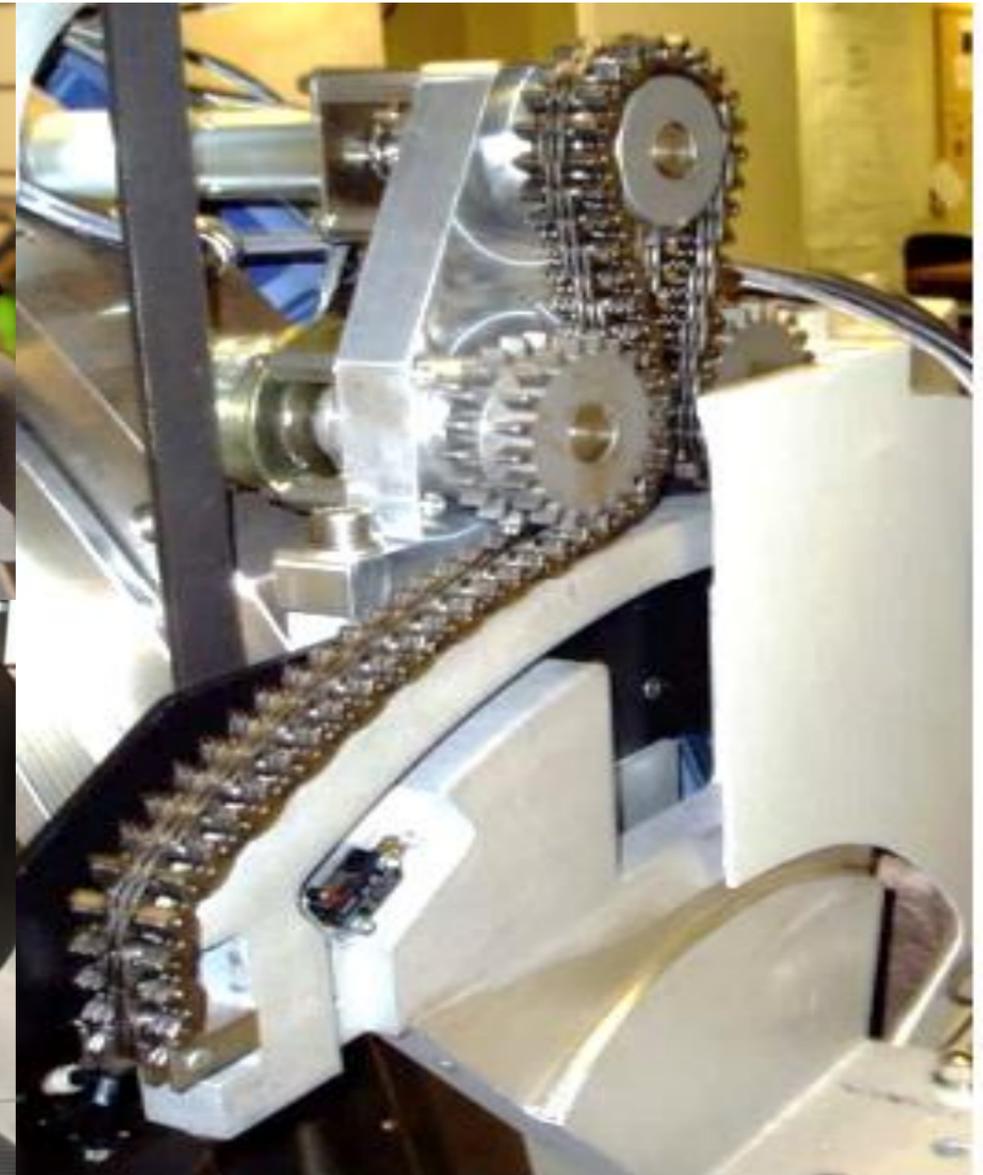
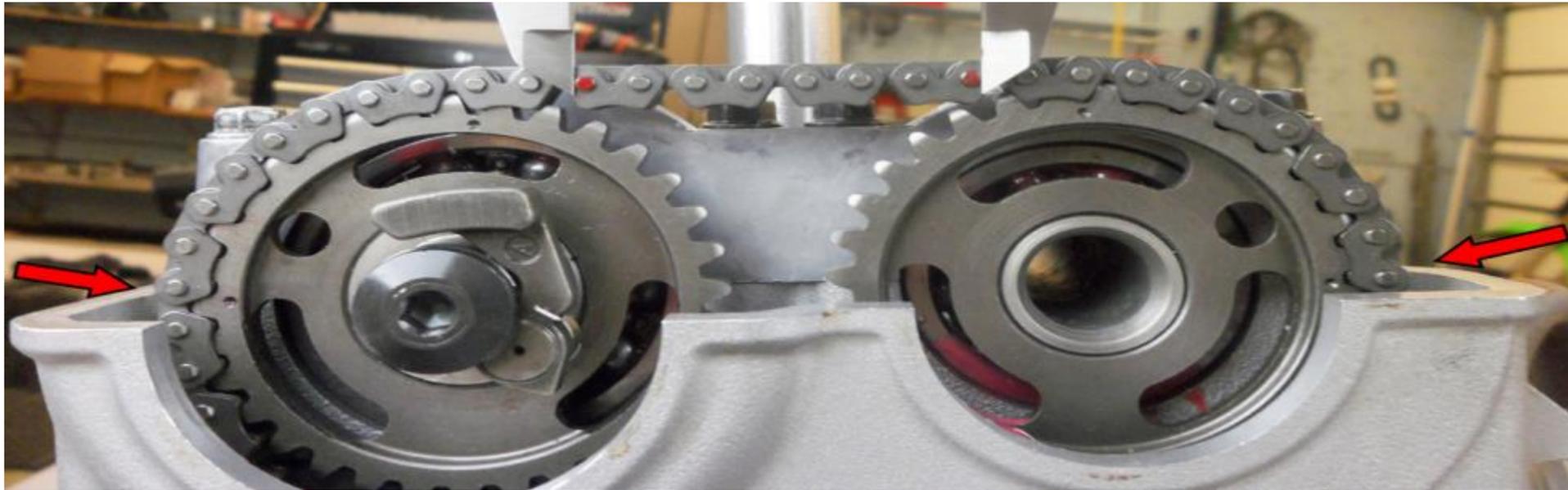
Type	Pitch	Length	Width	Weight
Roller Chain	9.525 mm (0.375")	3 m	33 mm (3 strands)	0.94 kg/m
Silent Chain	9.525 mm (0.375")	3 m	25,4 mm (1")	1.12 kg/m
Poly Chain Carbon Volt	8 mm	3 m	21 mm	0.28 kg/m

Type	Pitch	Sprocket Dia.	RPM	Width	kW Ratings
Roller Chain	9.525 mm (0.375")	57.9 mm (2.28")	1750	33 mm (3 strands)	~ 7.1
Silent Chain	9.525 mm (0.375")	57.9 mm (2.28")	1750	25,4 mm (1")	~ 5.5
Poly Chain Carbon Volt	8 mm	55.9 mm (2.20")	1750	21 mm	~ 10,1



APPLICATIONS EXAMPLES

Cam Drives



Conveyors

Mobility Walkways

CT Scans



ENGINEERING CLASS CHAIN

Engineering Class Chain

- **Broadly classified as a drive chain and conveyor chain**
- **Designed for certain applications to provide optimal performance**
- **Mostly used in material handling operations.**
- **Examples:**
 - Timber processing chain in the forest and paper Industry
 - Tram chain in the mining industry
 - Accumulator chain in the metal processing industry
 - Caterpillar drive chain in the automotive industry
- **They tend to operate 24/7, in abrasive environments, and rated to handle workloads up to 165.000 N.**



What Is Engineer Class Chain?

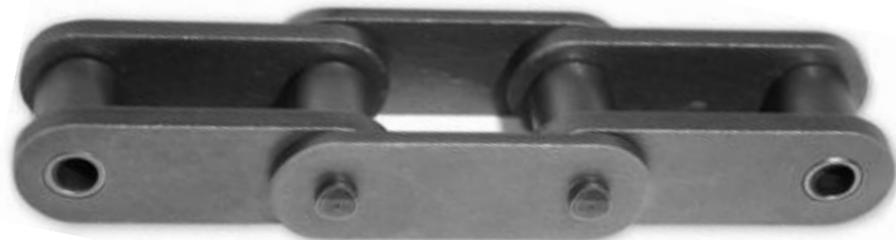
- **Exceptionally large and heavy duty chain**
 - For conveying / elevating / driving
 - Utilizes quality carbon steel alloys
 - Components can be heat treated / case hardened / carburized
 - Focus on robustness / high tensile strength / durability
- **Some have attachment capabilities**
- **Lube is less critical with component hardening and alloys**
- **Very few opportunities for conversion to belt drives**





81X Conveyor Chain

- **Common use in lumber mill conveyors**
- **One of the smaller Engineer Class chains**
- **Very Strong & Robust; Typical Features:**
 - Case hardened pins / bushings / rollers
 - Carbon heat treated sidebars
- **Comparison w Poly Chain GT Carbon**
 - Slow PC tensile decay (flexing / damage)
 - PC lacks robustness / debris resistance



Manufacturer	Chain Type	Pitch (mm)	Width (mm)	Weight (kg/m)	Avg Tensile (N)
Tsubaki	81X	66,27	52,6	3,72	66.500
Renold Jeffrey	81X	66,27	52,8	3,57	111.000
	81XH	66,27	64,3	5,21	178.000
	81XXH	66,27	69,8	6,85	187.000
Rexnord	81X	66,27	54,4	3,72	71.000 Min
Gates	PCGTC	14,00	90	0.71	115,000
	PCGTC	14,00	125	0.98	164.000
	PCGTC	19,00	100	1,04	245.000



Engineer Class Chain Applications





ATTACHMENT CHAIN

What are attachment chains?

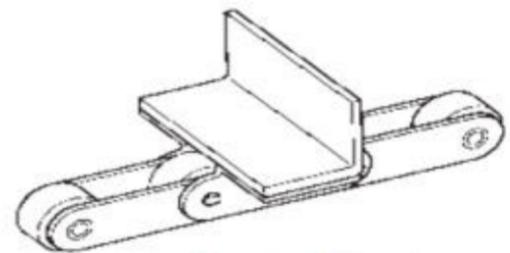
- **Side plates that mount onto standard roller chain**
- **Roller chain pins that extend beyond the outside link**
- **User can attach a variety of fixtures or jigs to the plates via screw holes or onto the pins**
 - Enables the chain to do more than transmit rotational power from one shaft to another
- **Offered in a variety of different metals and plating**



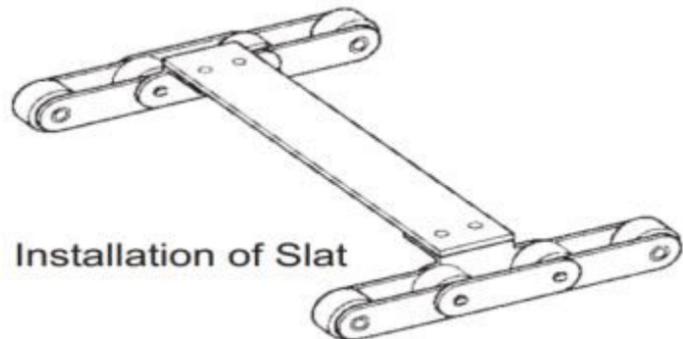


STANDARD ATTACHMENT TYPES

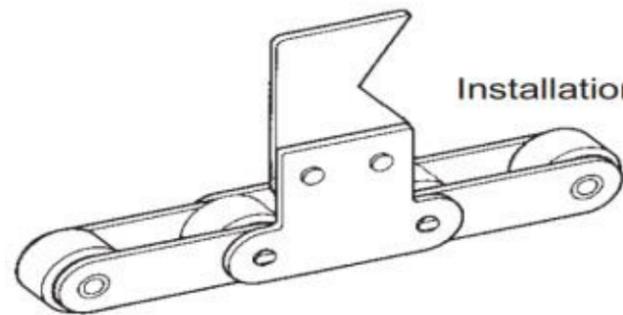
B	S	E
Bent link plate that form an L-shape	Straight link plates that extends up	Extended pins
Commonly used for conveying	One sided or double sided (S1 or S2)	One pin or two pins extended (E-1 or E-2)
One sided or double sided (B1 or B2)	One hole or two hole (1H or 2H)	
One hole or two hole (1H or 2H)		



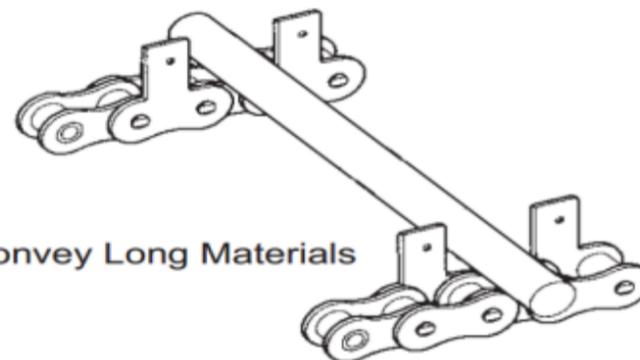
Installation of L-angle



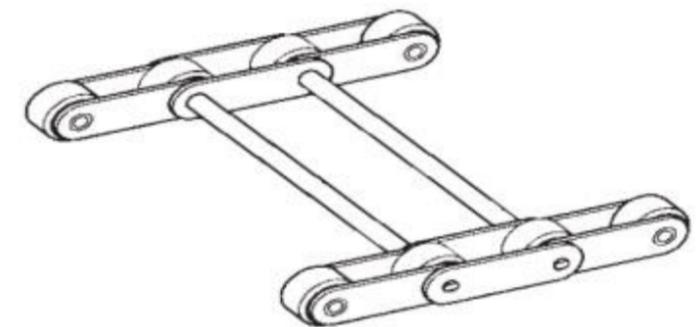
Installation of Slat



Installation of Hook



Double Strands Convey Long Materials

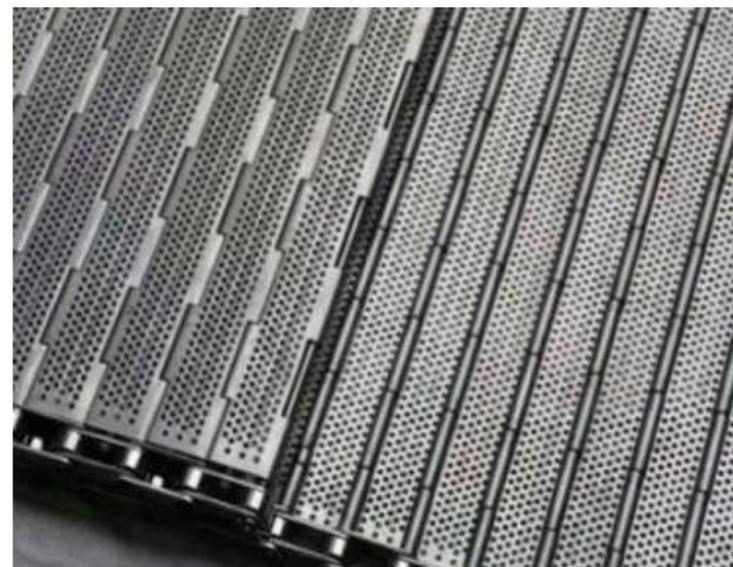
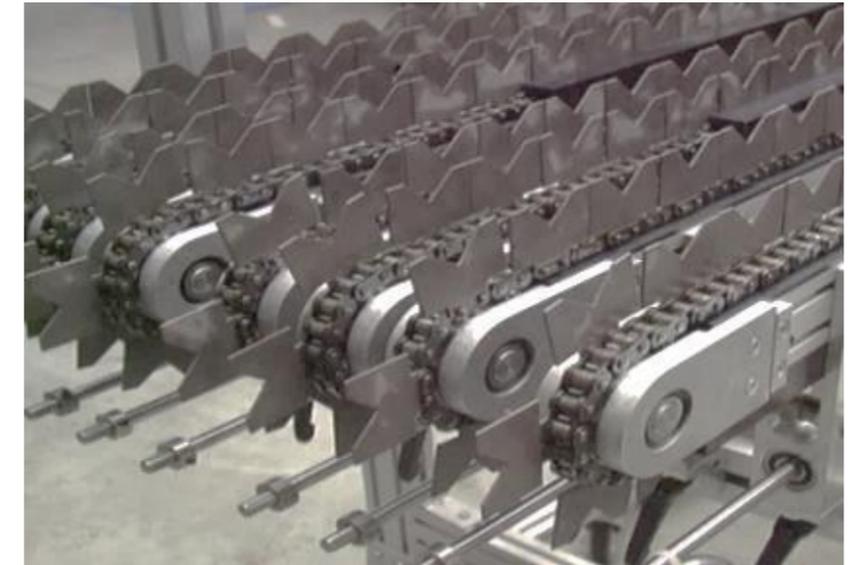


D Attachments with Crossrods and Jigs



ATTACHMENT CHAIN

Attachment Chain Applications





OTHER TYPES OF CHAIN

Lube-Free or Lambda Chain

- A maintenance-free roller chain that is recommended for applications in which proper lubrication is not feasible/possible

How does it work?

- Use of sintered alloy bushings, which are oil impregnated and work with the specially treated bearing pins, releasing lubricant to achieve maximum working life

Advantage

- Cleaner environment than traditional chain
- Can last 5 – 10 times longer than standard chain

Disadvantage

- Expensive
- Still requires lubrication
- Limited temperature range (90⁰C)

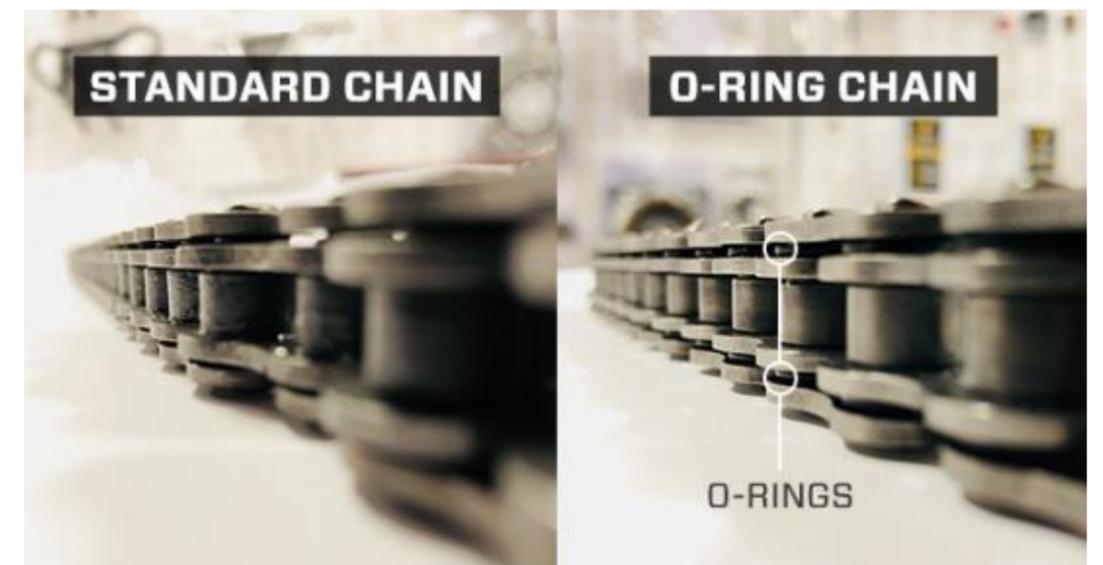
Things to consider:

- Always use sprockets with hardened teeth



O-Ring Chain

- **O-Rings try to seal lube in and dirt out**
- **Most common with motorcycles and motor sports**
- **Available in #50 through #160 sizes**
- **Good for dirty and wash down applications**
- **Costly**
- **Very uncommon in industrial applications**



Corrosion Resistant Chain

- **Stainless steel / Nickel plated chain**
- **Can cost 4 to 5 times more than standard chain**
- **Used for food and wash down applications**
- **Suffers from lack of lubrication in clean applications**
- **Stainless steel chain has reduced load capacity**
- **Some opportunities for conversion**



Double Pitch Chain

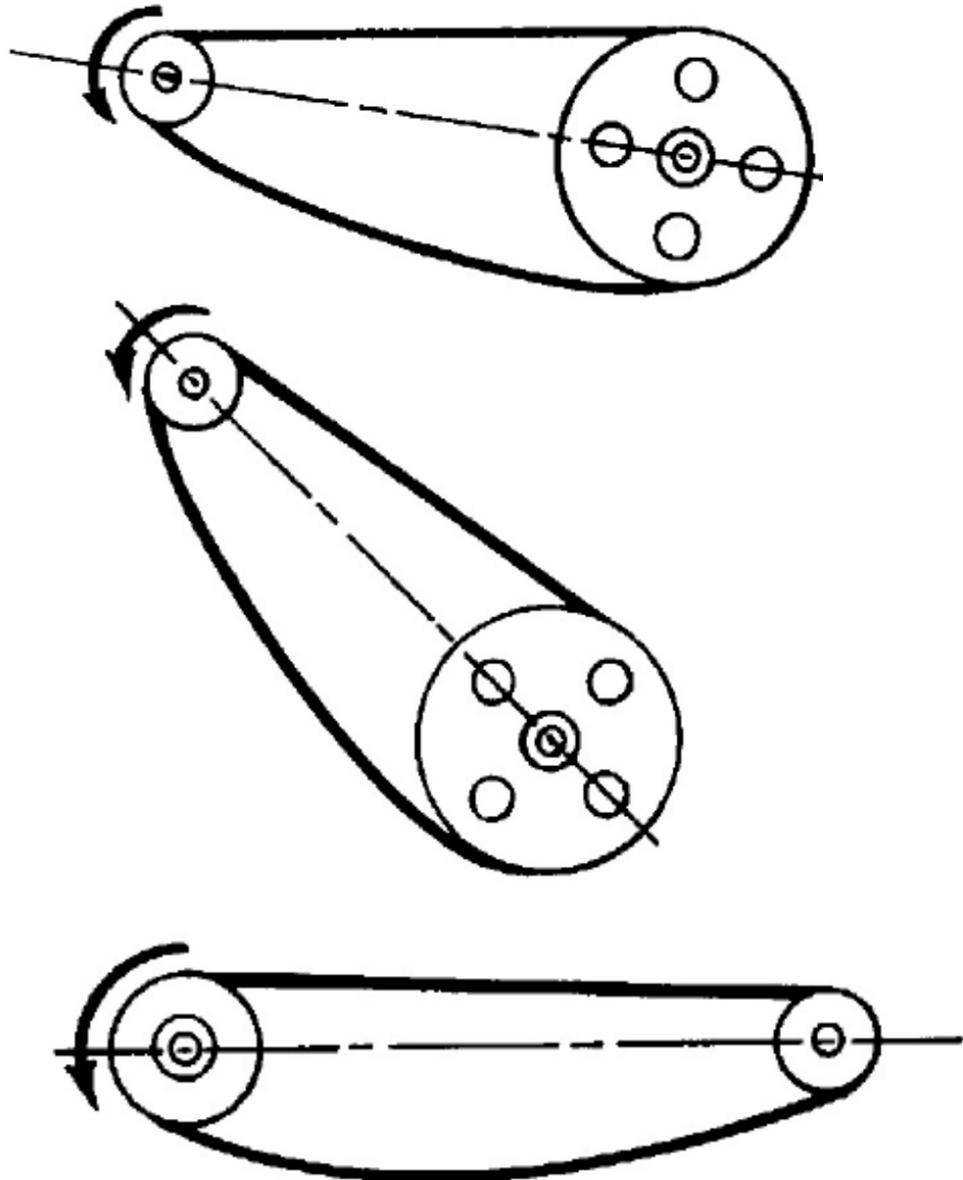
- Used in conveyor and agricultural applications
- For light loads and moderate speeds
- Common configuration for attachment chain
- Greater chordal action than standard chain
- Half of the components; saves cost



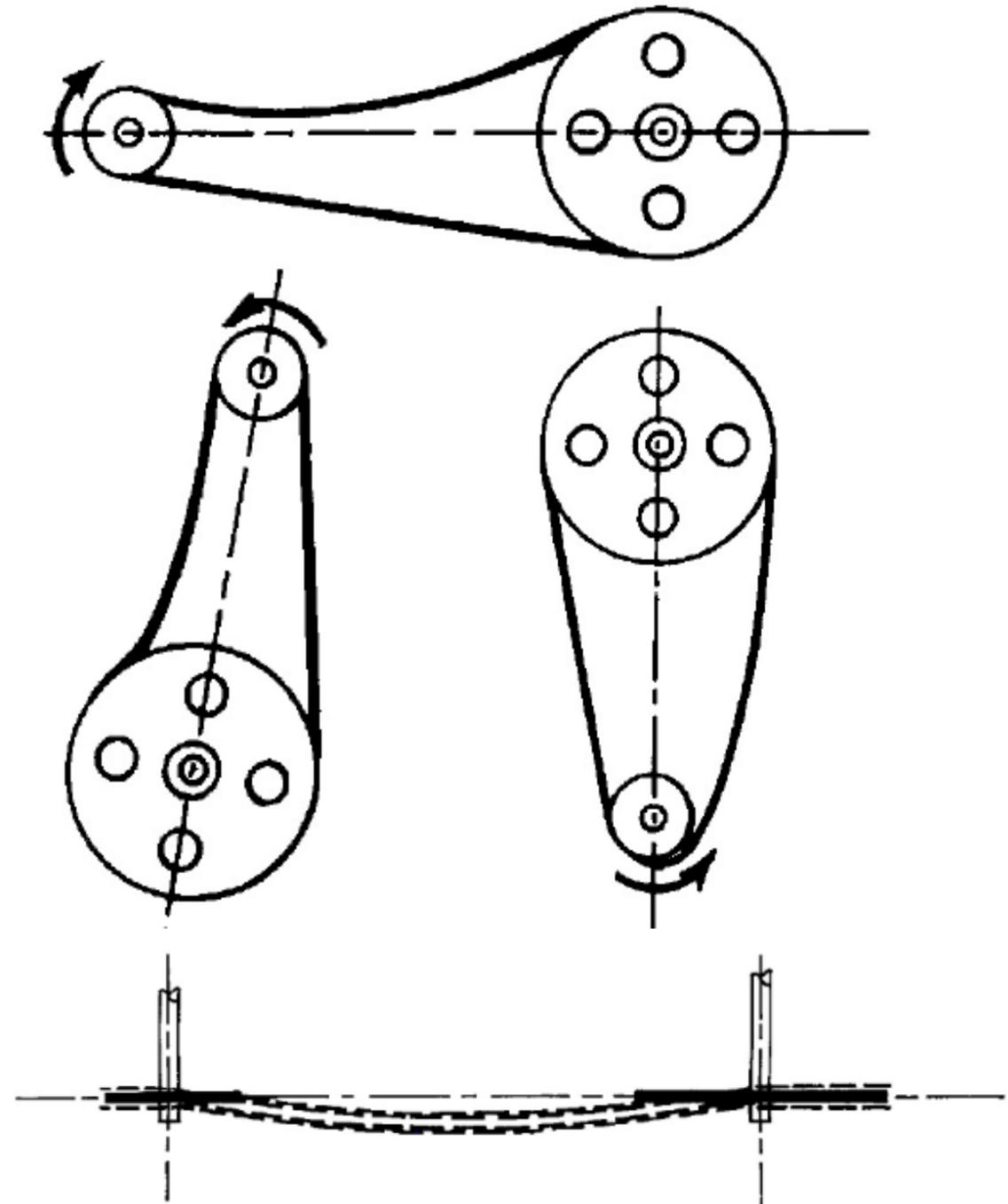


CHAIN DRIVE ORIENTATION CONCERNS

Recommended



Not generally recommended





ROLLER CHAIN

Advantages

- **Readily available**
- **Versatile (length, attachments, splicing)**
- **95+% efficient**
- **Serpentine capability**
- **Can accommodate fixed centers**
- **Low cost of acquisition**
- **Breakable**
 - Rejoining capabilities

Disadvantages

- **Limited chain and sprocket life**
- **Lubrication required**
 - Dirt attraction
 - Environmental contamination
- **High cost of ownership**
 - High maintenance requirements
- **Prone to noise & vibration**
- **High speed limitations**
- **Multi-strand chain rating not linear**
 - Eg. 2 strand = 1.7x capacity
- **Stretch**



SYNCHRONOUS BELTS





SYNCHRONOUS BELTS

Advantages

- **Maintenance free (no re-tensioning required)**
- **No lubrication required (clean running)**
- **Low cost of ownership**
- **High power density (compact)**
- **98+% efficient**
- **Wide operating speed range**
- **Widely available**
- **Accurate positioning**
- **Low vibration**
- **Quieter than roller chain at any speed**

Disadvantages

- **Finite belt lengths
(manufacturer dependent)**
- **Cannot be linked/spliced together**
- **Potentially noisy at high operating speeds**



POWERGRIP® GT3 BELTS

Key features:

- **Leading rubber synchronous belt**
- **Unique profile system allows clean belt entry/exit and full flank contact**
 - Best backlash characteristics
- **Reduced vibration and noise**
- **Offered in single sided and TwinPower construction**



Single sided	TwinPower
Where backlash is a concern	Serpentine chain drives
Lower load drives (small pitch)	Reverse rotating multipoint drives
Quieter at higher rpms	
Specialty backings	



POLY CHAIN[®] GT[®] CARBON[™] DRIVES

Key features

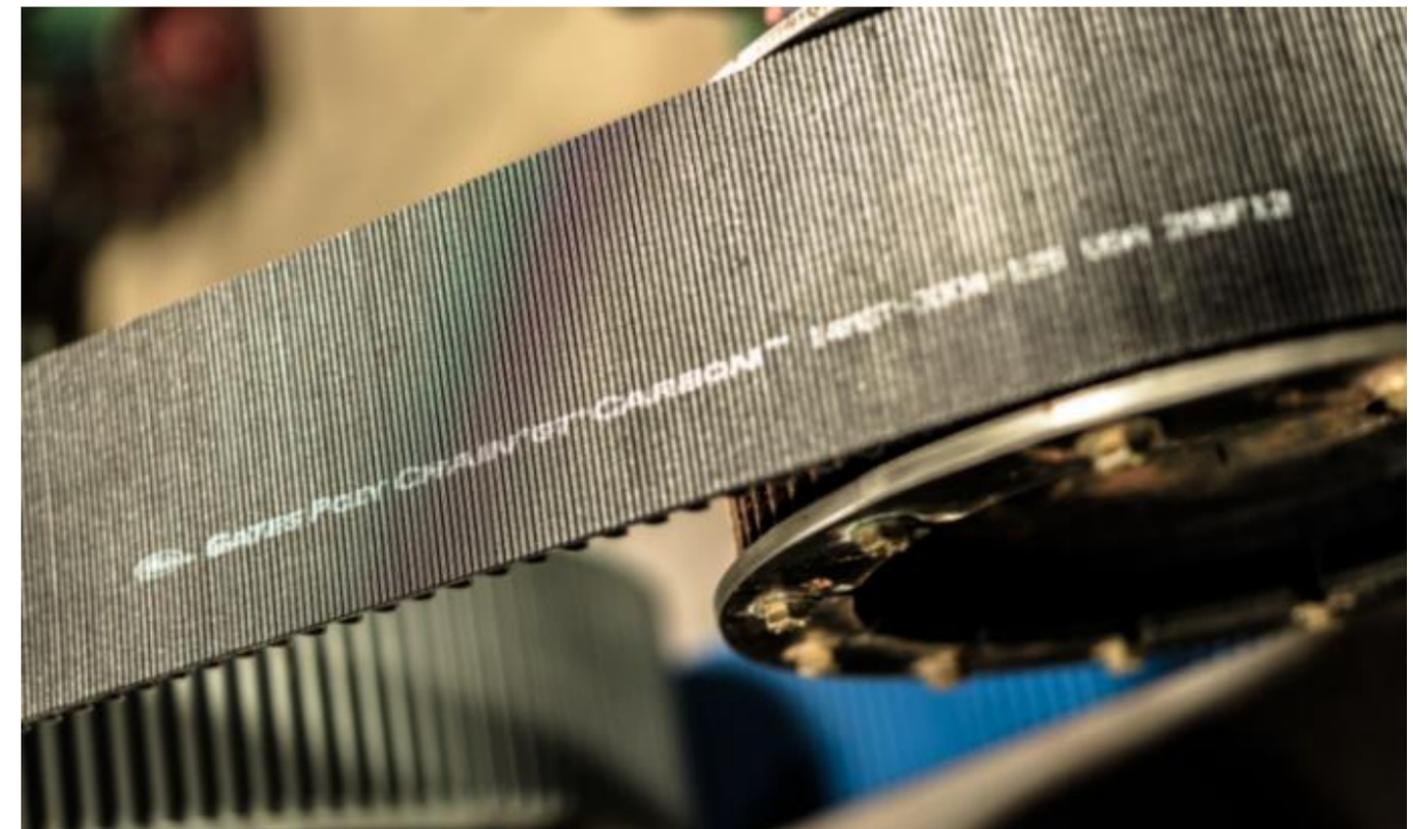
- Highest performance synchronous belt in the world
- 20+ years of the #1 position in the market

Typical applications

- The #1 belt to replace roller chain drive systems
- Very broad range of industrial applications
- High performance racing and sports applications

Design advantages

- Lightweight
- Clean
- Maintenance free
- Lubrication free
- kW/mm: 1.3x PC GT2; 1.6x-2.0x rubber-aramid belts





WHY CARBON CORD?

Improved tensile properties

- Increased tensile strength; increased load capacity
- Increased tensile modulus; increased load capacity

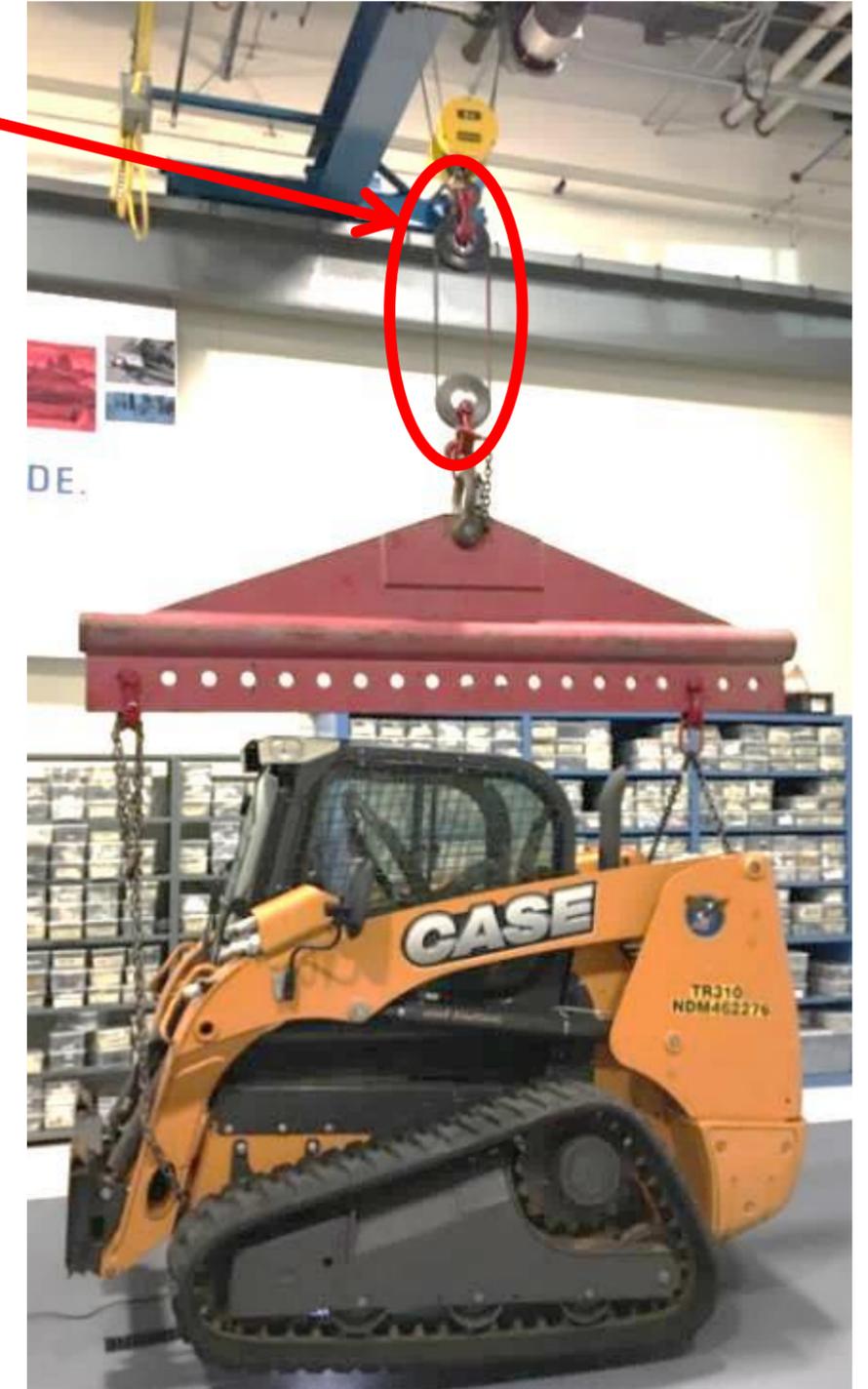
Dimensional stability

- Reduced negative thermal expansion compared to aramid fiber
- Length stable in humid environments

Tough and robust for harsh environments

Patented tensile cord design

21mm wide
carbon cord belt

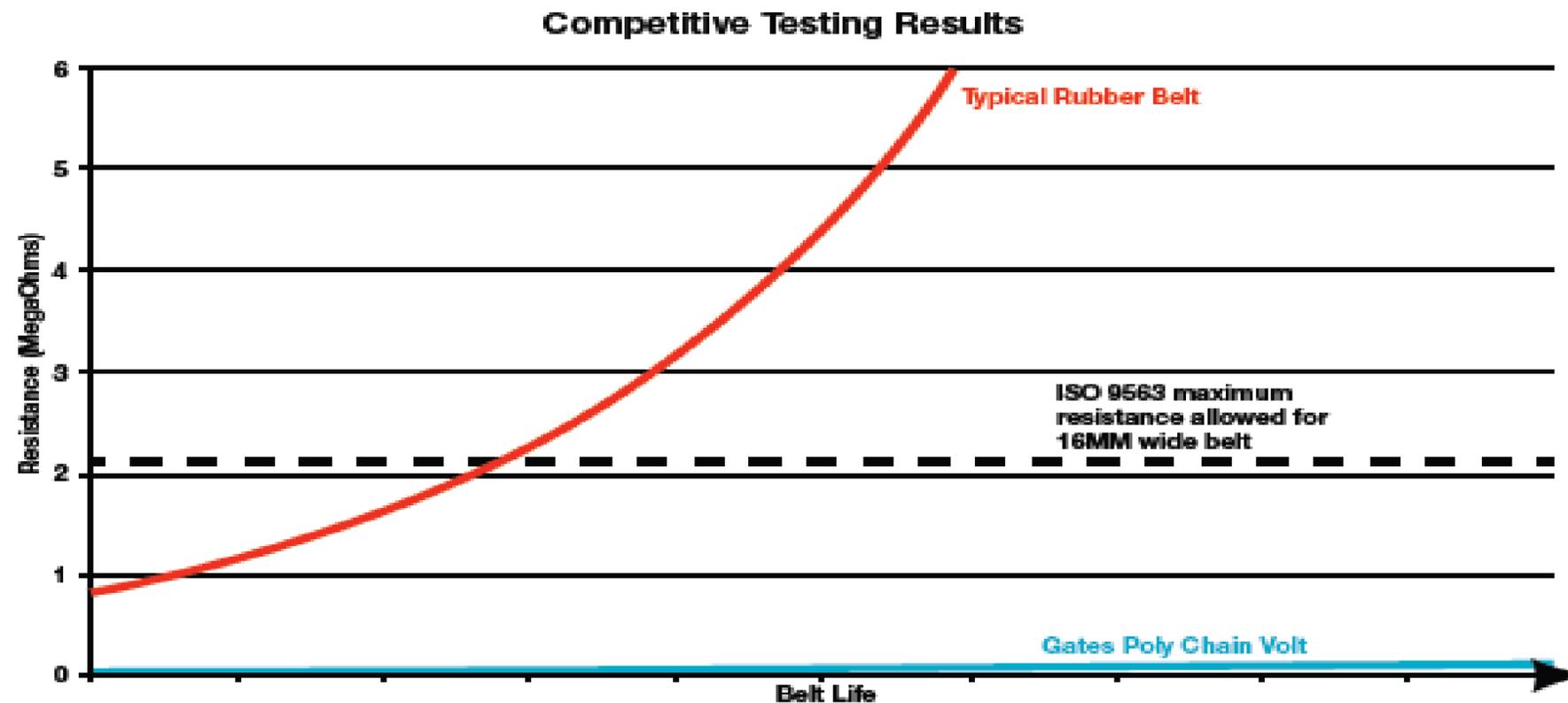




POLY CHAIN[®] CARBON[™] VOLT[™]

ISO 9563 defines conductivity properties of *brand new* belts

- Industry standards do not define used belt conductivity
- Typical rubber belt conductivity declines rapidly when running
- Innovative and proprietary methods used to test conductivity





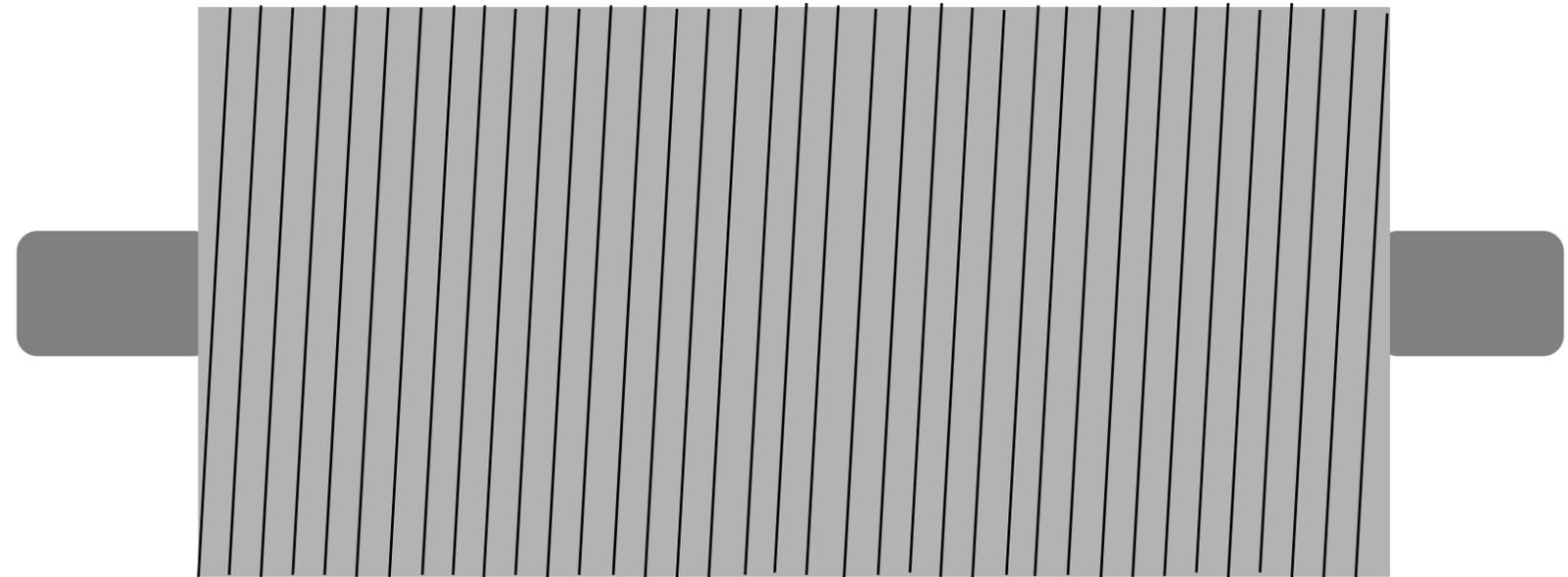
POLY CHAIN® GT® CARBON™ EXTENDED LENGTH IS A PRODUCT THAT IS ONLY OFFERED BY GATES

■ All the benefits of Poly Chain®

- Same load capacity
- 97% less weight than chain
- Comes in both 14M and 19M
- Length between 4410 mm to 20,000 mm

■ Cut along tensile cord wind angle

- Produces long length belting
- Re-bonded through proprietary process
- Produces longer than mold size options



Giant Roller Chain vs. 19M Poly Chain[®] GT[®] Carbon[™]

- **19M Poly Chain is LIGHTER WEIGHT than Chain**
 - 19M is 1,3 kg/m for 125mm width whereas 200-2 chain is 33 kg/m
- **Uses extended length process for large length offering**
- **Ideal for large chain conversions**
 - **EX. 240-2 chain to 200mm 19M drive**
- **Working Tensions up to 155.000+ N**
 - Speed and sprocket size dependent
- **Torque ratings up to 21.500+ Nm**
 - Speed and sprocket size dependent





POLY CHAIN[®] GT[®] CARBON[™] vs ROLLER CHAIN

Poly Chain GT Carbon is the ideal roller chain alternative

- **Virtually maintenance free drive**
- **Belts outlasts roller chain 3 to 1**
- **Overall drive widths are virtually equivalent for ratings**
 - We use higher S.F. so may see wider replacement

Withstands extreme environments

- **Excellent chemical and moisture resistance (withstands frequent wash downs)**
- **Operating temperature range: -54° C to +85° C**
 - High temperature construction available
- **Polyurethane body resists chemicals, oil, pollutants, and abrasion**





POLY CHAIN® GT® CARBON™ ROLLER CHAIN COVERAGE CHART

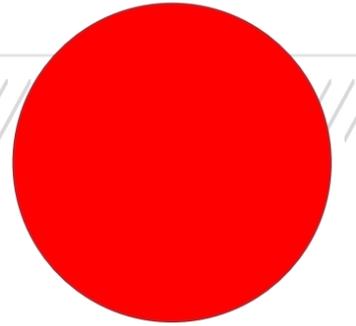
Roller Chain Coverage																
Chain	#35	#40	#50	2-#40	#60	#40-3	#50-2	#50-3	#60-2	#80	#60-3	#100	#80-2	#120	#80-3	#100-2
Width (mm)	12.7	17.0	21.1	31.5	26.4	45.7	39.4	57.4	49.3	33.5	72.1	40.9	62.7	50.8	91.9	76.7
8M-12	8M x 12 mm															
8M-21			8M x 21 mm													
8M-36							8M x 36 mm									
8M-62										8M x 62 mm						
14M-20						14M x 20 mm										
14M-37										14M x 37 mm						
14M-68														14M x 68 mm		

Roller Chain Coverage Cont.																
Chain	#140	#160	#120-2	#100-3	#180	#140-2	#120-3	#200	#160-2	#180-2	#200-2	#240-2	#200-3	#240-3	#200-4	#200-5
Width (mm)	54.4	64.5	96.3	112.5	73.2	103.4	141.7	79.2	123.2	139.2	150.9	184.7	222.5	272.5	294.1	363.2
14M-68	14M x 68 mm															
14M-90					14M x 90 mm											
14M-125								14M x 125 mm								
19M-100								19M x 100 mm								
19M-150									19M x 150 mm							
19M-200										19M x 200 mm						
19M-250												19M x 250 mm				
19M-300															19M x 300 mm	

- Notes:**
- Chain Size Ordered In Increasing Load Capacity
 - #35 - #100 Sizes Represent 99+% Of Total Unit Sales
 - Chart Indicates Poly Chain GT Carbon Belt Widths And Roller Chain Sizes With Equivalent Power Ratings
 - Chart Based On Current Poly Chain GT Carbon Power Ratings (2009)
 - Chain Ratings Per American Chain Association - Aug. 2003
 - Roller Chain Width Dimensions Represent Chain Pin Width



THE RIGHT BELT FOR THE JOB



Poly Chain GT Carbon

Poly Chain GT Carbon	Volt	Extended/Long length
5M, 8M, 19M pitches	ISO 9563 static conductive	Long center distances
#1 for standard chain conversion	Use with explosion-proof motors	Linear motion
Wash-down applications	Oil & Gas, Grain, etc...	Positioning systems
	Conductive for life of belt	





CHALLENGES



Sprockets

- **Keep sprockets as large or larger than existing chain sprockets**
 - Reduces risk of bearing/shaft damage due to increased shaft loads
- **Idlers are often needed to accommodate belt tension and installation**
 - Difficulties occur in roll-to-roll conveyors
 - MTO idlers needed for 19M and wide 14M drives
- **Special material/coatings may be needed to match existing chain sprockets**
 - Nickel plating
 - Stainless steel
- **Sprockets require flanges for proper belt tracking**
 - Ensure guard can accommodate total flange diameter





CHAIN CONVERSION CONSIDERATIONS

Reinforced flanges

■ Flange mounting

- Heat shrunk/staked flanges may not have sufficient strength to resist large belt drive tracking forces
- Flanging of both sprockets may be needed for large CD drives

■ Bolt-on flanges

- Thick, bolt on flanges found to be required for large 14M and 19M drives
 - 19 mm - $\frac{3}{4}$ " flanges used for large 19M drives
 - 9,5 mm - $\frac{3}{8}$ " bolts used every 30 degrees around sprocket





CHAIN CONVERSION CONSIDERATIONS

Reinforced motor base

- **Chain drives do not require as much initial tension**
 - Based on amount of sag in a free span
- **Belt tension can result in flexing and bending of drive base and structure**
- **Reinforcement may be needed to:**
 - Support the drive tension
 - Reduce tension fluctuation caused by weak structure
- **Rigidity can be checked by*:**
 - Pushing spans together which adds tension to the drive
 - Monitor shaft and structure for any movement



**With all safety measures followed*



QUESTIONS?

