FIRST Robotics Applications using Gates Rubber Synchronous Belt Drives

Welcome from Gates Corporation!

Gates Corporation is excited to be an Official Sponsor of the FIRST Robotics Competition!

Gates Corporation is a global leader in manufacturing products for industrial and automotive replacement markets, as well as original equipment manufacturers. The PowerGrip® rubber synchronous belts in your kit were manufactured by Gates. The synchronous belt sprockets were manufactured by a trusted Gates Supplier and Distributor - B & B Manufacturing.

Belt Benefits

Gates PowerGrip® GT®2 5MM belts are ideally sized for drives and functional applications on a FIRST robot.

- Lightweight – much lighter than chain and gearing systems for comparable loads
- Useful – PowerGrip rubber belt drive systems are ideal not only for drives, but also for linear motion, lifts, game object conveying, positioning, and even for precisely flinging objects
- Easy to Work With – aluminum sprockets are easy to machine and belting can be wrapped, cemented, or riveted to structure
- Oil-Free – these drives remain clean because oil is not needed and present a complete image of current technology
- Quiet – reduced noise as compared with other belt drive technology such as chain and gears

Additional Questions

Feel free to contact Gates before, during, and after the competition for any questions, opportunities, or inquiries you may have.

- Email ptpasupport@gates.com. Please include the words "FIRST" and your team name in the Subject line of the email
- Or call 303-744-5800
- Or visit www.gates.com/drivedesign
  - Download the Light Power and Precision Drive Design Manual or 2008 Industrial Power Transmission Solutions Catalog
  - Evaluate new drive designs using the Design Flex Pro software

Part Information

Your PowerGrip Component Kit Includes:

- 3 PowerGrip GT 2 Synchronous belts
- 3 pair of synchronous belt HTD® Sprockets

These parts can be used with the parts that were supplied in last year's kit!

Part Number	Qty	Detail
5MR-535-09	1	PowerGrip GT2 belt, 5mm pitch
5MR-535-15	1	PowerGrip GT2 belt, 5mm pitch
5MR-900-15	1	PowerGrip GT2 belt, 5mm pitch
P16-5M-09AL	2	Sprocket (fully finished with flanges)
P32-5M-15AL	2	Sprocket (requires machining for bore hole)
P56-5M-15AL	2	Sprocket (requires machining for bore hole)

See Appendix C for specification details for these parts as well as additional part availability.

Buying Additional Parts

B&B Manufacturing is a proud supplier to Gates Corporation and a supporter of FIRST Robotics, and will ship sprockets to locations across the USA. They accept credit card orders and can expedite delivery.

B & B Manufacturing
1712 Genesis Drive
La Porte, IN 46350
www.bbman.com
1-877-787-4022

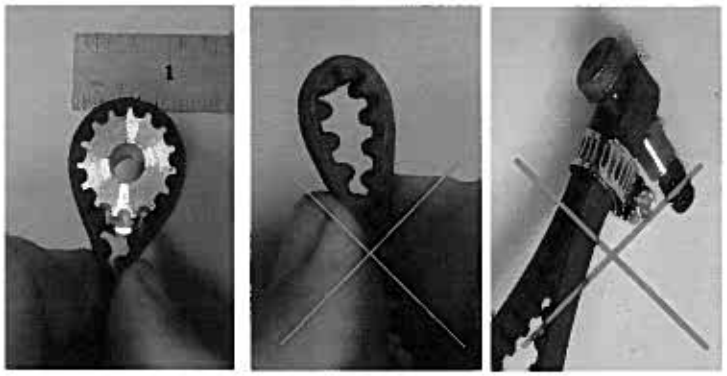
Gates sells all products only through our distributor network. To find a distributor in your area, please visit www.gates.com/distributors.

Best of luck in your FIRST competitions!

Appendix A: Belt Drive Application Tips

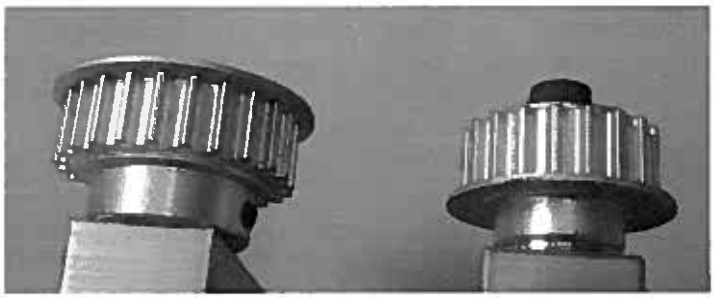
Best advice – One test is worth a 1000 calculations.

Handling the Belts – Do not bend belts smaller than the diameter of the 15 groove sprocket. A one time tight bend or crimp will break the belt's fiberglass tensile member and cause loss of strength and potential failure of the belt.

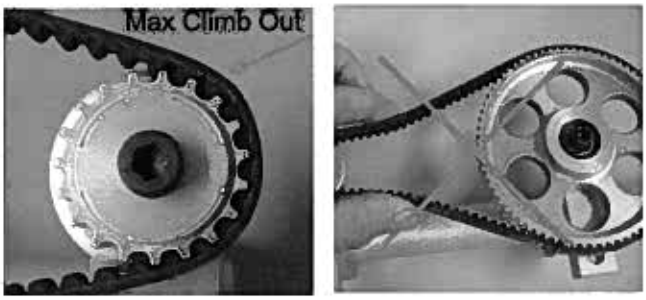


Do not pry belts off of sprockets. To remove, create slack by adjusting center distance or moving tensioner.

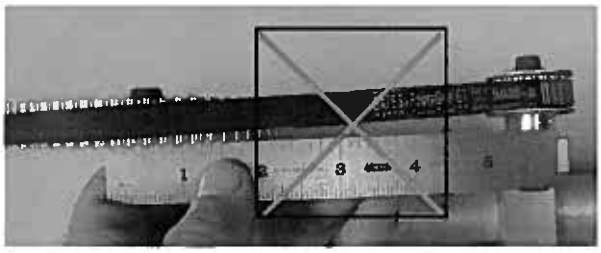
Sprocket Flanges – Provide flanges either on both sides of one sprocket or one side on the driver and the opposite side on the driven sprocket. All belts drive to one side of the sprocket. You must use flanges as described.

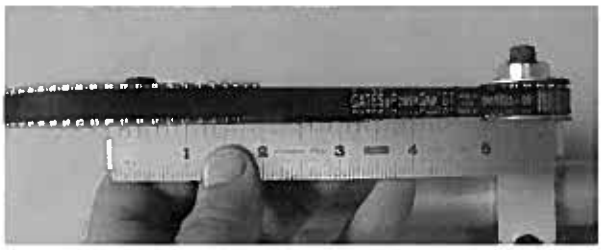


Belt Tensioning – Tension the belt so that when the drive is under full anticipated load (including shock loads) the belt does not get slack on one side, or the belt teeth try to climb out of the sprocket grooves. Make sure the mounting structure does not deflect when either tensioning the belt or under operating conditions. If you lose tension, the belt will jump teeth. Keep belt shafts parallel and sprockets in line with each other.

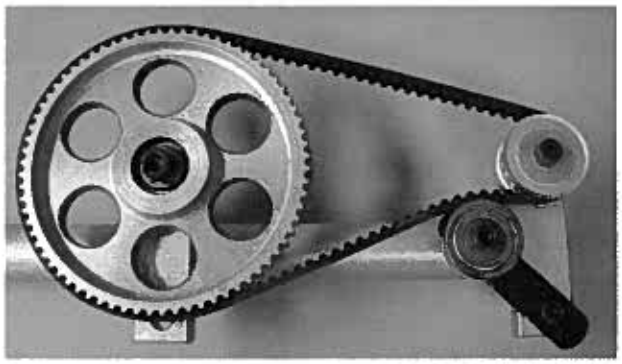


Belt Alignment - Sprockets must be aligned and shafts parallel in both planes.





Belt Wrap – Keep a minimum of 6 belt teeth fully in mesh belt wrap on the circumference of each sprocket. This will allow a properly tensioned belt to perform at 100% of its load rating. A backside idler can be useful for both tensioning the drive and increasing the belt wrap around the sprocket. The idler is used on the slack side of a belt drive.



Guarding & Debris protection – A piece of flat plastic supported in between the belt spans is a simple way to eliminate pinch points and keep debris out of the drive.

Product Ratings – Load capability of the 9 and 15mm width belts is proportional to their width. Gates belt ratings are set to guarantee long life on industrial applications. For FIRST applications, your load capability is going to be determined by the shaft to sprocket connections, belt wrap, and the ability to pretension the drive so that the belt does not jump teeth. With adequate belt wrap & proper installation tension, you will be surprised by the durability of this product!

Splicing Belts – Belts or belting can not be field connected or spliced together by any means other than connecting the belts with clamp plates. You need to use the correct pitch length belt.

Appendix B: Drive Design

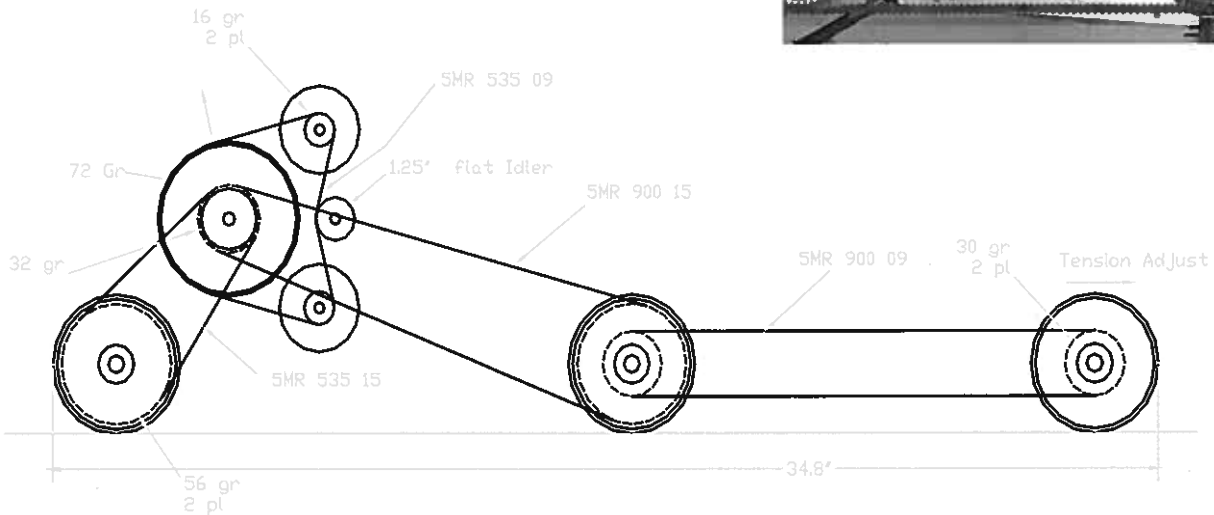
Example 1: 6-Wheel Synchronous Drive

- CIM motor primary drive uses 9mm wide belt.
- Higher torque load on wheel drives uses 15mm wide belt.
- Front wheel would be 9 or 15mm wide depending on loading.
- Total drive ratio is 7.9:1

Rule of Thumb: If using belts for speed reduction, use narrower belts on higher speeds (usually coming from the motor) and wider belts at the lower speeds (powering the wheels)

Note the use of sprocket flanges and belt tensioning points.

Provide adequate structure to maintain parallel shafts, sprocket alignment, and ability to maintain tension under load.

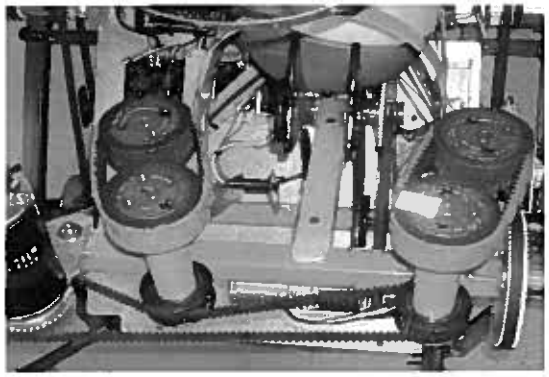


Example 2: Ball Positioning

- 2 stage, 13:1 ratio positioning drive.
- Small sprocket on inside of belt span drives a position feedback pot.

Example 3: Ball Pitching Applications

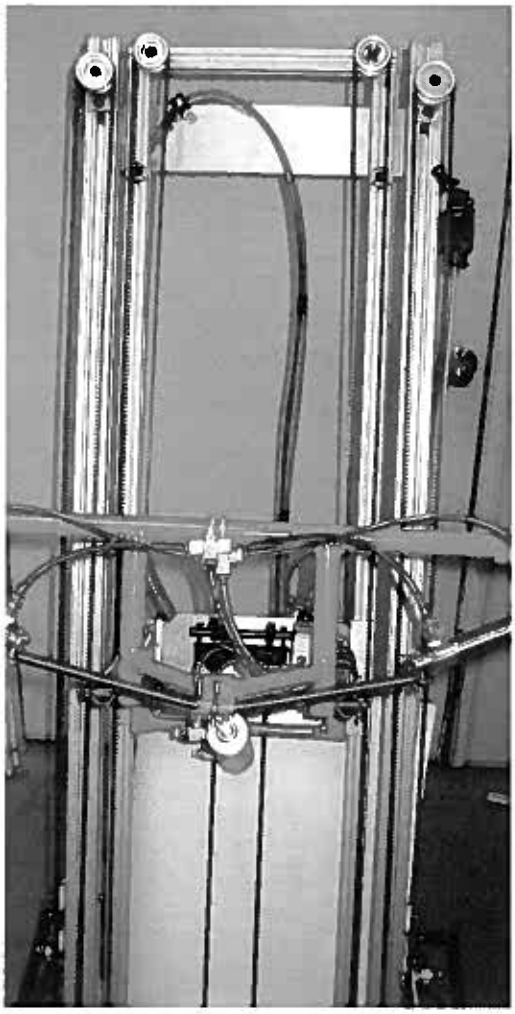
- Ball Pitching using opposing belts and a PowerGrip Twin Power belt (teeth on both sides) to reverse rotation.
- Fast and Accurate!

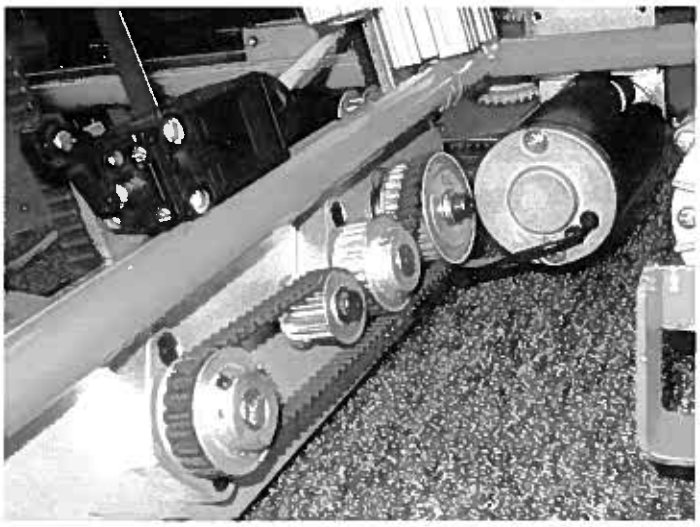


Example 4: Telescoping Lift with Door Motor & 5mm Long Length Belting

- 1.25" diameter flat rollers with a flange can be used for idlers (either side of the belt.)
- Make an easy end connection long length belting.
  - Make a ferrule from ½ diameter x .035 x 1" Al or Cu tubing.
  - Wrap belting around min. ½" diameter cylinder (to avoid belt cord damage) and insert belt loose ends through ferrule.
  - Crimp the ferrule in a vise. Don't crimp too tight and you will have a removable connection.
- Belt Tensioning – note adjustment screws

Need a reversing drive? PowerGrip Twin Power® belts have teeth on both driving surfaces.





Appendix C: Sprocket and Belt Size Availability

Components are categorized by "pitch", which is the distance from the center of one tooth to the center of the next tooth on a belt.

Belts are identified by belt pitch, pitch length, and width. Example: the 5MR-535-09 is a belt with a 5mm pitch, 535mm length, and 9mm width.

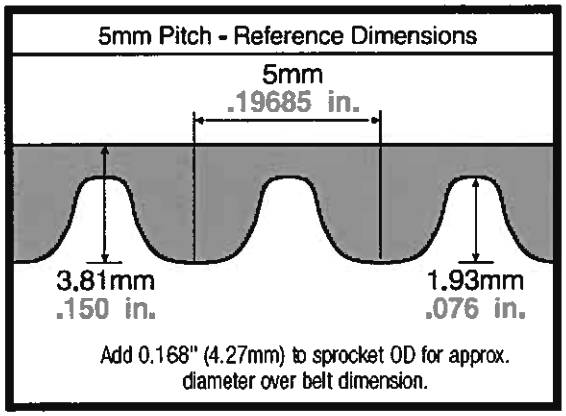
Sprockets are identified by tooth count, pitch, width and material. Example: P16-5M-09AL is a 16 tooth sprocket, 5mm pitch, 9 mm width and made of aluminu

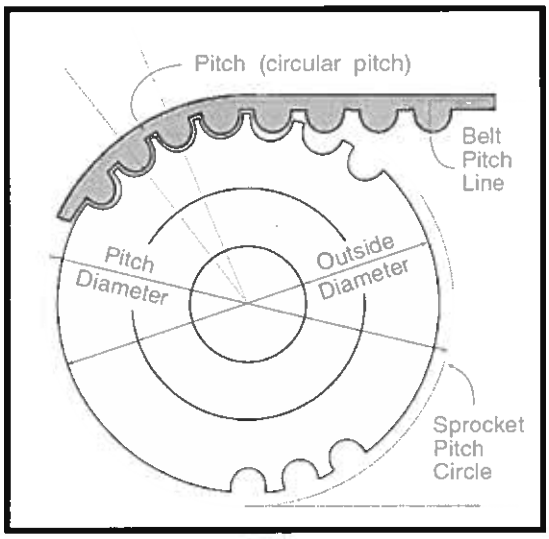
NOTE: The part number for a 15mm wide sprocket has "15-AL" at the end, rather than "09-AL".

NOTE: 25mm wide sprockets are not available as a stock part.

5mm Pitch 9mm Width Sprockets

Code Symbol	No. of Grooves	Pitch Diameter
P14-5M-09-AL	14	.877
P15-5M-09-AL	15	.940
P16-5M-09-AL	16	1.003
P17-5M-09-AL	17	1.065
P18-5M-09-AL	18	1.128
P19-5M-09-AL	19	1.191
P20-5M-09-AL	20	1.253
P22-5M-09-AL	22	1.379
P24-5M-09-AL	24	1.504
P26-5M-09-AL	26	1.629
P28-5M-09-AL	28	1.754
P30-5M-09-AL	30	1.880
P32-5M-09-AL	32	2.005
P34-5M-09-AL	34	2.130
P36-5M-09-AL	36	2.256
P38-5M-09-AL	38	2.381
P40-5M-09-AL	40	2.506
P44-5M-09-AL	44	2.757
P50-5M-09-AL	50	3.133
P56-5M-09-AL	56	3.509
P62-5M-09-AL	62	3.885
P72-5M-09-AL	72	4.511





5mm Pitch Stock Belt Widths

Belt Width Code	Belt Width (mm)	Belt Width (in)
09	9	0.354
15	15	0.591
25	25	0.984

5mm Pitch Belt Lengths

Description	Pitch Length (mm)	Pitch Length (in)	No. of Teeth	Description	Pitch Length (mm)	Pitch Length (in)	No. of Teeth	Description	Pitch Length (mm)	Pitch Length (in)	No. of Teeth	Description	Pitch Length (mm)	Pitch Length (in)	No. of Teeth
5MR-225	225	8.858	45	•5MR-375	375	14.764	75	5MR-550	550	21.654	110	•5MR-900	900	35.433	180
5MR-250	250	9.843	50	•5MR-400	400	15.748	80	•5MR-565	565	22.244	113	5MR-950	950	37.402	190
5MR-265	265	10.433	53	•5MR-405	405	15.945	81	•5MR-575	575	22.638	115	•5MR-1000	1000	39.370	200
5MR-275	275	10.827	55	5MR-410	410	16.142	82	•5MR-580	580	22.835	116	5MR-1050	1050	41.339	210
5MR-285	285	11.220	57	•5MR-425	425	16.732	85	•5MR-600	600	23.622	120	•5MR-1150	1150	45.276	230
•5MR-300	300	11.811	60	•5MR-450	450	17.717	90	•5MR-625	625	24.606	125	•5MR-1300	1300	51.181	260
5MR-325	325	12.795	65	5MR-460	460	18.110	92	•5MR-650	650	25.591	130	•5MR-1450	1450	57.087	290
5MR-330	330	12.992	66	5MR-475	475	18.701	95	•5MR-700	700	27.559	140	•5MR-1600	1600	62.992	320
5MR-340	340	13.386	68	•5MR-500	500	19.685	100	•5MR-750	750	29.528	150	•5MR-1720	1720	67.717	344
5MR-350	350	13.780	70	5MR-525	525	20.669	105	•5MR-800	800	31.496	160	•5MR-1755	1755	69.094	351
•5MR-355	355	13.976	71	•5MR-535	535	21.063	107	•5MR-815	815	32.087	163	•5MR-2100	2100	82.677	420
5MR-360	360	14.173	72	5MR-540	540	21.260	108	•5MR-850	850	33.465	170	5MR-2440	2440	96.063	488

Stock lengths are denoted by a •. All other sizes, contact Gates Customer Service for availability.

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