



Dear NWSL Gear/Mechanism Modeler,

With the introduction of a wide variety of miniature gearboxes over the years, NWSL has enabled a greater number of model builders to upgrade and improve the operating qualities of their models with more ease and success than previously possible. Although returns on our gear products have always been extremely low, we still want to guide model builders to improve their record of successful project accomplishment even further with usage reminders and hints beyond the general comments elsewhere in the catalog.

YOU CAN'T WEAR A GEAR IN -YOU CAN ONLY WEAR IT OUT!

Over the years models and mechanical components have often been of second quality or less in order to keep your costs (prices) as low as possible. As a result, modelers have become used to “wear-in” procedure in an attempt to remove binds and other problems caused by the non-precision components and/or inadequately engineered and built mechanical components. Proper procedure is to determine the bind cause (ie. eccentric gear; improper gear mesh whether too tight or too loose; foreign object in gear teeth; gear wobble; gear warpage such as often found in molded plastic gears; tight or misaligned bearings; etc.) and eliminate it.

In an apparently properly operating mechanism, excessive gear wear may occur. Our experience in modeling and more recently in gear manufacture has led us to conclude that the most common causes of excessive wear are:

1. Poorly made (or damaged) worm.
2. Improperly selected materials (most commonly a brass worm driving a brass wormgear - ie. Same materials - wear out rate will be very high, usually whether lubricated or not). Driving gear should be harder material than driven gear.
3. Worm not centered or too short for running mate wormgear.
4. Inadequate lubrication or lubricant (use a gear oil).
5. Improperly matched worm and wormgear.

And NWSL attacked these problems thusly:

1. NWSL uses a premium manufacturing technique to assure worms of very high surface quality. It is possible of course to damage worms during installation or handling or at any point in the manufacturing process.
2. Some NWSL gear sets require the user to locate the position of the worm in relation to the wormgear. The worm **MUST** be centered (front to rear) over the wormgear (and is best centered side-to-side) or the start of the worm thread can catch gear teeth as the wormgear rotates under the worm.
3. Virtually all of the confirmed instances of premature/excessive wormgear wear of NWSL products has been from inadequate lubrication and/or overload. Often due to the user purposely not lubricating while they “break it in” or “wear it in” or whatever (which translated means “wear it out”!). Would you drain the oil from your new automobile to break it in?

YOU MUST USE A GEAR OIL for adequate lubrication of gear teeth working surfaces. Light oils, while suitable for wormshaft bearings, etc., will not remain on the working surfaces of gear teeth and therefore cannot provide adequate lubrication. We use LaBelle #102 gear oil with good success and there are other suitable oils available. LaBelle #101, 107 and 108 are **NOT** suitable for this application (gear working surface lubrication), but are suitable for other lubrication such as shafts , axles, etc.

If you have incurred heavy wormgear wear, it would be most helpful to us at NWSL if you will advise us of the type of lubrication you have used and return the worm for inspection, repair or replacement. Re-using a damaged worm (whether from manufacturing, handling, installation or lack of lubrication) will only result in additional damaged wormgears even if appropriate lubrication is used.

We at NWSL will continue to provide you with top quality products precision manufactured specifically to increase your modeling skills and pleasure.

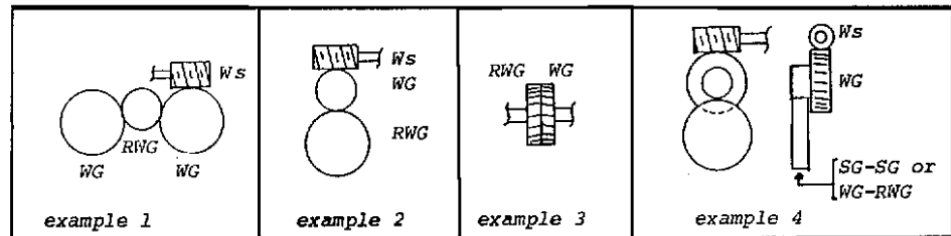
QUALITY GEARS FOR MODEL BUILDERS, TINKERERS, Etc.

These gears and suggestions are intended to aid you modeling pleasure. The examples below are meant to aid your understanding and maybe jog your imagination into figuring ways in which to accomplish your project. 72DP is a size of gear tooth in the English measuring system, a similar size in the Metric measuring system is 0.35module (abbreviated as 'mod'). Some HO models have larger 64DP/0.4mod. toothed gears or 48DP/0.5mod. If any combination of the NWSL 72DP gears can provide the same center-to-center distance to replace a larger toothed gear, the additional teeth provided in the same diameter can increase your reduction ratio (resulting in lower operating speed). Keep in mind that load carrying capacity decreases significantly as tooth size diminishes. In the DP system of measuring gears, the larger the number, the smaller the tooth size. In the metric system, the smaller the number, the

gear arrangement (example 1), each axle gear must have the same number of teeth, but the intermediate gears can have any number as required by spacing. Worm gears and reverse worm gears can be mated in place of spur gears to obtain quieter operation and longer gear life, but the slight axial thrust must be taken into consideration using thrust washers where appropriate. Example 4 provides a double reduction, Ws-WG ratio multiplied by the SG-SG (or WG-RWG) ratio.

Better gear life and less noise usually result if gears of dissimilar materials are mated with the driving gear harder (ie. steel worm to brass or plastic wormgear; brass worm to plastic wormgear, etc.). Noise is also a function of proper gear quality, spacing, bearing precision, and lubrication. Worn or sloppy bearings permit the shaft to vibrate causing both noise and excess gear wear. NWSL

Family of 72DP Gears—Dims.		
GEAR	O.D.	P.D.
WORM	.1875/4.8	.160/ 4.1
WG-RWG-SG	10T	.178/ 4.5
	15T	.240/ 6.1
	20T	.306/ 7.8
	24T	.361/ 9.2
	30T	.444/11.3
	36T	.527/13.4
	40T	.583/14.8
note: dimensions shown in inch/millimeter. 72DP and 0.35mod essentially the same.		



smaller the tooth size. 72DP is almost exactly equivalent to 0.35mod. Tooth size determines the load carrying capacity of a gear, the smaller the tooth size, the lower the capacity. Excessive load causes rapid tooth wear and gear failure.

What are referred to as 'worm gears' in common model applications are known technically as spiral or helical gears. A true worm gear is also referred to as a 'worm wheel'. This type gear has teeth which are cupped to the fit worm diameter providing more contact surface. Their manufacturing cost is too great to be practical for model building applications as well as being virtually impossible in these miniature sizes. The following abbreviations are used here: Ws = steel worm (the part that looks like a screw and is frequently mis-identified as a wormgear); WG = worm gear = RH (the gear that is driven by the worm); RWG = reverse worm gear = LH (gear that mates with WG but not a worm); SG = spur gear (gear with teeth straight across—ie. Parallel with its shaft). The above assumes a normal right hand worm. A left hand worm will mate with the RWG but not the WG.

Reverse worm gears and worm gears can be combined to build a herringbone type gear (eliminates end thrust). To determine gear shaft center-to-center distance, add their respective P.D. (pitch diameter) and divide by 2; add approximately .004" (thickness of this paper) for clearance. Bore is made for a light press fit, however, tolerance variations may not make this a tight fit. If so, knurl or 'upset' the shaft at the gear location or bond the gear in place with solder, Loctite, or similar. Before pressing a gear on the shaft, clean gear bore face of any burrs, sharp edges and keep gear perpendicular to shaft to assure 'square' assembly without gear wobble. THE SENSIPRESS+ can assist in this assembly. Another NWSL tool helpful in achieving precision operation is THE ALIGNER which can check for gear wobble and in many instances can remove gear wobble.

Reduction ratio is determined by number of teeth on the worm gear - ie. a 30 tooth worm gear mated with a worm will provide a 30:1 ratio or reduction. With an 'idler' or multiple intermediate gear (examples 1 and 2) type gear train, the final gear determines the reduction. On a multiple intermediate type

gears are of high quality and fine surface, but if you decide to lap the gears, toothpaste works well and is easy to wash out. Take extra effort to assure complete removal of ALL lapping compounds to avoid excessive mechanism wear, then lubricate the gears and bearing surfaces.

Most import models use metric (mod.) gears. U.S. manufactured models usually use DP gears. NWSL can provide, on special order, custom manufacture of metric worm gears and spur gears to match most models and sometimes the worm also. However, special handling and set-up charges are significant. Additionally, just replacing a worn or broken gear may not solve the problem that caused failure of the gear. If failure is due to wear, you should consider replacement of the gearbox or drive with a complete new drive for a longer lasting, better operating performance of your model. If failure is due to gear breakage, a replacement gear should serve satisfactorily in the original gearbox. The breakage (cracking) often occurs with moulded plastic gears pressed on a metal shaft or boss - this occurs due to natural shrinkage of the molded plastic over time. The gear cannot be repaired.

To keep your cost to a minimum, special order custom made gears are made on a 'time available' basis and may take anywhere from a day to several months, depending on shop workload. To inquire, send a sample of the gear to be replaced, even if worn or broken, and the O.D. of the worm. Advise what model the gear is from and provide a sketch of the gearbox/gear train showing which gear is required. Because of the wide variety of models and sometimes varied gears between production runs, we usually cannot reliably supply gears based only on model or manufacturer/importer name.

Imported HO locomotives usually have 3.0mm axle while U.S. manufactured HO locomotives usually have 1/8" axles. Many motors (both U.S. and imported) have 3/32" shafts (or 2.4mm which is .0007" larger). The 72DP 'Family of Gears' is available with bores to fit the 4 most commonly found shaft sizes for small models.

4. Designing for gears: If you are designing a model or mechanism, we recommend that metric size gears be planned. They are easier to calculate as well as the fact that you'll be ahead of the game in the coming conversion to metrics. NWSL will continue to offer 72DP size gears (0.35mod and 72DP happen to be interchangeable for all practical purposes), but we specialize in fine pitch metric gears. Metric sizes are easy to determine as shown above. Please keep in mind that tooth form changes in gears of less than 18 teeth causing both difficulty in manufacture (higher cost) and higher wear rate. It is not practical to make gears of less than 8 teeth due to the tooth form changes.

Ratio = number of teeth on final driven gear (if worm is single lead as are most NWSL worms). In the above idler type arrangement, if RWG is 36 tooth, ratio is 36:1 regardless of WG number of teeth. In non-idler boxes (Ws and WG only), number of teeth in WG determines ratio in the same manner. If the worm were a 2 lead type, the ratio would be 36/2 = 18:1. In double reduction arrangement (ie. WG shaft carries a second gear which engages the bottom gear - RWG in above illustration), the ratio is the product of the two separate ratios (ie. Ws-30T = 30:1; if a 10T on WG shaft mates to a 20T on bottom shaft /axle = 20/10 = 2:1; the total ratio is 30 x 2 = 60:1).

The chart below shows all commonly made fine pitch gear sizes. The finer tooth (higher DP or lower mod.) the lower the load carrying capacity and the higher the precision required in the mechanism to assure proper mesh and gear life. The chart is only a general guide of applicable sizes. the size, weight, life desired and power to be transmitted must be considered when determining tooth size to be used.

5. SPECIAL GEARS: All gears have theoretical specifications (OD, PD) which we manufacture for normal applications. However, we can often modify these specifications to fit a specific situation. For example, if a gearbox has been inadvertently made with wrong gear spacing, we may be able to modify gear PD and save you re-tooling and scrappage.

6. TO REPLACE A WORMGEAR, SPURGEAR OR REVERSE WORMGEAR:

It is relatively inexpensive to duplicate these gears (relative to Worm manufacturing cost). Setup will run approximately \$90 and unit cost approximately \$7 (brass or acetal). Quantity discounts apply on unit cost. To order gears or quote, send samples if possible and as much of the following information that you can determine. We MUST have the worm OD as well as the gear data if you are ordering a worm gear or reverse worm gear.

GENERAL DATA

- a. Pressure angle
- b. Material desired
- c. Quantity
- d. Date required
- e. Tooth size (DP/mod)

WORM DATA

- g. OD
 - h. Number of leads
 - i. Length
 - j. Bore
 - k. Type bore#
 - m. Material
 - n. Right or left hand
- #bore type - press-fit or slip-fit

GEAR DATA

- p. OD
- q. Number of teeth
- r. Face width (thickness)
- s. Bore
- t. Type bore#
- u. Material

CHART OF RELATIVE SIZES DP versus MODULE GEARS

Typical Module Sizes	Approx. DP (for comparison) <i>*All NWSL gears are 20 degree pressure angle</i>	Typical DP sizes <i>All NWSL gears are 20 degree pressure angle</i>	OD of 40 tooth gear (approx.)	Sizes NWSL makes*	Dimensions of NWSL Std. Worm		Appropriate range of sizes used in various models <i>(Use lower end of range for toys, us (toys, etc.) and upper end for lighter loads (trolleys, railcars, etc.)</i>
					OD	PD	
0.2	127.0	120	.33"				N
0.25	101.6	96	.35" .41" .44"	x			
0.3	84.7	80	.50"	x	5.0	4.4	H O
0.3		80	.53" .58" .59"	x	3.1	2.5	
0.35	72.6	72	.59"	x	3/16"	.160"	S
0.4	63.5	64	.66" .74" .75"	x	6.0	5.2	
0.45	56.5	56	.75"	x			O
0.5	50.8	48	.82" .88"	x	6.5	5.5	
0.55	46.2	40	.91" 1.00" 1.05"	x	8.0	6.8	G
0.6	43.3	40	1.05" 1.16" 1.24"	x			
0.7	36.3	32	1.24" 1.31"	x			

For best gear life, the gears should be dissimilar materials with the driving gear harder. This is particularly important for high speed and/or high load interfaces such as worm to wormgear and less important in low speed situations such as idler gears between axles. Acetal is the generic name for the engineering plastic trade named Delrin (DuPont) and Celcon (Celanese). NWSL acetal gears are machined from stable, aged material to avoid the shrinkage and cracking problems inherent in inexpensive moulded plastic gears. Gears can be machined in material of your choice with appropriate handling and difficulty charges (ie. gears in bronze usually require a 50% surcharge compared to brass because of added machining time and tool wear).

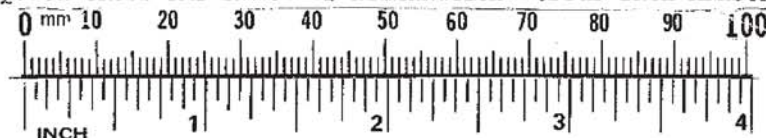
7. NOISE: Noise generation in gearing is a function of several factors including gear quality, mechanism quality, load and luck (it is considered an 'art' to achieve a quiet gear transmission). Literally, noise is vibration, so any sloppiness in bearings, shafts, etc. will translate into noise. Spur gears running at high RPM are inherently noisy and even with exceptional bearing clearances and precision assembly should be avoided if possible. Our experience is that tight gear mesh causes more noise than loose gear mesh. In worm and gear arrangements, a minimal worm end thrust is desired, not only to minimize noise, but to minimize downhill lurch common to many mass production model locomotives.

8. QUALITY: All NWSL gears are cut, including the acetal gears, assuring consistency and accuracy rarely achieved with injection moulded and cast gears. Gear TIR is less than 0.003". Closer tolerance can be provided with commensurate surcharges. Defective gears will be replaced free of charge upon return within 6 months of shipment. Gear wear is not within our control and therefore is not considered a defect. NWSL accepts no responsibility beyond the net sale price of the gear for any loss or costs incurred in the event of gear failure, or failure to perform in any particular manner. NWSL manufactures commercial quality fine pitch gears by process control.

9. MATERIAL: NWSL makes worms only of steel. Gears are cut from free machining half hard brass and acetal plastic. NWSL specializes in fine pitch metric gears of 16mm (5/8") or smaller OD. Larger gear sizes to 25mm (1") OD can be manufactured. All costs noted above are approximate for illustration purposes - inquire for current costs for your specific requirements.

SIZE	DECIMAL INCHES	SIZE	DECIMAL INCHES	SIZE	DECIMAL INCHES	SIZE	DECIMAL INCHES	SIZE	DECIMAL INCHES	SIZE	DECIMAL INCHES
97	.0059	59	.0410	2.75mm	.1083	5mm	.1969	N	.3020	13mm	.5118
96	.0063	1.05mm	.0413	7/64	.1094	8	.1990	7.7mm	.3031	33/64	.5156
95	.0067	58	.0420	35	.1100	5.1mm	.2008	7.75mm	.3051	17/32	.5312
94	.0071	57	.0430	2.8mm	.1102	7	.2010	7.8mm	.3071	13.5mm	.5315
93	.0075	1.1mm	.0433	34	.1110	13/64	.2031	7.9mm	.3110	35/64	.5469
92	.0079	1.15mm	.0453	33	.1130	6	.2040	5/16	.3125	14mm	.5512
.2mm	.0079	56	.0465	2.9mm	.1142	5.2mm	.2047	8mm	.3150	9/16	.5625
91	.0083	3/64	.0469	32	.1160	5	.2055	O	.3160	14.5mm	.5709
90	.0087	1.2mm	.0472	3mm	.1181	5.25mm	.2067	8.1mm	.3189	37/64	.5781
.22mm	.0087	1.25mm	.0492	31	.1200	5.3mm	.2087	8.2mm	.3228	15mm	.5906
89	.0091	1.3mm	.0512	3.1mm	.1220	4	.2090	P	.3230	19/32	.5938
88	.0095	55	.0520	1/8	.1250	5.4mm	.2126	8.25mm	.3248	39/64	.6094
.25mm	.0098	1.35mm	.0531	3.2mm	.1260	3	.2130	8.3mm	.3268	15.5mm	.6102
87	.0100	54	.0550	3.25mm	.1280	5.5mm	.2165	21/64	.3281	5/8	.6250
86	.0105	1.4mm	.0551	30	.1285	7/32	.2188	8.4mm	.3307	16mm	.6299
85	.0110	1.45mm	.0571	3.3mm	.1299	5.6mm	.2205	Q	.3320	41/64	.6406
.28mm	.0110	1.5mm	.0591	3.4mm	.1339	2	.2210	8.5mm	.3346	16.5mm	.6496
84	.0115	53	.0595	29	.1360	5.7mm	.2244	8.6mm	.3386	21/32	.6562
.3mm	.0118	1.55mm	.0610	3.5mm	.1378	5.75mm	.2264	R	.3390	17mm	.6693
83	.0120	1/16	.0625	28	.1405	1	.2280	8.7mm	.3425	43/64	.6719
82	.0125	1.6mm	.0630	9/64	.1406	5.8mm	.2283	11/32	.3438	11/16	.6875
.32mm	.0126	52	.0635	3.6mm	.1417	5.9mm	.2323	8.75mm	.3445	17.5mm	.6890
81	.0130	1.65mm	.0650	27	.1440	A	.2340	8.8mm	.3465	45/64	.7031
80	.0135	1.7mm	.0669	3.7mm	.1457	15/64	.2344	S	.3480	18mm	.7087
.35mm	.0138	51	.0670	26	.1470	6mm	.2362	8.9mm	.3504	23/32	.7188
79	.0145	1.75mm	.0689	3.75mm	.1476	B	.2380	9mm	.3543	18.5mm	.7283
1/64	.0156	50	.0700	25	.1495	6.1mm	.2402	T	.3580	47/64	.7344
.4mm	.0157	1.8mm	.0709	3.8mm	.1496	C	.2420	9.1mm	.3583	19mm	.7480
78	.0160	1.85mm	.0728	24	.1520	6.2mm	.2441	23/64	.3594	3/4	.7500
.45mm	.0177	49	.0730	3.9mm	.1535	D	.2460	9.2mm	.3622	49/64	.7656
77	.0180	1.9mm	.0748	23	.1540	6.25mm	.2461	9.25mm	.3642	19.5mm	.7677
.5mm	.0197	48	.0760	5/32	.1562	6.3mm	.2480	9.3mm	.3661	25/32	.7812
76	.0200	1.95mm	.0768	22	.1570	E	.2500	9.4mm	.3701	20mm	.7874
75	.0210	5/64	.0781	4mm	.1575	1/4	.2500	9.5mm	.3740	51/64	.7969
.55mm	.0217	47	.0785	21	.1590	6.4mm	.2520	3/8	.3750	20.5mm	.8071
74	.0225	2mm	.0787	20	.1610	6.5mm	.2559	V	.3770	13/16	.8125
.6mm	.0236	2.05mm	.0807	4.1mm	.1614	F	.2570	9.6mm	.3780	21mm	.8268
73	.0240	46	.0810	4.2mm	.1654	6.6mm	.2598	9.7mm	.3819	53/64	.8281
72	.0250	45	.0820	19	.1660	G	.2610	9.75mm	.3839	27/32	.8438
.65mm	.0256	2.1mm	.0827	4.25mm	.1673	6.7mm	.2638	9.8mm	.3858	21.5mm	.8465
71	.0260	2.15mm	.0846	4.3mm	.1693	17/64	.2656	9.9mm	.3898	55/64	.8594
.7mm	.0276	44	.0860	18	.1695	6.75mm	.2657	W	.3860	22mm	.8661
70	.0280	2.2mm	.0866	11/64	.1719	H	.2660	10mm	.3937	7/8	.8750
69	.0292	2.25mm	.0886	17	.1730	6.8mm	.2677	X	.3970	22.5mm	.8858
.75mm	.0295	43	.0890	4.4mm	.1732	6.9mm	.2717	Y	.4040	57/64	.8906
68	.0310	2.3mm	.0906	16	.1770	I	.2720	13/32	.4062	23mm	.9055
1/32	.0312	2.35mm	.0925	4.5mm	.1772	7mm	.2756	Z	.4130	29/32	.9062
.8mm	.0315	42	.0935	15	.1800	J	.2770	10.5mm	.4134	59/64	.9219
67	.0320	3/32	.0938	4.6mm	.1811	7.1mm	.2795	11mm	.4331	23.5mm	.9252
66	.0330	2.4mm	.0945	14	.1820	K	.2810	7/16	.4375	15/16	.9375
.85mm	.0335	41	.0960	13	.1850	9/32	.2812	11.5mm	.4528	24mm	.9449
65	.0350	2.45mm	.0965	4.7mm	.1850	7.2mm	.2835	29/64	.4531	61/64	.9531
.9mm	.0354	40	.0980	4.75mm	.1870	7.25mm	.2854	15/32	.4688	24.5mm	.9646
64	.0360	2.5mm	.0984	3/16	.1875	7.3mm	.2874	12mm	.4724	31/32	.9688
63	.0370	39	.0995	4.8mm	.1890	L	.2900	31/64	.4844	25mm	.9843
.95mm	.0374	38	.1015	12	.1890	7.4mm	.2913	12.5mm	.4921	63/64	.9844
62	.0380	2.6mm	.1024	11	.1910	M	.2950	1/2	.5000	1	1.0000
61	.0390	37	.1040	4.9mm	.1929	7.5mm	.2953				
1mm	.0394	2.7mm	.1063	10	.1935	19/64	.2969				
60	.0400	36	.1065	9	.1960	7.6mm	.2992				

QUICK CROSS REFERENCE of MILLIMETERS versus INCH MEASURE



GEARBOX kits -- 0.3mod, 0.4mod, 0.5mod, 0.6mod

High efficiency, precision manufactured NWSL gears and precision molded gearboxes molded in engineering acetal plastic to provide quiet, smooth operation of railroad models and other miniature mechanisms. The alternate input shaft size kits allow you to adapt these gearboxes to existing input shafts when desirable. The choice of input shaft height (from axle) permits you to more easily fit your particular model. See chart below for minimum recommended driver diameters. (use 'HiLo' set, a complete kit with matched gearboxes for re-powering articulated locomotives). *For Ball-bearing input shaft versions precede the stock number with a '1' (ie. 139-6 becomes 1139-6).

How to choose an appropriate gearbox? Use the actual illustrations on these catalog pages to help you determine visually which gearbox(es) can fit your available space. Check dimensions (see Dimensions chart).

Non-Idler Style: The axle gear is the worm gear and is somewhat more difficult to replace, however it is smaller and less obvious.

Idler Style: In high utilization, heavy load, difficult access (for lubrication and maintenance service), or other applications where it is likely that gear replacement may become necessary, the idler style is recommended. The worm gear [idler] is the gear most likely to wear out first, however it can usually be easily replaced. The idler style raises the driveline making installation/connection easier in many locomotives and tends to be smoother operating.

Other considerations: Axle Diameter: (3.0mm on most HO import lokies, 1/8" on most USA made) and RATIO: (the higher the ratio number, the slower the operating speed). For higher efficiency, smoother operation, select the ball-bearing (input shaft) version. Also consider the self contained power units, such as the Stanton Drive, FLEA and MAGIC CARPET, for simple and easy as well as prototypical solutions to your model powering projects. Some Korean built brass locomotives have undersize (0.115") dia. Axles—see the optional 'undersize axle' gears #2113-6 for 28:1 and #2110-6 for 36:1 to fit these axles.

HiLo ARTICULATED Gearboxes

Many beautiful articulated locomotives suffer from high operating noise even if running quality is satisfactory. The HiLo kits are special sets with gearboxes to provide angled driveline for direct connection to the motor shaft thus eliminating the noisy and troublesome spur gears or belts used in many HO articulated (mallet) locomotive models. Also includes precision NWSL universal couplings and shaft holding pillow blocks. Some model modification may be required to provide driveline clearance. NOT an easy installation but modelers report much improved operation in installations including Tenshodo, United, NWSL, and other brass articulateds as well as Bowser (1/8" axle) U.S. manufactured locomotives.



FLEA AUXILIARY Gearbox

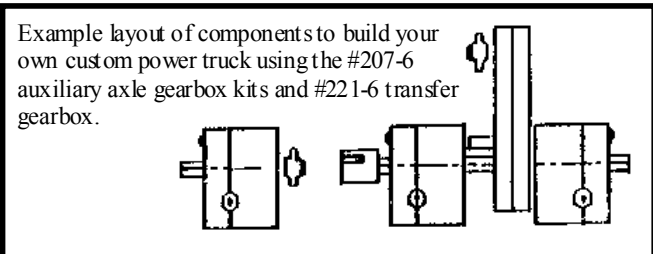
A miniature gearbox of 15:1 ratio with 1.5mm input shaft and 3/32" output (axle) shaft that can be used to power 2nd and 3rd axles from the FLEAs for model powering projects such as HOn3, Sn3, On2, On3 and HO railcars, speeders and other small models. Can also be used to build

streetcar, interurban, diesel or electric locomotive power trucks with individually geared axles that can be sprung or equalized to suit your modeling skills and desires. #207-6 includes gearbox, input shaft and worm - does NOT include output shaft or axle gear (see #2000-6, et al).

Minimum Wheel Diameter Recommendations									Stock #
size	Min*	O	S	OO	HO	TT	Actual Dia.		Series
0.3 28-1	Reg.	26"	34"	41"	46"	64"	13.4mm	.528"	136-6/ 149-6
	Abs.	19"	25"	29"	33"	46"	9.6mm	.378"	
0.3 36-1	Reg.	31"	42"	50"	56"	78"	16.4mm	.644"	150-6/ 159-6
	Abs.	23"	30"	36"	40"	56"	11.8mm	.460"	
0.4 28-1	Reg.	38"	51"	60"	68"	80"	20mm	.788"	240-6/ 249-6
	Abs.	24"	32"	38"	43"	59"	12.4mm	.488"	
0.5	Reg.	38"	51"	60"	68"	--	20mm	.788"	250-6/ 271-6
	Abs.	26"	36"	42"	48"	--	14mm	.552"	

* Reg. = Min. driver dia w/ bottom gear cover; Abs. = absolute min, gear cover removed

MINIMUM DRIVER DIAMETER by SCALES									
Size	Min*	O	S	OO	HO	TT	Actual Dim.		Series
0.3	R	11"	15"	17"	20"	27"	6.6mm	.221"	207-6
15:1	A	10"	13"	16"	18"	25"	5.2mm	.202"	
0.3 28:1	R	26"	34"	41"	46"	64"	6.7mm	.264"	136-6/ 149-6
	A	19"	25"	29"	33"	46"	4.8mm	.189"	
0.3 36:1	R	31"	42"	50"	56"	78"	8.2mm	.322"	150-6/ 159-6
	A	23"	30"	36"	40"	56"	5.9mm	.230"	



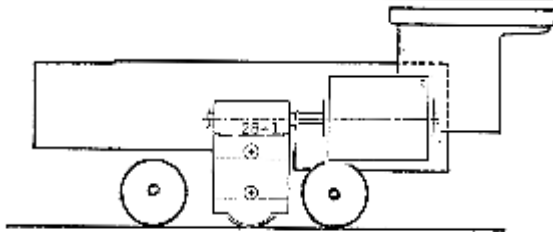
15:1 #207-6 (light duty)			
Input Shaft		Output Shaft	
1.5mm	.0591"	2.38mm	3/32"

Also see page 19 for listing of geared wheelsets and axle (output shaft) to fit this gearbox kit.

Illustrating fitting power system components to scale models

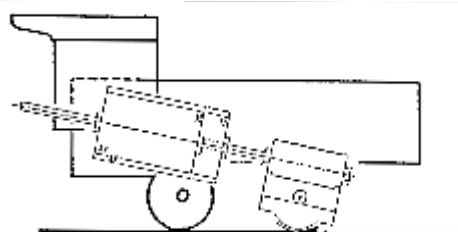
All illustrations were HO scale but have been reduced here for space fitting. As shown, the locomotive drawings do not have to be complex and fancy, you merely need the outline of the area(s) available to conceal the power system components. All illustrations here were light-box sketched direct from MODEL RAILROADER CYCLOPEDIA volume 1—STEAM LOCOMOTIVES drawings. The boiler backhead is drawn but may be omitted if not included in your finished model, thus leaving more space for motor installation. Two other considerations: 1. Scale models are sometimes manufactured overscale thereby having more space than scale drawings indicate; 2. Model construction technique will determine space efficiency, ie. Brass models have about as much space as the sketch indicates because of the thin shell, whereas a cast metal model superstructure will be somewhat thicker and more restrictive of interior space available for motor and gearing.

What if available drawings are not to your scale? You can reduce and re-draw of course, but there is an easier way in these days of inexpensive and versatile copy machines with reduction and enlargement feature at your local quick copy center, drugstore, office supply store. If you have an HO drawing but need it in 'S' scale, divide by 87 (HO is 1:87) by 64 (S is 1:64) which tells you that S is 136% of HO. Most copy machines have variable reduction/enlargement feature making exact size easy. If you can't locate a suitable drawing to represent your particular model, you still have two easy ways to proceed. You can find a drawing of a similar size locomotive, or you can measure your model and make your own sketch or more simply just lay the gearbox (the drawings in this catalog are actual size for easy fit evaluation) and motor drawings on the model and 'eyeball' them for fit!



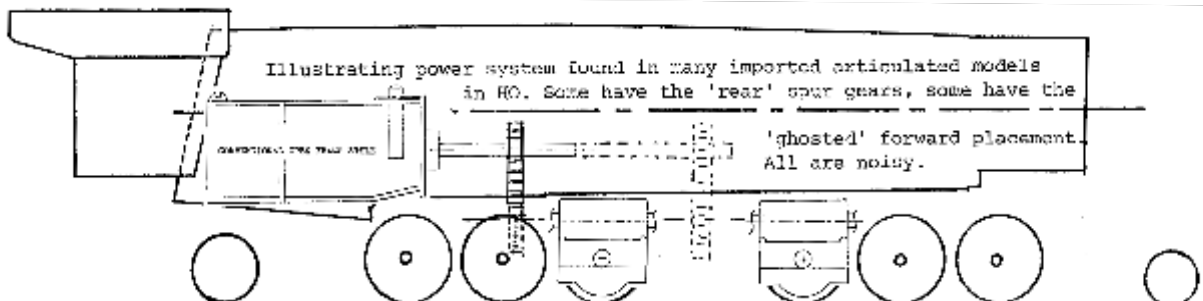
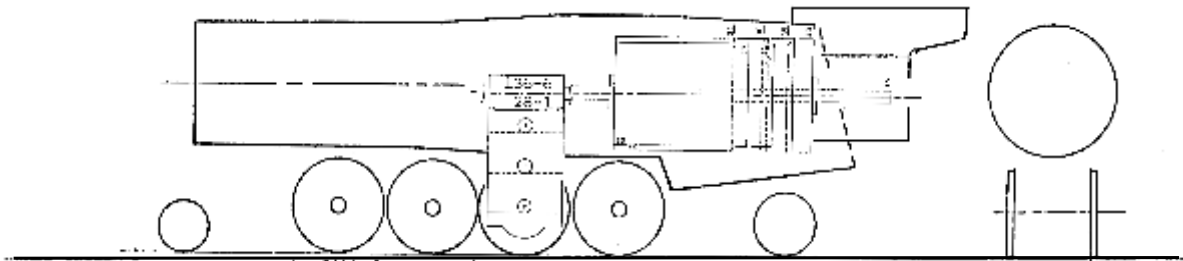
Omaha 0-6-0 50" drivers

A small locomotive model with a 1620 size motor and #139-6 gearbox (#142-6 for 1/8" axle) installed completely inside the boiler. A larger 1630 motor could be used if the boiler backhead is not modeled.

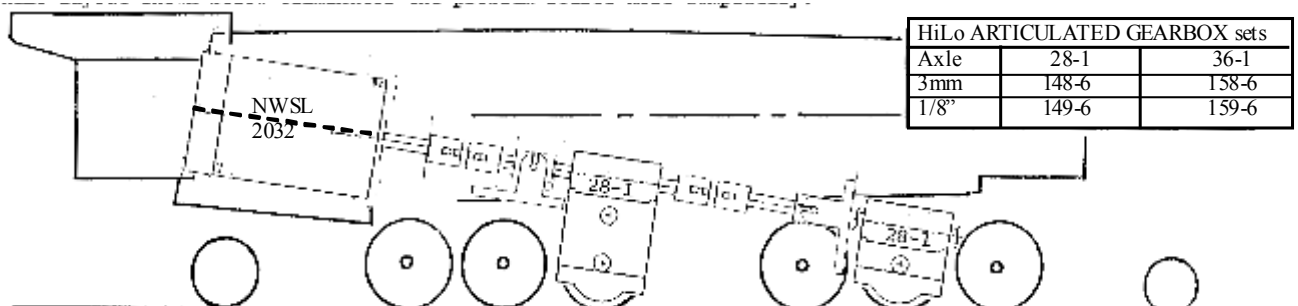


P.R.R 0-4-0 50" drivers

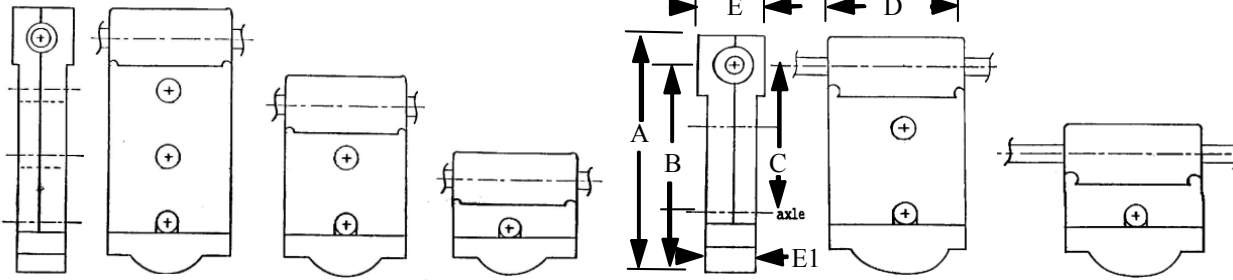
A small locomotive illustrating possible fitting of the 12mm motors using the non-idler #140-6 (3mm axle—#143-6 for 1/8" axle) gearbox in the more common sharply angled motor mounting method.



POWER SYSTEM PLANNER components augmented with sketching to illustrate a drive system common to many imported brass articulated HO models/. The spur gears of this type mechanism are typically the source of much operating noise and poor operation. While some modelers have improved operation using NWSL delrin spurgear replacements, rebuilding the model to the HiLo layout shown below, not a simple installation, eliminates the problem source more completely.



0.3 module GEARBOX kits 28:1 and 36:1 ratios with 2.4mm input shaft

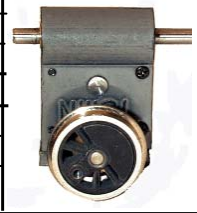


Scale
N
TT
HO
OO
S
O
32
29

0.3 Module GEARBOX DIMENSIONS							
Ratio	15:1			28:1		36:1	
Style	Db1	Idler	Idler	Direct	Idler	Direct	
A	11.0	32.5	24.0	15.5	30.3	19.4	mm
	0.433	1.279	0.945	0.610	1.193	0.764	inch
B	6.6	28.5	20.0	11.5	26.3	15.4	mm
	0.256	1.122	0.787	0.453	1.035	0.606	inch
C	3.8	23.5	15.0	6.5	18.6	7.7	mm
	0.151	0.925	0.591	0.256	0.732	0.303	inch
D	8.5	16.0	16.0	16.0	18.0	18.0	mm
	0.335	0.630	0.630	0.630	0.709	0.709	inch
E	6.2	8.0	8.0	8.0	8.0	8.0	mm
	0.245	0.315	0.315	0.315	0.315	0.315	inch
E1	3.1	6.0	6.0	6.0	6.0	6.0	mm
	0.123	0.236	0.236	0.236	0.236	0.236	inch

0.3 module teeth have load carrying capacity appropriate for most HO scale model applications, models of smaller scales and some light duty applications in larger scales (traction, speeders, etc.).

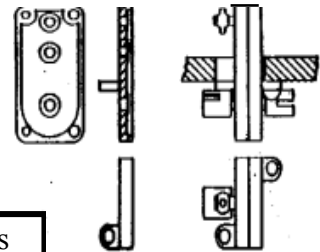
28:1 ratio GEARBOX STOCK NUMBERS*						Input Shaft	36:1 ratio GEARBOX NUMBERS*			
Axle diameter	Db1	Idler	Idler	Direct	HiLo		HiLo	Idler	Direct	
3.0mm	0.118"	136-6		139-6	140-6	148-6	2.4mm	158-6	150-6	151-6
1/8"	0.125"	141-6		142-6	143-6	149-6	2.4mm	159-6	153-6	154-6
2.4mm	0.094"			146-6	147-6		2.0mm			
Input Shaft Conversion Kits (include worm, 2 bearings, to fit indicated shaft size)										
							2.0mm		164-6	144-6
							1.5mm		165-6	145-6
							1.2mm		166-6	167-6



0.3mod TRANSFER GEARBOX kits - 3.125:1 ratio with 1.5mm input shaft

A miniature transfer gearbox as used in the KLV Shay powering kit. Suitable for small HO, HO_{N3} power from a body mounted motor driveline to underfloor location for better alignment to wormshaft of truck axle mounted gearboxes (see #211-6 series above). Uses three spur gears.

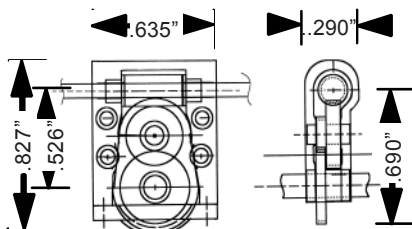
Illustrations are actual size for easy visual fit assessment of fit to your project



0.3mod Transfer Gearbox Stock Numbers					A	C	D	E	dims
Stk#	Ratio	InShaft	OutShaft		20.7	13.0	10.4	4.1	mm
221-6	3.125:1	1.5mm	1.5mm		.814	.510	.409	.160	inch

The really miniature 0.3mod GEARBOX kit 50:1 ratio with 1.5mm input shaft (1.2mm optional)

A high efficiency, miniature compound gearbox for some light duty applications in larger sizes (HO traction, speeders, etc.) may be suitable. The axle fit selection covers all known small scale sizes - for those few HO_{N3} applications with 3.0mm axle, the miniaturization of this gearbox made it necessary to build the axle integral with the axle gear (not available in HO gauge length)



Illustrated actual size

Applications include HO_{N3}, TT and large N scale locomotives

50:1 ratio GEARBOX STOCK NUMBERS					
stock #	Output shaft OD	Input shaft OD	ratio		
170-6	2.4-3/32"	.0944"	1.5mm	.059"	50:1
171-6	2.0mm	.079"	1.5mm	.059"	50:1
172-6	1.5mm	.059"	1.5mm	.059"	50:1
173-6	3.0mm	see note	1.5mm	.059"	50:1
<i>note: To achieve 3.0mm axle in this tiny gearbox, the shaft is integral with the gear and is HO_{N3} length - is not suitable for HO size locomotives and cannot be lengthened to HO length.</i>					
175-6	Conversion kit—changes input to fit 1.2mm motor shaft				

0.3 module GEARBOX kits

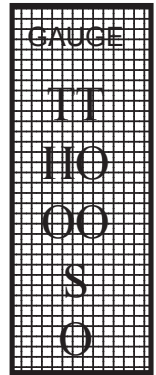
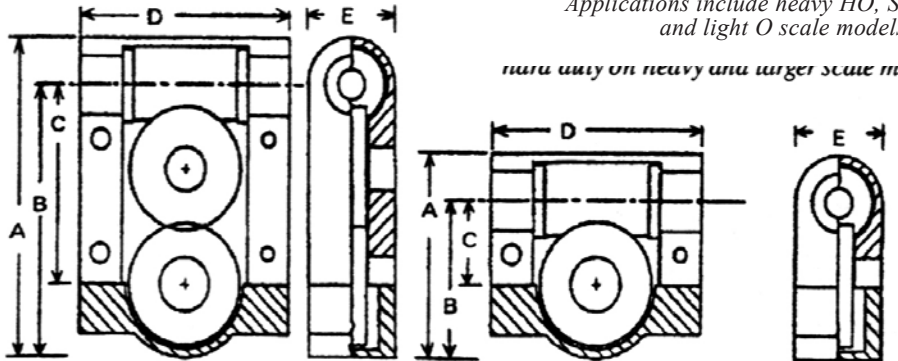
0.3 Module IDLER GEARBOX Kits	Std	Ball Brng	
28-1 IDLER Gearbox kit 1/8" axle	142-6	1142-6	
28-1 IDLER Gearbox kit 3/32"(2.4mm) axle	146-6	1146-6	
28-1 IDLER Gearbox kit 3mm axle	139-6	1139-6	
36-1 IDLER Gearbox 1/8" axle	153-6	1153-6	
36-1 IDLER Gearbox 2.4mm axle	160-6	na	
36-1 IDLER Gearbox 3mm axle	150-6	1150-6	
0.3 Module NON-IDLER GEARBOX Kits	Std	Ball Brng	
28-1 NON-IDLER gearbox kit 1/8" axle	143-6	1143-6	
28-1 NON-IDLER gearbox kit 3/32"(2.4mm) axle	147-6	1147-6	
28-1 NON-IDLER gearbox kit 3mm axle	140-6	n/a	
36-1 NON-IDLER gearbox 1/8" axle	154-6	1154-6	
36-1 NON-IDLER gearbox 3mm axle	151-6	1151-6	
0.3 Module DOUBLE-IDLER GEARBOX Kits	Std	Ball Brng	
28-1 DBL IDLER Gearbox kit 1/8" axle	141-6	1141-6	Discontinued
28-1 DBL IDLER Gearbox kit 3mm axle	136-6	1136-6	Discontinued
0.3 Module HI-LO GEARBOX Kits	Std	Ball Brng	
28-1 HI-LO Artic. Gearbox Kit 1/8" Axle	149-6	1149-6	
28-1 HI-LO Artic. Gearbox Kit 3mm Axle	148-6	1148-6	
36-1 HI-LO Arti.gearbox Kit 3mm axle	158-6	1158-6	
36-1 HI-LO Arti.gearbox Kit 1/8" axle	159-6	1159-6	
0.3 NON-IDLER style Wormshaft Conversions			
1.2mm Right Hand Worm-shaft	167-6	\$6.00	
1.5mm Right Hand Worm-shaft	145-6	\$6.00	
2.0mm Right Hand Worm-shaft	144-6	\$6.00	
1.2mm Left Hand Worm-shaft	166-6	\$7.50	
1.5mm Left Hand Worm-shaft	165-6	\$6.00	
2.0mm Left Hand Worm -shaft	164-6	\$6.00	
	Non-Idler (RH)	Idler (LH)	
Ball-Bearing Wormshaft Assy			
Wormshft assy: 2.4mm input shaft	1346-6	1347-6	
Wormshft assy: 2.0mm input shaft	1344-6	1345-6	

50-1 LIGHT DUTY gearbox, HOn3, N	
50-1 Compound Gearbox 2.4mm axle 1.5mm INPUT	170-6
50-1 Compound Gearbox 2.0mm axle 1.5mm INPUT	171-6
50-1 Compound Gearbox 1.5mm axle 1.5mm INPUT	172-6
50-1 Compound Gearbox 'N'/HOn3 only 3.0mm axle	173-6
Input shaft conversion kit—to 1.2mm for 50-1 gearbox	175-6
TRANSFER GEARBOX kits	
0.3mod 3.125-1 TRANSFER gearbox 1.5mm SHAFTS	221-6
0.4mod 1-1 TRANSFER gearbox 2.4mm SHAFTS	223-6
0.4mod 1.89-1 TRANSFER gearbox 2.4mm SHAFTS	224-6

0.4 module GEARBOX kits

0.4 module teeth have higher load carrying capacity appropriate for heavy HO scale model applications, most 'S' scale models and light 'O' scale applications such as traction models, speeders, etc. For most 'O' scale and larger applications, the 0.5mod and 0.6mod size gearing is more appropriate. These gearboxes can be used singly or paired for articulated locomotives (use 'HiLo' set, a complete kit with matched gearboxes for re-powering articulated locomotives). See chart below for minimum recommended driver diameters.

28:1 ratio with 2.4mm input shaft

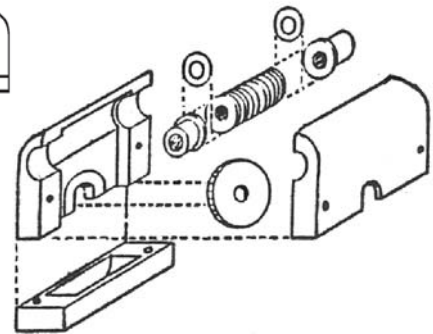


0.4 Module GEARBOX DIMENSIONS					
Ratio	1:1	7:1 & 14:1	28:1		
Style	xfer	Direct	Idler	Direct	
A	52.0	14.6	32.0	20.6	mm
	2.048	.577	1.26	0.811	inch
B	41.29	9.9	27.9	16.5	mm
	1.625	.389	1.10	0.650	inch
C	30.59	5.45	19.7	8.4	mm
	1.204	.2145	0.780	0.332	inch
D	21.95	15.3	21.8	21.8	mm
	0.864	0.601	0.858	0.858	inch
E	12.22	8.73	8.5	8.5	mm
	0.481	0.344	0.335	0.335	inch

0.4mod 28:1 Gearbox Stock Numbers				HiLo for mallets
Idler	Axle Diameter		Non-Idler	
240-6	3.0mm	0.118"	241-6	247-6
242-6	1/8"	0.125"	243-6	248-6
244-6	4mm-5/32"	0.1562"	245-6	249-6

7:1 and 14:1 ratio with 2.4mm input shaft

Suitable for HO, S and light 'O' scale models. Axle gearbox kits for building power trucks with motor in truck or driven by driveline from body mounted motor via transfer case (below) or direct drive line. Choice of 7:1 and 14:1 ratios; 2.4mm (3/32") input shaft; choice of 3mm, 1/8" or 2.4mm output (axle) shaft fit. See #2050-6 series and #8060-4 series for matching geared wheelsets or order custom assembly to fit your specific needs.



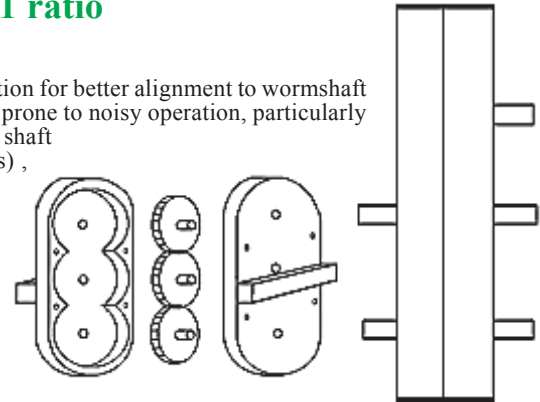
0.4mod Axle Gearbox Stock Numbers				
14:1	Axle Diameter		7:1	InShaft
211-6	3.0mm	0.118"	214-6	2.4mm
212-6	1/8"	0.125"	215-6	2.4mm
213-6	2.4mm-3/32"	0.9375"	216-6	2.4mm

MINIMUM DRIVER DIAMETER by SCALES								
Size	Min*	O	S	OO	HO	TT	Actual Dim.	Series
0.4	R	26"	34"	41"	46"	64"	6.7mm	240-6/
	A	19"	25"	29"	33"	46"	4.8mm	189"
28:1	R	11"	15"	17"	20"	27"	6.6mm	.221"
	A	10"	13"	16"	18"	25"	5.2mm	.202"
0.4	R	11"	15"	17"	20"	27"	6.6mm	.221"
	A	10"	13"	16"	18"	25"	5.2mm	.202"

0.4mod TRANSFER GEARBOX kits - 1:1 and 1.89:1 ratio with 2.4mm input shaft

Gearboxes to transfer power from a body mounted motor driveline to underfloor location for better alignment to wormshaft of truck axle mounted gearboxes (see #211-6 series above). Uses spur gears and thus prone to noisy operation, particularly at high speeds. Choice of 1:1 or 1.89:1 ratios. 2.4mm input and output shafts. Input shaft extends one side for connection to motor (see #480-6 series for universal connectors), output Use to build geared power trucks for S and O scale models.

0.4mod Transfer Gearbox Stock Numbers—Dimensions								
Stk#	Ratio	InShaft	OutShaft	A	C	D	E	
223-6	1:1	2.4mm	2.4mm	52.1	30.5	21.7	12.3	mm
224-6	1.89:1	2.4mm	2.4mm	2.05	1.20	.86	.48	inch

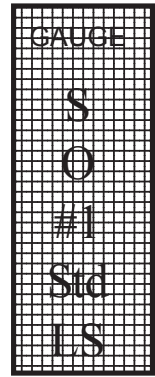


0.4 module GEARBOX kits

0.4 Module GEARBOX KITS	Std	Ball-Brg	
14-1 GEARBOX 2.4mm SHAFT 3mm AXLE	211-6	N/A	
14-1 GEARBOX 2.4mm SHAFT 1/8" AXLE	212-6	N/A	
14-1 GEARBOX 2.4mm SHAFT 2.4mm-3/32" AXLE	213-6	N/A	
7-1 GEARBOX 2.4mm SHAFT 3mm AXLE	214-6	N/A	
7-1 GEARBOX 2.4mm SHAFT 1/8" AXLE	215-6	N/A	
7-1 GEARBOX 2.4mm SHAFT 2.4mm-3/32" AXLE	216-6	N/A	
	Std	Ball-Brg	
28-1 IDLER gearbox kit 1/8" AXLE	242-6	N/A	
28-1 IDLER gearbox kit 3mm AXLE	240-6	N/A	
28-1 IDLER gearbox kit 4mm or 5/32" AXLE	244-6		
	Std	Ball-Brg	
28-1 NON-IDLER gearbox kit 1/8" AXLE	243-6	N/A	
28-1 NON-IDLER gearbox kit 3mm AXLE	241-6	N/A	
28-1 NON-IDLER gearbox kit 4mm or 5/32" AXLE	245-6	N/A	
0.4 Module HI-LO GEARBOX Kits	Std	Ball-Brg	
28-1 HI-LO ARTIC. Gearbox Kit 3mm AXLE	247-6	N/A	
28-1 HI-LO ARTIC. Gearbox Kit 1/8" AXLE	248-6	N/A	
28-1 HI-LO ARTIC. Gearbox Kit 4mm-5/32" AXLE	249-6	N/A	
0.4 Module SHAFT CONVERSION Kits			
Input shaft conversion to 2.0mm (24x-6 idler gearbox- RH)	228-6		
Input shaft conversion to 2.0mm (24x-6 idler gearbox- LH)	229-6		

0.5 module GEARBOX kits 25:1 and 12.5:1 ratio with 1/8" input shaft

0.5 module teeth have load carrying capacity appropriate for O scale and larger model applications. The small worm diameter combined with the high quality gear surface provides high efficiency meaning smoother operation and greater load pulling capacity for a given motor output. For even greater capacity and smoother operation, ball-bearing (worm shaft) versions are available. These gearboxes can be used singly or paired for articulated locomotives (idler style cannot be combined with non-idler (direct) and must use matched 'HiLo' gearbox set). The low profile non-idler (single) is particularly useful when desirable to hide the driving mechanism in the locomotive frame, either diesel or steam type.



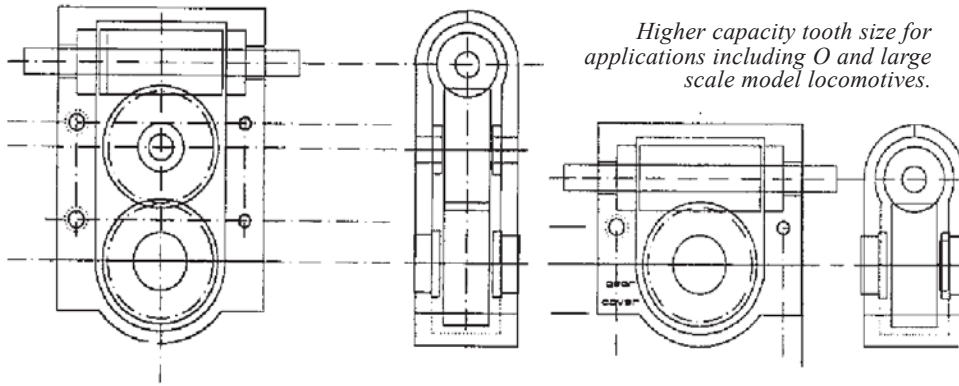
Idler style				Direct style				'HiLo' 25:1	Heavy loads or extended continuous operation can cause heat buildup in the wormshaft and failure of the plastic gearbox housing - use 'ball bearing' version by adding '1000' to stock #
0.5mod GEARBOX STOCK NUMBERS				General Axle Size Usage (Where axle size typically found.)					
25:1 - Ratio - 12.5:1	Axle Diameter		25:1 - Ratio - 12.5:1						
250-6	260-6	3/16"	0.1875"	251-6	261-6	'O' and other large scale models		290-6	
252-6	262-6	1/4"	0.250"	253-6	263-6	'O' and other large scale models		291-6	
254-6	264-6	5.0mm	0.1989"	255-6	265-6	'O' scale diesels, some steam & S		292-6	
256-6	266-6	5.8mm	0.2283"	257-6	267-6	some Sunset 'O' Scale Models		293-6	
258-6	268-6	6.0mm	0.2362"	259-6	269-6	'O' Scale Steam Locomotives		294-6	
270-6		AF	0.162"	271-6		American Flyer 'S' gauge steam loco.			

0.5 Module IDLER GEARBOX Kits	Standard	Ball Brng
12.5-1 IDLER gearbox 1/4" axle	262-6	1262-6
12.5-1 IDLER gearbox 3/16" axle	260-6	1260-6
12.5-1 IDLER gearbox 5.8mm axle	266-6	1266-6
12.5-1 IDLER gearbox 5mm axle	264-6	1264-6
12.5-1 IDLER gearbox 6mm axle	268-6	1268-6
25-1 IDLER gearbox .162" axle (AF 'S')	270-6	1270-6
25-1 IDLER gearbox 1/4" axle	252-6	1252-6
25-1 IDLER gearbox 3/16" axle	250-6	1250-6
25-1 IDLER gearbox 5.8mm axle	256-6	1256-6
25-1 IDLER gearbox 5mm axle	254-6	1254-6
25-1 IDLER gearbox 6mm axle	258-6	1258-6
0.5 Module NON-IDLER GEARBOX Kits	Standard	Ball Brng
12.5-1 NON-IDLER gearbox 1/4" axle	263-6	1263-6
12.5-1 NON-IDLER gearbox 3/16" axle	261-6	1261-6
12.5-1 NON-IDLER gearbox 5.8mm axle	267-6	1267-6
12.5-1 NON-IDLER gearbox 5mm axle	265-6	1265-6
12.5-1 NON-IDLER gearbox 6mm axle	269-6	1269-6
25-1 NON-IDLER gearbox .162" axle (AF 'S' gauge)	271-6	1271-6
25-1 NON-IDLER gearbox 1/4" axle	253-6	1253-6
25-1 NON-IDLER gearbox 3/16" axle	251-6	1251-6
25-1 NON-IDLER gearbox 5.8mm axle	257-6	1257-6
25-1 NON-IDLER gearbox 5mm axle	255-6	1255-6
25-1 NON-IDLER gearbox 6mm axle	259-6	1259-6
0.5 Module HI-LO GEARBOX Kits	Standard	Ball Brng
25-1 Hi-Lo Artic. Grbx set 3/16" axle	290-6	1290-6
25-1 Hi-Lo Artic. Grbx set 1/4" axle	291-6	1291-6
25-1 Hi-Lo Artic. Grbx set 5.0mm axle	292-6	1292-6
25-1 Hi-Lo Artic. Grbx set 5.8mm axle	293-6	1293-6
25-1 Hi-Lo Artic. Grbx set 6.0mm axle	294-6	1294-6
0.5 Module SHAFT CONVERSION Kits \$8.95		
2.4mm RH Worm Shaft Conversion for IDLER	280-6	
2.4mm LH Worm Shaft Conversion for NON-IDLER	281-6	

0.5 DIMENSIONS			
Spec.	Idler	Single	Dim.
A	37	25	mm
	1.45	0.975	inch
B	31.5	19	mm
	1.240	0.757	inch
C	21.5	9	mm
	0.847	0.360	inch
D	25	25	mm
	1.00	1.00	inch
E	10.5	10.5	mm
	0.425	0.425	inch

0.6 module GEARBOX kits 23:1 and 11.5:1 ratio with 1/8" input shaft

Released May 1997, the 0.6mod tooth size provides greater capacity and operating life for large and heavy models. Stock numbers in the 650-6 et al series – same axle fit and gearbox style choices as the 0.5mod series above. The heavy worm end-thrust load of large loads commonly results in overheating and failure, therefore the 0.6mod size is available only as premium ball-bearing worm shaft version for better life, operation, and reliability.



0.6 DIMENSIONS			
Spec.	Idler	Single	Dim.
A	41	27	mm
	1.62	1.07	inch
B	34.5	20.9s	mm
	1.36	0.82	inch
C	24.5	10.5	mm
	0.96	0.41	inch
D	26.7	26.7	mm
	1.05	1.05	inch
E	13.5	13.5	mm
	0.53	0.53	inch

	Idler	Non-Idler
0.6 Mod GEARBOX KITS		\$44.95
23-1 0.6mod GEARBOX kit 3/16" axle	650-6	651-6
23-1 0.6mod GEARBOX kit 1/4" axle	652-6	653-6
23-1 0.6mod GEARBOX kit 5mm axle	654-6	655-6
23-1 0.6mod GEARBOX kit 5.8mm axle	656-6	657-6
23-1 0.6mod GEARBOX kit 6mm axle	658-6	659-6
11.5-1 0.6mod GEARBOX kit 3/16" axle	660-6	661-6
11.5-1 0.6mod GEARBOX kit 1/4" axle	662-6	663-6
11.5-1 0.6mod GEARBOX kit 5mm axle	664-6	665-6
11.5-1 0.6mod GEARBOX kit 5.8mm axle	666-6	667-6
11.5-1 0.6mod GEARBOX kit 6mm axle	668-6	669-6
0.6mod Hi-Lo sets for articulateds \$76.95		
23-1 0.6mod Hi-Lo Artic. Gearbox set 3/16" axle	690-6	
23-1 0.6mod Hi-Lo Artic. Gearbox set 1/4" axle	691-6	
23-1 0.6mod Hi-Lo Artic. Gearbox set 5.0mm axle	692-6	
23-1 0.6mod Hi-Lo Artic. Gearbox set 5.8mm axle	693-6	
23-1 0.6mod Hi-Lo Artic. Gearbox set 6.0mm axle	694-6	

GEARS

WG=RH (//), RWG=LH (\\\), SG=Straight (|||)

See page 4-20 for steel worms.

Bachmann SHAY and CLIMAX gears

#2800-6 HO Shay 80T 3-trk bevel gears, steel (6)

#2801-6 On30 Shay 80T 2-trk bevel gears, steel (4)

#2802-6 HO Climax bevel gears, steel (6)

0.3mod GEARS (3.1mm worm)				
Teeth	Type	Bore	Brass	Delrin
8	SG	1.2mm	37808-6	n/a
8	SG	1.5mm	37408-4	n/a
10	SG	1.5mm	37410-6	n/a
12	SG	1.5mm	37412-6	n/a
20	SG	3/32"	37020-6	n/a
22	SG	3/32"	37022-6	n/a
24	SG	1.5mm	37424-6	n/a
24	SG	3/32"	37024-6	n/a
25	SG	1.5mm	37425-6	n/a
26	SG	1.5mm	37426-6	n/a
12	WG	3.32"	31012-6	n/a
15	WG	1.5mm	31415-6	32415-6
15	WG	3.32"	31015-6	32015-6

0.3mod GEARS (5.0mm worm)				
Teeth	Type	Bore	Brass	Delrin
28	RWG	3.0mm	n/a	1318-6
28	WG	3.0mm	n/a	1301-6
28	WG	3.0mm	1303-6	1305-6
28	WG	1/8"	1304-6	1306-6
28	WG	3/32"	1331-6	1339-6
30	RWG	3.0mm	n/a	1302-6
36	RWG	3.0mm	n/a	1319-6
36	WG	3.0mm	1321-6	1323-6
36	WG	1/8"	1322-6	1324-6

0.4mod GEARS (5.8mm worm)				
Teeth	Type	Bore	Brass	Delrin
22	WG	3.0mm	251722-6	n/a
28	WG (2-lead)	1/8"	n/a	1419-6
14	WG (2-lead)	3.0mm	1423-6	n/a
14	WG (2-lead)	1/8"	1424-6	n/a
14	WG (2-lead)	2.4mm (3/32")	1425-6	n/a

0.4mod GEARS (6.0mm worm)				
Teeth	Type	Bore	Brass	Delrin
14	WG	3.0mm	1420-6	n/a
14	WG	1/8"	1421-6	n/a
14	WG	2.4mm (3/32")	1422-6	n/a
28	WG	3.0mm	n/a	1410-6
28	RWG	3.0mm	1411-6	1412-6
28	RWG	1/8"	1413-6	1414-6
28	RWG	4.0mm (5/32")	1415-6	1416-6

0.5mod GEARS (6.5mm worm)				
Teeth	Type	Bore	Brass	Delrin
25	RWG	.162"	1533-6	n/a
25	RWG	1/4"	1513-6	n/a
25	RWG	3/16"	1511-6	n/a
25	RWG	5.0mm	1515-6	n/a
25	RWG	5.8mm	1517-6	n/a
25	RWG	6.0mm	1519-6	n/a
25	WG	.162"	n/a	1534-6
25	WG	1/4"	n/a	1514-6
25	WG	1/8"	n/a	1510-6
25	WG	3/16"	n/a	1512-6
25	WG	5.0mm	n/a	1516-6
25	WG	5.8mm	n/a	1518-6
25	WG	6.0mm	n/a	1520-6
25	RWG (2-lead)	1/4"	1523-6	n/a
25	RWG (2-lead)	3/16"	1521-6	n/a
25	RWG (2-lead)	5.0mm	1525-6	n/a
25	RWG (2-lead)	5.8mm	1527-6	n/a
25	RWG (2-lead)	6.0mm	1529-6	n/a
25	WG (2-lead)	1/4"	n/a	1524-6
25	WG (2-lead)	1/8"	n/a	1509-6
25	WG (2-lead)	3/16"	n/a	1522-6
25	WG (2-lead)	5.0mm	n/a	1526-6
25	WG (2-lead)	5.8mm	n/a	1528-6
25	WG (2-lead)	6.0mm	n/a	1530-6

0.5mod GEARS KMT/Tenshoso 'tower' gears				
Teeth	Type	Bore	Brass	Delrin
9	SG	2.4mm	77609-6	78609-6
10	SG	2.4mm	77610-6	78610-6
11	SG	2.4mm	77611-6	78611-6
12	SG	2.4mm	77612-6	78612-6
13	SG	2.4mm	77613-6	78613-6
14	SG	2.4mm	77614-6	78614-6
15	SG	2.4mm	77615-6	78615-6
16	SG	2.4mm	77616-6	78616-6
17	SG	2.4mm	77617-6	78617-6
18	SG	2.4mm	77618-6	78618-6
19	SG	2.4mm	77619-6	78619-6
20	SG	2.4mm	77620-6	78620-6
21	SG	2.4mm	77621-6	78621-6
22	SG	2.4mm	77622-6	78622-6
23	SG	2.4mm	77623-6	78623-6
24	SG	2.4mm	77624-6	78624-6
25	SG	2.4mm	77625-6	78625-6
26	SG	2.4mm	77626-6	78626-6
12	SG	2.0mm	n/a	78512-6

0.6mod GEARS (8.0mm worm)				
Teeth	Type	Bore	Brass	Delrin
23	RWG	1/4"	1613-6	n/a
23	RWG	3/16"	1611-6	n/a
23	RWG	5.0mm	1615-6	n/a
23	RWG	5.8mm	1617-6	n/a
23	RWG	6.0mm	1619-6	n/a
23	WG	1/4"	n/a	1614-6
16	WG	1/8"	n/a	20626-6
23	WG	1/8"	n/a	1610-6
23	WG	3/16"	n/a	1612-6
23	WG	5.0mm	n/a	1616-6
23	WG	5.8mm	n/a	1618-6
23	WG	6.0mm	n/a	1620-6

GEARS

Individual 72DP GEARS & WORMS

72DP x .085" face

WG=RH (/ / /), RWG=LH (\ \ \), SG=Strait (| | |)

3.0mm (.118") bore BRASS					3.0mm (.118") bore, DELRIN				
# Teeth	Spur Gear (SG)	Worm Gear (WG)	Reverse Worm Gear (RWG)	O.D.	# Teeth	Spur Gear (SG)	Worm Gear (WG)	Reverse Worm Gear (RWG)	O.D.
15	17715-6	11715-6	14715-6	0.24"	15	18715-6	12715-6	15715-6	0.24"
20	17720-6	11720-6	14720-6	0.306"	20	18720-6	12720-6	15720-6	0.306"
24	17724-6	11724-6	14724-6	0.361"	24	18724-6	12724-6	15724-6	0.361"
30	17730-6	11730-6	14730-6	0.444"	30	18730-6	12730-6	15730-6	0.444"
36	17736-6	11736-6	14736-6	0.527"	36	18736-6	12736-6	15736-6	0.527"
40	17740-6	11740-6	14740-6	0.583"	40	18740-6	12740-6	15740-6	0.583"
3/32" (.093") bore, BRASS					3/32" (.093") bore, DELRIN				
# Teeth	Spur Gear (SG)	Worm Gear (WG)	Reverse Worm Gear (RWG)	O.D.	# Teeth	Spur Gear (SG)	Worm Gear (WG)	Reverse Worm Gear (RWG)	O.D.
10	17010-6	11010-6	14010-6	0.178"	n/a				
15	17015-6	11015-6	14015-6	0.24"	15	18015-6	12015-6	15015-6	0.24"
20	17020-6	11020-6	14020-6	0.306"	20	18020-6	12020-6	15020-6	0.306"
24	17024-6	11024-6	14024-6	0.361"	24	18024-6	12024-6	15024-6	0.361"
30	17030-6	11030-6	14030-6	0.444"	30	18030-6	12030-6	15030-6	0.444"
36	17036-6	11036-6	14036-6	0.527"	36	18036-6	12036-6	15036-6	0.527"
40	17040-6	11040-6	14040-6	0.583"	40	18040-6	12040-6	15040-6	0.583"
2.0mm (.179") bore, BRASS					2.0mm (.179") bore, DELRIN				
# Teeth	Spur Gear (SG)	Worm Gear (WG)	Reverse Worm Gear (RWG)	O.D.	# Teeth	Spur Gear (SG)	Worm Gear (WG)	Reverse Worm Gear (RWG)	O.D.
10	17510-6	11510-6	14510-6	0.178"	10				0.178"
15	17515-6	11515-6	14515-6	0.24"	15	18515-6	12515-6	15515-6	0.24"
20	17520-6	11520-6	14520-6	0.306"	20	18520-6	12520-6	15520-6	0.306"
24	17524-6	11524-6	14524-6	0.361"	24	18524-6	12524-6	15524-6	0.361"
30	17530-6	11530-6	14530-6	0.444"	30	18530-6	12530-6	15530-6	0.444"
36	17536-6	11536-6	14536-6	0.527"	36	18536-6	12536-6	15536-6	0.527"
40	17540-6	11540-6	14540-6	0.583"	40	18540-6	12540-6	15540-6	0.583"
1/8" (.125") bore, BRASS					1/8" (.125") bore, DELRIN				
# Teeth	Spur Gear (SG)	Worm Gear (WG)	Reverse Worm Gear (RWG)	O.D.	# Teeth	Spur Gear (SG)	Worm Gear (WG)	Reverse Worm Gear (RWG)	O.D.
15	17115-6	11115-6	14115-6	0.24"	15	18115-6	12115-6	15115-6	0.24"
20	17120-6	11120-6	14120-6	0.306"	20	18120-6	12120-6	15120-6	0.306"
24	17124-6	11124-6	14124-6	0.361"	24	18124-6	12124-6	15124-6	0.361"
30	17130-6	11130-6	14130-6	0.444"	30	18130-6	12130-6	15130-6	0.444"
36	17136-6	11136-6	14136-6	0.527"	36	18136-6	12136-6	15136-6	0.527"
40	17140-6	11140-6	14140-6	0.583"	40	18140-6	12140-6	15140-6	0.583"

RE-GEARING KITS

Mfr/Importer	Product/Model	NW SL Part #	Comment/Description
Akane	any		Install NWSL gearbox(es) in the 240-6/241-6 series or 136-6/140-6 series or 150-6/151-6 series
ALCO MODELS	Diesels	100-6	Early ALCO MODELS diesel models (HO) were manufactured in Japan by KMT. Most of these are marked 'KMT' on the truck gearbox someplace and use the 13T axle gear. The plastic axle gears often crack from age (not operation) jamming the mechanism. See KMT section for replacement gear information. If your model has 15T axle gear, see #1001-6
		101-6	
		1001-6	
	ALCO RS	77609-6 77610-6	Later ALCO MODELS diesel locomotives were made by SamHongSa (SAM or SHS) in Korea. The first series used a mechanism design similar to the KMT 'tower gear truck' design. The top 'tower gear' (usually 9 tooth, some have are 10 tooth) often breaks. Be sure to count number of teeth carefully.
	U-50	333-6	Later models used the newer 'worm on top' gearbox design. The U-50 (and some others) has a 21 tooth spur gear (SG) between the upper and lower gearbox that cracks.
	H-20-44 FM	335-6	Early SAM built diesel models (usually switchers) have 15 tooth gear at top of gear tower, which often cracks. NWSL #335-6 can replace it.
	others		See Samhongsas section - gear breakage is endemic (or KMT as appropriate).
AHM	Large Steam, 2-8-4 thru 4-8-8-4 except 4-8-4	301-6	For those modelers who find the speed of AHM locomotives to be excessive, this regear set permits quick ratio conversion cutting speed by 2/3rds (increase ratio 3 times). Replaces upper gearbox gears only, no driver axle gear change required. NOT recommended if you plan to remotor also. Articulateds require two kits. For remotor, use NWSL 2032D-9 motor. Remotoring usually requires removal of backhead (if one exists).
	4-6-2, 4-6-4	307-6	63% speed reduction. Driver axle gear replacement required (1 worm, 2 gears)
	2-8-2	308-6	57% speed reduction. Driver axle gear replacement required (1 worm, 1 wormgear)
	USRA 0-6-0	310-6	69% speed reduction. Driver axle gear replacement required (1 worm, 1 idler wormgear). Does not fit 0-6-0T and others.
	0-4-0, 0-6-0T, KC Jones 4-6-0	309-6	65% speed reduction. Driver axle gear replacement required (1 worm, 1 wormgear). Fits models: #5078, 5152, 5155. Does not fit USRA 0-6-0, 0-4-0T.
	M10000	311-6	Replacement 17 tooth drive gear for UP M10000 train model. (Also sold under Nickel Plate brand).
	0-8-0	312-6	42% speed reduction. Driver axle gear replacement required (1 worm, 1 wormgear). Fits vertical motor version only (1974 and 1977 production)
	4-8-4	313-6	42% speed reduction. Driver axle gear replacement required (1 worm, 1 wormgear).
	E Units Diesel		Upgrade performance with NWSL Stanton Drive underfloor self-powered trucks.
Arbour Models	Steam locos	139-6 153-6 148-6	Fit NWSL gearboxes as appropriate.
Athearn		1162-4	Regear is not recommended because gearing is good quality and also ratio increase results in high motor operation, noise, and mechanism wear. Repower kit with one flywheel for narrow body geared diesels under 40' wheelbase F, GP, etc. Repower kit with one flywheel for wide body geared diesels under 40' wheelbase (F-Unit). Repower kit with two flywheels for wide body SD40 and other large diesels. Tight fit for some such as GP-38, must save shell. Repower it with two flywheel for narrow body geared diesel switchers (FM, SW).
		162-4	
		163-4	
		1163-4	
	RDC	Stanton Drive	See Stanton Drive self-powered truck.
	Hustler HO, Sn3, On2, Switchers, Road Diesels, SD, 6 axle units, PA	Stanton Drive	See Stanton Drive self-powered truck.
MB Austin	any steam	139-6 150-6	Install NWSL gearbox as appropriate for specific model.

RE-GEARING KITS

Mfr/Importer	Product/Model	NWSL Part #		Comment/Description
Lionel	Daylight 4-8-4 (original)			This model used a unique mechanism with transverse motor integral with the frame. See <i>Model Railroading</i> , May 1986 for repowering suggestion or use chassis offered by Bowser.
Model Die Casting (Roundhouse)	Shays, HO or HO _n 3	186-6 187-6 188-6		2-truck machined brass (tower) and delrin (axle) gears to improve operation. 3-truck, same as above. Parts kit for upgrade project described in <i>Model Railroader</i> , August 1985. (Compliments above kits, not duplication - do not need article to install, but it can help.)
	RS-3 diesel		\$84.95	Stanton Drive #39213-4
	Climax	39279-4	\$84.95	Stanton Drive #39279-4
	Boxcab	39279-4	\$84.95	Stanton Drive #39279-4
MDC/Roundhouse HO Steam locomotive kits - Replaces all original gears providing improved operation and control. Ratio not as great, but slow speeds are attainable with good power pack control. Fits original motor.				
	MDC HO kits <i>circa 1998 and later.</i>	178-6		72-1, fits 1.5m m shaft 'square' motor. Contains: (1) worm 2.0mm bore, (1) 30T WG/15T SG compound, (1) 36T SG
	MDC HO kits <i>circa 1998 and later.</i>	179-6		45-1, fits 1.5m m shaft 'square' motor. Contains: (1) worm 1.5mm bore, (1) 30T WG/20T SG compound, (1) 30T SG
	MDC HO kits <i>circa prior to 1998.</i>	180-6		72-1, fits 2.0m m shaft open frame motor. Contains: (1) worm 2.0mm bore, (1) 30T WG/15T SG compound, (1) 36T SG
	MDC HO kits <i>circa prior to 1998.</i>	182-6		72-1, fits 2.4m m shaft open frame motor. Contains: (1) worm 2.4mm bore, (1) 30T WG/15T SG compound, (1) 36T SG
	MDC HO kits <i>circa prior to 1998.</i>	185-6		45-1, fits 1.5m m shaft on NWSL 16x30 motor (not included). Contains: (1) worm 1.5mm bore, (1) 30T WG/20T SG compound, (1) 30T SG
	MDC HO kits <i>circa prior to 1998.</i>	181-6		45-1, fits 2.0m m shaft open frame motor. Contains: (1) worm 2.0mm bore, (1) 30T WG/20T SG compound, (1) 30T SG
	MDC HO kits <i>circa prior to 1998.</i>	183-6		45-1, fits 2.4m m shaft open frame motor. Contains: (1) worm 2.4mm bore, (1) 30T WG/20T SG compound, (1) 30T SG
MDC/Roundhouse HO_n3 Steam locomotive kits - Replaces all original gears providing improved operation and control. Ratio not as great, but slow speeds are attainable with good power pack control. Fits original motor.				
	MDC HO _n 3 kits <i>circa 1997 and earlier.</i>	184-6		Fits 2.0m m motor shaft. Contains (1) worm 2.0mm bore, (1) 37T WG idler, (1) 32T RWG axle gear
	MDC HO _n 3 kits <i>circa 1998 and later.</i>	177-6		Fits 1.0m m shaft on NWSL #1220S-9 motor (not included). Contains (1) worm 1.0mm bore, (1) 24T SG idler, (1) 20T SG axle gear, (1) 10T SG/24T WG compound
	MDC HO _n 3 kits <i>circa 1998 and later.</i>	190-6		Fits 1.2m m motor shaft. Contains (1) worm 1.2mm bore, (1) 24T SG idler, (1) 20T SG axle gear, (1) 10T SG/24T WG compound
	MDC HO _n 3 kits <i>circa 1998 and later.</i>	189-6		Fits 2.0m m motor shaft. Contains (1) worm 2.0mm bore, (1) 24T SG idler, (1) 20T SG axle gear, (1) 10T SG/24T WG compound
NKP Nickelplate	Zephyr	77614-6		CB&Q Zephyr Artic Streamliner, 14 tooth axle spurgear, brass, 2.4mm bore
		70600-6		CB&Q Zephyr, worm, steel, 2.4mm bore (to replace original brass worm for longer life).
NWSL	2-6-6-2T (early)	148-6		Early open gear versions; install this HiLo set on #3 and #5 axles (count from front) and a 1630 motor. Requires significant chassis rebuild, but avoids cutting boiler bottom forward of saddle. Alternate is to rebuild with NWSL 139-6 idler gearbox, same as latter mallets, cutting bottom of boiler out for clearance.
	2-6-6-2T (late)	139-6		For mallets originally with idler gearbox; this NWSL gearbox is a direct replacement with same ratio. Use 1630 motors if repowering also.
	2-8-2 or 2-8-2T or 2-6-2T	139-6 or 140-6		These gearboxes can be used for any of these NWSL logging locomotives. Use the 139-6 (idler) for higher driveline, easier remoting or the 140-6 for exact replacement of original alignment. Use 1630 motor if replacement desired.
	Shay	126-6 127-6		See description in PFM section.
	2-8-8-2	158-6 148-6		Noise and poor operation of these models can be eliminated with installation of NWSL HiLo gearbox system 148-6 or 158-6 (slower). In front engine, modify to gear #3 driver instead of #2. Use 1630 motor.
	Milw Rd K-1 2-6-2	139-6 or 136-6		This style gearbox permits use of 1630 size motor, providing more power and better performance than is possible with original equipment 1620 motor.
Oriental	GP-7, etc.	335-6		Replaces cracked 15 tooth gear at top of tower on the SamHongSa models.
Original Whistle Stop	PE HO Interurbans	329-6		10 tooth truck idler gear (see Suydam listing). Also consider the appropriate size Stanton Drive for repowering (catalog page 2-6 thru 2-8).
Overland	RF&P 4-8-4	150-6		We recommend NWSL gearbox 150-6 or 240-6 be installed for longer life solution to replacement idler gear failure.
	CB&Q 4-8-4	240-6		

RE-GEARING KITS

Mfr/Importer	Product/Model	NWSL Part #	Comment/Description
PFM see also Tenshodo United	Shays	121-6	Speed reduction gear set for most large PFM Shays such as B-2, B-3, Pacific Coast. Does NOT fit flyw heel and some other early PFM Shay models Includes bearing for motor shaft end support and quieter operation. Cuts speed to approx. 11 scale MPH at 12 volts (1/7th original). Note: kit results in VERY slow operation - too slow for many modelers.)
		124-6	12 tooth brass helical exact replacement for PFM B-2, B-3, Pacific Coast.
		126-6	7 tooth steel helical, 2.4mm bore - replacement for original motor shaft gear in B-2, B-3, Pacific Coast Shay models - use of dissimilar materials in mating gears provides longer life.
		127-6	7 tooth brass helical, 2.4mm bore, exact replacement for PFM B-2, B-3, Pacific Coast.
Penn Scale Models	streetcars		See Bow ser section.
Redball	Diesels		Diesel (HO) locomotive models imported by REDBALL were built by KMT, see the KMT (not KTM) section for replacement gear information.
Rivarossi	Steam and Diesel locomotives		See AHM section
SamHongSa (SAM/SHS)	Steam locos	139-6	Gear wear and noise are due to both gear and gearbox problems, replace completely with NWSL gearbox 139-6, 150-6, 240-6 or similar as fits and appropriate to your preference for speed.
		150-6	
		240-6	
	Shays	338-6 339-6	
	Diesels	322-6 thru 329-6	
Suydam	Interurbans	329-6 or Stanton Drive	10 tooth truck idler gear, 2.4mm bore. Replaces plastic gears that seem to break with age (whether operated or not) in the brass models. Also fits interurbans imported by Original Whistle Stop, and possibly others. Consider Stanton Drive (catalog page 2-6 thru 2-8) for complete replacement of original power drive system.
Tenshodo	Mohawk, other steam	139-6	Whether the gearing is the early 36 tooth axle gear or the later 50 tooth gear, look at upgrading with a modern, slower speed motor, such as the 2032 and the NWSL gearbox kit: 28-1 ratio (139-6, 240-6) or 36-1 ratio (150-6) or 158-6 for articulateds.
		240-6	
		150-6 158-6	
	2-6-8-0, etc. all articulateds	158-6	Replacement gearboxes set with universals and shaft pillow blocks (370-6, 372-6) to provide smooth, quiet, operation of these models. Requires replacement of driver axle gears (included in kit), some model chassis modification may be necessary to fit. 2032 motor recommended.
	GP-7, F-7, etc diesels	100-6 101-6 776xx-6	Replaces all worms and axle gears in 4-axle (100-6) or 6-axle (101-6) locomotives. Use these 'tower' gears to replace worn or improper size gears on the 'gear tower' at the end of the truck. (xx = number of teeth)
	Repowering		See repower kits 162-4, 1162-4, 163-4, 1163-4 - catalog page 2-4.
United	Rod steam locomotives	304-6	For all United HO rod locomotives with 40 tooth axle gear using 5.8mm (.228") worm. Gear is delrin (machined, not molded) for better operation and longer life when model has the commonly found brass worm. This 40 tooth gear press fits to the driver axle. However, NWSL recommends that as long as you are doing the toughest part of the mechanism work, replacing the axle gear, a better long term solution is to install a new gearbox and thus eliminating the problems of reusing an order worn gearbox - see 150-6, 139-6 or 240-6 gearbox kits.
			Convert these noisy and inefficient drives to smooth, quiet operation with NWSL HiLo gearbox system, which eliminates thru transfer spur gears. Use 148-6 or 158-6 depending on speed you desire. If gearboxes too close together (driveline at too sharp an angle to align with motor easily) install gearbox on next axle.
Varney	Steam	142-6 153-6	Install NWSL gearbox 142-6 or 153-6; see catalog page 4-8, 4-9.

RE-GEARING KITS

Mfr/Importer	Product/Model	NWSL Part #	Comment/Description
Westside Models	C-25, K-27 compound and slide valve	305-6	26 tooth delrin idler gear for some WSM HO ₃ locomotives that use the 5.5mm (.216") OD brass worm. Replaces the original brass idler for longer life operation with the brass worm. Replacement should be made immediately, before the brass worm is worn beyond use. (Replacement worm CANNOT be supplied.)
	K-37, K-27	350-6	Wormshaft support bearings for remotoring and improved worm mesh, (.095") bore to accept 2.4mm or 3/32" motor shaft. Fits 'receiving' arms in K-37, some K-27 HO ₃ WSM gearboxes provide bearing support for the worm assuring more accurate, better operation, longer life worm mesh.
Westside Nakamura	K-36, K-28		Replacement worm and wormgear with (8) bronze thrust washers for fine tuning. Do NOT use this set to replace only the worn idler gear, the existing worm will again destroy the new gear. Use 1630 motor to eliminate troublesome downhill lurch common to these models. DISCONTINUED
	E unit diesels	334-6	Original worm is brass working on a brass wormgear. This results in high wear rate and premature failure. This NWSL replacement set has steel worms and brass axle gears (does NOT include 'tower' gears)
	WSL #8 HO ₃ Shay		Mechanism must be completely rebuilt to eliminate troublesome helical gears which twist rear truck off track. Put motor assembly in tender integral with truck, with new custom mfr 29 tooth wormgear driven by NWSL 30400-6 worm.

STEEL WORMS Complete Listing

Part #	Type	Mod	Bore	OD	Length	Used in	Other part #
10801-6	LH	72DP	1.2mm	3/16"	.245"		
10401-6	LH	72DP	1.5mm	3/16"	.250"		
10501-6	LH	72DP	2.0mm	3/16"	.250"		
10502-6	LH	72DP	2.0mm	3/16"	.300"		
10001-6	LH	72DP	3/32"-2.4mm	3/16"	.245"		
10800-6	RH	72DP	1.2mm	3/16"	.245"		
10400-6	RH	72DP	1.5mm	3/16"	.245"		
10404-6	RH	72DP	1.5mm	3/16"	.300"		
10500-6	RH	72DP	2.0mm	3/16"	.250"	339-6	
	RH	72DP	2.0mm	8.0mm			2290-6
10000-6	RH	72DP	3/32"-2.4mm	3/16"	.245"	334-6	
60100-6	RH	72DP	3/32"-2.4mm	3/16"	.300"		
70100-6	RH	0.3	1.0mm		.234"	Stanton Drive	
30403-6	RH	0.3	1.0mm	3.1mm	.165"		
30800-6	RH	0.3	1.2mm	3.1mm	.165"	175-6, PDT II	1382-6
30402-6	RH	0.3	1.5mm	3.1mm	.165"	Flea II	1389-6
30410-6	RH	0.3	1.0mm	3.1mm	.236"		
20400-6	RH	0.3	1.5mm	3.1mm	.235"		
30400-6	RH	0.3	1.5mm	3.1mm	.250"	170-6, 1063-6	1381-6
30500-6	RH	0.3	1.5mm	3.1mm	.295"	185-6	
230610-6	LH	0.3	1.0mm	5mm	.500"		
230605-6	LH	0.3	1.5mm	5mm	.275"	165-6	1335-6
230602-6	LH	0.3	2.0mm	5mm	.275"	146/164-6	1334-6
230612-6	LH	0.3	2.0mm	5mm	.255"	1345-6/1150-6/1153-6	
230600-6	LH	0.3	2.4mm	5mm	.275"	139/142/150	1317-6
230611-6	RH	0.3	1.0mm	5mm	.500"		
230603-6	RH	0.3	1.5mm	5mm	.275"	145/156/157	1313-6
230606-6	RH	0.3	2.0mm	5mm	.250"	1344-6	
230604-6	RH	0.3	2.0mm	5mm	.270"	147-6/184-6	1312-6
30312-6	RH	0.3	2.0mm	5mm	.275"	312-6	
30307-6	RH	0.3	2.0mm	5mm	.335"	307-6 / 308-6	
30310-6	RH	0.3	2.0mm	5mm	.345"	310-6	
230601-6	RH	0.3	2.4mm	5mm	.275"	136/140/141/143/151	1311-6

STEEL WORMS, cont'd

Part #	Type	Mod	Bore	OD	Length	Used in	Other part #
2240-6	LH	0.4	1.8mm	6.0mm	.235"		2240-6
50501-6	LH	0.4	2.0mm slip	6.0mm	.355"		1405-6
50503-6	LH	0.4	2.0mm slip	6.0mm	.250"	1241-6	1406-6
50602-6	LH	0.4	2.0mm	6.0mm	.295"		
2240-6	LH	0.4	1.8mm	6.0mm	.235"		2240-6
50601-6	LH	0.4	2.4mm	6.0mm	.355"		1404-6
50800-6	RH	0.4	1.2mm	6.0mm	.375"	190-6	
50400-6	RH	0.4	1.5mm	6.0mm	.375"	189-6	
50100-6	RH	0.4	1.0mm	6.0mm	.375"	177/6	
50309-6	RH	0.4	2.0mm	6.0mm	.275"	309-6	
50313-6	RH	0.4	2.0mm	6.0mm	.335"	313-6	
50500-6	RH	0.4	2.0mm	6.0mm	.355"	2137-6/228-6/240-6 series	
50402-6	RH	0.4	2.4mm	6.0mm	.240"	214-6 / 216-6	1402-6
250900-6	RH	0.4	2.4mm	5.8mm	.245"	328-6	
50600-6	RH	0.4	2.4mm	6.0mm	.355"		1401-6
50401-6	RH	0.4	2.4mm	6.0mm	.375"		
450505-6	RH 2-lead	0.4	1.5mm	6.0mm	.250"		
450502-6	RH 2-lead	0.4	2.0mm	6.0mm	.235"		
50317-6	RH 2-lead	0.4	2.0mm	6.0mm	.255"	317-6, 2100-6	317-6
450500-6	RH 2-lead	0.4	2.0mm	6.0mm	.350"	226-6/230-6/2140-6/2107-6	1407-6
450504-6	RH 2-lead	0.4	2.4mm	6.0mm	.357"	233-6, 1408-6	
450600-6	RH 2-lead	0.4	2.4mm	6.0mm	.235"	214/215/216-6/2710-6	1408-6
470800-6	LH	0.5	2.0mm	6.5mm	.455"		
2217-6	LH	0.5	2.5mm	7.5mm	.465"		2217-6
270101-6	LH	0.5	1/8"	6.5mm	.375"		
270115-6	RH	0.5	1.5mm	6.5mm	.375"		
470200-6	RH	0.5	2.0mm	6.5mm	.275"	2142-6/2658-6	
270600-6	RH	0.5	2.4mm	6.5mm	.375"		
270700-6	RH	0.5	2.4mm	6.5mm	.450"	8690-4	
270100-6	RH	0.5	1/8"	6.5mm	.375"	250-6 +	1501-6
470100-6	RH 2-lead	0.5	1/8"	6.5mm	.275"		
470101-6	RH 2-lead	0.5	1/8"	6.5mm	.375"		260-6 -> 269-6
2154-2	RH 2-lead	0.5	2.0mm	6.5mm	.250"	2154-6	
470803-6	RH 2-lead	0.5	2.4mm	6.5mm	.500"		
470802-6	RH 2-lead	0.5	2.25mm	6.5mm	.450"	used in 8690-4	
470801-6	RH 2-lead	0.5	2.25mm	6.5mm	.545"	used in 8690-4	
470600-6	RH 2-lead	0.5	2.4mm	6.5mm	.375"		
60300-6	LH	0.6	1/8"	8.0mm	.560"		1603-6
60400-6	RH	0.6	2.0mm	8.0mm	.560"	650-6 series	1604-6
60500-6	RH	0.6	4.0mm	8.0mm	.450"		1059-6
60600-6	RH	0.6	1/8"	8.0mm		25x-6	
60201-6	RH	0.6	1/8"	8.0mm	.560"	654-6	1601-6
60200-6	RH 2-lead	0.6	1/8"	8.0mm	.560"	660-6 series	1602-6

Model Die Casting (Roundhouse) Locomotive Kits

MDC SHAY 'PARTIAL' REGEAR KIT

The Model Die Casting HO scale Shay locomotives are excellent kits of a complex locomotive provided to modelers at exceptionally reasonable prices. However, the gearing complexity exceeded the capability of economical mass production techniques resulting in occasional operating difficulties. NWSL has identified three problem areas requiring attention. Two areas have been resolved at this time with one problem area, the geared wheel/lineshaft mesh, evading economical resolution to date (see modelers suggestions below). To assist modelers having a balky mechanism, we have released a partial kit covering the transfer box (top 2 gears) and the truck gearboxes (new precision delrin axle gears) in order to improve operation of these locomotives. The following kits work in all MDC Shay locomotives, whether HO or HOn3 gauged (see also #188-6 below)

#186-6 MDC 2-truck Shay partial regear kit, HO or HOn3

#187-6 MDC 3-truck Shay partial regear kit, HO or HOn3

SHAY BULL GEAR UPGRADE

The August 1985 issue of MODEL RAILROADER article on MDC Shay performance upgrade describes (requires) machining of a precision very difficult for most modelers to achieve with satisfactory results. The #188-6 kit provides a new brass bullgear complete and ready to install without machining plus all the other parts listed in the article (except the 4-40 screws). This kit is complimentary to the #186-6 and #187-6 kits - does not duplicate them.

#188-6 MDC Shay BULL GEAR UPGRADE KIT

Modelers Suggestions - Lineshaft gears

The lineshaft/wheel gearing problems can be lessened or alleviated by the following model construction modifications:

1. Thin the lineshaft gear by one half.
2. Engage only one lineshaft gear per truck (slide the other such that it does not engage the wheel gear teeth).

MOTOR REPLACEMENT

There is usually no need to replace the original open frame motor which was a SAGAMI #10130-9 open frame motor with operating quality comparable to a can motor. If you do wish to install a Can motor, the #16x30 size works well but shaft size is 1.5mm and requires appropriate universal coupling (ie #482-6 or similar).

#1630D-9 NWSL can motor 16x30mm Double 1.5 shaft

MDC HOn3 LOCOMOTIVE KIT GEARING

NWSL manufactures two sets for upgrading operation of the HOn3 gauge Model Die Casting locomotive kits. The #184-6 replaces the gearing in the pre-1998 HOn3 kits, retaining the original equipment motor providing slow, smooth operating control despite the lower ratio.

#184-6 HOn3 MDC Loco Kit Regear set (pre-1998 versions)

1998 HOn3 Chassis Update

Effective 1-98 and/or 11-97 (based on dates reported on MDC instruction sheets), the motor and chassis gearing layout was changed. To fit these "1998" design chassis, use the #189-6 kit (#184-6 will NOT fit).

#189-6 HOn3 MDC Loco Kit Regear set (post-1997 versions)

Because of the slight fit, the recommended motor for HOn3 rod engines is the NWSL 12x20 motor, #1220S-9

#1220S-9 NWSL can motor 12x20mm Single 1.0mm shaft

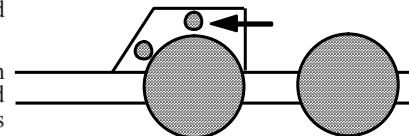
MDC HO STEAM LOCO REGEAR SETS

Model Die Casting (Roundhouse) has been through 3 generations of gearing for their HO gauge steam locomotive kits.

The original design used the common 'worm on motor shaft' driving an driver axle gear (phase I) - regear these with an NWSL 0.3mod idler gearbox such as #142-6 or #153-6.

During the 1970s the original design was replaced with a high ratio compound gearing design (phase II) which could sometimes provide fine slow speed operation but was often hampered by gear quality problems. The NWSL #180-6/#183-6 series regear sets were made for these MDC HO gauge locomotive kits with compound gearing but will not easily fit the revised kits issued after 1988 which eliminated the sometimes troublesome compound gearing.

The changed design (phase III) released during 1988 appears similar visually but the



middle gear is an idler - not a compound gear. There appear to be two versions of this gearing design- in the first version (phase IIIa), the 'idler' gear shaft is directly above the geared driver on a shaft through two holes in the frame bracket. Slightly to the rear are two holes (phase IIIa rear hole) that were used by the original compound gearing shaft - an NWSL #180-6/#183-6 gearset can be installed using these two rearward holes.

The next gearing revision (phase IIIb) has plugged these rear holes. Regearing this version requires either determining proper location for the compound gear shaft holes (location can usually be "read" by studying frame casting for mould plug marks and attempting to determine hole center - not a high success probability project!) and boring them for installation of a #180-6 series gearset or preferably installing an 0.3mod NWSL gearbox (ie. #142-6, or #153-6 or other selection).

GEARSETS FOR COMPOUND GEARED KITS

These (Phase II) locomotives include either a small (2.0mm shaft) open frame motor or a large (3/32" or 2.4mm shaft) motor. The motors were made by Sagami and provide quality performance comparable to a can motor. If you do wish to replace them anyway, the #1630D-9 size motors are commonly used, some of the larger kits can take a #2032D-9 size motor, the smaller locomotives take no larger than the #1627S-9 size - be sure to measure your boiler cavity width.

#178-6 Regear set 1.5mm Motor Shaft Cmpnd gearing 72-1

#179-6 Regear set 1.5mm Motor Shaft Cmpnd gearing 45-1

#180-6 Regear set 2.0mm Motor Shaft Cmpnd gearing 72-1

#181-6 Regear set 2.0mm Motor Shaft Cmpnd gearing 45-1

#182-6 Regear set 3/32" Motor Shaft Cmpnd gearing 72-1

#183-6 Regear set 3/32" Motor Shaft Cmpnd gearing 45-1

See MODEL RAILROADER May 2002, pp58+ for installation ideas

MDC "STATIC" LOCOMOTIVE KITS POWER

MDC has released several 'static' locomotive kits (or bashed kits) that can provide much modeling latitude and fun for your visionary projects. While these are sold as non-operating locomotive kits, many modelers have powered them using NWSL gearbox kits and NWSL motors. To determine motor size, measure the cavity space available - a #1630D-9 will usually fit, use a #1225D-9 for smaller spaces.

#142-6 28-1 Idler Gearbox 0.3mod 1/8" axle 2.4mm Input Shaft

#153-6 36-1 Idler Gearbox 0.3mod 1/8" axle 2.4mm Input Shaft

MDC CLIMAX/BOXCAB DIESEL

The noisy gearing on these locomotives is not economically upgradeable. See NWSL Stanton Drive #39279-4 for the Boxcab/Climax or #39213-4 for the MDC RS-3.