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Pinball Medic's

Electromechanical and Solid State Pinball Solenoid Coil Charts

Go directly to The Coil Charts

Coil Sleeve & Flipper Bushing charts Electro-Magnetic Coil types Pinball Game Type and Coil Chart Abbreviations

Metal VS Plastic coil sleeves Coil Part Number suffix & Prefix numbers and letters Coil Wire Turns and Strength Rules Flipper Coil Wiring Flipper Coils, Drive Circuits, Coil Supply Voltages and Current Types

We are building pinball relay coil charts and will either post them here or on a separate page



The majority of Williams coil part numbers indicate the construction method of the coil. The first letter or two indicates the type of sleeve, the position or length of the wire terminal lugs.

Example of a Williams coil part number AE-23-800 In our example - 23=wire gauge; 800=number of turns of wire.

Coil Body and Stop Differences - Bally and Gottlieb use the same coil body. A

typical **Williams** or **Data East** coil uses a 1/16 of an inch shorter coil body. A standard sized Gottlieb or Bally coil body is 1 1/2 inches long (uses a 1 5/8 inch long coil sleeve). Williams used a 1 5/8 inch length coil body (with a 1 3/4 inches long coil sleeve). Replace a Gottlieb coil with a Bally manufactured substitution coil only if a genuine Gottlieb coil is unavailable.



A **Coil Stop** is the metal bracket located usually at the base or bottom end of a coil (near the wire lugs or the coil's plastic base). It is used to hold the coil to its mounting bracket and to stop the solenoid plunger at the end of its travel (see coil stop examples in the photo to the left).

Special purpose coil stops let the coil's plunger travel through them to allow for a greater travel distance. For example, a bell or knocker solenoid has a coil stop with a hole in the center of it. The longer the distance a plunger moves the more force it will have at the end of its travel and the louder the noise it will cause when the plunger

Bell and knocker units usually require a coil sleeve with an extended base like the Williams/Bally Reference Part Number 03-7067-3 and are sometimes longer then a stock sleeve.

Vast differences exist between coil stops used by pinball manufacturers. These differences include stop bracket height, width and mounting hole spacing. We will add coil stop info to this page soon.

Coil stops can become magnetized by the coil's magnetic field. This situation is the third most likely cause of slow to operate or stuck/jammed solenoid plunger problems. The Number one reason is dirt and then coil overheating resulting in a melted plastic coil sleeve and a bad coil.

Flipper coil stops are very prone to "magnetizing and mushrooming" caused by the strong magnetic field strength of the flipper coil windings. A magnetized coil stop can cause a solenoid to be sluggish, slow to operate or to become stuck at the end of the solenoid plunger core's travel. The only sure way to solve a problem with magnetized or mushroomed coil stops is with replacement.

Bally, for a short period of time in the 70's and early 80's, used a cheap coil stop with mounting holes too close together and used too thin of a metal to make the stop. These issues caused mounting holes in the coil stop brackets to crack between them. A broken coil stop can destroy the coil by allowing it to either fall off the mechanism and overheat or become misaligned with its plunger core causing excessive wear, loss of power and sometimes noise. No aftermarket part manufacturer seems to make this often broken part. The only replacement available is a completely new mechanism (flippers are very prone to coil stop breakage) with a stronger made coil stop installed.

NOTE: *Pinball Medic* has had to start upgrading whole flipper units by replacing the old mechanism with a complete new flipper unit and mounting bracket. These new flipper units are expensive (more then \$50 each), however, provide a path way to rebuild the flipper in the future as coil stops can be found for these new mechanisms, but not for the original Bally/Stern flipper units.



In the early days, **Gottlieb** tended to use a wrap around coil stop on its strongest coils (coil stop is shown in the photo on the left). Other pinball manufacturers tended to use the common ninety degree angled bracket with only two mounting screws. The Gottlieb wrap around coil stop incorporates stronger mounting using four screws and doesn't tend to bend or break apart.

Damage can occur to all coil stop types after long periods of use. They often have "mushroomed" front surfaces due to the impact of the plunger or solenoid core and are in need of replacement. Flipper coil stops take the most abuse and should be checked often.

Note on Gottlieb pinball replacement parts: New or NOS Gottlieb solenoid parts are usually much harder to find then the more common Williams stops. Gottlieb has forbidden any aftermarket company from remaking their unique game parts. No one can legally download a copy of a Gottlieb game manual, schematic, side art, game PROM image or even a parts catalog. This is making Gottlieb pinball games difficult to repair or restore. This situation will eventually cause

Gottlieb games to become non-repairable as soon as the limited stock of NOS parts are depleted and when no one can find any information on Gottlieb manufactured games. There is currently only one authorized Gottlieb parts dealer in the USA! **NEW NOTE:** Williams chose to sell all of their pinball part designs to a small Austrian company that never produce very many replacement parts or replacement playfields. Bally and Williams parts designs have lately been resold to a new pinball parts manufacturing company in the U.S. It is yet to be determined if this new company will remake many of the rare and hard to find coils and other pinball parts so desperately needed by pinball hobbyist and coin-op repair shops around the world.



Metal VS Plastic Coil Sleeves and Sleeve Lubrication Metal or Copper coil sleeves should be replaced with plastic sleeves, if they can be removed. A plastic coil sleeve will operate for a longer time and provide an improved berformance.

Solenoids are designed to operate without any lubrication. Application of any type of OIL

or Grease is NOT recommended and can cause jamming or in some cases grease/plastic

No type of coil sleeve, plastic or metal, ever require ANY FORM of OIL or any other type of lubrication.



See our Tech Tip pages for more information on why not to use any lubrication on plastic pinball parts and what type of oil to use on motor oiling felt pads and leg level adjusters. A thin, round and made of spring metal ring spacer was often used by Gottlieb and Chicago Coin games between the top coil bracket and the solenoid coil to keep the coil from moving or vibrating when activated.

These "spacers" can often be found on Gottlieb or Bally pinball games to allow for a Data East or Williams coil

substitution and for other erroneous reasons. This is not a legitimate use for this spring steel spacer. Leaving out the ring spacer during legitimate coil substitution can cause the coil to vibrate and make a loud noise every time the coil is activated.

Coil part number suffix or prefix (suffix=numbers or letters following a coil part number) - AE-23-800 - 04) and letter or number coil suffix / prefix (SA3-23-850DC) indicate the following coil modifications: coil sleeve type used (metal or plastic sleeve and length), coil diode polarity and position (top or bottom of wire lugs), wire lug placement, length of the wire lug at the base of the coil or the length of the mounting insulator or coil base.

Bally or Williams pinball solenoid coils have places for three terminal lugs; **left edge**, **middle**, and **right edge** of the coil's plastic base. The positions are as viewed with the lug end of the coil facing you and the lugs on top of the plastic coil base.

The 'AL' and 'AR' coils are used when the lugs on an 'AE' coil would be in the way of a metal coil mounting bracket or any other close mechanical device.



AL has lugs on the left and middle. AE has lugs on left and right (both corners) AR has lugs on the right and middle of the coil base.

Wire Gauge, Number of Wire Turns and Coil Strength Rules



The **higher** the American Wire Gauge number, the **smaller** the **diameter of wire**. A small diameter wire has more resistance per foot of wire then a large diameter wire and will take fewer turns of wire for a given coil supply voltage. This makes the coil cheaper to manufacture because wire is sold by the pound and not by the length of the spool of wire. Small sized wires can also lead to a coil that is easy to burn because a small size wire will heat up faster then a large diameter wire.

The first two digits in the Williams coil part number (Ex. AE-23-550) indicate the American Wire Gauge (AWG).

The last set of part number digits (Ex. AE-23-**550**) indicate the number of turns of wire on the coil. American wire gauge/size information



Coil Strengths, Turns of Wire Rule and Coil Power Supply Voltages

Coil pull in strength wiring rule: The greater the number of turns of wire on a coil the weaker the solenoid coil.

The fewer the number of wire turns the stronger the pull-in strength of the solenoid coil.

The coil's wire diameter does **not** effect coil strength to any effective degree. Large diameter wires will not heat up as fast as a small diameter wire (This assumes the same amount of current is flowing through the two different wire sizes with the same amount of total coil resistance.) Large sized wires are used in coils that are to be activated many times during game play and/or for strong coils like the power stroke winding on flipper coils. Pop bumpers, sling shots and chime coils are all examples of mechanisms that typically use a coil with a low wire gauge number (large diameter wire).

Long energized relays (coin lock-out, lock relays) use another wiring method to keep from overheating. Typically they are wound with small diameter wire and use many turns of wire. This produces a physically small coil size and very high resistance relay coil (low relay coil pull in strength). High coil resistance provides little current flow and less heat inside the relay's core. Wire size information

Raising the power supply voltage was also used over the years to increase the strength of solenoid coils in arcade games (This is not the same as high tapping a game.). An increase in voltage gives a coil designer a wider range of coil strengths, an easier way to 'tune' the coil's strength to the pull in force required and increases the upper maximum strength level of a coil. High coil supply voltages (greater then 24volts) can also make a coil easier to over heat, increases the likelihood for the game's player to receive a shock and usually requires more turns of wire then a coil designed to work at a lower voltage due to Ohm's Law.

The **type of coil supply current** can also effect the power of a solenoid coil. Direct Current **(DC)** offers approximately four times the strength of an Alternating Current **(AC)** coil with the same supply voltage and the same number of wire turns. Also, DC coils can be driven by transistors (instead of relays) that use no moving parts, as long as a coil diode (reverse polarity biased) is provided to absorb the 'kickback' of the coil. DC can simplify the driver circuitry used in electronic pinball games and provide stronger solenoids.



When some early EM pinball games were made, AC to DC current conversion was both rare and expensive to do. Current conversion was eventually made cheap and easy with semiconductors inside of a bridge rectifier. However, the early expense of current conversion started the tradition of not converting AC into DC that lasted all the way to to the start of electronic pinball games.

There were a very few old table top or wood rail pinball games powered with a battery. No AC to DC conversion was needed and the whole game was powered with battery supplied DC current.

This tradition or trend is one reason why very few electromechanical pinball game was ever made with all direct current powered coils. Game designers would rather spend a lot of time trying to engineer AC relays that don't hum then to convert a whole game to DC. Everyone had to wait till electronic games forced the use of DC to power everything to get the coil strength and ease of design benefits that direct current provides.

Weaker coils (large number of turns of wire, Example a relay coil with 6000 turns of wire) can withstand longer activation times without overheating because of the many turns of wire that has to be used and the higher coil wire resistance. Many turns of wire produces

a coil with lots of resistance that limits current flow and hence decreases the heat inside of a coil.

Pinball solenoid coils are never activated for more then about a quarter to half of a second during normal game play. Unless they were designed to be activated for a very long time like "coin lock out" or "hold" relay coils (Electromechanical (EM) pinball coils are activated for a much longer time when compared to electronic pinball games). If a relay or coin lockout coil is built with enough turns it can be activated indefinitely without overheating and eventual coil destruction.



Coils that may be activated for a long period of time (either by design or by a faulty/shorted play field switch on an EM pinball) usually have at least 1300 or more turns of a large diameter wire. Score reel, chime, 'lock' relay, coin lockout coils and the 'hold' relay coil on most EM pinball games are examples of a coil designed to be activated for a long time without overheating.

New Coil suppliers often offer "Hot" or "Extra Strong" solenoid coils as a way to "upgrade" a game for faster play or perhaps make a particularly hard to make skill shot on a steep ramp easier to obtain. These coils are modified regular stock coils with a few turns of wire removed from the coil (often resold at a premium price). These aftermarket coils usually don't last very long in a game and are not recommended. They can often **break playfield or other hard to find game parts** with their increased strength. Non standard or too strong replacement coils can also over burden already stressed coil drive electronics shorting their life spans.



"High Tapping" a game with a normal line voltage is not recommended either as this can cause coils to overheat. Fixing or repairing the game's power supply is vastly superior to increasing the power supply voltage through "High Tapping" a game. See our Arcade Tech Tips page for more info on high tapping the game's transformer. Or our coin-op catastrophe collection for some interesting coil photos.

Flipper Coils, Drive Circuits and Coil Supply Voltages and Current Types Additional Data East and Saga flipper coil information is on our pinball circuit board charts

Flipper coils usually have two sets of part numbers (Ex. 21-550/26-1200, EOS flipper wiring) because they have two coil windings on the same solenoid coil body. The first set of part numbers (21-550 in example) indicate the strength of the flipper (pull in coil used to raise

the flipper). The last set of numbers (**26-1200**) indicate the coil strength used to hold the flipper fully upright (solenoid core hold in coil). The number of wire turns on the second set of the flipper coil part number is always larger then the first number of wire turns because the coil does not need to be strong when holding the flipper upright. The flipper coil "hold" coil does have to be able to be activated permanently without burning up the coil. This is why a lot of turns of wire are used on the "hold upright" coil on a flipper coil.

Flippers on modern pinball games (Dot Matrix Display pinball games) use only one coil winding. One winding flipper coils are supplied with two different voltages at different times in the operation of the flipper. (One winding flippers are sometimes referred to as "solid state" flippers even though they are still operated by a solenoid coil. They are driven by solid state electronics (driver transistor instead of directly from the flipper buttons). A higher voltage (usually 50 volts) is used to move the flipper and a lower voltage (usually 18 volts) is used on the same flipper coil winding to hold the flipper upright.



This new type of flipper coil doesn't have two sets of coil winding numbers in its part number. In fact, single winding flipper coils usually have only an arbitrary, non-specific part number on them (example; 090-5020-20). The part number doesn't indicate anything about how the coil was constructed or its pull in strength. One coil winding flipper coils can be identified by a flipper strength chart using the coil's wrapper color or by simply using the game's manual. However, Data East and some other pinball manufacturers liked to use a wrapper less coil with only a small part number sticker that usually burns up with the coil.

Coil Voltages - Early EM pinball and late model electronic games use a relatively high 50 volt solenoid coil voltage. This high drive voltage produced coils with very strong pull in strengths and a wider range of coil strength adjustment then the much lower 28-39 voltage solenoid coils.

28-39 voltage solenoid coils. Use Caution: Anything over 48 volts is considered dangerous by an electrician. Wear rubber gloves if you are not comfortable when working around these higher voltages.

Higher coil voltage speeds up the game play and allows for mechanisms that have to physically lift a game ball and plunge it back onto the playfield. (such as a Vertical Up Kicker (V.U.K.)). The 50 volt source was abandoned during the "middle ages" of pinball (late 70's to 80's games) because of the shock potential of this high of a voltage.

Players could receive painful shocks if the game was not properly grounded either by the missing grounding lug on the power cord or by a missing ground wire on a metal game part.

If a coil needed more strength or a slightly faster plunger pull in speed, then the Alternating Current power supply was converted to Direct Current for only a few coils inside of the late model EM pinball game. This current type conversion (AC to DC, converted by bridge rectifier) was done mostly on Pop Bumpers and Sling Shot coils during the electromechanical ages of pinball. Electronic pinball game coils were usually all powered by DC current (transistor driven coils).

The higher 50 volt supply (DC current) was reintroduced in late model pinball games because game metal parts grounding methods slightly improved and the typical game player demanded higher game speeds. Stronger flippers were needed for the steeper sloped ramps and playfields of the modern pinball game. Also, greater playfield mechanism complexity began to be used on modern (Dot Matrix Display or DMD) pinball games requiring very strong solenoid coils.

Differences in Coil Driver Circuits - Old model Williams/Bally Electronic pinball games use bipolar driver transistors to supply Direct Current to an activated coil. Usually, but not always, transistors (tip120) are used to ground one side (wire lug) of a solenoid coil in an early solid state pinball game. The other coil wire lug is connected to the appropriate supply voltage for the coil to be activated.

In later model games, both sides (wire lugs) of a solenoid coil have a transistor connected to it. Both transistors have to be activated before the solenoid coil will activate. These types of circuits are commonly referred to as a solenoid coil matrix.

All DC (Direct Current) coils use a coil diode across their terminals to absorb the voltage spike caused when the coil is deactivated. Unless this diode is incorporated into the coil driver



Changing a coil with a "- DC" after the part number to an Alternating Current (AC) coil can be accomplished by removing the coil diode across the coil's wire lugs.

A coil diode can also be added to a substitute ACC coil to make it compatible with direct current (DC) activated coils. The AC or DC coil's part number must match the required coil before a current type conversion can take place. Compare the wire size and the number of

turns on the replacement coil with the original coil before removing or adding a coil diode. Both the size and number of wire turns have to match before this type of coil substitution can be done.

In electromechanical games (EM), each relay or game mechanism coil gets it's power from the appropriate voltage tap on the main transformer. This power is routed though a combination of leaf, score cam and relay switches to one side of the coil to be activated. The other coil wire lug connects to a common wire usually connected directly or indirectly through relay or score cam leaf switches to a "0" or center tap terminal on the transformer's secondary winding. This "common wire" connects one side of many coils to the same tap on the transformer

A common supply wire can be used to de-energies banks of relays and/or multiple solenoid mechanisms at the same time. For example, the "Tilt" relay uses a relay to disconnect the supply wire to a bank of relays and playfield parts in the event the game is tilted. During a "tilt" all flipper coils and/or all ball manipulation playfield mechanisms not needed to remove the ball from the playfield are disabled along with all scoring units.

Because multiple "supply wires" can be used on the same transformer tap inside of a game, the tilt relay only interrupts the common wire to any mechanism that is "safe" to remove power from without trapping the ball on the playfield. Kickout holes, vertical up kicker and other mechanisms that require the game ball to drop into a hole are supplied with power during the tilt so they can operate normally to remove the game ball from the playfield. The "tilt" relay removes power to all scoring circuits so any activated playfield mechanism will not add to the total score for the player who tilted the game.

Coil Voltages by Game Manufacturer

Gottlieb 1947 to 1989: 28 volts, Gottlieb 1989 (system3) to 1996: 50 volts Williams 1947 to 1963: 50 volts, Williams 1963 to 1986: 28 volts, Williams 1986 to 1989: 28 or 50 volts, Williams 1989 to 1999: 50 volts

1999. 50 Volts

Bally 1947 to 1977: 50 volts, Bally 1977 to 1988: 43 volts, Bally 1988 to 1999: 50 volts

Zaccaria: 39 volts

Coil voltage information is from a R.G.P. post and has not been 100% verified.

Coil Voltage and Resistance Readings - Voltage measurements are affected by the method of measurement and the condition of the circuit (loaded or unloaded circuit, Peak versus RMS versus Average voltage readings). It is common place to indicate a standard supply voltage on a schematic when presenting a coil voltage (24 volts instead of the measured 28 volts - 50 instead of 60 volts (60 volts=unloaded circuit voltage).

Coil Resistance measurements can also be affected by the method of measurement. Ohm meter lead resistance, accuracy of the meter, temperature of the coil wire, condition of the coil's wire lugs (corroded or clean), coil diode bias during the resistance measurement.

Your readings in the real world may very slightly from what has been presented on this arcade coil charts page. All coil voltage and resistance readings listed are the average or most common voltage / resistance measurement.



Low Line Voltage Adjustment - Most Coin-Op Arcade games including both Electro-mechanical and electronic games have a way to increase the amount of voltage the power supply provides to compensate for low line voltage (Line voltage is measured at the wall plug or voltage source receptacle). Usually a long distance between power transmission line transformers, an old fuse breaker, wiring corrosion and even different power line voltages between countries can cause a lowering of the power supply voltage. This condition can cause all of the game coils to appear to be weak or sluggish. A low line voltage condition can even cause random game resets as describe on the Tech Tips page. Line Voltage should be checked before a game is turned on for the first time or when the game has been moved to a new location.

Coil Part Number Substitutions

It is always best to use a coil with a small wire gauge number (large diameter wire) and same number of wire turns as the original coil, but only if the exact part number cannot be found. However, specs like core length,

coil diode (if present on original coil) and coil body style should always be the same between the original coil and its substitute coil. For example; a **23-800** coil will have the same pull in strength as a **26-800** coil, however, the larger wire used in the 23-800 will take a longer time to heat up. Therefore, the coil should last longer without overheating assuming there is not a fault with the coil's driver suppling continuous current to the coil. Coil body length, lug placement / length and coil sleeve type should always be considered when substituting coil part numbers. Usually the original coil part number can be purchased new. A coil part number substitution should **only be considered** when a new replacement coil is not available.

Pinball game coils have been specifically designed to operate the mechanism they were installed in. If a coil is no longer available and two potential substitute coils are manufactured then install the coil with the lower wire gauge number and the same wire turns number. This rule assumes there is **no difference** in the construction of the original and the substitution coils except for their wire diameter.

For additional information on coils see the **Coil Body Differences** by coil manufacturer section on this page and our Tech Tips and the Arcade Game Tech Tips pages.

Gottlieb is always the exception to any industrial coin operated game coil or part number scheme. Their coil part numbers do not provide any useful information and usually start with the letter "A".

A substitute for Gottlieb coils can be found by matching a known good Gottlieb coil's ohmage with the ohmage of a **Bally coil** or by matching a typical coil function.

Solenoid coil sleeve, coil magnet and flipper bushing information.



Other pinball game and coin-op arcade technical info can be found on Pinball Medic's Tech Tips

on Arcade Game Tech Tips or on our Forum pages.

Pinball Type and Chart Abbreviations: EM = Electromechanical (score reels, relays)

SS = Solid State or Electronic (digital score displays, chips (integrated circuits))

NOS = New Old Stock. An old part that has never been used on a game.

VUK=Vertical Up Kicker G. P. = General Purpose Application

EOS = End of Stroke Switch used on most flipper units (usually a leaf type of switch).

The charts below show solenoid coil numbers and typical application. They do not indicate Pinball Medic's current solenoid coil inventory.

Pinball Medic Amusements does not have any Atari or Zaccaria pinball coils.

Pinball Coil Charts by Manufacture



Bally EM Pinball Coil Chart Williams Pinball Coil Chart GAMEPLAN GOTTLIEB Chicago Coin Zaccaria



Williams EM Pinball Solenoid Coil Chart

Coil Number	Typical Application	Coil Number	Typical Application
A-22-550	Ball Release, Unit Step-up	C2-26-800	Bell, Chime
A-23-600	Ball Ejector, Unit Step-up	FL-20-300/28-400	Flipper
A2-23-750	Knocker, Bell	FL-21-375/28-400	Flipper
A2-26-1025	Chime	FL-26-950/250	Step-up
A2-26-1300	Chime	G-21-400	Horse Race Ball Shooter
B-26-800	Score Drum, Unit Reset	G-22-550	Jet Bumper, Drop Target, Reset
B-27-1100	Reset	G-23-750	Jet Bumper, Ball Ejector, Kicker
B-28-1450	Score Drum Unit	G-23-750-DC	DC Jet Bumper, Kicker
B1-26-800	Score Drum, Unit Reset		

Williams Old Coil Number to New Coil Part Number Cross-Reference Chart

If a Williams coil has a "DC" in its part number, this designates the coil is made for Direct Current. Coils made for DC have a diode across their terminals.

Power supply wires to DC Coils have polarity and can only be attached to the coil with the positive wire going to the coil diode's cathode (negative end wire of diode, Marked with either a white or black band on diode's body) and the negative (grounding or common) wire going to the Anode or positive end of the diode (a reversed biased diode will only conduct when there is a high voltage reversed polarity inductive "kick back") (Positive end of diode is not normally marked). This reverse polarity "kick back" only occurs when the coil is deactivated. See this coil diode photo or the replacement BYV 26d diode part listing for more information. Most coils including relay coils used in most early EM Pinball games are powered by Alternating Current. No coil diode is required for AC driven coils.



Williams Coil Prefix / Matching Coil Sleeve chart "=inch COIL SLEEVE INFO SG-23, SG-1-23, SF-20 = 1 3/4" plastic coil sleeve SA-23 = 1 3/4" aluminum coil sleeve SA-2-23 / 2 3/4" plastic flanged coil sleeve SA-3-23, SFL-19 = 2 1/4" plastic coil sleeve SA-4-23 = 2" plastic flanged FL-23 = 2 3/16" plastic coil sleeve

Late Model Williams Electronic Pinball Game Flipper Coils (1990-Later) (DC Coils)

FL11753 used for small flippers, parallel coiled, "weak" flipper strength (Yellow coil wrapper) - power 9.8 ohms; hold 165 ohms

FL11722 "weak" flipper strength, parallel coils (Green Coil Wrapper Color) power stroke coil 6.2 ohms; hold flipper upright coil 160 ohms

FL24/600-30/2600 same as FL11722 except series round coils

FL11630 "standard" flipper strength, parallel coils, used on nearly all Williams system 11 pinball games (Red Coil Wrapper Color) - power 4.7 ohms; hold 160 ohms

FL23/600-30/2600 same as FL11630 except series coils

FL15411 strong flipper, parallel coils, used for main flippers on Addam's Family, Twilight Zone, etc. (Orange Coil Wrapper Color) - power 4.2 ohms; hold 145 ohms

FL11629 strongest Williams flipper, parallel coils, Used on most of the newest WPC system games (Blue Coil Wrapper Color) - power 4 ohms; hold 132 ohms

Bally EM Pinball Coil Charts

Bally	EM Pinball Coil Chart	Old Bally Coil Number to New Coil Cross-Reference Charts (Old Bally Coil Chart information is originally from a Bally Chart dated Jan. 6, 1971)				
Coil Number	Typical Application Coil Resistance	Old ~ New Coil Number	Old ~ New Coil Number			
A-25-850	Outhole Kicker	CO-25A-7 ~ A-25-1050	E-184-213 ~ A-27-1300			
A-25-950	Outhole Kicker	CO-25GG-7 ~ B-25-925	E-184-218 ~ F-31-1500			
A-25-1000	Thumper Bumper	CO-25H-7 ~ BC-25-925	E-184-224 ~ F-31-2100			
A-26-1100	Outhole Kicker	CO-26A-9 ~ A-26-1100	E-184-231 ~ CA-29-800/31-900			
A-26-1200	Sling Shot	CO-26GG-9 ~ B-26-1100	E-184-235 ~ AK-25-1050			
A-27-1100	Kickout	CO-27R-11 ~ C-27-1000	E-184-236 ~ J-28-1100			
A-28-1900		CO-28R-15 ~ C-28-1100	E-184-241 ~ AF-25-600/31-1000			
AF-25-500/28-1000	Flipper	E-184-41 ~ BF-27-1250	E-184-243 ~ A-26-1200			
AF-25-600/28-800	Flipper	E-184-46 ~ EA-30-1150	E-184-248 ~ FC-30-1300			
AF-25-600/31-1000	Flipper	E-184-47 ~ EA-32-1550	E-184-249 ~ BF-28-1500			
AF-26-650/28-800	Flipper	E-184-55 ~ B-29-1200	E-184-250 ~ D-30-700			

AF-26-750/28-800	Flipper	E-184-56 ~ A-27-1100	E-184-252 ~ BB-26-655/32-1245
AF-27-1000/32-1300) Flipper	E-184-74 ~ CF-28-1025	E-184-254 ~ FC-30-1400
AK-27-1300	Knocker	E-184-75 ~ E-32-1700	E-184-257 ~ AP-25-1050
AP-25-850	Outhole Kicker	E-184-112 ~ EA-29-950	E-184-260 ~ B-28-1600
AP-26-1200	Disappearing Post	E-184-135 ~ BA-25-925	E-184-261 ~ AP-31-3000
AP-27-1300	Thumper Bumper, Sling Shot	E-184-155 ~ D-27-425	E-184-262 ~ A-26-1200
B-25-750		E-184-156 ~ D-28-500	E-184-263 ~ AF-27-775/31-861
B-25-925		E-184-160 ~ B-25-750	E-184-264 ~ A-28-1900
B-26-1100	Ball Count, Bonus, Credit Units Step-up	E-184-175 ~ AP-27-1300	E-184-265 ~ AF-25-600/31-1000
B-27-1300	Free Ball Escape, Stepping Unit	E-184-180 ~ CE-33-4800	E-184-266 ~ D-29-675
BA-25-925		E-184-190 ~ AF-25-600/31-1000	E-184-268 ~ AF-26-750/31-900
BA-26-1040		E-184-204 ~ AF-27-1000/32-1300	E-184-269 ~ FC-33-2600
BC-25-925		E-184-205 ~ B-27-1300	E-184-270 ~ AB-31-3000
BF-27-1250		E-184-206 ~ CD-29-1600	E-184-271 ~ AK-24-750
C-27-1000	Knocker	E-184-207 ~ A-27-1400	E-184-272 ~ A-25-1000
C-27-1300			E-184-274 ~ FC-32-2100
C-28-1100	Ball Count, Bonus, Credit Units Reset		
CB-31-2000	Bell		
CC-31-2000	Chime	m m	
CD-29-1600	Ball Count, Bonus, Credit Units Step-up	(1)SAVIM	
CG-29-1600	Chime	Certify,	
N-21-650	Drop Target		
N-24-800	Drop Target		

Chicago Coin EM Pinball Coil Chart			GAMEPLAN COILS			
Coil Number	Typical Application	Coil Number	Resistance	Wire Gauge	Number of Turns of Wire per Coil Winding	
FJ-24-850	Thumper Bumper	21-50001B	4.75	24	850	
FJ-25-1050	Action Kicker	21-50002B	2.8/13.4	25/27	400/1000	
FJ-26-1200	Ball Saver	21-50003B	7.5	25	1050	
FJ-29-400/21-375	5 Flipper	21-50004B	33.9	29	2000	
H-26-650	Unit Reset	21-50005B	15.4	27	1400	
J-22-500	Player Control Unit Step-up	21-50006B	25.8	28	1800	
J-22-550	Ball Return, Unit Step-up	21-50007B	8.0	24	1000	
J-23-700	Match Unit (00-90 Unit)	21-50008B	1.2/21.5	22/30	375/800*	
J-23-750	Action Kicker	21-50009B	6.2	23	1100*	
J-24-850	Thumper Bumper	* No William	ns coil equiva	alent as coil	diameter is vary large.	
J-26-800	Ball Kicker					
J-27-1700						
J-28-1700	Pop-Up Target					
J-29-400/21-375	Flipper			ABUIDA		
J-29-400/22-400	Flipper			(*) PINKA	I I MEDIC COM	
N-24-700	Scoring Drum Unit					
N-24-700-X	Scoring Drum Unit					
N-26-1000	Knocker, Chime					
NA-26-900-X	Scoring Drum Unit					

Data East to Stern Part Number Conversions

Note: The coils on this DE to Stern substitution chart are approximately interchangeable but chart does not account for special length coil sleeves or coil body differences between flipper coils and their equivalent non-flipper coil counterparts. Substitutions are based on number of turns of wire and wire gauge only. Data East was bought by Stern.

1		
Data East Coil Part Number	Approximated New Stern Pinball Coil Part Number and Coil Resistance in Ohms	Typical use
090-5006-00 Flipper coil used on 500-5031-03 flipper assembly.	23-620 / 30-2600 Coil Resistance 2.4 / 75	Flipper Coil SECRET SERVICE
090-5012-00	22-800 / 30-2600 Coil Resistance 2.8 / 90.5	TORPEDO ALLEY- upper right flipper
090-5020-30 single winding flipper coil Three lugged coil body (one lug not used) with one diode across coil.	23-900 Coil Resistance: 3.8	single winding flipper coil TEENAGE MUTANT NINJA TURTLES, STAR TREK 25th ANNIVERSARY HOOK (lower flippers), BATMAN, ROCKY & BULLWINKLE JURASSIC PARK (upper right is 090-5030-00) LAST ACTION HERO, BAYWATCH, TOMMY BATMAN FOREVER (upper right flipper) AUSTIN POWERS (left flipper only, right flipper is 090-5030-00)
090-5030-00 single winding flipper coil Only two wire lugs on coil body with coil diode wired across them.	AE-23-1100 with long Data East flipper sleeve and coil diode added.	single winding flipper coil HOOK, LETHAL WEAPON 3, MARY SHELLEY'S FRANKENSTEIN BAYWATCH (lower left, upper right flipper, lower right flipper is 090-5020-30), STARSHIP TROOPERS VIPER NIGHT DRIVIN', LOST IN SPACE, SOUTH PARK,

		SHARKEY'S SHOOTOUT, NASCAR	
090-5032-OT single winding flipper coil. Three lugged coil body (one lug not used) with one diode across coil. Flipper coil with diode for solid state flipper systems replaces part 090-5032-00.	Single winding flipper coil. BATMAN FOREVER, STAR WARS (Data East), TALES FROM THE CRYPT, WWF ROYAL RUMBLE, GUNS N' ROSES GOLDEN EYE, ID4 INDEPENDENCE DAY, SPACE JAM, STAR WARS TRILOGY, LOST WORLD JURASSIC PARK X-FILES, GODZILLA, Stern/Sega HARLEY DAVIDSON, STRIKER XTREME, MONOPOLY MAVERICK, APOLLO 13, STARSHIP TROOPERS - upper right flipper, ROLLER COASTER TYCOON Note:'T' suffix indicates diode is on the 'Top' or coil winding side of the spool lugs. 'B' suffix indicates diode is on the 'Bottom' side of the spool lugs.		
090-5026-00	Equivalent to Gottlieb A-19217	CHECKPOINT - Used on single bank drop target assembly 500-5240-00.	
090-5011-00	22-750 / 30-2600 Coil Resistance 2.6 / 92	LASER WAR, TORPEDO ALLEY, TIME MACHINE	
090-5020-20 single winding flipper coil. Three lugged coil body (one lug not used) with one diode across coil.	22-900 Coil Resistance in ohms: 3.4	ROBOCOP, PHANTOM OF THE OPERA, BACK TO THE FUTURE THE SIMPSONS, CHECKPOINT	

Data East to Williams Coil Part Number Conversion Chart

Note: The coils on this DE to Williams substitution chart are approximately interchangeable. Chart does not account for special length coil sleeves or coil body differences between flipper coils and their equivalent non-flipper coil counterparts. Substitutions are based on number of turns of wire and wire gauge only.					
Data East Part Number	Williams Coil Number	Data East	Williams		
090 - 5001 - 00	23 - 800	090 - 5023 - 00	22 - 600		
090 - 5002 - 00	24 - 900	090 - 5025 - 00	24 - 1570		
090 - 5003 - 00	27 - 1300	090 - 5030 - 00	23 - 1100		
090 - 5004 - 00	27 - 1500	090 - 5031 - 00	32 - 1800		
090 - 5005 - 00	23 - 840	090 - 5032 - 00	22 - 1080		
090 - 5006 - 00	23 - 620 / 30 - 2600	090 - 5034 - 00	25 - 1240		
090 - 5008 - 00	23 - 1200	090 - 5036 - 00	24 - 940		
090 - 5010 - 00	32 - 590	090 - 5036 - 01	24 - 940		
090 - 5011 - 00	22 - 750 / 30 - 2600	090 - 5037 - 43	23.5 - 765*		
090 - 5012 - 00	23 - 800 / 30 - 2600	090 - 5041 - 00	25 - 1800		
090 - 5013 - 00	23 - 700 / 30 - 2600	090 - 5042 - 01	22 - 650		
090 - 5015 - 00	27 - 1400	090 - 5044 - 00	26 - 1200		
090 - 5016 - 00	29 - 2000	090 - 5046 - 00	28 - 1050		
090 - 5017 - 00	22 - 500	090 - 5053 - 00	23 - 800		
090 - 5019 - 00	23 - 750	090 - 5054 - 00	31 - 1500		
090 - 5020 - 10	21 - 900	090 - 5059 - 00	29 - 1000		
090 - 5020 - 20	22 - 900	090 - 5061 - 00	24 - 780		
090 - 5020 - 30	23 - 900	090 - 5062 - 00	23 - 1500		
090 - 5021 - 00	20 - 400	090 - 5064 - 02	20.5 - 480*		
090 - 5022 - 00	23 - 700	*One half of a wire gauge will make very little diff Use the next lower (preferred) or higher wire gau	erence. ge when substituting.		

Gottlieb EM Pinball Coil Chart

	Typical Application		
Catalog	Coil Body Differences	Catalog	Typical Application
Number	Bally and Gottlieb use the same coil body.	Number	Typical Application
	A typical Williams or Data East coil uses a 1/16" shorter coil body.		
A-489	gate	A-5196	bank set up
A-1084		A-5197	roto unit, bank set up
A-1118	bank relay, bonus control	A-5662	•
A-1119	rollover relay	A-6698	
	replay unit step up, stepping unit step-up, hole kicker, bonus step-up	A-6821	
A-1496	(advance coil), player unit step-up, ball return	A-7676	V
		A-7677	coin lockout
A-1856		A-7687	
	CaottileD	A-7688	
A-3498		A-7800	bank set up
A-3890	"R" relay coil	A-7833	A-9479 drop target bank reset, sequence bank reset
A-3891		A-7834	A-9736 coin lockout
A-4893	pop bumper, multiple hole kicker 23-535 2.1 ohms	A-7835	A-9740 vari-target reset
A-5141	flipper	A-7836	A-9740 vari-target reset
A-5143	bell, knocker	A-7837	A-12092 chime
A-5193	ten step unit	A-7846	A-15259 scoring unit
			-

A-5194	G.P, replay unit reset, slingshot kicker, hole kicker, subtract bonus 24-780 4.5 ohms					A-7847	A-15555	drop target ba	ank reset
A-5195		ball stop, cl	hime 26-1305	12.3 ohms		A-8447			
Catalog Number	Typical Application	Coil Resistance (Ohms)	Wire Gauge- Number of Turns	Coil Wrapper Color	Catalog Number	Typical Application	Coil Resistance (Ohms)	Wire Gauge- Number of Turns	Coil Wrapper Color
A-1496	General Purpose	2.95	23-635		A-18642	Trip/Relay	58	33-1590	WHITE
A-4893	G. P.	2.1	22-535	RED	A-19300	G. P.	7.8	25-1075	ORANGE
A-5194	G. P.	4.5	24-780	BLUE	A-19508	Target Trip / Relay	35	32-1250	
A-5195	G. P.	12.3	26-1305		A-20558	Relay	156	34-3400	WHITE
A-15259	EM Score Reel	??	??	WHILE	A-21741	VUK	2.5	23-575	ORANGE
A-16570	G. P.	15.5	28-1750	GREEN	A-26450	G. P.	42	29-2400	PINK
A-16890	G. P. / Relay	231	27-1450	ORANGE	A-26451	G. P.	65.8	30-3000	BLUE
A-17876	G. P.	24	35-4000	TAN	A-26452	Target Trip / Relay	137	35-2450	PINK
A-17891	5 Target Reset	3.35	22-850	WHITE	A-26926	3 Target Reset	32.8	27-2650	
A-18102	3/7(X2) Target Reset	9	24-1430	RED	A-27926	G. P.	64.7	29-3475	BLUE
A-18318	4 Target Reset	6.7	24-1130	ORANGE	A-30297	G. P.	66.5	30-2750	

GOTTLIEB FLIPPER COILS

Catalog Number	Typical Application	Pull-In / Hold Coil (Ohms)	Wire Gauge / Number of Turns	Coil Wrapper Color	Gottlieb Coil	Wire Gauge/Turns	Ohms	Wrapper Color	Usage
A-17875	Flipper	2.4 / 40	24-560/ 31-1100		A-17875	24-560/ 31-1100	2.8/ 40	Yellow	Flipper
A-20095	Super Flipper	1.55 / 35.5	22-450/ 31-900	RED	A-20095	22-450/ 31-900	1.55/ 35.5	Red	Super Flipper
A-24161	Small Flipper	2.2 / 40	23-520/ 31-1050	BLUE	A-24161	23-520/ 31-1050	2.2/ 40	Blue S	small Flipper
A-25959	Flipper	3.85 / 202	22-445/ 30-1225	RED	A-25959	22-445/ 30-1225	3.85/ 202	Red	Flipper (new)
A-26646	Flipper	4.57 / 201	25-725/ 33-3470	BLUE	A-26646	25-725/ 33-3470	4.57/ 201	Blue	Flipper (new)
A-27642	Flipper	9.1 / 203	27-950/ 33-3700		A-27642	27-950/ 33-3700	9.1/ 203	Yellow	Flipper (new)
A-27643	Flipper	11.59 / 269	28-960/ 33-4700	WHITE	A-27643	28-960/ 33-4700	11.59/ 269	White	Flipper (old)
A-28740	Flipper	6.02 / 207	26-790/ 33-3600	TAN	A-28740	26-790/ 33-3600	6.02/ 207	Tan	Flipper (new)
A-29876	Flipper	2.36 / 202	23-560/ 33-3325	ORANGE	A-29876	23-560/ 33-3325	2.36/ 202	Orange	Flipper (new)
A-30468	Flipper	11.59 / 269	28-960/ 33-4700	WHITE	A-30468	28-960/ 33-4700	11.59/ 269	White	Flipper (Old)
A-31272	Flipper	44.8 / 268	30-2200/ 34-3575	BLUE	A-31272	30-2200/ 34-3575	44.8/ 268	Blue	Flipper

Gottlieb Coil/Relay Coil Wire Turns and Resistance Chart

Gottlieb Coil	Wire Gauge/Turns	Ohms	Wrapper Color	Usage
A-1118	?	3.6	black	feature bank relay
A-1496	23-635	2.95	Yellow	Pops, Slings, General Purpose
A-4893	22-535	2.1	Red	Up kicker, pop bumpers
A-5141	?	1.7/ 6	Green	Flipper (EM)
A-5141 y dot	?	1.0/ 6	Green w/ yellow dot	Flipper High Power EM
A-5143	?	3.6	Black	1960s Bell coil
A-5194	24-780	4.5	Blue	Up kicker, Pop Bumpers, Slings
A-5195	26-1305	11.6	White	Knocker, Outhole coil
A-7112	?	155	red or black	120 volt start relay (1960s)
A-9736	?	22	?	1st ball relay (1975-1979)
A-9738	?	32	?	tilt hold relay (1975-1979)
A-9740	?	24	?	Game Over relay (1975-1979)
A-16570	27-1450	15.5	Green	Ball release
A-16890	35-4000	231	Orange	Q/T Relay sys1&80
A-16890	35-4000	225	Orange	Q/T relays
A-17875	24-560/31-1100	2.8/40	Yellow	Flippers
A-17876	28-1750	24	Tan	General Purpose
A-17891	22-850	3.35	Red	5 bank reset
A-17891	22-850	3.35	White	5 Target Reset
A-18102	24-1430	9.0	Orange	target bank reset (uses 2)

A-18318	24-1130	6.7	Orange	4 target bank reset
A-18642	33-1590	58	White	Memory relay, target trip relay
A-19300	25-1075	7.8	Orange	Ball kicker
A-19508	32-1250	35	Yellow	Target Trip/Relay
A-20095	22-450/31-900	1.55/35.5	Red	Super flipper
A-20558	34-3400	156	White	Gate relay
A-21741	23-575	2.5	Orange	Vertical Up kicker
A-26450	29-2400	42	Pink	General Purpose
A-26451	30-3000	65.8	Blue	General Purpose
A-26452	35-2450	137	Pink	Target Trip/Relay
A-26926	27-2650	32.8	Blue	3 Target Reset
A-27926	29-3475	64.7	Blue	General Purpose
A-30297	30-2750	66.5	Blue	General Purpose

Gottlieb Flipper Coil Chart

Gottlieb Coil	Wire Gauge/Turns	Ohms	Wrapper Color	Usage
A-17875	24-560/ 31-1100	2.8/ 40	Yellow	Flipper
A-20095	22-450/ 31-900	1.55/ 35.5	Red	Super Flipper
A-24161	23-520/ 31-1050	2.2/ 40	Blue S	small Flipper
A-25959	22-445/ 30-1225	3.85/ 202	Red	Flipper (new)
A-26646	25-725/ 33-3470	4.57/ 201	Blue	Flipper (new)
A-27642	27-950/ 33-3700	9.1/ 203	Yellow	Flipper (new)
A-27643	28-960/ 33-4700	11.59/ 269	White	Flipper (old)
A-28740	26-790/ 33-3600	6.02/207	Tan	Flipper (new)
A-29876	23-560/ 33-3325	2.36/ 202	Orange	Flipper (new)
A-30468	28-960/ 33-4700	11.59/ 269	White	Flipper (Old)
A-31272	30-2200/ 34-3575	44.8/ 268	Blue	Flipper

Equivalent Gottlieb Solenoid & Relay Coil Substitution Chart

Coil Number Equivalents	Туре	Ohms	Usage
A-1119	relay	2.1	in series usage with another relay
R20-1, A-9746	relay	1.5	in series usage with another relay
R20-2, A-7688, A-9733, A-487	relay	2.5	Interlock, in series usage with another relay
R20-3, A-9742, A-7834, A-1084	relay	10	Tilt
R20-4, A-9735, A-7676, A-7835, A-5662, A-3891, A-489	relay	15	most common relay used for general use
R20-5, A-9736, A-7677	relay	25	30v hold, Alt, Coin Lockout, 1st ball
R20-6, A-5294, A-3890	relay	385	120 volt R (reset) & S (start) relays
A-9740, A-6698, A-7846	relay	22	Credit Hold, Game over hold, pop relay, vari-target
A-9738, A-7836, A-3498	relay	32	110v hold, 30v hold, Tilt Hold
A-6821, A-5457	relay		general
A-5141, A-1657, A-1546	solenoid	1.7, 6	Flipper
A-5193, A-3104	solenoid		reel drive
A-5195, A-1943, A-622, A-12092	solenoid	12	Chime, Ball release
A-5196, A-1318, A-9479, A-15555	solenoid		Bank step-up, Bank reset
A-9479, A-5196, A-1318, A-15555	solenoid		bank reset
A20-2, A-17875 (use high power winding)	solenoid		Counter
A20-4, A-5197, A-7800, A-1640	solenoid		Bank reset, Bank SU, Roto, turret shooter
A20-6, A-5143, A-5194, A-940, A-1448, A-3537, A-2563	solenoid	3.6	Reset, Kicker, Bell, Knocker
A20-8, A-4893, A-939, A-2435	solenoid		Bell, Pops, Hole eject
	NAT IN COMPANY		



Zaccaria Pinball Coils

Zaccaria coils numbers specify the diameter of the wire and the number of turns. Example: D. 50 - S. 1600

The D. in the coil part number is the diameter of the wire in the coil in millimeters multiplied by 100. The S. number is the number of turns of wire in the coil.

i.e. D=50 & S=1600 then a coil with .5mm diameter wire or approximately a 24 Gauge wire size with 1600 turns of wire should be used.

Flipper coils usually have two sets of coil numbers because they contain two coils of wire on the same solenoid coil form.

When substituting another brand of coil for a Zaccaria pinball coil, it is better to go down on the gauge of wire (larger sized wire) then change the number to turns on a coil. i.e. coil calls for 27 Gauge wire. However, a 26 gauge wire is the more common size, then a 26 Gauge wire should be used instead of a 28 or higher gauge wire. A large diameter wire can take more current flow without heating up then a small diameter wire. The number of turns on a coil (S value) dictates the strength of the pull in force of the coil (lower number of turns = stronger pull in or coil strength).

To find a Williams substitute coil number use the AWG spec from the National Bureau of Standards Chart below:

Typical Application Zaccaria Coil		Coil Wrapper Color	Resistance	Williams Brand Coil Substitution (Approximated)
Flipper Coil D.50 S.600 / D.14 S.5000		Tan	3.50 / 4800 Pull In/Hold coil	24-600/35-5000
Flipper Coil D.45 S.500 / D.14 S.6000 (This coil doesn't have a plastic wire lug base)		Green	3.50 / 5300	Williams 25-500/35-6000 or Bally 25-500/34-5050
Small Sized Flipper	D.355 S.1000 / D.14 S.6000	Blue	10 / 5500	27-1000/35-6000
Ball Trough Kicker	D.40 S.1200	Pink	110	26-1200
Knocker	D.40 S.1200	Pink	110	26-1200
Coin Door Lockout	D.12 S.6000			
Drop Targets Reset	D.50 S.1600	Orange	110	24-1600 Original coil has an unusual coil sleeve with an extended center section. A new Williams substitution coil will not come with this type of coil sleeve.
Pop Bumper	D.45 S.1000	Yellow	7.70	25-1000
Ramp	D.355 S.1000 / D.14 S.6000	Blue	100 / 5500	27-1000/35-6000
Slingshot	D.40 S.1200	Pink	110	26-1200

AWG - Zaccaria to Williams Coil Conversion

AWG Wire Gauges	Wire Diameter (mm)	Linear electrical wire resistance (Ohm/km)	AWG Wire Gauges	Wire Diameter	Linear electrical wire resistance (Ohm/km)	Zaccaria = Willaims substitution (Approximated)
0000	11.7	0.17	19	0.912	26.40	
000	10.4	0.21	20	0.812	33.30	
00	9.27	0.26	21	0.723	41.99	D. 71 - S. 1700 = 21 - 1700
0	8.25	0.33	22	0.644	52.95	
1	7.35	0.40	23	0.573	66.80	
2	6.54	0.51	24	0.511	84.20	D. 50 - S. 1600 = 24 -1600 or A 24 -1400
3	5.83	0.64	25	0.455	106	D. 45 - S. 1000
4	5.19	0.81	26	0.405	134	D. 40 - S. 1200
5	4.62	1.03	27	0.361	169	The total length of wire on a coil can not be
6	4.12	1.30	28	0.321	213	calculated from the Ohms per km approximation data on this chart. General purpose Ohm meters are
7	3.66	1.63	29	0.286	268	not accurate enough. Also, wire and test equipment
8	3.26	2.06	30	0.255	339	lead resistance will vary with temperature.
9	2.91	2.60	31	0.227	427	
10	2.59	3.28	32	0.202	538	
11	2.30	4.13	33	0.180	679	
12	2.05	5.21	34	0.160	856	
13	1.83	6.57	35	0.143	1079	
14	1.63	8.29	36	0.127	1361	
15	1.45	10.4	37	0.113	1716	
16	1.29	13.20	38	0.101	2164	
17	1.15	16.60	39	0.0897	2729	
18	1.02	20.90	40	0.0799	3441	

Solenoid Coil Sleeve Chart

Also see Coil sleeve length charts

All new replacement solenoid coils are shipped with the proper length and style of coil sleeve. Replacing old dirty coil sleeves and cleaning the coil plunger are the least expensive ways to cure sluggish solenoids. Replacement of metal coil sleeves with plastic sleeves is mandatory as the nylon plastic sleeves perform better and last longer.



1-3/4" This 1-3/4" nylon coil sleeve is the most commonly used length on all brands of pinball machines. Typically found on pop bumpers, slingshots, kickers, and early solid state and electromechanical flipper

2-3/16" This nylon sleeve is used on Williams post- 1980, Bally post-1988, Stern post- 1999, Data East, and Sega flipper assemblies. This is the standard flipper coil

2-1/4" This is the proper nylon coil sleeve

for Williams System 6 and System 7 flipper assemblies.

This coil sleeve is slightly longer than the much more common 2-3/16" sleeve. The extra 1/16 inch



nylon coil sleeve with a 3/16" flan

Williams/Bally Reference Part Number 03-7067-3

Plastic VS Metal

Reference Part Numbers: Williams/Bally 03-7066. Stern/Sega/Data East 545-5411-00. Reference Part Numbers: Williams/Bally 03-7066-5. is needed to keep the flipper plunger return spring from getting wedged between the plunger and coil.

See our Arcade Tech Tips page for more info on coil and flipper sleeves.



electromechanical pinball games wit new plastic sleeve when ever possib The plastic sleeve offers greater longevity and performance over the metal coil sleeve.

Plastic does have a draw back as it v melt if the coil is energized for too lo of a time. However, if a coil is hot enough to melt its coil sleeve then it probably already burnt itself out.

Bell, Chime or V.U.K. coil sleeve.



This special purpose Ball Popper/Shooter rod sleeve looks like a normal coil sleeve. Except they are usually at least two inches in length. Also, they usually can slide inside a normal coil sleeve (see photo on right of shooter sleeve) and most have a 1/4 inch inside diameter.

This type of special sleeve is getting harder to find, but is essential to proper ball shooter rod operation.

NOTE: Check for bent, dirty or "mushroomed tipped" shooter rods and for bad rod springs when replacing this sleeve.



Notice the extra length of sleeve after the coil stop ridge.

This type of coil sleeve is used with coil stops with a centered hole.

The coil's plunger passes through the coil stop to all

It a greater travel distance. The greater travel equates to more momentum and louder bell sounds. A VUK uses this greater travel to lift the game ball much higher then it could if the

plunger core was stopped by a normal coil stop. Allowing it to thrust the ball though a metal ramp above the VUK unit.

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Standard solenoid and Bell/Chime Coil Sleeve Lengths

G=Gottlieb, W=Williams, WB=new B and W part number (after W bought B) CC/OS=Chicago Coin / Old Stern (PN), S/S/DE=new Stern / Sega / Data East (?)=(original sleeve manufacturer) - This is Not part of the part number							
Coil Sleeve Length in Inches	Manufacture's Part Number		Bell/Chime/Up-kicker /V.U.K.	Manufacture's Part Number	Specialty		
1-1/4"	A8111 (G), 03-7066-1 (WB), 130-1536 / 91-1509 (CC/OS)		1-3/16" - 1-1/2"	4A-159-1 (CC/OS)			
1-3/8"	143-808 (CC/OS)		1-5/8" - 2"	A6087 (G), 03-7067 (WB), 4A-159 (CC/OS)	Bell (short)		
1-5/8" - standard length for both G and B	A5064 (G)		1-9/16" - 1-13/16"	03-7067-3 (WB)			
1-3/4" - standard length for W	545-5031-00 (S/S/DE), 03-7066 (WB)		1-11/16" - 1-13/16"	545-5076-00 / 545-5076-01 (S/S/DE) 21411 (G)			
1-13/16"	A5065 (G), 03-7066-3 (WB)		2-1/16" - 2-1/4"	25605 (G), 545-5709-00 (S/S/DE), 03-7067-5 (WB)			
1-15/16" - 9/16" Diameter	2A-232 (CC/OS)		2-1/2" - 2-5/8"	03-7067-1 (WB)			
2-1/16"	03-7066-4 (WB)		2-1/2" - 2-3/4"	A5142 (G), 545-5847-00 (S/S/DE), 03-7067-6 (WB), 167-800 (CC/OS)	Bell (long length)		
2-3/16"	545-5388-00 (S/S/DE), 03-7066-5 (WB)		The short bell length is used to ring a small sized bell mounted close to the coil. The long Bell length is used on knockers, bells, and VUKs were the solenoid core must move a great distance without falling out of the coil. This sleeve usually sticks way out of the coil.				
2-15/16" - 9/16" Diameter Sleeve	03-7068 (WB)		All sleeves listed on this chart are 1/2 inch diameter unless indicated otherwise. Bell/Chime/Up-Kicker/V.U.P. are listed by two flange lengths by the following				
2-1/2"	A5172 (G)		Bell or Flanged Sleeve Length=To be included in the next update.				

Flipper Shaft Bushings

These are flipper shaft plastic bushing and not coil sleeves.

Important Note on Flipper Bushings:

Worn out or wrong type of Flipper bushings cause "flipper scrapes". If they do touch at any point in their movement then replace all flipper bushings immediately.

Scrapes caused by the plastic flipper body or its metal mounting bracket can be prevented but can't be restored to pre scrape condition. Often route people and game repair shops install the wrong bushing type for the pinball they are working on. Check and double check the flippers to make sure they have enough clearance between the flipper and the playfield.



Data East #545-5070-00



03-7568 Flipper Bushing

Used on all Williams pinball machines from 1980 to 1999. Used on all Bally pinball machines from 1989 to 1999.

Williams/Bally reference #03-7568



03-6014 and A-2408 Flipper Bushing

Williams nylon flipper bushing used on all games from Post Time (04/69) to Laser Ball (12/79).

Williams Part Reference #03-6014 Gottlieb Reference Part Number - Gottlieb A-2408

The following pinball games use this size of flipper bushing.

1969-04 Post Time, 1969-05 Suspense, 1969-06 Smart Set, 1969-09 Paddock, 1969-10 Expo, 1969-10 Roto, 1969-12 Set Up, 1969-12 Seven Up, 1970-01 Gay 90's, 1970-03 4 Aces, 1970-04 Jive Time, 1970-04 Rock 'N Roll, 1970-06 Aces & Kings, 1970-09 Strike Zone, 1970-10 Straight Flush, 1970-11 3 Jokers, 1970-12 Dipsy Doodle, 1971-02 Solids N Stripes, 1971-03 Doodle Bug, 1971-03 Love Bug, 1971-04 Gold Rush, 1971-04 Jackpot, 1971-08 Klondike, 1971-08 Planets, 1971-08 Yukon, 1971-08 Zodiac, 1971-10 Stardust, 1971-10 Yukon Special, 1972-01 Olympic Hockey, 1972-03 Granada, 1972-03 Spanish Eyes, 1972-05 Honey, 1972-05 Winner, 1972-08 Super Star, 1972-09 Big Star, 1972-09 Fan-Tas-Tic, 1972-12 Swinger, 1973-01 Travel Time, 1973-02 Fun-Fest, 1973-02 Summer Time, 1973-03 Match Race, 1973-05 Gulfstream, 1973-05 Tropic Fun, 1973-06 Jubilee, 1973-06 Skee Skill, 1973-09 Darling, 1973-10 OXO, 1974-01 Star Action, 1974-01 Tramway, 1974-02 Triple Action, 1974-03 Dealer's Choice, 1974-05 Skylab, 1974-07 Spacelab, 1974-07 Strato-Flite, 1974-10 Super-Flite, 1974-11 High Ace, 1974-11 Lucky Ace, 1974-12 Star Pool, 1975-03 Satin Doll, 1975-04 Big Ben, 1975-05 Pat Hand, 1975-07 Valencia, 1975-08 Triple Strike, 1975-09 Black Gold, 1975-09 Little Chief, 1975-12 Toledo, 1976-01 Space Mission, 1976-06 Space Odyssey, 1976-07 Aztec, 1976-11 Aztec, 1976-12 Blue Chip, 1976-12 Grand Prix, 1977-04 Liberty Bell, 1977-05 Big Deal, 1977-06 Hot Tip, 1977-07 Lucky Seven, 1977-08 Rancho, 1977-09 Argosy, 1977-10 Wild Card, 1977-11 Hot Tip, 1977-12 Road Champion, 1978-03 Lucky Seven, 1978-05 Contact, 1978-05 World Cup, 1978-08 Disco Fever, 1978-10 Pokerino, 1978-11 Phoenix, 1979-01 Flash, 1979-03 Stellar Wars, 1979-06 Rock 'N Roll, 1979-07 Tri Zone, 1979-09 Time Warp, 1979-12 Gorgar, 1979-12 Laser Ball



20-10179

Magnet coil used on Tales of the Arabian Nights and Theatre of Magic.

Williams/Bally reference #20-10179.



Williams/Bally Magnet Coil 20-10197

Electro-magnet coil used on Magna-saves Theatre Of Magic, Champion Pub, No Fear, Tales of the Arabia Nights, Cirques Voltaire, Star Wars Episode 1



Magnet coil used on many machines such as The Addams Family, Theatre of Magic, World

Cup Soccer, and Twilight Zone.

Williams/Bally reference #20-9247.



Magnet coil used on Williams High Speed II - The Getaway supercharger ramp.

Williams reference #A-15685.

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Electro-Magnetic Coils