Effective HF Mobile Antennas

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One of the problems with HF mobile operation, especially on 160, 80 or 40 Meters is antenna efficiency. The problem has been addressed in numerous publications for years, including, but not limited to the ARRL "Mobile Manual", the ARRL "Radio Amateurs Handbook", Editors & Engineers "Radio Handbook" and many others. If you are operating below 21 MHz,it is all but impossible to run a full-sized mobile antenna, so some sort of loading coil(s) will be needed.

Loaded antennas fall into three categories, Base-Loaded, Center-Loaded and Continuously-Loaded. The Base-Loaded antenna is the easiest to construct with the tools available to the "average" ham, but shows a lower efficiency than the other designs. Working with an 8-foot whip, typical of the stainless-steel whips sold for 11 or 10 Meter operation, a loading coil with an inductance of 1.1 uH to 350 uH would be needed for the 160 - 12 Meter bands, the lower the frequency, the larger the coil.

The radiation resistance of the 8-foot whip falls in a very low range, running from 0.08 ohms on the 160 Meter band to 16.1 ohms on the 12 Meter band as shown in the table below. If you have an ATU with a wide enough range, you COULD feed the whip directly with the ATU through a VERY short connection. At least one company (SGC) makes a mobile antenna system that does just this, mounting the ATU in a weatherproof box right at the antenna. It's kinda pricey though, running more than the price of some rigs. But, it CAN be done, 17 - 12 Meters for sure, and maybe even 20 Meters.

Here's the electrical length (in degrees) and the Radiation resistance

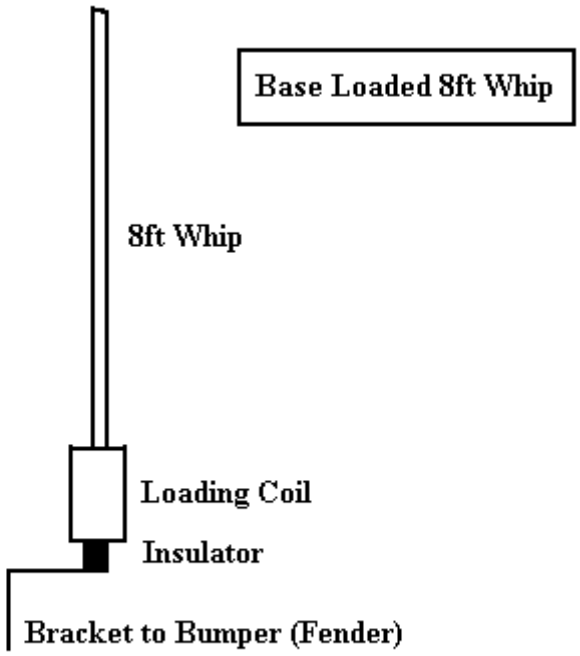
(Rr) for an 8-foot vertical, listed in tabular form:

F(Mhz)	L(degrees)	Rr
1.8	5.27	0.08
3.6	10.53	0.34
7.1	20.78	1.31
10.1	29.55	2.65
14.1	41.26	5.17
18.1	52.96	8.52
21.1	61.74	11.58
24.9	72.86	16.12
28.1	82.22	20.54

Now, the feedpoint impedance will NOT be the same as Rr. Ground losses, feedline losses and so on have to be factored in. The 10 Meter value is a good example for this point. An 8 foot whip, mounted to the average car/truck will show a feedpoint impedance of 30 - 45 ohms in the real world, and an acceptable SWR even without the use of an ATU. Mucho DX has been worked on the

10 Meter band with nothing more than this 8-foot whip, and before the advent of solid-state gear, the SWR was almost never considered. For that matter, my first HF mobile (a Heath HW-100) would handle a 3:1 load with the "stock" Pi-Net tuning. Tube rigs are/were very forgiving for loads.

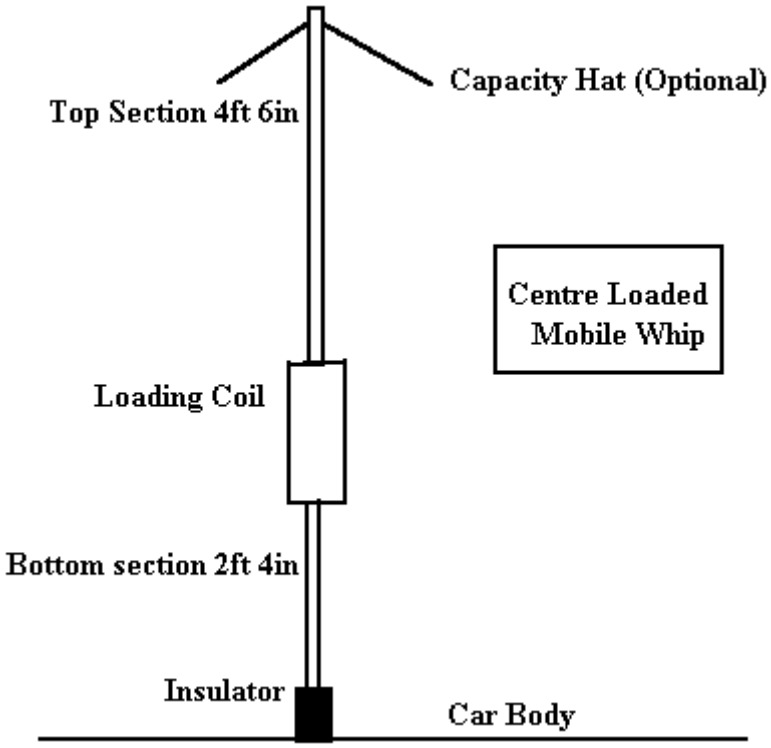
Here's a "sketch" of a Base-Loaded mobile antenna:



The base loading coil has to be mounted on a strong enough mount to take the normal flexing seen during mobile operation. Typically, the spring for the whip mount would be above the coil, allowing the whip to move without putting undue stress on the coil. Some commercial coils from the 50's had a bandswitch on coil allowing one to switch between the taps on the coil quickly.

Here's a "sketch" of a Center-Loaded mobile antenna:

(The "Bugcatcher is a Center-Loaded antenna)



Typically, the bottom section is made of a larger diameter rigid section of tubing EMT, also known as conduit, makes a rugged makes a rugged bottom section, and the heavy galvanizing not only protects it from the elements, but allows one to solder directly to it for an improved connection. The zinc in the galvanized coating is a moderately good conductor, having a conductivity of 26 - 32% IACS. Copper, for comparison, has a conductivity of 100% IACS. Only silver is better.

While pure aluminum has a conductivity of 61% IACS, the common alloys are in the 28 - 35% IACS conductivity range, so galvanized steel is very close to aluminum for RF purposes, and is much stronger (but also much heavier). For RF applications, only the zinc coating need be considered due to the skin effect.

NOTE: The "Hat" is a capacity hat, and is optional. It WILL greatly improve the performance on the 160 - 40 Meter bands as it reduces the size (and losses) of the loading coil.

If you look over on Frank, G3YCC's homepage, he has some compact Base-Loaded antennas shown for mobile or portable operation. Radio Shack has a 6-foot telescoping whip in the $4.00 price range, and it would lend itself to a portable base-loaded whip, or the top section of a Center-Loaded potable antenna. The metal in the whip is too thin & flimsy for mobile and/or fixed-station service. A portable dipole would be a possibility with two of these whips and a suitable set of loading coils. Ham Radio magazine had just such an antenna years ago, but I have long since lost (lent out?) the copy, and can't remember the author.

If you want to "Roll your own" Base- or Center-Loaded mobile antenna, here's a chart from the "Mobile Manual" and others for a starting point on your coil values. REMEMBER! Make the coil BIG, with FAT WIRE! Keep the losses down as much as possible! (I have added the 30, 17 and 12 Meter bands to the original list...)

BASE LOADING COILS
(For an 8-foot whip)

F(Mhz)	L(uH)	Z(ohms)*
1.8	345	23
3.6	86	16
7.1	21	15
10.1	10.5	13
14.1	5.0	12
18.1	3.0	14
21.1	1.3	16
24.9	0.9	20
28.1	None	36

*** Based on a coil Q of 300, ground losses of 10 ohms and coil resistances of 1 to 13 ohms. Your actual impedance will vary**

CENTER LOADING COILS
(4-foot top and 4-foot bottom sections)

F(Mhz)	L(uH)	Z(ohms)*
1.8	700	40
3.6	175	22
7.1	45	20
10.1	22	20
14.1	12	20
18.1	7.3	24
21.1	5.3	30
24.9	3.8	32
28.1	None	36

NOTE: If you use a capacity hat, the loading coil value will be reduced by as much as 15%. Use these as starting points. Make the coils larger than necessary and trim to resonance.

As you can see from the chart, the Center-Loaded whip will be easier to match, but the construction is not as easy to duplicate in the average "home-shop". There are a number of homebrew "Bugcatcher" designs out there, W6RCA's comes to mind right away. If you picked up one of these "High-Power" CB mobiles that go under the names "Stinger" or "Interceptor" at the truck stops, you would have all of the hardware you would need to build a hefty Center-Loaded antenna. They are sold in the $40 to $80 range though, not exactly cheap. Keep an eye out at yard sales and hamfests for good deals.