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FUSES

FUSE EQUIVALENTS

According to the owner's manual, and stamped on a slip of paper inside the fuse itself, the correct fuse rating for a Triumph TR6 is 35 amps. This means if a fuse blows, and I don't have a spare, I can just go to the local auto parts store and pick up a 35 amp fuse from the rack and pop it in the holder, right? WRONG! Never, ever, replace a Lucas 35 amp fuse with a 35-amp fuse of American origin.

Why not? Although there is really not that much difference between the structure of a Lucas and an American fuse, there is a big difference in the way they are rated. Every fuse has a time/current characteristic curve, depending on the type of fuse. Below a certain current, the typical fuse will last indefinitely without blowing. Above a little higher current, the fuse will blow in a few minutes. As the current increases, the time required before the fuse blows is decreased. Above a maximum current for a particular fuse, the time to blow is reduced to near instantaneous. There are other types of fuses, some (fast-blow) designed to blow very quickly if the current exceeds the rating by only a bit, and others (slow-blow) designed to blow over a longer time, even if the current is higher than rated. For an American fuse, a 20 amp fast blow will blow fairly quickly above 20 amps, while a 20 amp slow-blow will take a while at higher amps (not a great while - just long enough to ignore short current spikes). Normally, though, these other types of fuses are available only on special order from electronic supply houses, and not from the local auto parts store.

This gets us then to the rating of the Lucas fuses. According to the Haynes manual for the MGB, the 35 amp Lucas "...fuses are 17 amp current rated, 35 amp blow rated." What does that mean? Well, not being a fuse expert, and not having precise data, I'm going to have to take a guess, but I assume that over a long time period, current "around" 17 amps will blow the fuse, and 35 amps will blow it instantaneously. By comparison, a 35 amp American fuse will handle current very near 35 amps indefinitely. I don't know how much it would take to blow it instantly, but it would be a lot more than 35 amps, and certainly a lot more than the wiring in a Triumph is rated for.

PURPOSE OF FUSES

This would be a good place to explain the purpose of fuses in an automobile. There is a lot of misunderstanding about this. The purpose of fuses is to protect the WIRING, and ONLY to protect the wiring. A fuse is NOT meant to protect a radio, heater motor, lights, etc. It is not meant for that purpose because it can't perform that function. It is entirely possible for a radio, for example, to be damaged due to the heat of an internal short while it is pulling less current than the fuse rating, and even while pulling less current than it uses when played at high volume. A fuse can't protect a lamp, because the only way to get more current through a lamp is for it to have failed already. A fuse serves its purpose by offering itself up as a sacrifice when a short occurs to save the wire from burning. It is much better to replace a fuse than to replace burnt wiring, or, even worse, a burnt car! (As an interesting aside, the National Electric Code, which governs most electrical installations in this country, is published by the National Fire Protection Association, rather than by an electrical engineering organization as one might think).

DETERMINING FUSE RATINGS

Lacking a conversion table, how then should you determine the correct size American fuse to replace the original Lucas fuses? Ideally, fuses should be sized according to the current carrying capacity of the wires they are feeding, without regard for the size of the original Lucas fuse (and the wire, in turn, should be sized for the load it will carry). If the wire is rated for 30 amps, then it is safe to use a thirty-amp fuse as a MAXIMUM! A 15-amp fuse should be used for a wire that is rated at 15 amp. Of course, a wire that is rated at 15 amp will not burst into flames if 15.5 amps are ran through it. Running 30 amps through it, though, for a long period of time will probably heat it up enough to melt the insulation, and maybe even catch it on fire. For a very short period of time, you might even be able to shoot 50 or more amps through it without any problem, depending on how the wire is routed. If it is in open air in a cool atmosphere, it will handle it better than it would if it were in a wiring harness running close to the exhaust manifold. I can state from experience that a 16 gauge wire, rated at about 10 amps, will carry the total load of a TR6 (including headlights), without burning, if you route the wire through the cockpit, away from the engine. In an emergency once, I ran my car that way for about an hour. I held the wire in my hand just to monitor the temperature, and it got quite warm. In a wiring harness, it probably would have burned (the insulating effect of the other wires and the harness wrapping would have held the heat in).

Most wires in a Triumph, with the exception of the battery and main alternator cables, are rated at 8 amp continuous, with a few rated at 5.75, and a very few rated at 17.5. When you are choosing the fuse based on the wire size, you have to keep in mind that a 17.5 amp wire may feed into an 8-amp wire, which in turn may feed a 5.75 amp wire. The fuse should be sized for the 5.75 amp wire, and not the 17.5 amp. This means that the fuses in a TR6 (or any Triumph, for that matter) probably should be all sized at 6 amps or less, unless you have traced the wires and know for sure the sizes involved. If you do this, however, I doubt that you could use the car for blowing fuses. Fortunately, there is a lot of conservatism built into the wire ratings.

FUSE SIZE RECOMMENDATIONS

For practicality sake, I would size the fuses to be just over the maximum current draw for all loads fed by a given fuse. For a stock TR6, and typical for other Triumphs, this would be:

"RED" fuse - This fuse feeds red wires and supplies all the tail, parking, marker, and dash lights, and pulls less than 6 amps.

"PURPLE" fuse. - This fuse feeds purple wires and supplies the glove box lamp, courtesy lamps, trunk light, the horns, the hi-beam flasher, and the hazard flasher circuit. With the exception of the horns and the hi-beam flasher, the maximum expected load is less than 8 amps on this fuse. For a stock headlight, flashing the hi-beams pulls about 9 amps, and the horns draw around 5 amps. If you have high powered lights, the current will be more, but you probably should have them on a separate, un-fused, power source anyway, if they are very high powered (yes, I said "un-fused" - that is not a typo!), and they should be relay operated. It is very unlikely that you will have the hazard flasher going, the doors, trunk, and the glove box open while blowing the horn and flashing the lights. Even if you should do this and blow the fuse, the headlights, both hi and low beams, will still work, as they are fed from another circuit. The hi-beam flasher merely bypasses the headlight switch. None of the PURPLE loads are what might be considered mandatary loads anyway, so even this very unlikely scenario is not a problem.

"GREEN" fuse - This fuse feeds the green wires, supplying power to almost all of the loads that are switched on with the key, the most notable exception being the ignition circuit, which is fed directly from the ignition switch with no fuse. The load on this one is a little harder to determine, as you will seldom have all loads on at the same time, but the maximum load, with everything on, is less than 20 amps.

My recommendation? For a TR250/TR6, I recommend 10 amp for the RED fuse, 15 for the PURPLE, and 20 for the GREEN (all values are stated in American fuse ratings). I'm using a 15 amp for the GREEN circuit, and I've had no problems with it blowing. It should go without saying that you should always carry spares. To simplify spares, as the fuse box only has room for two, you can use a 15 amp fuse as a spare for both the RED circuit and the PURPLE circuit as well. See the tables below for clarification.

TABLE ONE

The following table lists EVERY electrical load in an early model TR6. It would be extremely rare for you to have ALL loads listed on at one time, so a fuse rated for the maximum current draw would not be needed. Loads for a TR250 or a later model TR6 would be similar, so the table will be usable for them as well. If you want the precise values for the other models, use the table below as a guide.

“RED" fuse:

Parking Lamps	2	X	5	watts	=	10	watts	=	0.8	amps
Marker Lamps	4	X	4	watts	=	10	watts	=	1.3	amps
License Plate Lamps	2	X	6	watts	=	12	watts	=	1.0	amps
Tail Lamps	2	X	5	watts	=	10	watts	=	0.8	amps
Instrument Lamps	8	X	2.2	watts	=	18	watts	=	1.5	amps
Total									5.4	amps

"GREEN" fuse.

WS Wipers	1	X	14	watts	=	14	watts	=	1.2	amps
WS Washer	1	X	7	watts	=	7	watts	=	0.6	amps
Brake Lights	2	X	21	watts	=	42	watts	=	3.5	amps
Back-up Lights	2	X	21	watts	=	42	watts	=	3.5	amps
Fuel Gauge	1	X	2.4	watts	=	2.4	watts	=	0.2	amps
Temperature Gauge	1	X	2.4	watts	=	2.4	watts	=	0.2	amps
Heater Fan	1	X	48	watts	=	48	watts	=	4.0	amps
Turn Signals	2	X	21	watts	=	42	watts	=	3.5	amps
Total									16.7amps	

"PURPLE" fuse:

Horns	2	X	30	watts	=	60	watts	=	5.0	amps
Hi-Beam Flasher	2	X	50	watts	=	100watts		=	8.3	amps
Hi-Beam Indicator	1	X	2.2	watts	=	2.2	watts	=	0.2	amps
Hazard Flasher	4	X	21	watts	=	84	watts	=	7.0	amps
Glove Box Lamp	1	X	2.2	watts	=	2.2	watts	=	0.2	amps
Trunk Lamp	1	X	3	watts	=	3	watts	=	0.3	amps
Key Lamp	1	X	2.2	watts	=	2.2	watts	=	0.2	amps
Courtesy Lamp	1	X	3	watts	=	3	watts	=	0.3	amps
Total									21.6amps	

TABLE TWO

The table below lists all of the loads that would normally be on at any one time during any normal driving condition. The back-up lights, for example, are never on while driving. These values indicate the absolute minimum fuse ratings required for each circuit. Other loads will have to be added to this to get the correct size fuse. For example, even though the back-up lights won't be used while driving, there will be times when you have to back up, and you don't want to have to turn off the heater to keep from blowing a fuse. Normally, there are no loads at all on the purple fuse, but if you are stuck alongside the road, the loads listed in the table would be the normal loads for this condition.

"RED" fuse

Parking Lamps	2	X	5 watts	=	10 watts	=	0.8	amps
Marker Lamps	4	X	4 watts	=	16 watts	=	1.3	amps
License Plate Lamps	2	X	6 watts	=	12 watts	=	1.0	amps
Tail Lamps	2	X	5 watts	=	10 watts	=	0.8	amps
Instrument Lamps	8	X	2.2 watts	=	18 watts	=	1.5	amps
Total							5.4	amps

"GREEN" fuse

WS Wipers	1	X	14 watts	=	14 watts	=	1.2	amps
Fuel Gauge	1	X	2.4 watts	=	2.4 watts	=	0.2	amps
Temperature Gauge	1	X	2.4 watts	=	2.4 watts	=	0.2	amps
Heater Fan	1	X	48 watts	=	48 watts	=	4.0	amps
Total							5.6	amps

"PURPLE" fuse

Hazard Flasher	4	X	21 watts	=	84 watts	=	7.0	amps
Glove Box Lamp	1	X	2.2 watts	=	2.2 watts	=	0.2	amps
Trunk Lamp	1	X	3 watts	=	3 watts	=	0.3	amps
Key Lamp	1	X	2.2 watts	=	2.2 watts	=	0.2	amps
Courtesy Lamp	1	X	3 watts	=	3 watts	=	0.3	amps
Total							8.0	amps

HEADLIGHTS AND FUSES

I said above that headlight circuits should not be fused. At first glance, that sounds like heresy, but there is a good reason for that. A fuse is an instantaneous, non-resettable device. A momentary short will blow a fuse, and once it is blown, that circuit is out of service until the fuse is replaced. Suppose you are driving along your favorite winding country road, on a moonless, cloudy night, in a very "spirited" manner. You hit a pothole, causing one of the leads to your headlights to bounce against the body of the car. If the wire is frayed, or the connectors are not firmly in place, a momentary short can occur, instantly blowing the fuse, leaving you without any lights at all. Navigating in the dark through a cornfield can be difficult at best; failing to see the large oak tree dead ahead at 55 mph can be fatal.

If you must have fuses in the headlight circuit, use four fuses, one each for the RH and LH low and high beams, and RELIGIOUSLY check your headlights to ensure they are working. Having redundant fuses won't do you any good if one of the bulbs is out. You could just switch beams in that case, but you may very well not have time to do it before you are in deep trouble.

A better option is to use fusible links. These have the property of taking time to blow, so that a momentary short will not do it. On the other hand, a sustained short will blow the link before any damage is done, protecting the wiring. A fusible link is nothing more than a very short (2 inches or so) piece of wire with a special insulation. The insulation is of a nature that it will burn without coming off of the wire, thus still providing short circuit protection after the link has "blown."

The wire size is selected to be 2 gauges (four numbers) smaller than the wire it is protecting, e.g., To protect a 12 gauge wire, use a 16 gauge fusible link. Because it is smaller, the wire in the fusible link will burn up before the main wire can be damaged.

Circuit breakers are another option, but less desirable in my opinion. Circuit breakers can withstand very brief overloads without tripping, but may trip if the shorted condition exists for a longer period of time. Under some conditions, a momentary short, such as described above, may last long enough to trip the breaker. If you are using the automatic reset type, the breaker will re-close and not trip again if the shorted condition is gone, but a lot of distance can be traveled during the tripped interval.

No matter what type of set-up you use, there can be conditions that will permanently disable your lights, and there is nothing you can do to prevent it, other than making sure your wiring is in tip-top condition. For example, a really deep pothole may jar a wire loose from the light switch. Whether you use fuses, breakers, fusible links, or straight wiring, if that happens, -- not a pretty sight!