Leitfaden fur Freunde des Gespannfahrens

Bundesvererband der Motorradfahrer e. V.

BVDM

USCA

Manual for Enthusiasts of Riding with a Sidecar

Federal Motorcycle Riders Association

Cover from 4th edition.

MANUAL FOR ENTHUSIASTS OF RIDING WITH A SIDECAR

2nd Expanded Edition

Federal Motorcycle Riders Association

In Conjunction With The

United Sidecar Association

Sidecars are fun and practical and convenient and efficient and fun. You really know that -- As a matter of fact; most motorcyclists share a deep down urge to one day get a sidecar.

Think about it, you could take everyone for a ride, be able to "ride down to the store" or take your "Sweetie for a ride".

Once you have a sidecar, a metamorphosis .. just like that. Everybody notices...and deep down...you know.

CONTRIBUTORS to the Original Edition

The USCA appreciates the financial support, donations, and assistance of the following associations, companies, and individuals who made this manual possible:

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The Sidecar Connection

Midwest Sidecar and Accessories

Introduction

This publication was prepared by the Federal Motorcycle Rider's Association (Bundesverband der Motorradfahrer e.V.) of West Germany as an instruction manual for their sidecar skill riding schools. While it was specifically written for a German audience, sidecaring is universal and their advice may be used by any sidecar enthusiast in any country.

The authors emphasize that while sidecars may be fitted to any modern motorcycle such an arrangement may be less than satisfactory unless steps are taken to fit or modify the motorcycle for sidecar usage. In fact, only a very few modern motorcycles are allowed to have sidecars fitted in West Germany because of their stringent regulations.

We are indeed grateful to the Harley-Davidson Motorcycle Company, and especially to Ron Plender, Manager of Customer Service, who made this English translation possible, to Jim Dodson, Publisher and Editor of Hack'd who reviewed the final English version, and to Dave Dobson for the artwork on the front cover.

We are also indebted to Mrs. Martha Barnes, without whose help in producing the several versions required, this manual would not have been possible.

The translators did a fabulous job. However, some terms common in the automotive industry are not familiar to the average motorcyclist. Thus a "single" motorcycle becomes a "solo" motorcycle; the "positive caster" becomes "trail"; the motorcycle "camber" becomes "leanout"; and the sidecar "negative caster" becomes the sidecar wheel "lead." Some terms have been left in metric units where not essential to the understanding of the text, others have been converted to U. S. terms.

While this publication compliments my own Sidecar Manual and my Sidecar Operator Manual, it also contains considerable sidecar model theory and a rigorous analysis of sidecar and motorcycle frame and chassis design. This should prove a boon to any enthusiast wishing to build his own rig.

As Horst Orlowski, Chairman of the BVDM, says, enjoy this manual and have fun on three wheels.

Hal Kendall, Executive Secretary

United Sidecar Association

Note:

This edition includes updates extracted from the later 4th edition, especially the enhanced photos.

Original Cover

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PREFACE

In the Fifties, motorcycles with sidecars were being used as a means of transport for the family, the baggage and even for tools. They were a common sight in traffic. In those years almost every cycle could be used with a sidecar and there were many manufacturers of sidecars who offered a wide range of models.

However, during the first years of the motorcycle boom the sidecar seemed to have been forgotten. Later, when the demand for cycles with sidecars rose steeply, the manufacturers of sidecars were able to expand their production to such an extent that it was possible to buy any type of sidecar desired. It also became apparent that the knowledge of motorcycles with sidecars was very sparse and not widespread. For this reason, Edmund Peikert and Friedhelm Feld, members of the Federal Motorcycle Riders Association in West Germany, held training sessions in riding a motorcycle with sidecar in Weiler in the Eifel since 1977.

The participants liked these courses. They wanted to take home in black on white what they had been taught, they also thought this was practical and besides, it looked so very simple since the text of the lessons was already available.

Unfortunately, it did not turn out that easy. Further time-consuming preparations and testing were necessary to prepare a manual. For reasons of cost they had to be done with our own funds. However, the quality of the lessons did not suffer because of this. Only by mobilizing every reserve was it possible in the end to keep the planned publicaton date, the opening of the IFMA in 1980. My thanks to all those involved, and especially to Mr. Edmund Peikert, for making this possible.

Horst Orlowski, Chairman of the Federal Motorcycle Riders Association

PREFACE TO THE (GERMAN VERSION) SECOND EDITION

Exactly two years have gone by since the introduction of our manual. Two years, during which the motorcycle manufacturers have rained on us a multitude of technical refinements. The endless number of models offered belong to a large extent to the many and differring fashion trends, such as Enduro or semi-chopper.

Even though the interest in motorcycles with sidecars has grown at a steady rate and will continue to do so, it has not become the fashion and a motorcycle with sidecar has never been offered in large production numbers. Enthusiasts of riding with a sidecar still have to acquire a large amount of knowledge about this vehicle and how to ride it. For this reason we have prepared this new edition of the manual, expanding it considerably.

Have fun reading it and doing your riding on three wheels!

Horst Orlowski, Chairman of the Federal Motorcycle Riders Association

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FEDERAL MOTORCYCLE RIDERS ASSOCIATION

This book represents only a small part of our work.

WE represent the interests of motorcycle riders.

WE COMBINE many associations, interest groups, and individual members in an umbrella organization.

WE ARRANGE the exchange of experiences, good times, and fellowship in the local clubs and during meets.

WE ARE THE ORGANIZERS of large motorcycle meets, for instance jumbo meets and track meets, as well as of one day events for the motorcycle rider, and smaller meets in the local clubs and, as a winter program, technical seminars and lectures.

WE WORK FOR interested motorcyclists of both sexes who do not think that [IMHO) for joining and monthly dues of DM 3 are too much for becoming a member.

WE NEED YOU as a member so that we can serve the interests of motorcyclists even better.

WE PUBLISH general information, entertainment, and the current calendar of events in our magazine "BALLHUPE.".

WE ORGANIZE regional and inter-regional competitions, sport and touring competitions, and rallyes.

WE ARE a member of the German Traffic Safety Council.

WE OFFER hospitalization and accident insurance abroad, a special insurance for motorcycles, liability insurance for organizers of meetings and for associations and, aid in setting up clubs.

IF YOU would like to know more about us, please write to:

Bundesverband der Motorradfahrer e.V.

Augustenstr. 2

5630 Remscheid ii

ALL ABOUT THE USCA

The United Sidecar Association, Inc., is an independent organization of enthusiasts who own motorcycles with sidecars attached, ranging from the luxurious Harley-Davidson to the classic Steib, from contemporary Watsonians to futuristic Side Riders, and from racing kneelers to homemade hacks. They are attached to all machines, from the magnificent Harley-Davidson to the humble scooter. The members are as varied as their machines, from the youngest in their late teens to our senior enthusiasts in their eighties.

The club, known as the USCA, started in Chicago and spread rapidly throughout the United States (and abroad) as sidecarists learned of our organization, our expertise, and our ability to speak up for sidecarists on political issues. Our successes include rolling back turnpike toll charges on all turnpikes in the United States for motorcycle-sidecar outfits.

The Sidecarist, the world's most knowledgeable monthly sidecar publication, is written by and for sidecar enthusiasts, and is part of your membership. You will find great variety in the Sidecarist , including articles on driving, alignment, and mounting. There are letters from members, construction featues, technical articles, and news of and about members and events. There are regular sections from local chapters prepared by area coordinators and we communicate and work with other sidecar clubs throughout the world.

We provide an extensive classified section to members where they can make known what they wish to buy, sell, or exchange.

You will also share in sidecar rallies. In short, the Sidecarist keeps you in touch with thousands of sidecar owners.

Everything we do is meant to appeal to sidecar owners, drivers, and passengers, as well as sidecar mechanics and engineers. While exchange of technical data is always important in discussions about sidecars, the Association's activities encompass many interests. Events include, to name a few, an associaton rally, area mini-rallies, local meets, just plain kicking tires, museum tours, and picnics. There is always something happending in the USCA and membership is as enjoyable as driving an outfit.

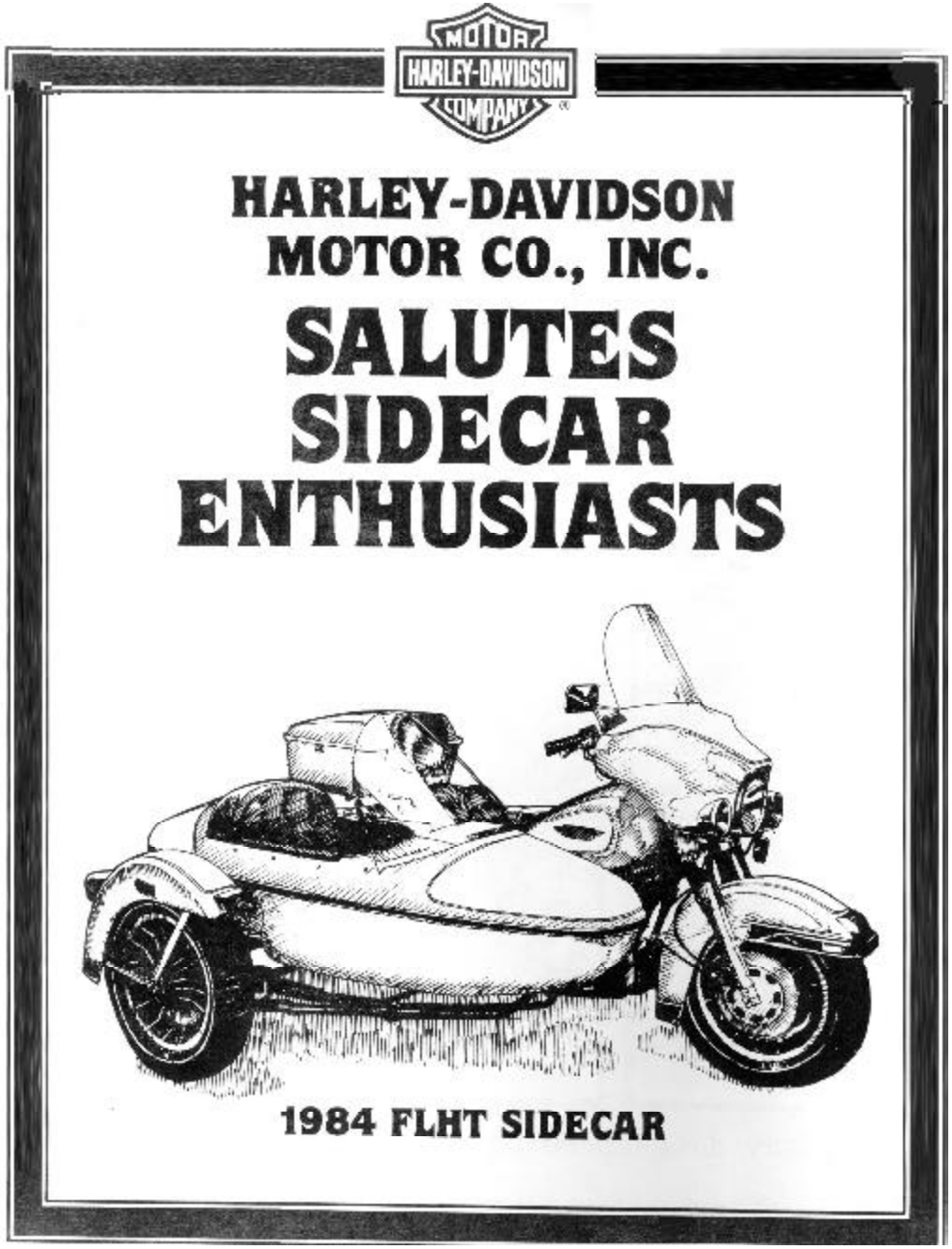
Not only does the USCA keep you informed, it provides you with another view point about sidecaring by virture of its position as the largest independent sidecar group in America. This allows the USCA to be an informed club. The members prefer to be without the usual trimmings found in other motorcycle organizations.

You will find it refreshing to belong to a group where your ideas are welcome and where there is no pressure to be active, but where your participation and help is always appreciated. This informal atmosphere has made the USCA the largest sidecar club and has generated much enthusi-

asm and interest from the rest of the sidecar world.

Membership in the USCA is extended to all sidecar owners, dealers, manufacturers, and enthusiasts. The membership dues are only $22.00 per year beginning the month you join with a $2.00 registration fee.

If you wish to become part of this fast growing, aggressive association, please fill in the application form in the center of this manual.



FOREWORD

Dear Sidecar Enthusiast:

Before you can ride your own motorcycle with sidecar, you will have to overcome some difficulties:

1. You may not be able to buy the motorcycle with sidecar you really want, even for a large sum of money. You will have to compromise between what you would really like to have and what is available for sale or can be manufactured.

2. A motorcycle with sidecar rides entirely differently from a solo motorcycle. You will have to relearn!

During our training sessions we discuss all the questions about a sidecar over the course of a day and a half. However, there is so much to be learned that it appears practicable to look up the most important things in a written manual. We have therefore tried to put this knowledge into writing. In the course of this, we found out that we had not even recognized many problems.

We say above - Before you can ride your own motorcycle with sidecar...

This is already no longer true in its entirety! It became necessary, during the 1978 motorcycle with sidecar training session, to introduce a new term to differentiate between a "motorcycle with sidecar" and a "supercombo":

1: Forward

I. The "motorcycle with sidecar". As was customary, any old sidecar is attached to any old motorcycle. As long as the motorcycle had less than 40 hp and had a short spring deflection this outfit was quite acceptable. Motorcycles in this class have, as a rule, trail values which permit the use of a sidecar. Regular motorcycle tires are sufficient. The vehicles are slow enough so that aerodynamic complications do not occur. A sufficient number of sidecars are available; however, the number of motorcycles suitable for use with a sidecar is limited: Guzzi, Dnyepr, Sanglas and Hercules W 2000. (Applicable to Germany only).

2. The "Superclass". This is built as a unit. The chassis of cycle and sidecar are matched to each other. Nothing else will do for high performance and long spring deflection. If you think this could be done in a simpler way, then consider the amount of development work a car company expends for a new model.

For a motorcycle with sidecar which is traveling at, let's say, more than 75 mph, no less of an effort will be needed. These cars have wider tires (mostly belted tires) and a trail of about 2 inches. No longer is it possible to ride the motorcycle alone, without the sidecar. These combos are those built by EML, Hegi and - even if you do not, at first, believe so - the old fully sprung ones made by MZ. The builders of these combos have taken some pains, which are, of course, reflected in the prices.

If you attach a sidecar with a spring deflection of 3.1 inches to a motorcycle with spring deflections of no more than 0.8 inches, the result will be unsatisfactory riding characteristics. It is no better the other way around, for instance an MZ sidecar on an NSU-Max. This has been recognized by some sections of the Technical Inspection Service. The Technical Inspection Service of West Germany is the equivalent of the National Highway Traffic Safety Administration of the USA.

What do you expect from a motorcycle with sidecar? Of course, you would like to have as large a unit as possible so that you can travel swiftly, but speed is relative. If you base it on a solo motorcycle, you will lose about 25% in top end speed, using the same H.P. output as a solo and even changing the rear end gearing ratio. You will lose at most 15% of cruising speed, especially over long distances. In bad weather the motorcycle with sidecar is faster than a motorcycle without. Something not known for very long: A good chassis will make up somewhat of the loss in vehicle performance.

How much performance is required? If you are doing much of your riding alone on the road, you can be fast with an MZ motorcycle. If you want to travel on the superhighway at more than 90 mph, you would be better off in a car. Why? You would need a motorcycle with sidecar costing more than DM 15,000 (aprx. $6,000). Prices are for 1978.

(A similar unit in America would cost $9,000 to $12,000.) Because such units are made in small numbers, a motorcycle with sidecar simply cannot be as well developed as a car. Despite the large cost you will have to expect some dissatisfaction. In addition, a motorcycle with sidecar needs a lot of fuel at high speeds because of the poor aerodynamic design. Even in the nicest motorcycle with sidecar you will probably find things you do not like and which you would like to change. Once you have reached the point where you can no longer improve your motorcycle with sidecar, you will keep it for a long time because you have invested so much time, money and your own labor.

Should you start with a new motorcycle with sidecar, please keep in mind that the wear of all its parts is considerably greater in a motorcycle with sidecar than in a solo motorcycle. Only buy a motorcycle with no more "extras" than can be repaired without too much outlay. If spare parts are only available after weeks of waiting and at inflated prices, it is not suitable for use with a sidecar.

Motorcycles with sidecars are used a great deal during Winter; do not let yourself be swayed by the designers who have prettied up the motorcycle. The production people have made sure that the glitter does not last too long.

HOW FAST CAN YOU GO WITH A MOTORCYCLE WITH SIDECAR?

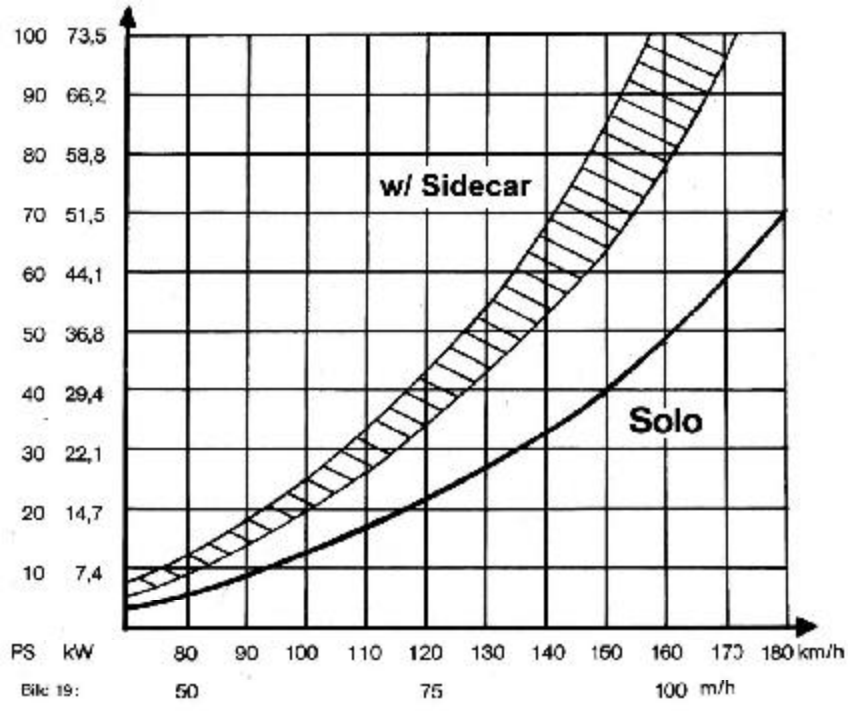


Diagram of power vs speed

The diagram was drawn from observations of motorcycles with sidecars of 15 to 60 hp. Even had they been actual measurements, they would not have been necessarily compatible - they cover a period of over twenty years. Do not get excited over the difference of a couple of miles per hour; to get precise measurements would cost as much as a full research effort by a federal or government agency. The cross-hatched area is the result of motorcycles with sidecars having different road resistance. The vehicles with a wide wheel track and of non-streamlined construction show up on the left edge of the hatched area. Motorcycles with MZ and Koepsel sidecars are at the right edge, sometimes "to the right of the right edge". These observations agree largely with tests conducted by H. Hutten in the Fifties.

I have shown the spread to 10 hp, because in December of 1979 someone asked me if it was correct that their Triumph motorcycle with sidecar and a new engine of 10.5 hp did only 50 mph. Above 40 hp, modern motorcycles with sidecars are shown, without exception, having a wheel track under 46 inches such as sidecars made by Koepsel or Clipper. The aerodynamically advantageous shape of the latter is the reason for the narrower spread. My experience does not extend beyond 60 hp; the line has been drawn based on "reliable assurances". Riders of EML outfits may be able to provide this information.

The "solo" line is based on a person of a height of 6' 8", wearing a Barbour riding suit. The difference in the highest possible speed is clearly shown. If your motorcycle with sidecar does not fit the diagram regardless of any possible adjustments, there are several other possibilities. Measuring the top speed is not very easy, the wind conditions change very rapidly and the drag and

rolling resistance of your motorcycle and sidecar are unknown to you. Unfortunately you also do not know the power output at the rear wheel. A modern chain drive motorcycle without a fairing can have an efficiency of 0.8 from engine to wheel power output.

Why does the top speed decrease by 20 to 25% while the fuel consumption increases? The road resistance increases. It is comprised of rolling resistance, drag, and resistance due to gradient.

The rolling resistance is not only increased by the third wheel but also by the increased weight. The constant friction of all three wheels increases the rolling resistance considerably. Pulling a 715 lb motorcycle with a rope attached to a spring-type scale, a pull of 8.8 lbs. is required at walking speed over a level road. For a motorcycle with sidecar of 715 lbs and under the same conditions a force of 13.2 ibs is required. Even when considering my measuring to have been done by a "seat of the pants" method, the difference is 50%.

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Conversion Factors

g/kWh = grams of fuel per kilowatt-hour;
1 g/kWh = 0.001644 lb/hp-h
kg/l = kilograms per liter or specific gravity
l/kWh = liter of fuel per kilowatt-hour
l/h = liters per hour = 0.26 US gal
kW = kilowatt; 1 kW = 1.34 horsepower
km = kilometer; Ikm = 0.6214 miles

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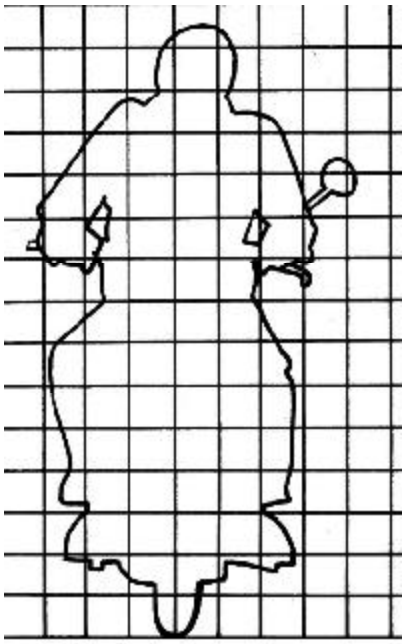
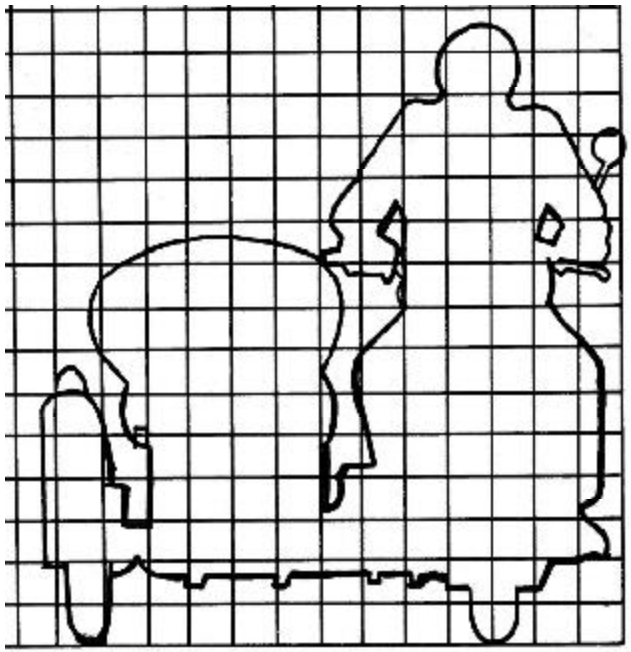
Frontal area of a solo motorcycle - 6.46 sq ft



Frontal Area of a Motorcycle with sidecar - 11.84 sq ft By contrast, an Audi 60 has 14 sq ft of frontal area



Drag

Drag is determined according to the formula:

$W = 0.0048 \times cw \times A \times V^2$.

where: 0.0048 = a functlon of air density

cw = drag coeffiecient

A = frontal area of the vehicle

V = velocity

NOTE: A different value than 0.0048 is used for United States units.

This formula is contained in every book of mechanics; it can be used for calculations. However, in a motorcycle with sidecar the values for cw and A are somewhat different than you would assume.

cw or the drag coefficient shows how well the air flows around the vehicle. This can only be accurately determined in a wind tunnel. A value based on experience for solo motorcycles is 0.7. Mercedes claims 0.36 for its latest models in its advertising. The 0.7 value can only be achieved in the most favorable cases for a motorcycle with sidecar. If one includes a steeply inclined windshield or an exposed square fender then pretty soon a factor of 0.9 appears to be more realistic. These are contributing reasons for the higher fuel consumption and lower top speed with a sidecar outfit.

2. How Fast Can You Go

Considering today's gas prices, the following calculation should be made so as to avoid unpleasant surprises:

The fuel consumption of an engine is measured in g/kWh. For instance, MZ lists a consumption of 490 g/kWh for the old fully sprung model ES 250 at full load.

Given a density of 0.75 kg/l for gas, this results in 0.65 l/kWh. Newer models might do a little better. The two-cycle engine is especially disadvantageous when considering fuel consumption at full load. A motorcycle with sidecar with a maximum output of 14 kW is almost constantly running at full throttle. Under these circumstances the vehicle reaches a top speed of 95 km/h (aprx. 63 mph) and uses 14 x 0.65 l/h = 9.1 l/h. 95 km have been traveled. Converting this to 100 km, a consumption of 9.6 l per 100 km results (or 26 nkDg).

If a four-cycle engine of large capacity is used under partial load, a consumption of 325 g/kWh can be expected. That results in 0.43 l/kWh, which is about a third less.

A, the frontal area of the vehicle in square meters, can be measured, however, the results are astonishing.

Because of the higher road resistance the obvious solution is: different gearing is required, gearing for a motorcycle and sidecar.

Unfortunately, this is still disputed by some sellers of motorcyles capable of using sidecars. But it really is the simplest type of problem in a motorcycle with sidecar. The engines of motorcycles reach their horsepower capacity only at high rpm. If the highest rpm cannot be achieved in the highest gear because of the greater road resistance, the motor cannot put out its top performance.

Highest speed then is reached at a value much lower than the value which could be achieved if the correct gearing were used. The basic rule is: Even with a sidecar, the motor has to reach its highest allowable engine speed! Then, if a friendly designer has determined the correct gearing, it will be possible to start on a gravel road with a fully loaded sidecar without torturing the clutch.

Determination of the gearing for a motorcycle with sidecar for the MZ TS-1:

It has 13 kW and, based on the power vs speed curve (p 12) diagram, a top speed of 95 km/h (aprx. 63 mph) can be expected under favorable conditions. Overall gearing therefore has to allow 95 km/h to be achieved at a top rpm value of 5,500 rpm.

The tire has a rolling circumference of 1.8 m (68.7 in). The rear wheel has to make 880 revolutions per minute at 95 km/h.

$$\frac{95{,}000 \text{ m/h}}{1.8 \text{ m} \times 60 \text{ min}} = 880 \text{ rpm}$$

2. How Fast Can You Go

A total gearing in fifth gear of 6.25 is needed for 5,500 rpm at the crankshaft and 880 rpm at the rear wheel.

$$\frac{5{,}500 \text{ rpm at the crankshaft}}{880 \text{ rpm at the rear wheel}} = 6.2i$$

The transmission has a gearing of i = 2.11 between crankshaft and gear-box countershaft.

In order to achieve a total gearing of 6.25, it is necessary to divide it by the transmission gearing of 2. 11.

$$6.25/2.11 = 2.96$$

This value of 2.96 is the desired secondary gearing. MZ uses a countershaft sprocket of 16 teeth and a rear wheel sprocket of 47 teeth for its sidecar models. The result is 2.94.

It's that simple: theory and practice agree! If the Sanglas motorcycle is calculated in this way, a secondary gearing of 3.35 is the result. The secondary gearing of the solo motorcycle has chain sprockets with 15:44 teeth.

Required calculations are:

$$\frac{5{,}500 \text{ rpm at the shaft}}{958 \text{ rpm at the rear wheel}} = \text{total gearing of } 5.7$$

$$\frac{\text{Total Gearing}}{\text{Primary}} = 5.7/1.7 = 3.35, \text{ secondary}$$

The 15 tooth gearbox sprocket is already too small for an acceptable chain life, it cannot be smaller! Therefore the rear sprocket has to be increased to 15 teeth x 3.35 or 50 teeth or 14% more teeth.

It should be possible to ride the motorcycle with sidecar pretty well. Depending on the prevaling conditions of use, such as total weight, wind-shield or not, use in mountains or on the super-highway, it might be useful to use a rear sprocket two teeth smaller or two teeth larger than opti-mum. The performance characteristics of the motor become obvious here.

Note: An overall increase of at least 10 percent for larger engines to 15 percent or more for smaller engines provides reasonable performance - HAK

THEORY OF RIDING W/A SIDECAR.

Why does a motorcycle with a sidecar behave differently from a solo? It is a dual-track vehicle, but it cannot be compared with other dual-track vehicles such as a car. The direct steering of the motorcycle and the offset third wheel are obvious. However, the most important factor is that the center of gravity is not in the center of the vehicle but is offset and located very high. It can only be determined by calculation. It is this location of the center of gravity in conjunction with the narrow track and the short wheel base which is responsible for the strange riding qualities of the motorcycle with sidecar.

The center of gravity is the point at which the total weight of the vehicle is considered to act.

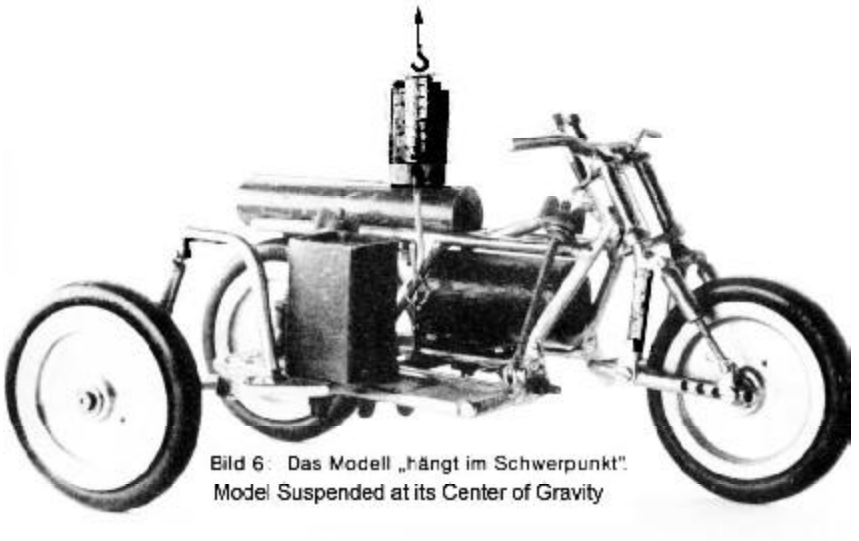
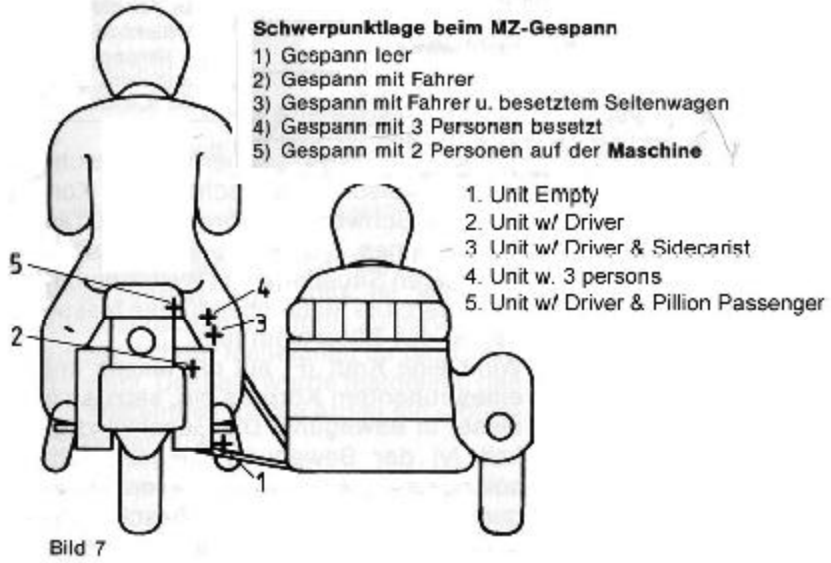


Bild 6 Das Modell „hängt im Schwerpunkt".
Model Suspended at its Center of Gravity



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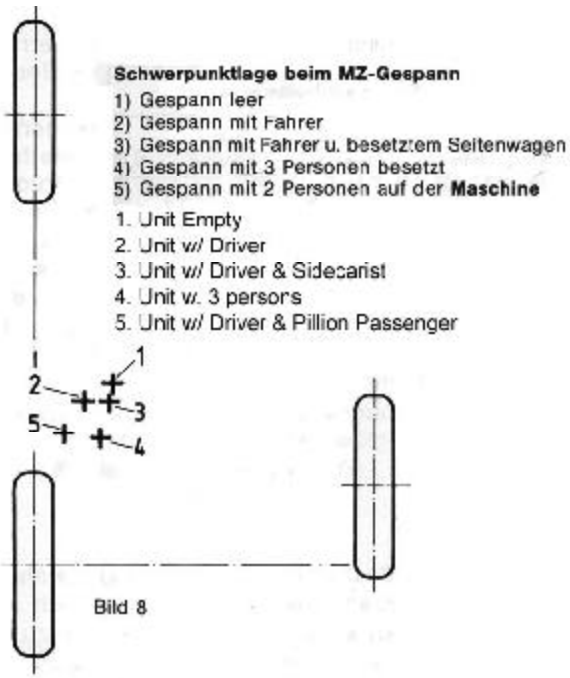

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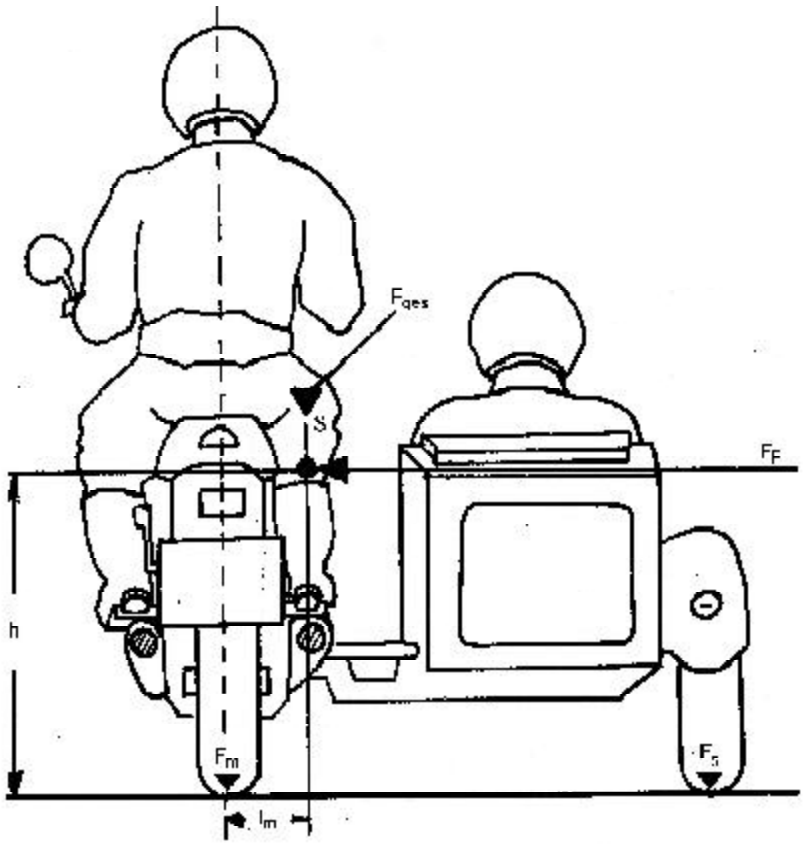

Depending on the load, the center of gravity moves sideways by about six inches and also in the direction of travel. It can also move by about 10 inches vertically.

Why is the position of the center of gravity so important?

The centrifugal force acts thru the center of gravity to try and upset the motorcycle and sidecar! The following can be deduced from this:

Action of centrifugal force in a right turn

FF = Centrifugal force (right turn)

S = Center of gravity

h = Height of the center of gravity

l = Distance of the center of gravity from the vertical axis of the vehicle

ls = Distance of the center of gravity from the wheel of the sidecar

Fges = Total weight

Fm = Weight on the cycle wheels

Fs = Weight on the sidecar wheel

X-X = Verticle axis of the vehicle

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If the position of the center of gravity is changed, the riding characteristics are changed as well as the possible turning speeds. Since road conditions also affect the riding characteristics, it is impossible to predict riding attitude and turning speed.

A rider therefore requires a lot of experience before he can take full advantage of the riding possibilities of a motorcycle with sidecar! In order to learn what occurs when riding, why motorcycles with sidecars work or why they sometimes turn over, it is necessary to absorb some theory.

The center of gravity is located to the right of the rider. The weight on several wheels add up to the total weight.

Centrifugal force acts outwardly from the center of the curve; it acts thru the center of gravity and tries to upset the motorcycle and sidecar. It is measured in kilograms or pounds (force). It increases with the square of the speed and proportionally with the reduction of the radius of the curve. Centrifugal force, measured in kilograms or pounds, the height above the road surface to the center of gravity, measured in meters or feet, together form an angular momentum (torque). If the centrifugal force in kg is multiplied with the height in m, the resulting product will be mkg, the measurement of torque (I mkg = INm); or an equivalent value in ft-lbs in the U.S. system.

If the following measurements are inserted into the illustration "Effect of Centrifugal Froce in a Right Turn":

Gges = 400 kg

h = 0.6 m

l = 0.25 m

ls = 0.85 m

then the total weight results in a right torque of
400 kg x 0.25 m = 100 m-kg.

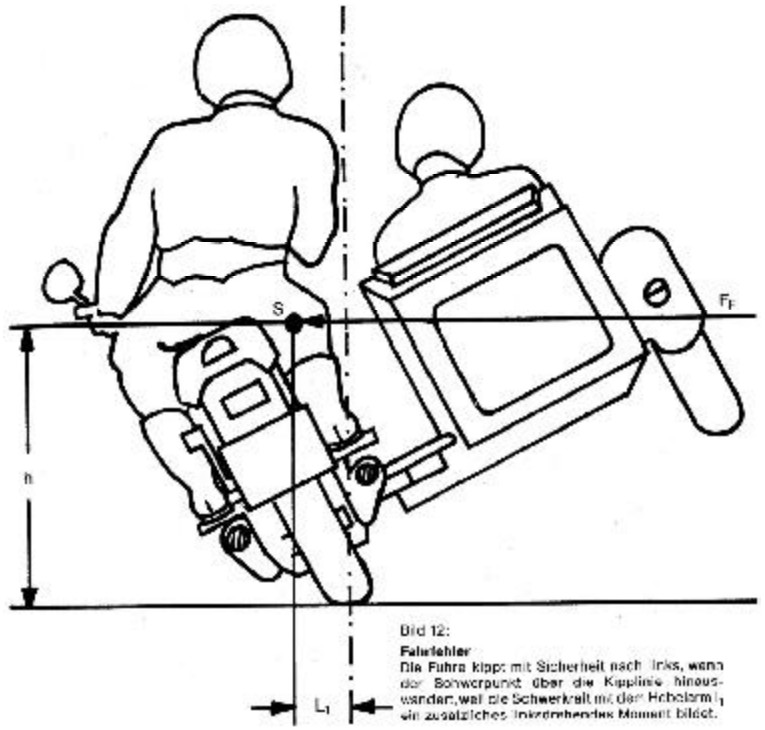
If the sidecar is to be raised, a left torque of 100 m-kg is required. The height h, the arm of the lever of the centrifugal force, is 0.6m; this results in a centrifugal force of (100 m-kg)/(0.6m) = 167 kg.

3. Theory Of Riding w/ Sidecar

Then, if in this case the centrifugal force exceeds 167 kg, the sidecar will lift. As long as the center of gravity remains to the right of the point where

the tires meet the surface, this is not dangerous. As soon as it moves to the left, as in the illustration of the right turn, the total weight, multiplied by the distance 1_l, results in an additional angular momentum and the vehicle is upset.

Note - This presupposed that both the entering speed and the curve radius remain constant, that no unusual body english is used, and that power sliding is not attempted - JD.



Right Turn - Centrifugal Force Wins Out

Right turn: Centrifugal force v

Left Turns

Basically the same occurs here as in the right turn. Only the lever action of the total weight is greater. In this case it amounts to 0.85 m and results in a left torque of 400 kg x 0.85 m = 340 mkg. This results in a centrifugal force of:

(340 m-kg)/(0.6m) = = 567 kg.

which would lift the rear wheel from the ground.

The motorcycle with sidecar could make the left turn at considerably greater speed than the right turn - but, alas, only if it had 4 wheels. Why? We'll cover that later. In reality the following occurs:

The springs of the sidecar are compressed, the center of gravity moves to the right which takes some load off the rear wheel. The unit assumes a more oblique position and the center of gravity moves up. This results in the centrifugal force having an easier job of it. The angular momentum is increased, the rear wheel spring is fully extended, and the wheel rises from the surface. And a roll-over can occur with lightning speed.

The calculation for the left turn example:

6.5 kg x 14.8 cm / 9 cm = 10.7 kg which would have to be in the balance.

Depending on the lead of the sidecar wheel the rear wheel may lift at 5 to 8 kg.

This is the result of the missing fourth wheel.

Note: Experienced sidecarists can execute a three wheel drift, wherein the outfit maintains its forward momentum while the radius of the curve is increased by the tires sliding outwards thru centrifigal force. This feat is most noticeable when turning away from the sidecar but can be employed in either direction as long as the outfit is in a controlled drift situation. Not a technique for the inexperienced. An outrigger canoe is never turned hard into the outrigger. (JD)

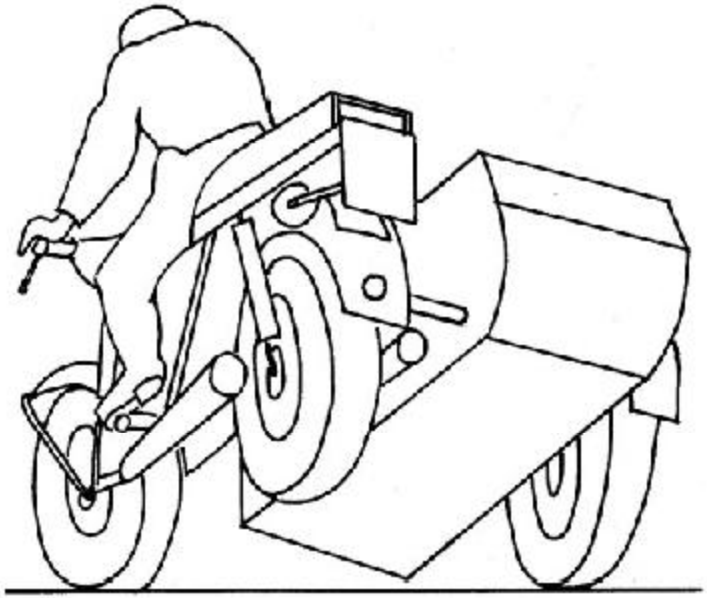


Bild 15: **Linkskurve, zu schnell gefahren**
Das Hinterrad hebt ab. Der Überschlag ist unvermeidlich, weil er blitzschnell erfolgt.

Left Turn: A Rollover can be Unavoidable

Bild 88: Das Abbremsen eines Gespanns hat seine Tücken.

Bild 11: Auch Polizisten lernen Gespannfahren. Nach einer schnellen Linkskurve, die Seitenwagenfederung ist noch eingedrückt, steht der SW-Reifen noch neben der Felge.

A 3-Wheel Drift

Bild 45: Die Seitenwagennase schleift schon auf der Erde. Meistens überschlägt sich das Gespann in einer solchen Situation.

Sharp Left Hander

Bild 9: Sie beherrschen das Spiel der Kräfte. Ein „linksdrehendes Moment" hebt den weißen Seitenwagen hoch.

Sharp Right Handers

ACTUAL RIDING

How to Ride a Motorcylce with Sidecar

Surely you have admired the riders of motorcycles with sidecars during meets as they took the turns at high speed. Perhaps you think you could do as well. We want to warn you against this dangerous misconception. A skilled rider of a solo motorcycle, especially, has to re-learn the riding of a motorcycle with sidecar. This is because of the basically different riding attitude of a motorcycle with sidecar and the different reactions in right and left turns.

Even though the German Class 1 drivers license, for motorcycles with engines of any displacement, permits riding a motorcycle with sidecar, it is the person who has been riding a solo motorcycle for many years who turns into a beginner again.

If the rider of a solo motorcycle is offered a motorcycle with sidecar for a test ride, he should refuse, unless he has the chance to test it in a place with plenty of room without traffic or other obstacles. The muscular reactions of a rider of a solo motorcycle cannot help but act according to the experience of solo riding. The longer a person has been riding solo, the longer he will need to replace the solo riding reflexes, long stored in the brain, with new reflexes for riding a motorcycle with a sidecar. There is no predicting when this process will be completed and when the muscles will react correctly on their own. Most likely intelligence plays a very small part in this.

What, basically, can we. say about riding with a sidecar?

At every track meet you can observe the rope trick. A cord is tied to the end of the right handlebar of the solo motorcycle, the rider rides with hands off and holds only the cord in his hand. As soon as he pulls it to the left, the motorcycle moves to the right. This reaction has become so basic with solo riders that they are no longer aware of it. The pull to the left tilts or leans the machine to the right. The machine turns to the right because it now leans to the right. This is known as countersteering of a single track vehicle. The opposite is true for a motorcycle and sidecar.

A sidecar outfit is a two-track machine. It behaves the same as any car or truck. If you pull to the right, the machine moves to the right. Or, to make it crystal clear: If you want to go to the right, you have to heave mightily to the right. Countersteering or leaning have no effect on turning a sidecar outfit.

Our advice, in order to save you the beginner's dues or the caved-in nose of the sidecar: To simulate the correct weight proportions, you should ride your three-wheeler without a passenger in the sidecar at first; instead, put ballast in the sidecar. Even better is a fully loaded trunk. Even more reckless than to ride with an empty sidecar is to take along a rider on the motorcycle. This is

the easiest way for centrifugal force to overturn the motorcycle and sidecar at the merest pull on the handlebar to the right. This is true for all motorcycles with sidecars on the right.

It is no longer possible to find one answer for all motorcycles with sidecars in respect to starting and even less so for turning. Why? Motorcycles with sidecars run from 17 to 100 hp and have totally different chassis and tires.

With 17 hp it is hardly possible to assist steering with the engine, but this technique is very effective with 100 hp at your disposal. Therefore, let someone who can do so move your new motorcycle with sidecar to a large empty lot where you can try it out.

Starting and Braking.

When starting you will notice that the sidecar, because of inertia, hangs back and the unit turns to the right. You can compensate by steering to the left.

For this reason no jack rabbit starts at first. You first need the feel for the adhesion of the front tire and you should not overrate it.

If you have a sidecar without brakes, you will note the opposite effect when braking. The sidecar pushes the unit to the left. You will have to compensate by steering to the right.

Note: The effect of the "pushing" inertia while braking can be controlled or overcome by braking the sidecar wheel. An independent sidecar wheel brake can also assist turns into the sidecar if applied just prior to the turn and as long as that wheel is in contact with the ground. (JD)

Turns.

As we said in the beginning, the unsymmetricai vehicle in which only the rear wheel is driven and the sidecar only runs along, needs its own specialized techniques for turning.

Making right turns, a novice usually is cautious enough and rides comparatively slowly. The cycle has to “turn around the sidecar". This works very nicely and enenly if the turn is approached with only just enough speed so that you can accelerate out of the turn,. The acceleration of the motorcycle and the inertia of the sidecar assist in the turning of the handlebars. As we said before, it is especially easy for centrifugal force in a right turn to overturn a motorcycle with sidecar.

Practice right turns in the large empty parking lot, and use an ever tighter or an ever increasingly faster turns as you gain practice.

Eventually, and sooner or later, what will happen is that which the novice fears: the sidecar will rise. You panic and do not hold the handlebars tightly enough. The vehicle pulls to the right, the

sidecar settles, and the motorcycle and sidecar make a jig. This is basically no big deal in an empty parking lot, but in traffic you have no room on your]eft. This will have to be approached differently. The sidecar rises because centrifugal force is trying to overturn the motorcycle and sidecar. Therefore, centrifugal force has to be reduced. This is done by either increasing the radius of the turn, and/or by braking.

There is usually no room to increase the radius of the turn in traffic. Since the centrifugal force increases with the square of the speed, this force also decreases with the square of the speed when decelerating. If it is early enough for braking the sidecar will settle. If not, then things can become critical.

There are no generally applicable rules for this condition; different actions have to be taken with every motorcycle with sidecar and with every road condition.

The only helpful advice we can give you in this respect is:

Practice the "lifting of the sidecar" until you have a feel for it. Then it is "up" then sometimes brake softly, sometimes hard- and if you dare, accelerate. How your motorcycle with sidecar will react on the road in each case cannnot be predicted. If you have a sidecar with brakes and you are still braking when the sidecar settles, the unit will make a jig; therefore let go of the brake beforehand.

4. Actual Riding

When doing left turns, a novice will dare to use higher speeds because he has the feeling that nothing much is likely to happen. To what extent that is correct depends on the lead of the sidecar wheel. You will have to experiment how effective it is in your particular motorcycle and sidecar. If you go beyond the limits, everything will happen and with lightning speed; you cannot prevent it.

Practice: make the same left turn with increasing speed. The effects of the tires and of the center of gravity are very important; it can happen that the motorcycle with sidecar does not "go off", but that the rear wheel rises immediately; with bald tires and on wet, slick roads it is easier to feel your way slowly to the limits.

If your "seat of the pants" feeling is well developed you will notice how the motorcycle with sidecar rises from the rear struts as the speed increases. If you cannot trust your feeling, mark the struts and have an observer watch.

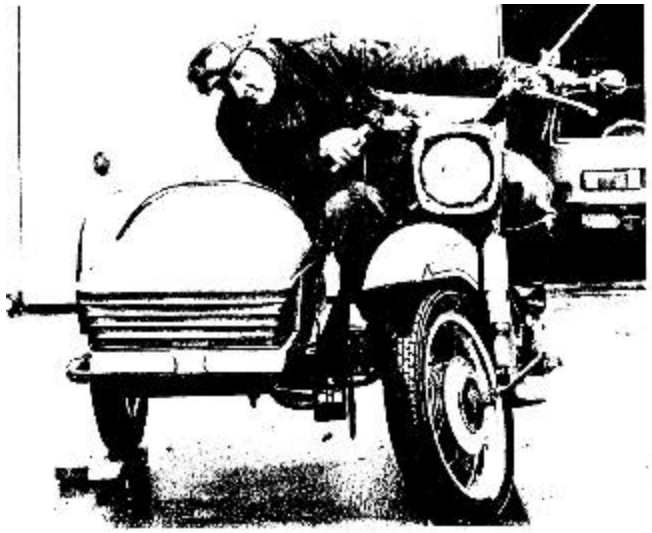
If you have an engine which brakes well when letting off on the gas, you make the hard pull on the handlebars a little easier by letting off on the gas. The motorcycle decelerates, while the sidecar wants to continue.

Note: During normal cornering, acceleration in tight turns assists while decelerating assists in left turns. (JD)

Shifting Your Weight

Gymnastics has a considerable effect.

If the driver leans over as far as shown in the photo, the load on the sidecar increases from 136 lbs to 178 lbs. The center of gravity is also lowered somewhat. However, you have to lean over before the turn. If you try this when the sidecar is already up, the motorcycle with sidecar tips over even more because of the reaction momentum of the driver sliding to the right. In traffic you should not rely on the gymnastics of the passenger in a motorcycle with sidecar designed for road use without practice. And if he forgets to do it when you count on it, your ship will be sunk without hope. A passenger's assistance in tight turns is essential!



Shifting of weight: The sidecar wheel is placed on a weighing machine,

4. Actual Riding

There are also some gymnastics which the rider should be able to do, especially if he rides on unpaved roads or in the mountains. There are still enough motorcycles with sidecars with sufficient ground clearance to make this fun.

If the rear wheel does not grip on snow or a loose surface, stand on the rear footrests or kneel back as far as possible on the seat. A greater load is put on the rear wheel and the outfit will move again. The rider must then lean forward over the handlebars. Now it is important not to have too much power on the rear wheel, but a suitable gearing for a motorcycle with sidecar instead.

You can often find a track for the motorcycle in deep snow, but not for the sidecar. In such a case the rolling resistance of the wheel of the sidecar can become so great that the sidecar comes to a halt. The motorcycle tries to move around it, describes a quarter circle and then you are definitely stopped. After you have sweated a bit and have righted the motorcycle and sidecar again, put both feet on the left footrest and lean far enough to the left that the sidecar comes up. With an empty sidecar and halfway normal track width this will always work. The cycle wheels are put under a heavier load, the wheel of the sidecar is up in the air and in most cases you can move again.

If you get stuck, the passenger should push at the outermost edge of the sidecar. In most cases it is his fault anyway; if he had leaned over the

rear wheel early enough, you would not have got stuck. If you are alone, clear the area in front of the sidecar wheel as far as possible, then either stand on the left footrest or help to get going by pushing.

This is how to traverse a short piece of icy road with a very light motorcycle with sidecar. If you get stuck on a grade: push it sideways and alternately inch it upwards fore and aft. Put the sidecar cover under your feet so that you do not slip. If it is very cold, this maneuver has the added advantage that you will no longer be cold afterwards. If unfortunately you have slid down into the ditch, you may have to remove the sidecar and push the lot back on the road piecemeal.

Novices traveling real mountain roads for the first time with a motorcycle and heavily loaded sidecar for vacation do not understand why they have difficulties on grades of 20% in spite of an engine output of 50 hp or more. Grades like this were overcome 25 years ago by a Puch of 250cc, even though the roads were gravel then and not asphalt.

Usually there are two reasons for this:

1. The motorcycle with sidecar has no sidecar gearing.
2. First gear is too high; the gear spread in modern motorcycles is too small.

This knowledge does the rider little good at this time. He can burn up a clutch in his first unsuccessful starting attempt.

4. Actual Riding

Since, in most cases, the vacation is over if you need a clutch on some lonely mountain in a foreign country, you should not risk situations like this.

From the start you should climb unusually steep hills in first gear and at an rpm at which the motor develops sufficient power and which it can keep up over a period of time; whether it can do this or not you will know later. It is astonishing how quickly the motor losses rpm, especially under the influence of 6,000 ft above sea level. It can even happen to experienced people that, in spite of belated "stepping on the gas", the motor gets slower and slower and finally just quits.

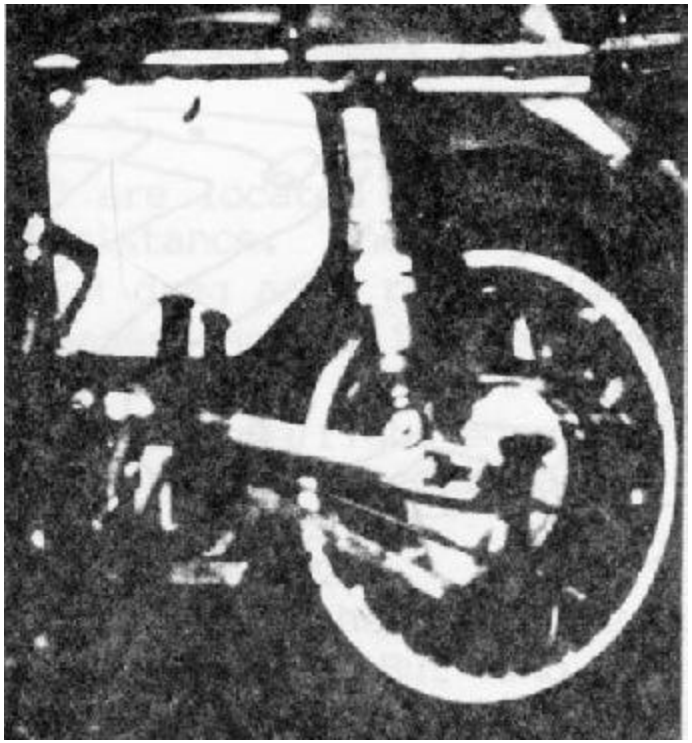
Trying to start up again at the same place where you killed the engine is the wrong thing to do. Instead, back up until you come to a place that is less steep, or find a side road which you can come out of with enough momentum, such as a side road which can be helpful when starting up on an icy road.

It had formerly been possible to observe great artistry in the riding of motorcycles with sidecars during cross-country reliability races and to imitate it with the help of a little skill. Today this should be approached with caution. Cross-country motorcycles with sidecars only have the three wheels in common with those designed for road use; they should be used only with the assistance of a skilled co-rider, but then they can do things impossible to do with a normal motorcycle with

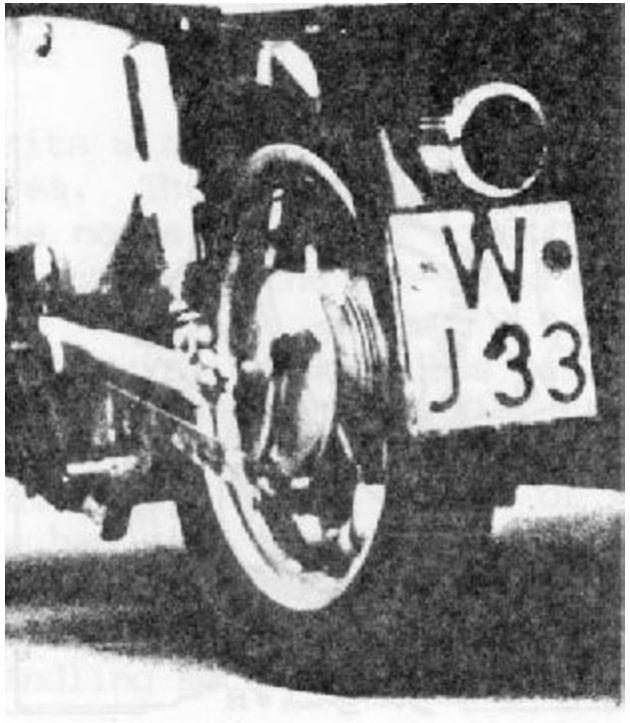
sidecar. It would be better - even if you are no longer a greenhorn - if you came to our training courses for riders of motorcycles with sidecars. There are always people who can show you what is possible.

If you have to relearn on your own, and even if you do not think it necessary, please ride very slowly in the beginning (nobody can say how long that miqht be)!

Look at each curve, so that you "can tell your muscles specifically what-to do." You will have to wait for the feeling that you do everything right automatically, as when riding a solo bike. The most dangerous time will come when you are already riding quite easily and have a few hours of riding without fear under your belt. But if you then get into a critical situation in which you have to react quickly, you will react like a rider of a solo motorcycle, which will be wrong! You will get into head-on traffic, or, if you are lucky, wind up in the bushes.



Fast Left Turn - Strut has Expanded by 2 Inches



Slow Left Turn - Strut in Normal Position

TECHNICAL ASPECTS OF SIDECAR RIG.

Track width is one of the most important terms in a motorcycle with sidecar. How large should it be? It would really be nice if I could say that x number of inches would be optimal.

Unfortunately it is not quite that easy. Nobody has made tests by riding motorcycles with sidecars of differing track widths and has shown documented results.

From the observations leading to the power-speed curve it can be deduced:

1. Units with track widths between 45" and 48" are located at the left edge of the area. They have a large amount of road resistance. The large frontal area and the non-streamlined construction have a high drag as a result, and the wide track because of the one-sided propulsion, increases the rolling resistance.
2. Units with track widths below 43" are located at the right edge of the area. You can feel how maneuverable such a unit is when driving off.
3. Units with track widths of more than 48" are also made. At the IFMA '78, Harley had such a machine. It may be possible to study the basic disadvantages of motorcycles with sidecars with large track widths. But who will admit such disadvantages? With some effort it may be possible to prove which is better on the handling section of the track. But that is only of theoretical interest.

Modern motorcycles with sidecars have track widths around 43". Why? It is necessary to have room for a person, and the rider needs room for his right leg. If the construction is as tight as possible, about 40 1/2" is needed; to provide a little comfort, 42" to 43-1/2" is needed, the usual values you will find used today.

If you build it wider, the machine is a little steadier, but the disadvantages of the wider track are greater. Those offering a sidecar today which, when attached to a Guzzi-Falcone, has a track width of 45.7", should rethink their design.

In my experiences with motorcycles with sidecars having 15 to 33 hp cover more than 155,000 miles I find:

* A narrow unit accelerates better and is more maneuverable.
* On ice or in deep snow it does not spin around on its axis quite as often.
* You get stuck less in snow or mud and, if you do get stuck, it is easier to get free again.
* The rider behind you is no more concerned whether your track width is 40-1/2" or if it is 46-1/2".
* The narrower track squeals less around the turns.
* If the wheel of the sidecar does come up, it is not so serious. Most likely it will come down again.

The resistance, W, at the front and rear wheels diminishes the available motive force V. That makes sense. The rider does not notice this too much. The resistance W1 at the wheel of the sidecar also consumes motive force, but this acts through a distance displaced by the amount of the track width. It generates an angular momentum derived from track width in feet times resistance in pounds.

You will notice this in your shoulders when starting; you will have to countersteer. With powerful motorcycles and sidecars the front wheel is pulled sharply to the right. You also notice it when you want to free a motorcycle with sidecar which has become stuck in mud. The passenger has to push the sidecar - as far to the outer edge as possible - otherwise you will describe circles to the right. This pull to the right is always present and the shoulders of the rider could not stand it for long. But you can do something about it. The wheel of the sidecar is given toe-in. In other words it is permitted to run offset to the left. If track alignment poles are applied to the wheels, the frontal distance should be 1" to 1.6" shorter than the rear distance. Measuring must be at right angles to the longitudinal axis and, with tires of different width, add to the narrower tire until it has the measurement of the wider one. Toe-in is pretty effective. Up to a certain track width and motor output a toe-in of 1.6" at the most is sufficient. With larger engine outputs and track width you really need more but experience shows this does not work. The wheel of the sidecar would drag even more. This drag would increase the resistance at the sidecar wheel instead of diminishing it.

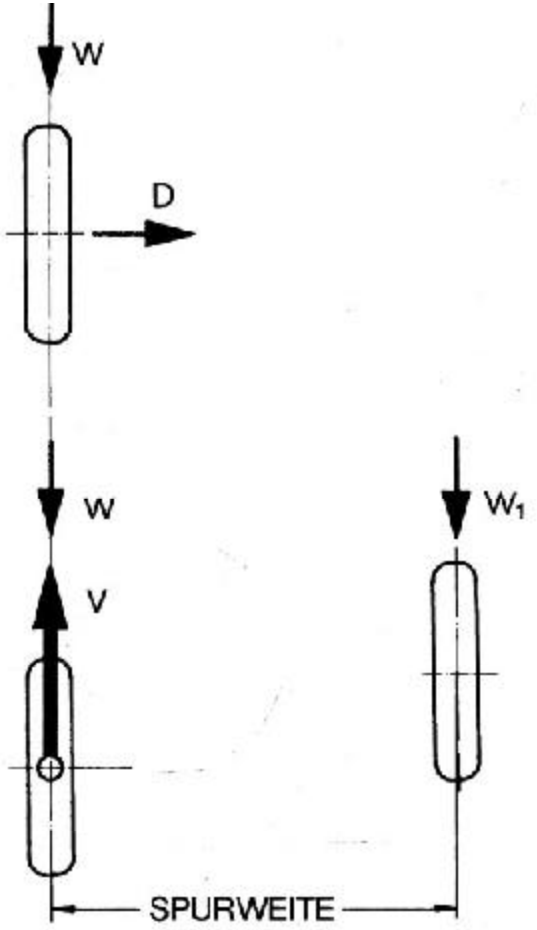
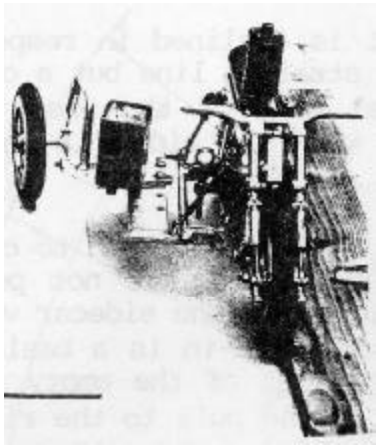


Bild 62: Wirksame Kräfte.

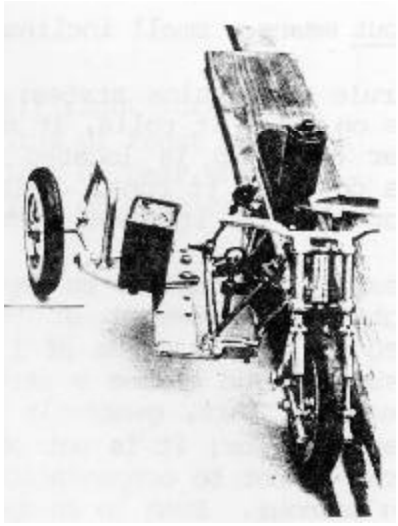
<--------- Track Width -------->
Effective Forces

Model Analysis

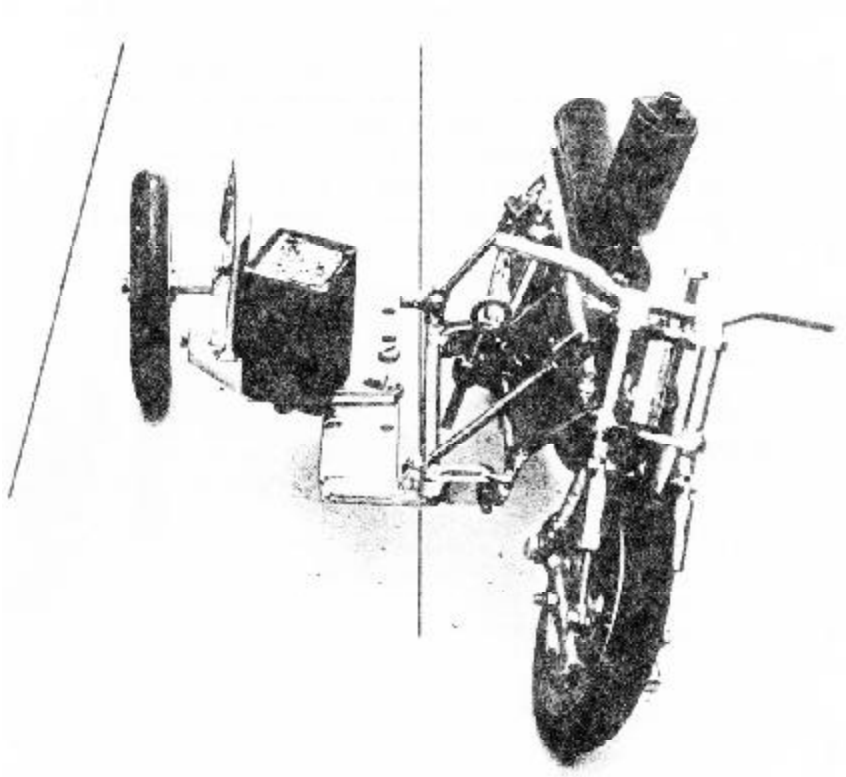
The model has a toe-in of .6". If it is moved ahead, the piece of cardboard is pushed to the right. That means: on a solid surface, the sidecar wheel pushes the unit towards the left. If the toe- in is reduced to zero, the cardboard remains in position. Since toe-in alone will not suffice, another means is employed, the cycle is given lean-out.



Effect of Toein - Start



Finish



The model was then given excessive lean out, and then was moved backwards and forwards 10 times. The model wandered to the left by the width of the tire after every move.

Leanout

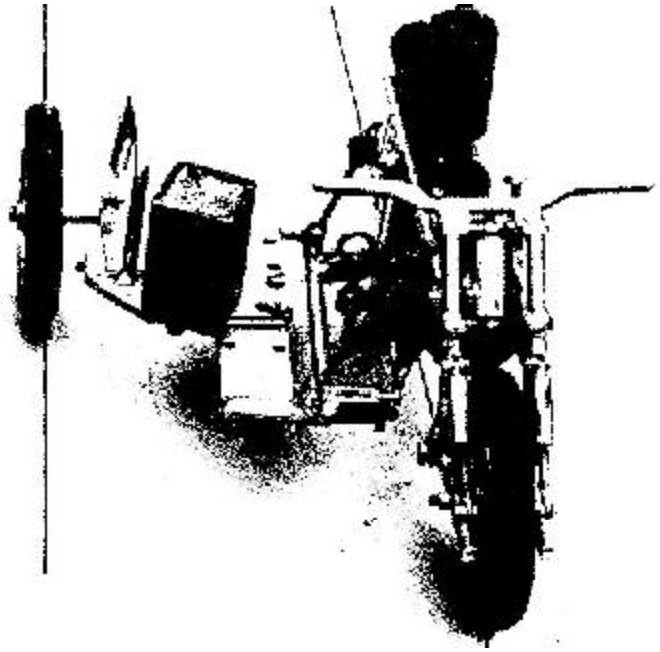
Leanout means a small inclination of the motorcycle away from the sidecar. The rule of physics states: As soon as a wheel is inclined in respect to the plane on which it rolls, it no longer describes a straight line but a circle, the center of which is located where the geometrical axis of the wheel meets the plane on which it runs. This can be easily seen with the aid of a wheelbarrow; if you tilt it, it moves in a curve.

In reality, leanout is an important means for the rider with which to correct the staight-ahead movement of the motorcycle and sidecar. It is not possible to exceed the toe-in value of 1.6" to 2", because otherwise the sidecar wheel drags excessively and causes a strong rolling resistance. Toe-in is a basic setting.

By means of this, generally only the pull to the right of the empty sidecar is compensated for; it is not changed afterwarads. If the pull to the right of the sidecar cannot be compensated by even the greatest toe-in, the motorcycle must be given leanout. Even in an optimally adjusted unit the characteristics of running straight ahead might change.

If the sidecar is heavily loaded, the leanout has to be increased in most cases. If you ride for some time on a road which has a high crown, your shoulders will begin to hurt. The reason for this is that you have to pull your handlebars strongly to the left; increase the leanout! During left-hand traffic on the highly-crowned roads of England you get the impression that your sidecar is always trying to rise; decrease the leanout!

For these reasons it is advantageous if you are able to change the degree of leanout en route without too much trouble. Importantly, it has to be possible to reset the old setting without having to experiment. If the setting is done with threaded struts, count the turns; if with sliding sleeves, mark the position.



Model was given zero leanout, then moven back and forth 10 times; model remained on its track

Modern motorcycles with sidecars have a large sidecar wheel lead which also has disadvantages for you. The unit makes a right turn around the turning point of front and rear wheel. The sidecar wheel can only roll around a turning point which is located somewhere on its axle. The axle, because of the toe-in, has a - let's call it - opposite direction from the axles of the motorcycle wheels. Under these conditions the sidecar wheel cannot roll, it drags.

Put the wheel of the sidecar in sand and the wheels of the motorcycle on a solid surface. Now place weight on the motorcycle but not on the sidecar. Turn the handlebars as far to the right as possible and push the motorcycle and sidecar.

You will see that the wheel of the sidecar hardly turns, it just pushes the sand aside. If you look closely you will observe that the tire is somewhat compressed laterally and then makes a slight jump to the right. If you have a motorcycle and sidecar with a sidecar wheel lead of about 12" you can see this very clearly. This effect is not as great when making a left turn.

The sidecar wheel is - because of the toe-in of the sidecar wheel - always slightly turned in towards the left side. If the handlebars are deflected a little less than shown in the drawing, you will find a steering angle (line I-i) where the axes of all three wheels have a conlnon center. Determine this angle for your vehicle. Perhaps you can derive some solace from the fact that, when you ride this radius, you do not have to pull so hard on the handlebars. In all other cases you have to apply very strong forces to steer.

The novice, coming from a solo motorcycle, finds this so hard to do. This is one reason why he sometimes travels in a direction he had not intended to pursue.

The "having to pull hard on the handlebars" requirement has an advantage: As long as this pressure in the handlebars is felt, the vehicle runs true and follows the direction of the front wheel. If you no longer feel this pressure, you are on ice or a slick surface and perhaps you will have time to slow down.

Low Speed Wobble

The reason for the low-speed wobble: the sidecar tries to pull the motorcycle to the right. Because of the lever action of the trail the handlebars pull to the right. The propulsive force of the motorcycle tries to straighten the handlebars. This tug of war continues until, with the increase in speed, the action of the propulsive force gains the upper hand.

Axis and Radius - Right Turns
Rv- Radius of Frount Wheel
Rh - Radius of Rear Wheel
Rs - Radius of Sidecar Wheel

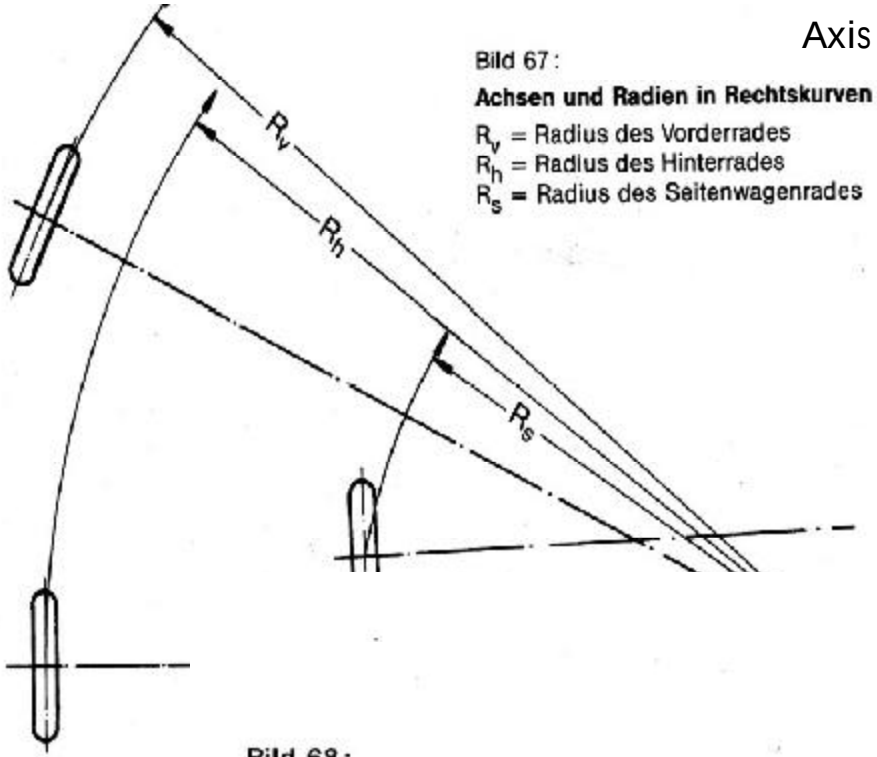
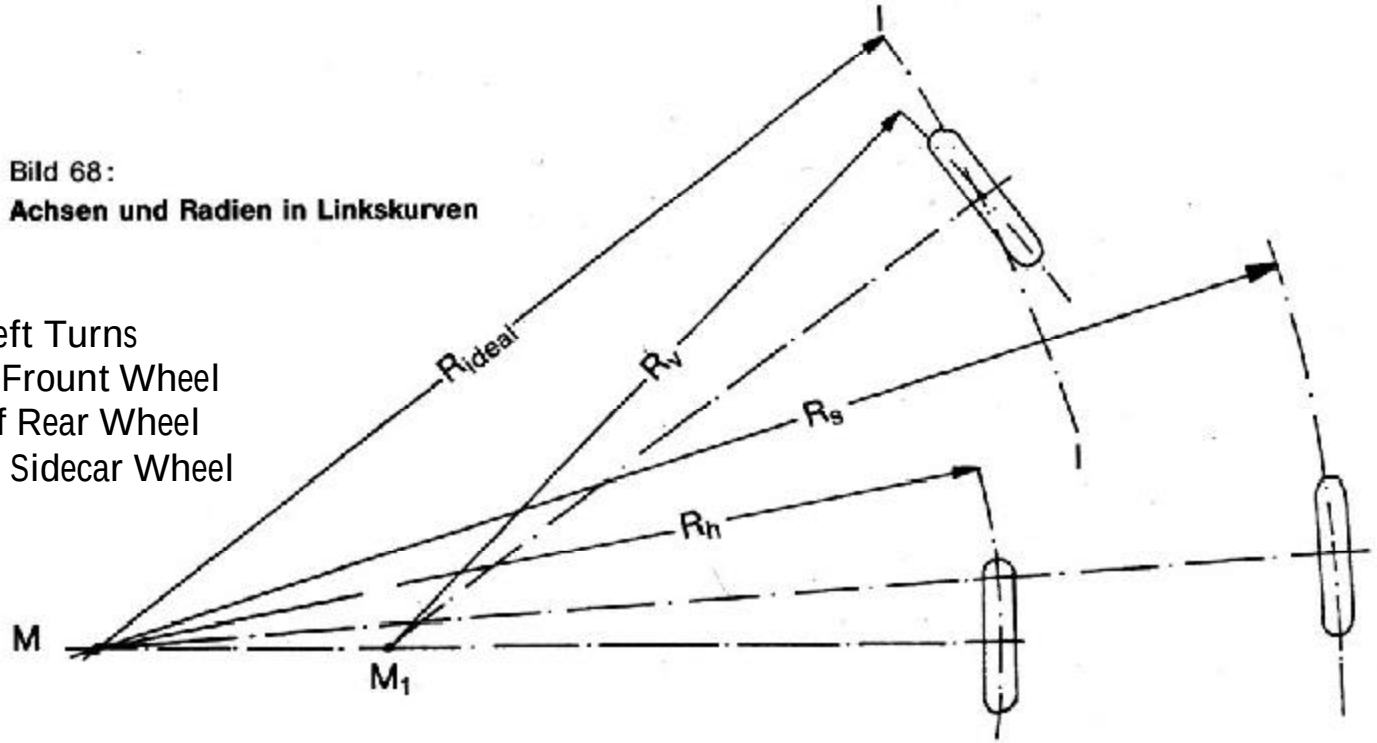
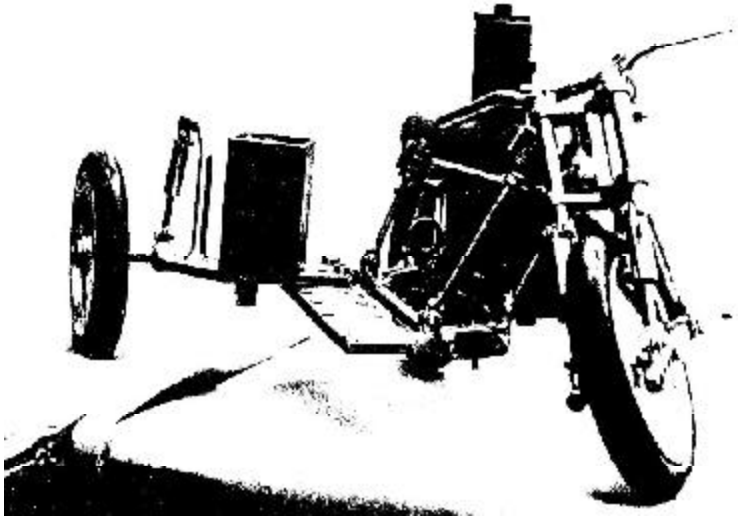


Bild 67:
Achsen und Radien in Rechtskurven
R_v = Radius des Vorderrades
R_h = Radius des Hinterrades
R_s = Radius des Seitenwagenrades

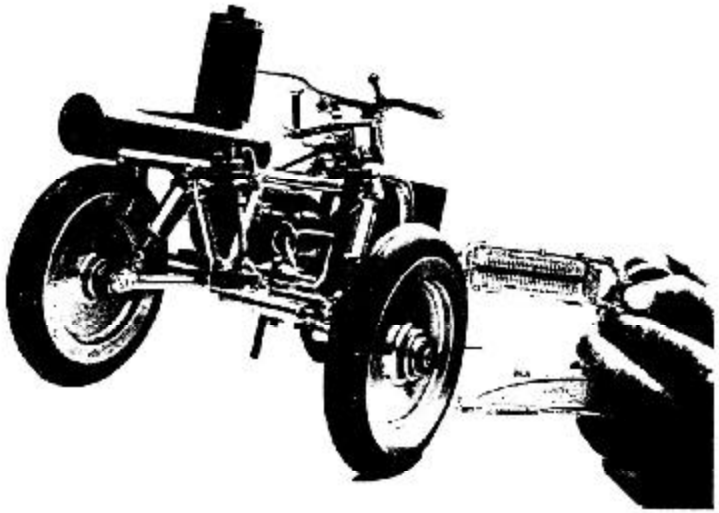
Bild 68:
Achsen und Radien in Linkskurven

Axis and Radius - Left Turns
Rv- Radius of Frount Wheel
Rh - Radius of Rear Wheel
Rs - Radius of Sidecar Wheel

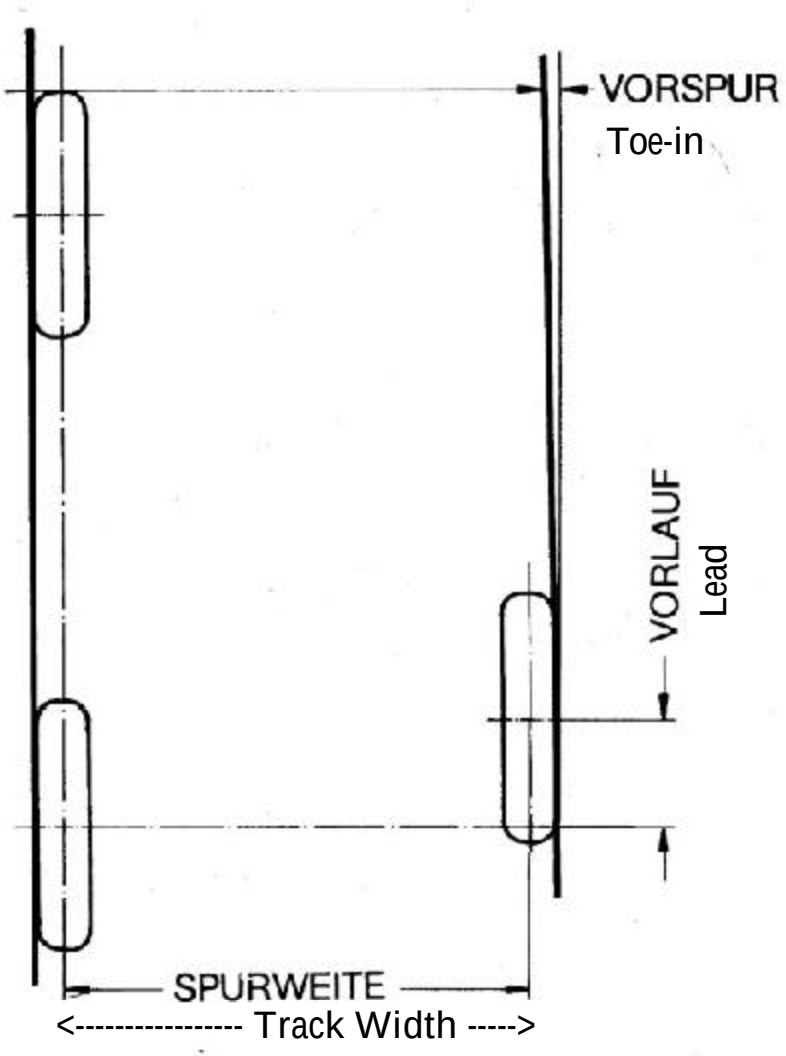




Zero Sidecar Wheel Lead - the foam material is hardly pushed up



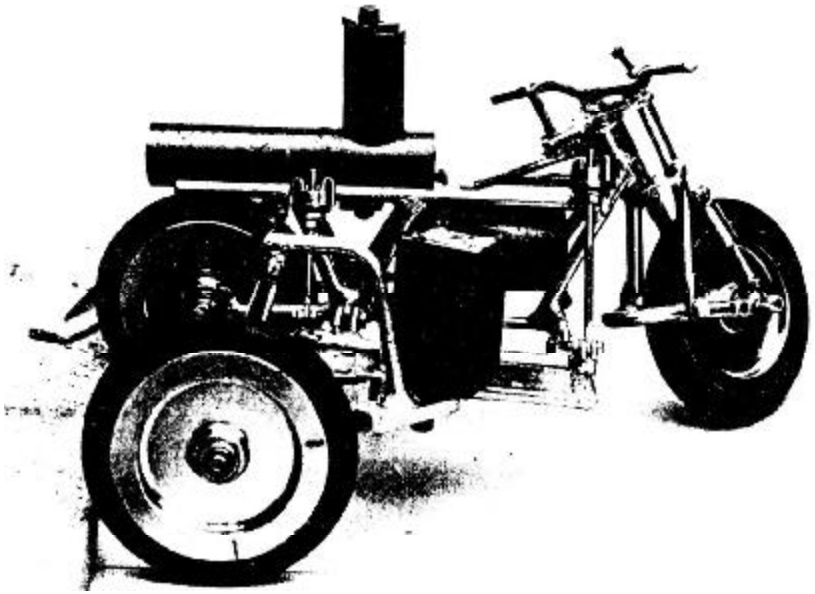
Zero Sidecar Wheel Lead - the rear wheel lifts up at only 11 pounds

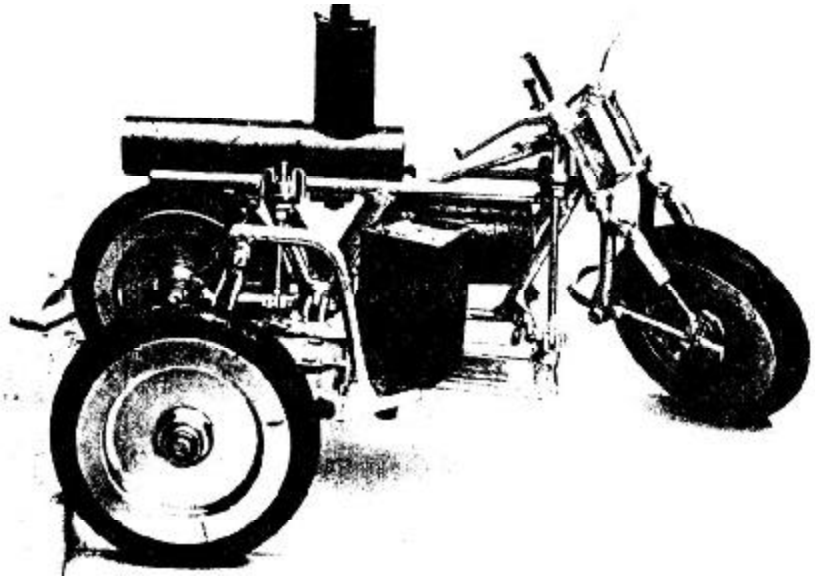


Toein, Lead, and Track Width

Zero Trail - Model

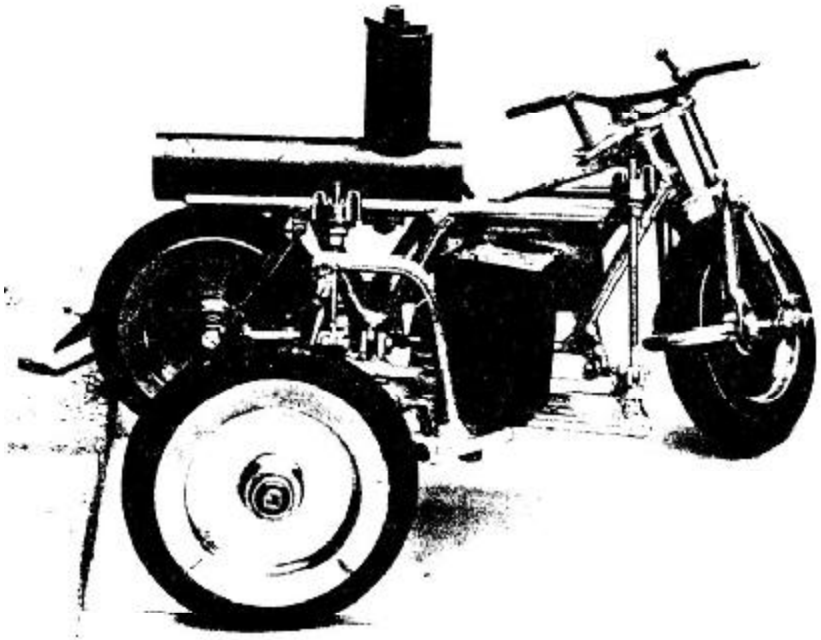
Zero trail- If handlebars are moved from full left lock to full right lock sidecar wheel hardly moves.

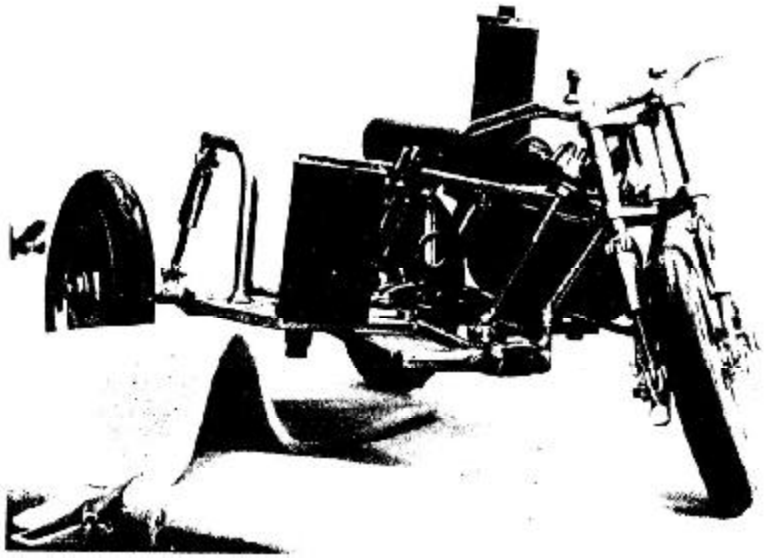




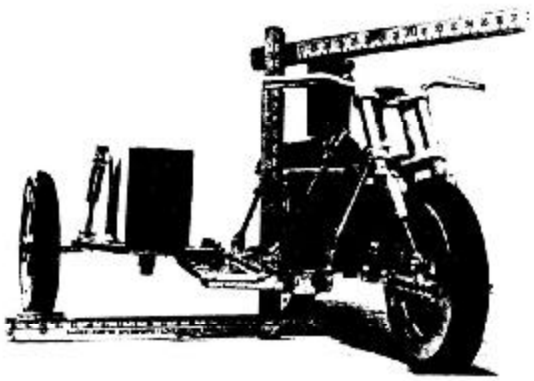
Large Trail - Model

Large trail - The sidecar wheel moves 3/4" when the handlebars are moved from full left lock to full right lock.





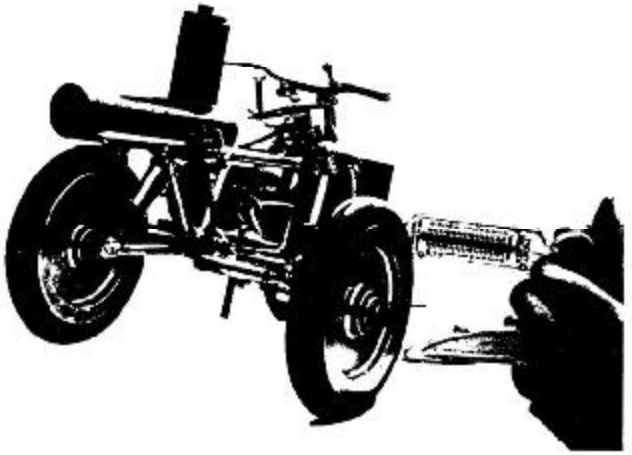
The model has a sidecar wheel lead of 1", the foam material is pushed up a lot. In tight right turns the sidecar wheel does not roll anymore but the rear wheel only lifts at 17-1/2 pounds. Large or small sidecar wheel lead? You have to compromise.



Measurements taken on the model

Model - left turn:

Effect of centrifugal force on the model



The model weighs 6.5 kg; Height: h = 9 cm

Distance 1 = 4.2 cm

The sidecar should rise off the spring scale at

6.5 kg x 4.2 cm / 9 cm = 3 kg

Right turn: Effect of Centrifugal force on model

3 kg ... correct!

Trail (of the front wheel)

A line is drawn through the steering axis. A plumb line is made through the wheel axis. The amount by which the wheel axis lies behind the line thru the steering axis is called trail.

Trail is a means of stablizing the steering. However, it also makes the steering more cumbersome. This is hardly noticable in a solo motorcycle, but in a motorcycle with sidecar the dragging wheel of the sidecar must be moved against the lever of the track width, which can be hard - especially with an inclined road surface.

If the front fork has a trail of more than 3.6" steering becomes unpleasantly difficult. Motorcycles intended for both solo and sidecar use, such as the Link-BMW, the MZ and the Zundapp-KS 601, have a provision to alter the trail. Modern motorcycles do not have this provision; you will have to ride with the trail of a solo cycle. Guzzi has fork yokes with a trail of 2" in the works. FJ4L motorcycles with sidecars also have this value, but also a restriction in the vehicle permit: not to be used as a solo motorcycle.

The steering of almost every motorcycle with sidecar begins to oscillate at about 25 mph. Because of this, a steering damper is required. There are motorcycles with sidecars you cannot ride for more than 15 feet without a damper. To show you how strong this can be: Stand on the footrests, arms straight down. Get up to the speed at which oscillation occurs. You cannot hold the motorcyle with your arms straight down. (The novice should never attempt this - HAK)

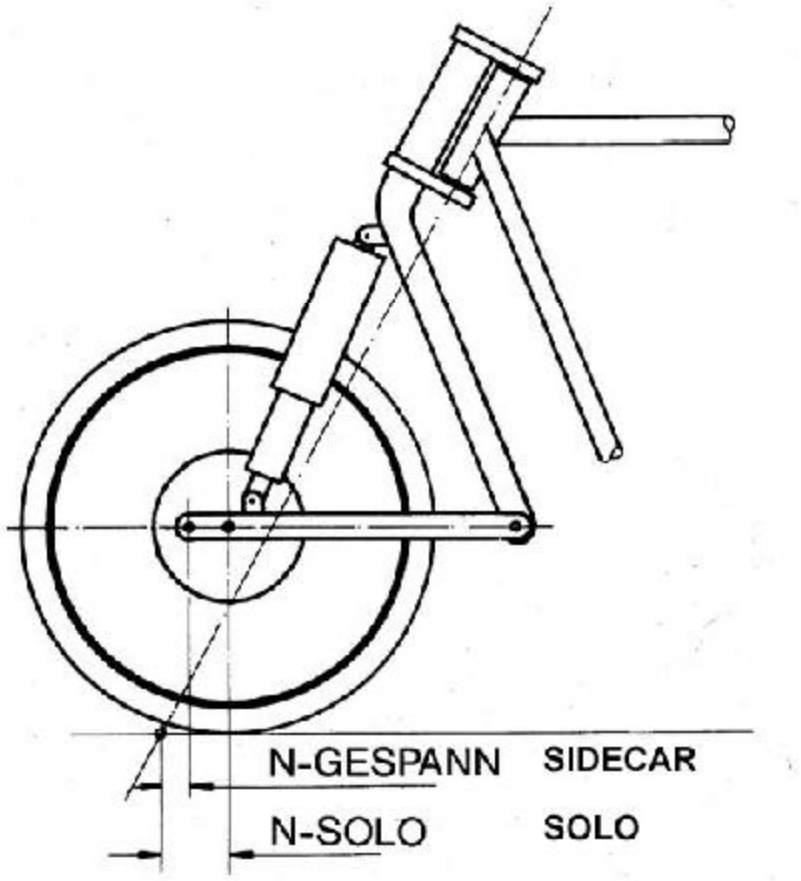


Bild 71: Verstellbarer Nachlauf.

Summary

The sidecar pulls the unit to the right with such force that riding would be impossible without some countermeasures. With sidecar toe-in and motorcycle leanout a means to equalize this pull had been found, it cannot be eliminated. The sidecar wheel lead can only moderate the lack of a fourth wheel and the tendency to tip over in left turns because of the missing fourth wheel.

What is the cost of this compromise?

1. A toed-in sidecar wheel which pushes the vehicle to the left and constantly drags.

2. The two motorcycle wheels try to move to the left because of the leanout but are forced to run straight by the force of the push to the right of the sidecar. They also drag.

These two values, sidecar wheel toe-in and motorcycle leanout, should be adjusted fairly skillfully so that all three wheels contribute more or less equally to keeping the vehicle on track. Tire wear will be more even and the front wheel can transfer noticeable braking force. If very little sidecar wheel toe-in is employed, a lot of leanout is required. The front wheel would use up a large amount of its adhesive force to keep the vehicle straight. It could hardly transfer braking force.

What are the disadvantages of these steps?

1. High rolling resistance.

2. Tire wear as in no other vehicle. But - this excessive tire wear also has an advantage!

If you just recently learned to ride a motorcycle with sidecar, perhaps you still drive a car, you will notice something the veteran rider of a motorcycle with sidecar no longer notices. The steering of a motorcycle with sidecar feels entirely different- you can sense the road conditions in the handlebars: the icy road, the slickness of mud As long as there is “pressure” on the handlebars the wheels stick to the surface. With a motorcycle with sidecar you have the advantage on a slippery surface over a car.

Why is that?

If a tire is deflected by 2 to 6 degrees from its intended direction, strong adhesive forces are created. They also cause the well-known "feel of the road in the steering".

==========

Note: The larger the trail the greater the self centering effect. This is why high performance solo machines have trails between 4 and 5". But the large trail requires a tremendous steering effort if turning the front wheel is required to change direction. That is why a trail of 2 to 3" is desirable for sidecar operation. - HAK

CHASSIS DESIGN

What is the purpose of the sidecar chassis?

1. It is intended to connect the motorcycle chassis with the wheel of the sidecar and to maintain the shape of the chassis under all loads. And, like any other structure, it should not be subjected to bending. Designing for bending forces requires large diameter material. This makes the structure very heavy and expensive.
2. It is intended to carry a passenger and baggage. Unfortunately, these two requirements oppose each other. The exception is the motorcycle with sidecar used in motorcross events. There, the designer only considers the first requirement; the passenger will have to conform to the design.

Prior to considering the design of the chassis the loads have to be considered. Unfortunately, this is not easy. H. W. Bonsch writes in Introduction to the Science of Motorcycles: "Technical science in respect to motorcycles so far has almost exclusively been working on the basis of experiences gathered by the industry itself and passed on to its successors. The dominant influence of the rider and the multitude of forces acting on riding behavior make it very hard to evaluate in a techincal-scientific manner. It is even harder to calculate their interaction beforehand with sufficient accuracy."

This is for motorcycles which have an industry to back them up. For sidecars, nobody - at least not

in Germany - is ready to back them up with research; except for people who like to ride motorcycles with sidecars and who, after working hours, build sidecars. You have no choice but to start on the basis of proven designs. These designs were created at a time when motorcycles had no more than 35 hp. To do justice to the capabilities of today's motorcycles, very rough calculations have to be made. You arrive at the impression that in most chassis the tubing is stressed beyond "the permissible limits". What do we mean by "permissible limits"? That is the load at which the tubing begins to bend - even if only to a small degree. All of the chassis cannot be considered to be "rigid".

Unless very bad mistakes are made during assembly they will hold. There were competition motorcycles with sidecars in 1951 (Haldemann, Switzerland) with a totally rigid lattice-tube chassis. They broke on the second day of the six-day race. Therefore it would make little sense to construct a totally rigid chassis.

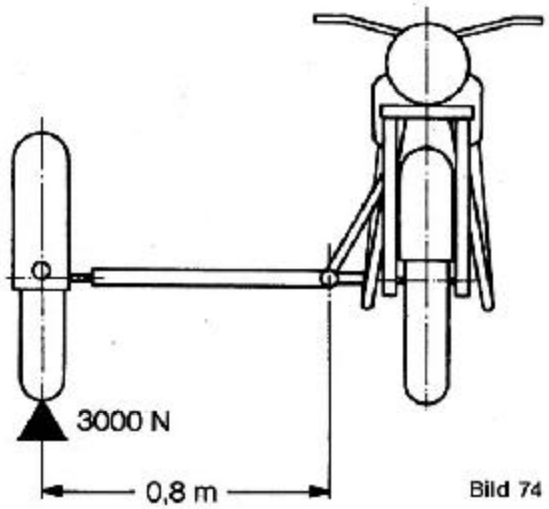
The question of how a sidecar chassis is stressed can only be answered with common sense by cons idering:

1. The load
2. Centrifugal force in the turns
3. Roughness of the road surface
4. Braking and acceleration forces.

The influence of centrifugal force and load can be calculated - each by itself. The roughness of the road is more difficult. All the variables together, plus the effects of vibrations of different motors and other, still unknown, variables would probably make a calculation of stresses in a sidecar chassis impossible.

The manufacturers of sidecars have no other choice than to remain with tubing sizes which have proven satisfactory in the past, to apply special care in case of doubt - and to hope that the buyer will use sound technical skills when assembling the sidecar to the motorcycle.

Everyone probably has seen how, in a hard left turn, the sidecar tire of a 3.50x18 size has almost been pulled off the rim, even when sufficiently inflated. Using a tire manual, it has to be assumed that the tire load was around 300 kg (660 lbs).



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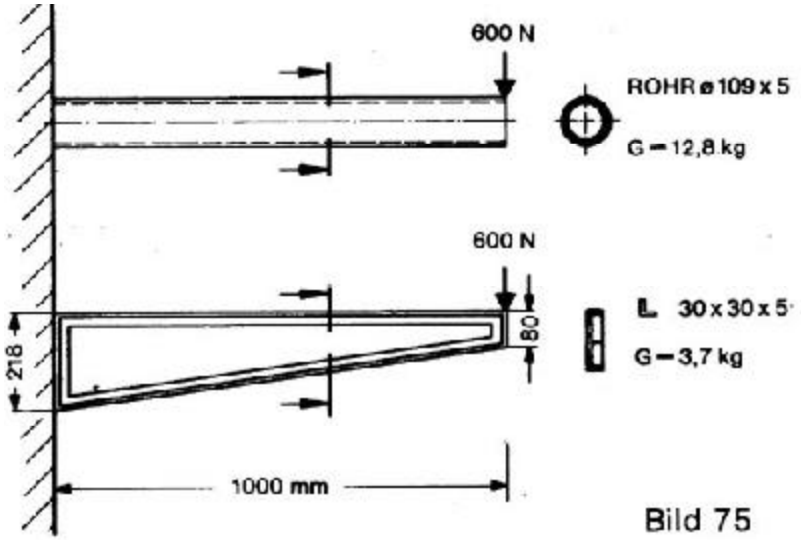
6. Chassis Design

Given a chassis width of 32", this results in 660x2.67 = 1760 ft Ibs of turning moment acting on the point of the sidecar frame which is under the greatest load. It seems logical that something solid has to be designed for those load conditions. Since the material can be stressed less for "bending" than for "pull" or "push", strong, i.e. heavy, tubing must be used. If the bending forces are split up into pulling and pushing forces by means of triangular construction, it becomes possible to provide lighter designs. Examples for heavy and light construction can be found in any book of specifications.

Tube Dia. 109 x 5; Weight: 12.8 kg (28.16 lbs)

600 kg (1,320 lbs) 30 x 30 x 5

Weight: 3.7 kg (8.14 Ibs)



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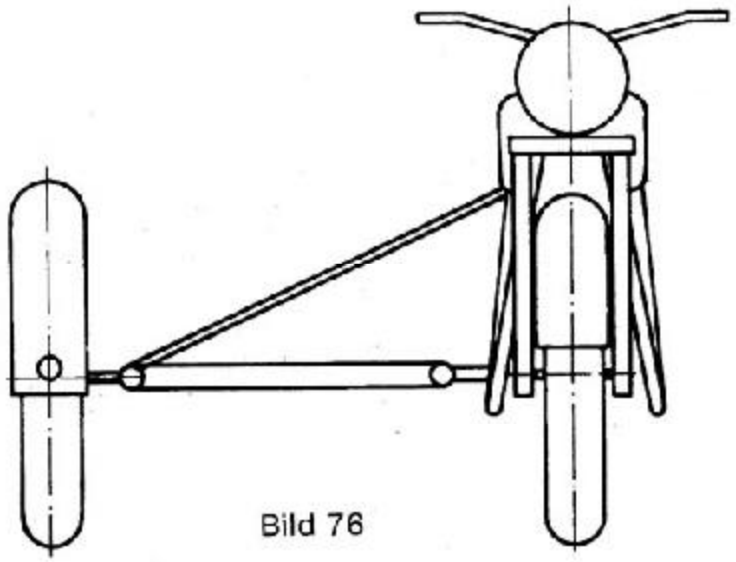
Both supports have the same section modulus of 2.5 cu in and can therefore be equally loaded, in case of a static load, with 1,320 lbs. But - the most important difference is in their weight; the tube weights 28.16 lbs, the frame 8.14 lbs.

Motorcycles with sidecars for motocross events are constructed with this knowledge.



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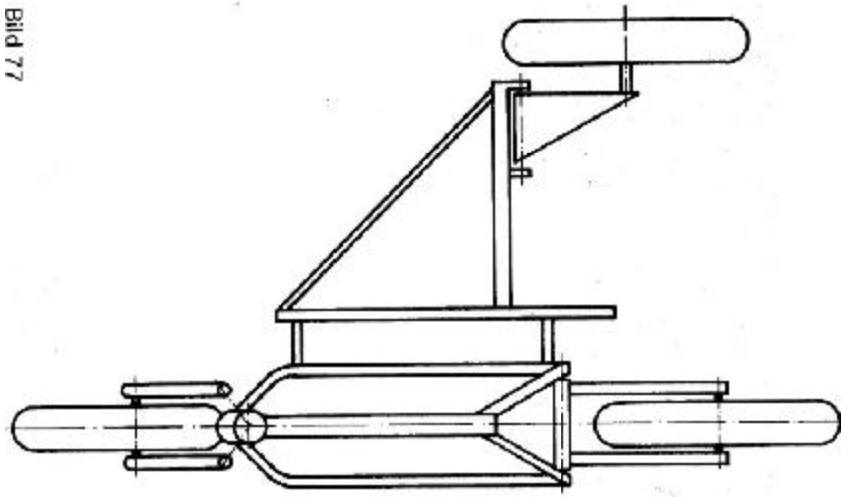
The strut is connected between the steering head and the spring seat. Tubing of very small diameter, but of very great strength is used.

6. Chassis Design



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This is how the motorcycle with sidecar for motocross competition looks in longitudinal direction. Motorcycles with sidecars for road use can also be constructed so that the loads caused by the uneven road can be absorbed and the passenger is not shaken.

Designs of sidecars:

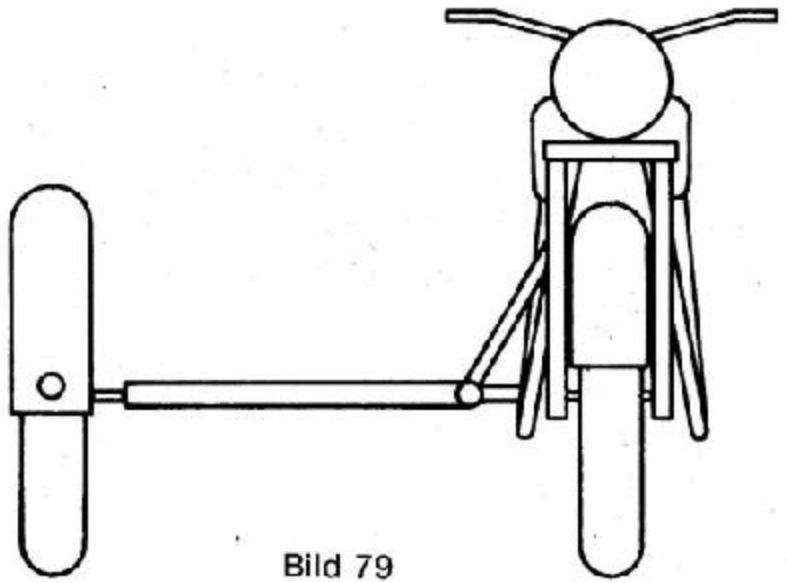
MZ takes the most logical course. The chassis consists of a very strong longitudinal and cross members, conically tapered at their ends and well braced at the junction. This is a design which shows that an hour of labor is very cheap in the GDR. Spring length is about 3.2". A cross stablizizer keeps the unit straight.

The MZ motorcycle with sidecar is much faster than the motor output leads you to believe because of this chassis. Since the chassis is designed to be connected to the MZ motorcycle only, the loads have been well distributed to all three connecting points. Of course this causes difficulties when the sidecar is to be connected to any other motorcycle but a MZ.

Connecting pieces, especially fabricated for the particular motorcycle, have to be used in that case. Even though it is only intended for 19 hp, the MZ sidecar is used with much more powerful motorcycles. I have not heard of any breakdowns. For reasons of safety you should not use more than 40 hp. Some people in the Technical Inspection Service, who have considered the matter, are also of this opinion.

6. Chassis Design

The Stolzenberg sidecar of Koepsell is the easiest one to connect to any motorcycle.



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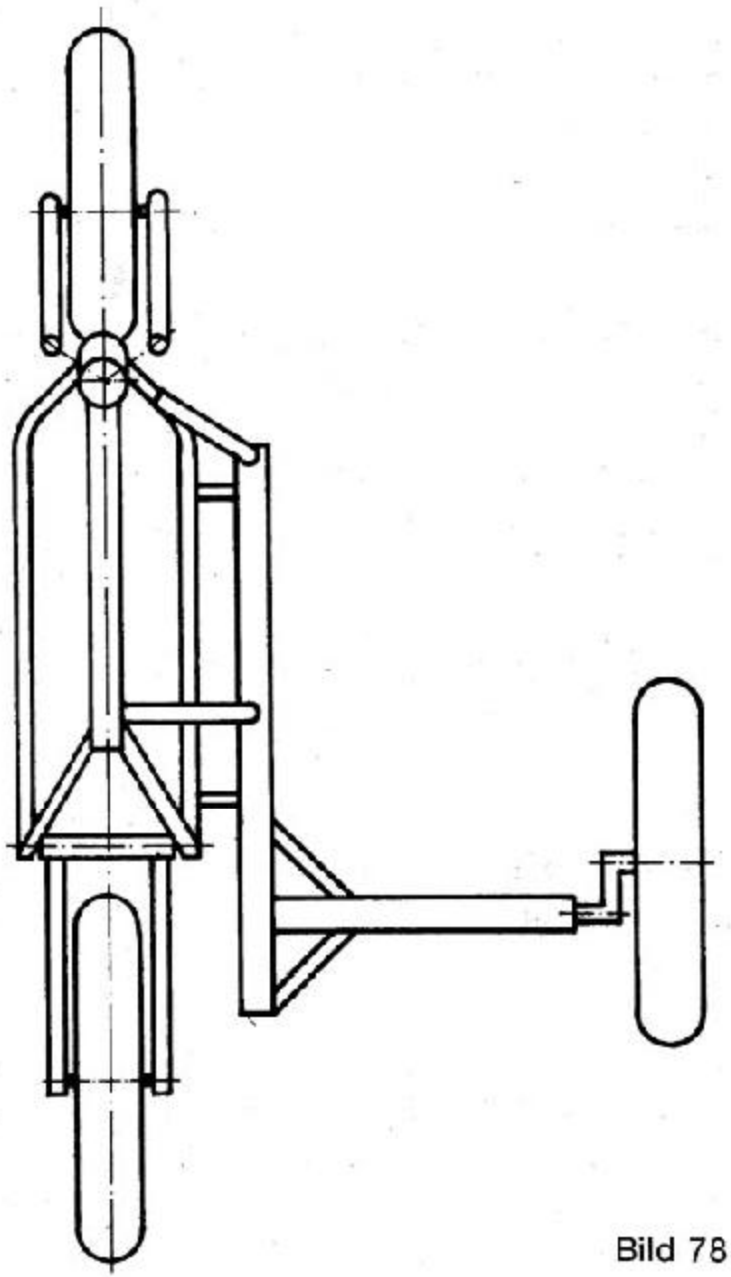
All of the fastening straps are located on one piece of tubing. The danger of twisting is not very great; the tubing has a diameter of 2.52" and the struts are well made. The junction is the weakest point. It should be made by a very good welder; welding mistakes cannot be tolerated in this design. The "Longhi" sidecar is made in the same manner but with two cross members.



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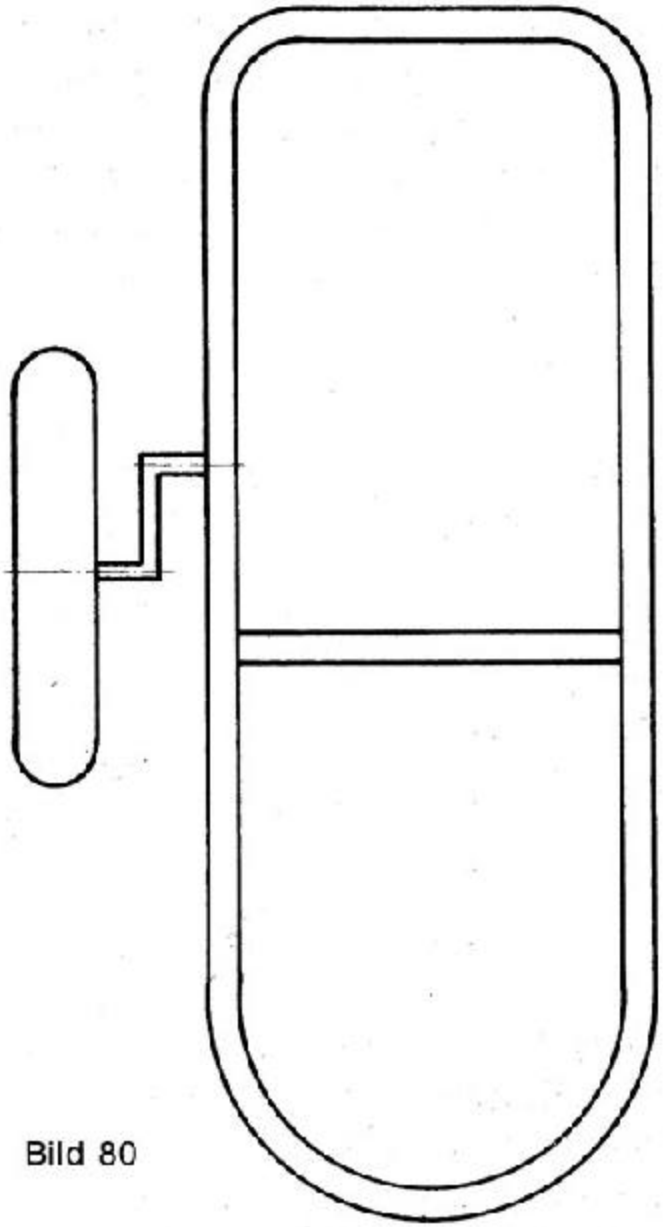
6. Chassis Design

Frames with circumferential tubing: "Squire", "Delfin", "Steib", "Watsonian", and some antiques. This needs a lot of tubing, of course. The frames are always 6'8-1/2" long and are considered "elastic." If, as with Steib, the spring is only fastened to the right frame tube, it is especially important that both tubes are thoroughly attached to each other. Otherwise the right tubing will flutter and will cause a distrubance in the steering. For this reason these frames have at least one connecting piece between the longitudial frame rails. "Squire" has two connecting pieces to the spring seat.

In the "Delfin" the longitudinal pieces of tubing are connected with a spring support tube as well as with a hoop.

Ali frame connector hoops have a second and very important purpose: to distribute loads. Part of the connecting pieces should be attached to them. Even if the clamps on the frame tubing do not twist, they do load the tube additionally with torque. Try and adjust the leanout on a motorcycle with sidecar, where the struts have only been attached in the manner shown by the dotted lines. You have to undo all the clamps, jerk the motorcycle by guess-work, and hope that this will suffice.

Re-tighten everything, drive off. If it was too much or too little, you start again. You have no idea where you started in the first place.



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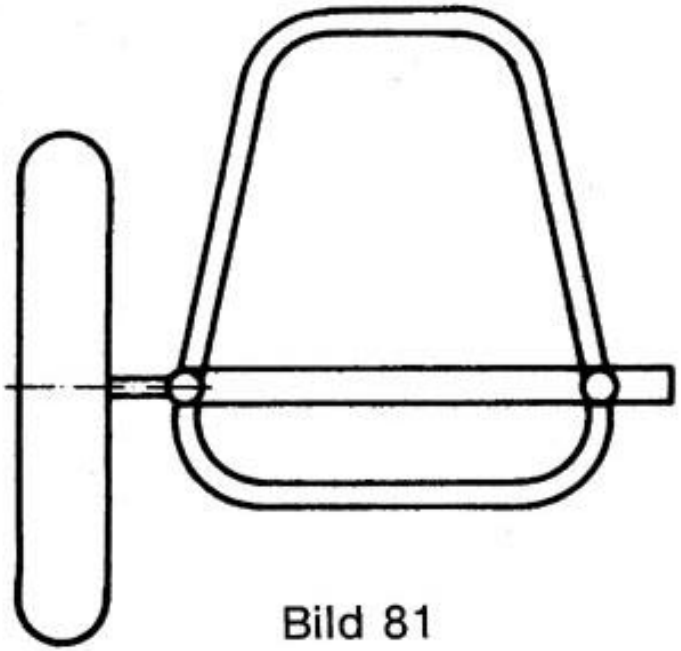

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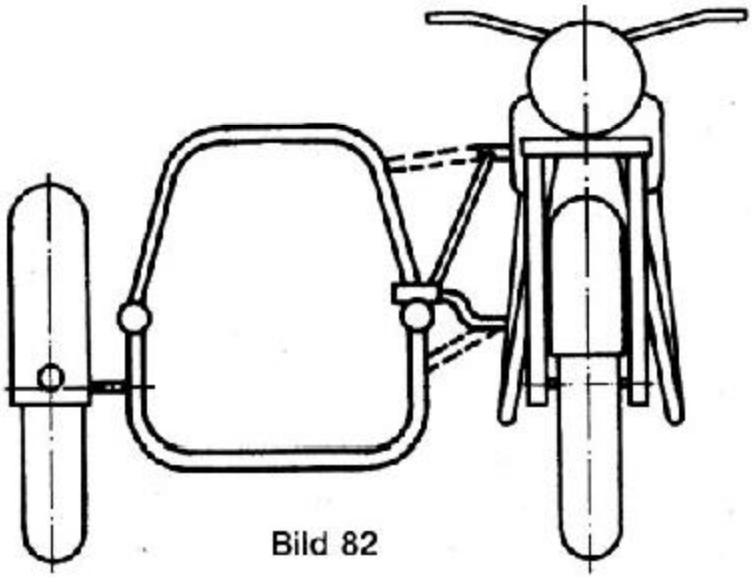

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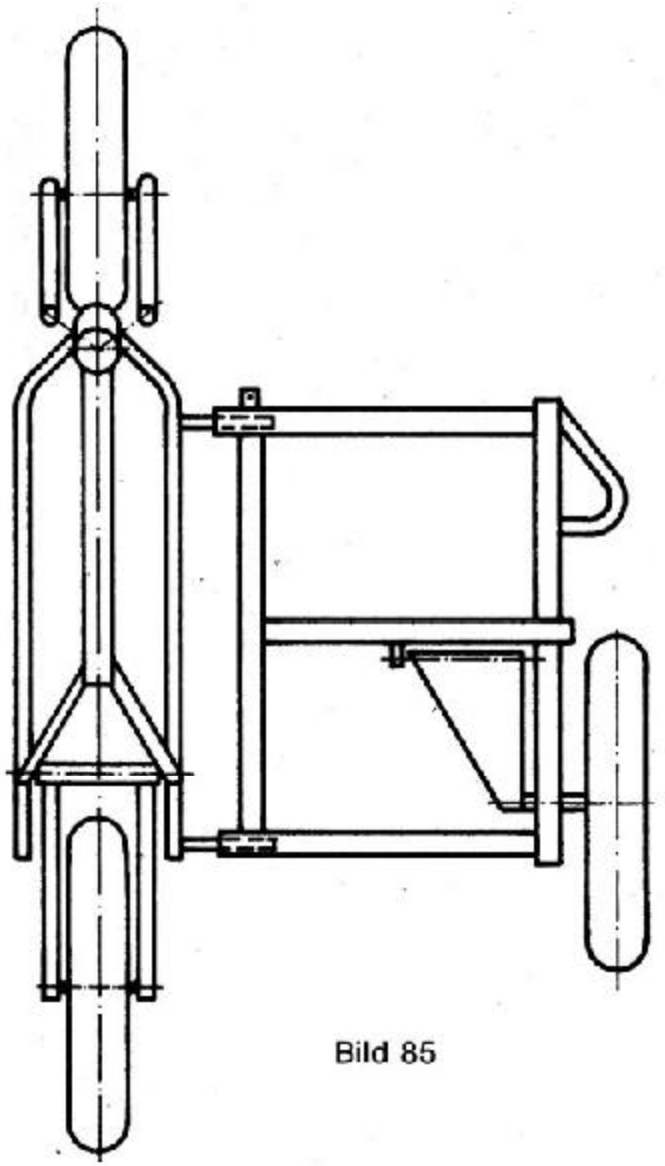
Steib "TR"

The stronger tubing of 48.3x2.6 mm (1.93" x 0.1") is obvious. The bending strength is about 70% better than that of tubing of 32x4 mm (1.28" x 0.16") used in many other sidecars. Only a second look will show: the lower connector tubing peices are inserted into each other; they cannot twist. A strut leads from U-shaped section that is welded to the front cross member to the steering head. A second strut from a clamp at the longitudinal piece of tubing leads under the seat.

With the lower connector they form two solid triangular elements. A rider of a motorcycle with sidecar will not have any difficulties with the rigidity of a TR frame. The modern frame has a third cross member holding the Peugeot type rocker. The right longitudinal tubing is crimped to hold the spring strut. Note: A rocker is equivalent to a link type suspension, (HAK)



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Spings and Wheel Guidance

In modern sidecars the wheel is guided by a rocker or link type mechanism. Whether the linkage should be leading or trailing has not yet been decided. The most advantageous length of the rocker is also not known. Everything has its advantages and disadvantages.

With the many sidecar designs and the differing motorcycles to which they are attached, a single satisfactory design will never be found. The demands made on a sidecar rocker can be satisfied only by the lavish use of technology.

1. The rocker should guide the wheel. It must be able to stand all - even extreme - loads. It must not warp and the set toe-in value must be retained. Demands for strength do not pose any problems on its design.

   Note: Another approach used by Harley-Davidson is to spring mount the sidecar body to a rigid sidecar chassis. Some early Steibs used a rigid chassis with the body suspended by 4 large rubber bands ! (JD)

2. Springs are a different matter. There is no reason why the passenger in the sidecar should be subjected to worse springing than the rider on the motorcycle. The sidecar should have even better springs. In the case of hitting a pothole, the rider can stand up on the footrests; that is not possible in the sidecar. The springs of the sidecar should have the same travel as

   that of the motorcycle - 3 2", there must be spring travel; no use quibbling over 0 4". There must be spring travel even when the motorcycle and the sidecar are fully loaded.

This is the start of the problem: You can assume a wheel load of between 120 and 132 lbs with an empty sidecar and travel in a straight line. You have to figure on 660 lbs with a loaded sidecar and a tight left turn. In both of these extreme

cases the springing must react to small differences in the evenness of the road surface, even when braking. This is only possible with different spring rates.

Biasing of the spring does not work with such load differences. Who would really take off the wheel and adjust the spring strut every time somebody gets in or out of the sidecar? It is simpler with an air-assisted spring strut. Adjustment of pressure is no longer difficult if you place the connector for the air in an easy to reach place.

The differences in wheel load resulting from the different loading of the motorcycle with sidecar are only a part of the problem! Because of the elevated position of the center of gravity, the springing of the sidecar is highly compressed in a left turn while that of the motorcycle is not. The vehicle tilts and easily tips over. The MZ motorcycle with sidecar remains upright - except in extreme cases - thanks to its cross stabilizer, even with very soft springing.

Tests are under way in a Suzuki TR replica, using a stabilizer and air struts. Whether this embodiment is advantageous in all cases will only be known after testing.

All sidecars built in Germany are made in minute numbers. It is utopian to think that a rocker with an expensive springing system could be designed and tested for every model. For this reason some manufacturers employ trailer axles.

These rocker trailer axles are used but they have the following disadvantages:

They were designed for larger loads and they were not designed for passenger comfort.

Passengers call them pothole finders and demand something better. One manufacturer has taken notice. Two long rockers are being tested. If the proper spring strut is selected these rockers provide considerable improvements in riding comfort as well as roadability.

Another manufacturer uses automobile rockers - possibly the best from the standpoint of stability. However, only two rockers out of all European cars offered are suitable and it is not easy to procure them in small quantities.

The result of this struggle for better chassis is that the buyer has to accept the fact that a good sidecar chassis is not inexpensive!

Axles

"Grind down a Steib axle of 0.88" diameter to a diameter 0.8", I want to use it with a BMW wheel."

I often receive this order. I refuse as a matter of routine.

Then they say- "What difference does 0.08" make? The BMW axle doesn't break!"

This answer has two mistakes:

1. A rear axle and a sidecar axle have structurally different load factors.
2. If you grind down an axle from 0.88" diameter to a diameter of 0.8", its circumference is reduced by only 9%, but its bending strength has been reduced by 27%!

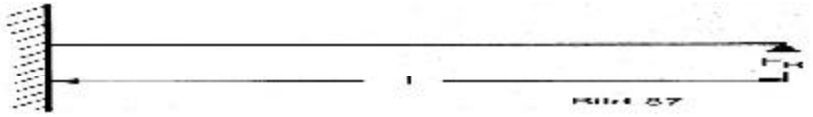
The rear axle is supported on both sides.`

A = Seat of the axle in the rockers

FR = wheel load

The bending resistance or required stability is:

W = (FR x L) / (4 x db)



Where:

W = Resistance value in cm^3

FR = (Force) Load in da N (deca-Newton); 1 daN (1 kg) for both wheels with 300 kg assumed.

L = Unsupported length of the axle; for the rear wheel assumed to be 25 cm (10")

db = Permissible load under conditions of "recurring load"; 4,000 daN per cm2 (Chart value for the material designated 42 Cr Mo 4).

The bending resistance needed is therefore:

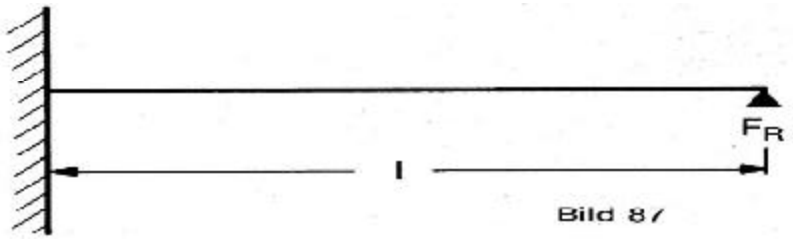
$$W = \frac{(300 \times 25)}{4 \times 4{,}000}$$

$$= 0.047\ cm^3$$

The dimension cm^3 is not a measure of volume, it is a measure of the bending resistance.

Sidecar Boom or Stub Axle

Structurally, the bending resistance of a sidecar boom or stub axle can be determined from the following formulae:



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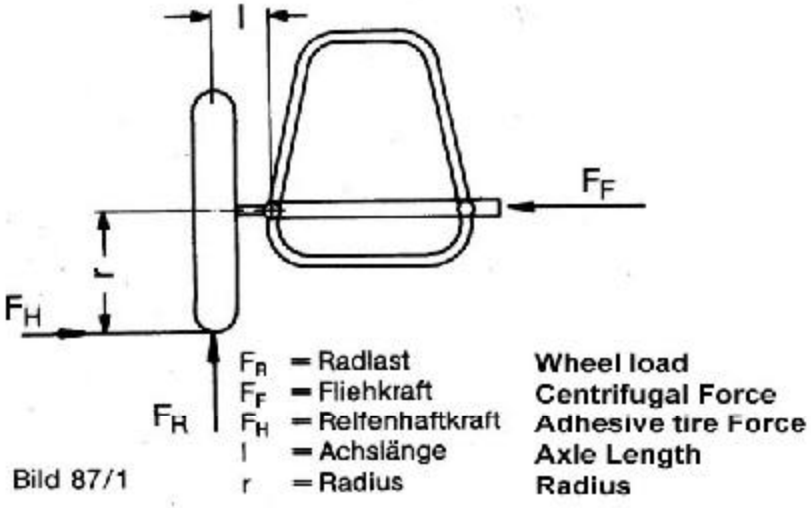
w :

7. Springs, Wheel Guidance

This is four times larger than is required for the supported rear axle. But since the sidecar axle has only about a fourth of the "unsupported length" of a rear axle, you get the same load. Everything should be okay - but - as with a car - a second torque value acts on the axle. The value consists of the adhesiveness and the radius of the wheel.



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FR = Wheel load

FF = Centrifugal force

F = Adhesive force of the tire

FH = Length of axle

r = Radius

Because of the more advantageous structure this is not too tragic in the case of the rear axle. If you make a sharp left turn on a road which holds very well and with a fully loaded sidecar, the value formed by wheel size and adhesion becomes very large (especially if you have a 19" wheel). Together with the wheel load value - and perhaps a pothole - an exact calculation is not possible. For the sidecar axle I would assume twice "W", i.e. W = 1 cm^3.

The resistance value does not mean much, but the needed diameter is important.

For a round axle it is calculated: $d = (10W)^{0.33}$

Rear axle must have a dia. of $(4.7)^{0.33}$ = 17 mm

The sidecar axle needs a dia. of $(10)^{0.33}$ = 22 mm

The weakest rear wheel axles have a diameter of 15mm, but I have roughly guessed at axle length, weight and quality of the material. Since the old sidecar axles had a diameter of 22mm, this guess should not be too far off. Take a look at an axle of a VW Golf auto/The bending resistance value of a round bar is: $W = 0.1d^3$

The smallest change in the diameter has a large effect. If you turn down an axle from 22mm (0.88") to 20mm (0.8”), the following will result:

You have lost 27% of bending resistance; you cannot risk that!

During the 1981 Sauerland Winter Rally, I saw a broken sidecar axle. It had a diameter of 17mm (0.68") and a sharp-edged step. The owner had lived. I hope he reads this. He just could not un-

Bild 100: Eins der teuersten Gespanne. Die BMW K 100 hatte viele Geburtswehen zu überstehen.

A Letter to Lothar

Dear Lothar, may you have many winter rides. It is possible to let the BMW wheel run on a 22mm axle. With that, you will have to use bearings of the next smaller size with a bore of 25mm (1") and you will have to prepare a bearing bushing of size 22mm. Of course, these bearings have a lower load tolerance, and will not last as long. It is far better to replace bearings routinely every two years than to risk a broken axle just once.

The sidecar brake became necessary in the Fifties, when performance increased because of improved chassis and traffic became heavier. It became mandatory for new motorcycles with sidecars in 1964. However, because of the standardization of EC Regulations in 1972 it is now not necessary to install a sidecar wheel brake if the brakes on the motorcycle are sufficient. But is this as safe?

The brakes of modern motorcycles are generally of a size that they can provide sufficient braking, even with the larger load caused by the sidecar. In any event, on a well-holding road and in dry weather, (conditions which are very rare in our latitudes) the braking is usually sufficient.

What happens when you brake a motorcycle with a brakeless sidecar? The cursed asymmetry comes very much to the fore. The motorcycle is slowed down, but the sidecar tries to keep running onwards.

The mass of the sidecar with its load is not evenly distributed over the motorcycle wheels. The sidecar wheel can carry a load of up to 300 kg (660 lbs). If only the motorcycle is braked, the sidecar tries to keep on running. The load on the wheel of the sidecar times the track width causes a torque which pushes the front wheel to the left, into oncoming traffic. The front tire only has a certain amount of adhesiveness which is quickly used up during braking because of the "need to track".

This means that you cannot use the front wheel for additional braking, and you only have the rear wheel brake - not a nice way to be. Under certain conditions and even with easy use of the brakes, the front wheel is pushed several feet to the left and the vehicle is turned broadside. There does not have to be ice, snow, cobblestones or loose gravel. It happened to me during my vacation with my first motorcycle without sidecar brakes on dry asphalt. The wider and heavier the vehicle is, the more this becomes noticable.

Note: Without a sidecar wheel brake you turn the front wheel slightly into the direction of the sidecar to stop in a straight line. This is the reverse of the starting procedures where you turn the wheel slightly away from the sidecar to compensate for the inertia of the sidecar. (JD)

You should ask yourself: In today's heavy traffic, can you really risk having to brake over 1,500 lbs of fast motorcycle and sidecar repeatedly with nothing but a rear wheel brake?

I say no way! The manufacturer of motorcycles with sidecars will sell his vehicle to anybody with the money. He does not know the riding experience of the buyer. He should also say "NO" for reasons of safety!

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How should the brake be constructed?

In earlier days the brake was cable operated. The cable had to be very long and was turned 180 degrees; nobody bothers with that today. The old Steib ATE brake cylinder is no more - it also had disadvantages.

EML uses hydraulics for rear wheel and sidecar wheel, or even for all three wheels. In a motorcycle with sidecar, where the entire brake system is from one manufacturer, this is okay. Under the conditions when I rode such a motorcycle with sidecar, it was outstanding. But that is the exception.

The general rule is still that some sidecar is attached to some motorcycle and the whole thing should be as cheap as possible. The technical problem is that the wheel load of the sidecar can vary between 88 and 1,320 lbs. The anti-wheel lock braking system capable of automatically evening this out does not exist for reasons of cost. Adjustment by hand is too unsafe.

At present, the safest method is to brake the sidecar only to the point where it is not being over-braked when empty. A brake force limiter takes care of that.

Tests are being conducted with TR replicas for equipping the sidecar with its own main brake cylinder. As in the MA, the lever for this cylinder is worked together with the lever for the motorcycle.

Note: J. Dodson solved this problem by using two trailing sidecar wheel brake shoes, versus one leading and one trailing in the brake plate. The sidecar wheel brake is strong enough to stop ONLY the sidecar, and will, by itself, not create enough friction to stop the vehicle at any but the slowest speeds.

As with all other details in connection with a motorcycle with sidecar, a final and foolproof solution of the brake problem is still in the future.

Dear Reader: if you have read the article about sidecar chassis with just a little bit of attention, you are probably now saying: All right, it is nice that somebody worries about this; but has anybody considered how the chassis of a motorcycle suitable for use with a sidecar should look? That appears to be very important!

Nothing exists in writing on this. But there is a manufacturer of sidecars who, together with someone from the Technical Inspection Service, tests motorcycle chassis. During the training courses for riding a motorcycle with sidecar at the Federal Motorcycle Riders Association you can always hear and see the latest developments in regard to motorcycle with sidecar construction.

THE MOTORCYCLE WITH SIDECAR

1. When is a motorcycle "suitable for sidecar use"? When was a motorcycle first fitted with a sidecar?

No one can pinpoint the exact year. Soon after the first motorcycles appeared, it became obvious that a solo motorcycle does not permit very much luggage and that a solo motorcycle is only suited to carry two persons at most. As a result a trailer was attached to it. Surely there must have been a reason for not putting the trailer behind the motorcycle, but next to it. Thus the "side carriage" or "sidecar" was created. It was now possible to carry three people and additional luggage on such a motorcycle with sidecar. The sidecar was also used as a freight carrier. In this manner it not only served the craftsman, but also served the Yellow Angels of the German Automobile Club with their KS and Konsul motorcycles with sidecars.

They used the side-box to carry tools. As a side effect of placing the sidecar to the side of the motorcycle the riding characteristics were totally changed, as was the loading of the motorcycle frame, the wheels and the wheel supports. These were changed in accordance with the side forces now appearing. This fact makes it difficult for today's "motorcycle and sidecar designers". However, we will discuss the technical details later.

Indeed, it has formerly been possible to attach a sidecar to almost any motorcycle, starting at about 125cc. Below 125cc performance is negligible; after attaching the sidecar the conveyance was simply too slow. But starting with 200cc (NSU, Lux, Triumph BDG, etc.) the motorcycle of the Fifties already was "sidecar usable". A 500cc with 23hp (BMW R-51/3) and sidecar was a heavy vehicle even then! During the post-war period, when the motorcycle was in demand as an inexpensive means of transportation, the sidecar also regained its place in the sun. People could appreciate the fact that three (or four) could ride together. In addition, the motorcycle with sidecar offered a certain amount of safety during the winter or in general during bad weather. Such a vehicle with its direct steering and therefore its direct contact with the road surface is always the safest type of vehicle if it snows or is icy in winter. As a prerequisite, the rider has to have mastered the peculiar riding charateristics of a motorcycle with sidecar.

2. Were the motorcycles of the Fities "suitable for use with sidecars"?

As far as the lawmaker (licensing authority) was concerned, a motorcycle is basically suitable for use with a sidecar if it has been released for such use by the manufacturer. Since there was a demand for motorcycles "suitable for use with sidecars", the manufacturers of motorcycles had of course a legitimate interest in offering their motorcycles as being "suitable for use with sidecars".

Curiously, and with a few exceptions, no manufacturers of motorcycles offered complete motorcycles with sidecars. Fitting was usually done by the seller of motorcycles or in the shop at home. Sidecars were available in the trade as parts, just like other accessories. However, the law did and still does require the construction of sidecars to be "in a licensed form". A manufacturer therefore has to obtain a design permit for his sidecars which is based on an evaluaton by experts. This is usually provided by a test station of the Technical Inspection Service of The Federal Transportation Office. In a few cases the licensing office will issue the design permit. It is furthermore required that the attachment of the sidecar undergo inspection by an officially licensed expert. This is also done by the test station of the Technical Inspection Service.

Formerly people liked to ride their solo motorcycle during summer - you can go faster - but for a vacation (because of the luggage problem) and in winter (because of safety), they attached the sidecar. In order not to have to register the sidecar with a test station of the Technical Inspection Service every time, the sidecar was registered as "optional" equipment.

Were the motorcycles of the Fities usable with sidecars?

Yes, and they are still usable today because they were released by the manufacturer for use with sidecars.

But were these motorcycles especially designed for use with a sidecar?

No! The demand by his customers for a motorcycle to which a sidecar could be attached, if so desired, forced the manufacturer of motorcycles to release his models for use with sidecars, if necessary with adjustments such as larger rear tires, installation of an auxiliary frame, etc. It is remarkable that not only were the motorcycles of that period "usable with sidecars", but so were the motor scooters!

Someone knowledgeable in motorcycles with sidecars will say that the engine output of the Fifties was correspondingly smaller. That is correct. The BMW R-51/3 with 23 hp or the Zundapp KS-601 with 28hp (up to 35 hp for the sport model) were the motorcycles for sidecars in the Fifties. The last classic motorcycle for use with sidecar, the BMW R/69S had an engine output of 42 hp.

3. Technical details of a motorcycle with sidecar

To approach the matter with a little more depth, it is necessary to deal with the forces acting on a motorcycle with sidecar. In contrast to a solo motorcycle, the following changed load factors appear:

1. Higher loads because of a higher allowable total weight.
2. Side forces during turns, which act differently during right and left turns.
3. Acceleration and deceleration forces because of

the asymmetric installation of the sidecar, i.e., which causes a different distribution of the dynamic wheel loading.

The designer must consider these three points when he release his motorcycle for use with a sidecar.

What happens to engine output?

The engine output is not one of the prime considerations when considering a motorcycle frame as "suitable for use with a sidecar". However, indirectly this does make a difference since a more powerful engine generally is heavier and can reach higher speeds. In order to better understand this proposition, imagine riding two motorcycles with sidecars of very different engine performance, but with the same actual weight and with the same speed around the same turn. The loads on the motocycle and sidecar frames are due to centrifugal force and do not depend on engine output at all. In both cases the equation for the centrifugal force is:

Centrifugal Force, $F = (m \times V^2)/r$

where:

V = velocity

r = the radius of the curve

m = mass of MC, SC, plus passengers

This is not quite true, since higher speeds are reached with higher engine output. Higher turning speeds also mean higher centrifugal forces with higher loads on the frame. Attainable turning speeds are limited by the chassis design and rider skill.

4. Are the motorcycles of the Seventies and Eiqhties "suitable for use with sidecars"?

The physical laws of the Fifties still apply.

How are the motocycles of today different from those of the Fifties?

The motor output has been increased and the motorcycles have become faster. The steering geometry is more and more directed towards satisfactory straight-ahead running at high speeds. One of the determinations for satisfactory straight running is a large trail. The greater the trail, the more satisfactory the straight-ahead running at higher speeds. An extreme example for satisfactory straight running are the choppers. However, such a great amount of trail is not useful in a motorcycle with sidecar! The restoring torque at the front wheel becomes too large and enormous force is needed at the handlebars to force the motorcycle with sidecar into a turn. A motorcycle with sidecar does not need nearly as much trail since it cannot reach the top speed of a comparable solo motorcycle anyway. The trail for a motorcycle with sidecar can be selected at a lower value while still attaining a satisfactory

straight-ahead performance at the speeds possible for motorcycles with sidecars. If it were possible to adjust (decrease) the trail of the solo motorcycle while using it with a sidecar then it would be possible to make the solo motorcycle "suitable for use with a sidecar". This has been done for some models. (See BMW rocker models and MZ ES models.) The change of trail was done by simply relocating the rocker arm forward, something only possible with a rocker fork - in this case embodied as a rocker with a long arm. Note: Rocker forks are the equivalent of leading link forks or of the Earles Fork type. (HAK)

Now the telescopic fork predominants for solo motorcycles. In such cycles it has some advantages over rocker forks, but the rocker fork definitely has the advantage in motorcycles with sidecars. In principle, however, the telescopic fork is also usable for motorcycles with sidecars, but its disadvantages become more apparent the heavier and faster the motorcycles become - mainly because of the trail required for solo operation. Solo motorcycles today have a trail of between 3.6" and 4.8". For satisfactory steering, coupled with satisfactory straight running in ordinary traffic, a trail of between 1.6" and 2.4" is required for sidecar outfits. Cross country and motocross motorcycles with sidecars have even less trail, but the straight running is correspondingly poor. In this case little consideration is given to satisfactory straight running - cross country riding seldom is straight ahead - more consideration is given to easy steerability in turns.

8. Motorcycle w/ SIdecar

It is not sufficient to attach just any sidecar to any available motorcycle and thereby make it into a motorcycle-sidecar combo. Now and then, and depending on the motorcycle and the sidecar, it might be possible. I consider the limit to be around 50 hp of engine output. The following examples are intended to show this; these manufacturers have released their production model motorcycles for use with a sidecar:

MZ 250 TS (17 hp), Sanglas 400F to 500S 2V5 (to 27 hp), Triumph 750 Bonniville and Tiger (to 49 hp), Ducati GT 860, GTS 860, 900S (to 70 hp), all models of Moto-Guzzi from 700cc on (to 70 hp).

All other manufacturers have not officially released their motorcycles for use with sidecars. Most motorcycles today are no longer "usable with a sidecar" in the form they leave the assembly line. It would be more correct to call these motorcycles "not suitable for use with sidecars in their form as production models". That does not mean that they are not basically suitable for use with a sidecar. It is important to remember that certain changes have to be made in order to make these motorcycles "suitable for use with sidecars". This is where the real problems start.

Which manufacturer today can determine what changes have to be made?

Who has practical experience and has made actual tests?

Who is cognizant at all of the problems connected with sidecar riding?

Does it pay to consider them, given the few riders of motorcycles with sidecars?

What changes in an available solo motorcycle would generally be reasonable or necessary to attain "suitability for use with a sidecar"?

1. Changing the trail: Since there is hardly a chance to change the trail of a telescopic fork, other forks could be installed or you could proceed to the next step.
2. Installation of a front wheel rocker fork, in which the trail can be reduced in a very simple manner by moving the rocker arm.
3. Installation of 15 inch car wheels, which has two immediate advantages. The motorcycle and sidecar are lower so the center of gravity is lower. Tire wear, especially at the rear wheel, is improved.
4. Installation of the sidecar: This is a point of increasingly greater importance because so many mistakes are being made here. We therefore would like to discuss this in more detail.

Installation of the sidecar and the manner of the connecting load to the motorcycle: curiously enough, these vital connecting parts are not subject to any special testing procedure. The respective specialist of the Technical Inspection Service can use his own judgement as to their being correct or incorrect. There are only suggestions in DIN 74 033 and 74 034, but these are dated back to 1935! The ball connectors previously used have proven themselves and can still be used today with heavy motorcycles and sidecars. The same goes for fork connections with adjustable struts. As to the material from which the connecting pieces are made it should be stated that they should, of course, be made from steel and should be designed accordingly. If welding becomes necessary, attention should be given to the rules of weldability and welding standards.

It is also important where the connection is made on the motorcycle frame. Previously there had been no problem with this since the vehicle manufacturers had determined the connection points as needed. In the BMW and KS 601 cycles, the rear balls had been welded on during production. Suitable connecting pieces were included with the sidecar. Today it is necessary to give considerable thought to the problem of how to transfer the side loads as easily as possible to the motorcycle frame. A study of engineering is not really needed for this but it would help. Welding to the motorcycle frame should be avoided under all circumstances - the manufactureres of motorcycles and the Technical Inspection Service do not like to see that! Why? Not even the man from the Technical Inspection Service can look underneath a welding seam, once it is made. Many mistakes can be made when welding. Keep you hands off it, unless you have the needed theoretical knowledge and practical experience.

We only have one possibility: The sidecar connections have to be made by clamping to the motorcycle frame! The most important question is: three point or four point connection? With smaller motorcycles and sidecars the three point connection was used because that is the best solution structurally speaking. Two ball connectors below and a diagonal strut form a triangle of forces. In the past the four point connection was already the choice in connection with heavy motorcycles, wherein the forces from the sidecar are transferred more easily to the motorcycle frame. All though this is not quite right struturally, the connection between the frames of the motorcycle and that of the sidecar should be considered to be flexible entities. Indeed, they are not rigid.

As a final choice a five point connection should transfer the forces even more easily to the motorcycle frame. With most of today's motorcycle frames it is possibile to install three diagonal struts.

The standard is, as it used to be: ball connections below, flat connections above. The lower ball connections have an advantage, they do not transfer bending forces. They only transfer diagonal forces, pulling or pushing forces.

In practice this means that the ball can operate in the clamp cup without danger of breaking. Flat connectors are sufficient for the upper connections, these are only stressed by pull or push.

8. Motorcycle w/ SIdecar

It is necessary to devote considerable thought to the manner in which sidecars are connected. You can hardly ask the motorcycle manufactures to do it, considering the small production numbers of sidecars. It would also be necessary to provide a special connecting diagram for each type of sidecar. Logically, the manufacturer of the sidecar determines the connecting points on the frame of the motorcycle; after all, he has to provide the correct connecting pieces! The makers of sidecars are, after all, the people who take the most interest in motorcycles with Sidecars and the ensuing problems. And they are the ones who often have good practical experience.

In closing, most motorcycles of the Seventies and Eighties are not "suitable for use with sidecars" in their production model state and are therefore rightfully not released by the manufacturers for use with sidecars in Germany. But here, too, there are exceptions. Small manufacturers still issue "Certificates of Safety for Use with Sidecars", for instance Motor Guzzi, Ducati, and Triumph.

The small Spanish firm of Sanglas has had a German test sample report prepared for its models, MZ offers a motorcycle and sidecar as a production model. In the case of Japanese models, certificates of safety for use with sidecars have only been issued in isolated cases and then only by their German representatives.

There are two reasons for this:

1. No help can be expected from the manufacturers in far-off Japan since no test runs have been made in respect to the "suitability for sidecar use" of the respective models.
2. Because of the relatively small n~r of motorcycles expected to be fitted with a sidecar, the issue of expensive test sample reports in Germany is not cost-effective.

Such a report or a safety certificate for use with sidecars is only demanded by the test station of the Technical Inspection Service! This means that in other European and non-European countries these Japanese motorcycles are altogether "suitable for use with sidecars". This is proven by a large number of Dutch, French, and English riders of motorcycles with sidecars. Basically, the following can be said about the "suitability for use with sidecars" of the Japanese motorcycles; from a purely technical point of view they can be suitable for use with sidecars, provided the following pre-conditions are met:

1. A stable double-loop tube frame with a well-built steering head section.
2. A stable rear wheel swinging arm and a stable support for it.

Basically, Japanese motorcycle frames are no worse in regard to durability, even if the looks of the welding seams often generate the wish for better workmanship.

Frames open at the bottom, such as the Honda CX-500 or CBX (6 cylinder) would not be suitable for use with sidecars in their production model state. Even though the Ducati models, released by the manufacturer for use with sidecars, have a frame open at the bottom, wherein the motor acts as part of the support system, a small auxiliary frame is needed for use with a sidecar, connecting the forward frame ends. The new Guzzi frames, starting with the 850 T, are considered to be the most durable frames for use with sidecars even though they have split frame trusses for the removal of the motor. Other frame models, for instance the BMW models /5 and /7, are not suitable for use with sidecars in their production model state because the rear frame is screwed on and it has not been designed to absorb the side forces occuring with the use of a sidecar. This is why these models, in their production model state, have been designated in their vehicle papers as "not suitable for use with sidecars" by their manufacturer, BMW. In spite of this, these motorcycles can be made "usable with sidecars" as shown in Dutch and French vehicles. However, the sidecar has been attached with the aid of an auxiliary frame.

Probably every motorcycle can be made "usable for a sidecar" - this is determined by the amount of technical and financial effort necessary. The final choice would be a new frame "usable with a sidecar", such as made by EML and HEGI for the BMW models /5 and /7.

"usable with a sidecar".

Let's first define the term "usable with a sidecar". There are two ways to look at this:

1. The usefulness for sidecar operation from a purely technical point of view, i.e., durability of the chassis parts, safety, and so on; and,
2. The usefulness for sidecar operation from a purely legal point of view, i.e., from the point of view of the licensing office and the Technical Inspection Service.

The German Licensing Regulations for Use in Traffic (StVZO) knows only the term "motorcycle with sidecar". The term "motorcycle/sidecar combination" simply is not included! Today, however, two kinds of "motorcycles with sidecars" are distinguishable:

1. "**Motorcycle with sidecar**" in its classic form, i.e., the solo motorcycle is provided with a sidecar without any extensive technical alterations. Such a "motorcycle-combo", not even optimally suited for opertion as a motorcycle with sidecar and especially not having the shorter trail necessary for such operation is a compromise. But it does have usable riding characteristics. After all, until the appearance of the BMW rocker models, all motorcycles were used with sidecars without a change in trail. The obvious advantage of such a "motorcycle with sidecar" is that it can be changed back into a solo motorcycle very quickly.

8. Motorcycle w/ SIdecar

2. "**Motorcycle/sidecar combination**". Some technical alterations are necessary with higher engine output - about 50 hp and above. Installation of a rocker fork in front, mounting of 15" radial tires as well as the installation of a steering damper and perhaps a sidecar brake. This combination of a motorcycle with a sidecar should be viewed as a unit and must be matched. Such a combination has been designed as such without compromise; solo opeation of the motorcycle is no longer possible. In exchange for that it offers optimal riding characteristics in use as a combo - the best solution from a technical point of view.

Summary

If someone interested in a motorcycle with sidecar looks in the market place for an available true "motorcycle/sidecar combination", he will find that not one manufacturer of motorcycles offer such a combination. A few exceptions are models from the East Bloc counties, such as MZ and URAL/DNEIPR, which as pure utility vehicles, should not be included in the category of the true motorcycle/sidecar combination, because they are only "motorcycles with sidecars". As far as the presently available MZ combination is concerned, opinions are divided as to its "usefulness with a sidecar".

You will have to rely on the combinations built by small and enthusiastic dealers by hand and in

single unit construction. It should be clear that, because of the small numbers, necessity for expensive test reports and measurements, prices have to be correspondingly high. Unfortunately, the buyer of a motorcycle with sidecar does not want to accept this. A price comparison with mass produced motorcycles available "from the rack" and "combinations" from the East Bloc countries does not come out favorably for small production models. Who can see, by looking at such a combination, what expense is required to have such a single unit - and all motorcycle combinations available in Germany are single units - licensed for use on the road.

Considerable technical effort is involved in a true motorcycle/sidecar combination which has to be paid for. The buyer has the s~eet agony of a choice between combinations in a price range between [IM 4,000 to IM 25,000.)

8. Motorcycle w/ SIdecar

Note:

1. Other factory sidecar units are available outside of Germany such as the Harley-Davidson. Harley-Davidson has produced sidecar units from 1911 to 2003 and beyond.
2. Adjustable trail forks have been fitted to telescopic front ends by Harley-Davidson and by HRD. It is possible to alter the trail of telescopic forks on almost any motorcycle by replacing the stock upper triple tree with a modified offset upper triple tree. These units are available from Doug Bingham. Another way to reduce the trail is to relocate the front wheelaxle ahead of the front forks and secured by a custom mounting brace.
3. Telescopic forks lack the structural rigidity of rocker or earles type forks (leading link forks). The rigidity of telescopic forks can be enhanced by fitting a front fork brace at the top of the lower fork legs.
4. No technical requirements are necessary in the United States for fitting a sidecar to a motorcycle. It is therefore of great importance that the sidecarist know and understand the principles contained in this manual. No state inspection office does. - HAK

MOTORCYCLE W/ SIDECAR & THE TECHNICAL INSPECTION SERVICE

What do we mean by a "production model"?

In Germany, the Federal Transportation Office at Flensburg issues a General Operational Certificate (ABE) for various types of motor vehicles licensed to operate in traffic in the Federal Republic and a General Operational License (ABG) for vehicle parts. The technical data are laid down in a test report by the test stations of the Technical Inspection Service concerned. Based on this test report, the Federal Transportation Office may issue an ABE or ABG to the manufacturer. The most important operational data, such as engine output and capacity, chassis number, tires, etc. are noted in the motor vehicle papers. This provides an opportunity to make sure that the data and the vehicle match during checks by the police. The vehicle is also checked to its "standardized" condition during the main inspection each two years at a test station of the Technical Inspection Service (or DEKRA test station).

As a rule, the ABE's of the various motor vehicles are on file with test stations of the Technical Inspection Service.

The law makers have prescribed that all changes on a vehicle or on a part of a vehicle subject to type approval, such as exhaust, steering, etc. are to be approved by an officially recognized expert or examiner for motor vehicle operation (aaS/P). The expert or examiner usually requires a test

report or a "Certificate of Safety for use" in regard to these changes from the manufacturer of the vehicle. If needed, a "Certificate of Safety for Use", issued by the importer, could also be permitted. The vehicle owner bears the burden of proof in all cases. He has to prove to the expert or examiner that the change he wants to make is approved by the manufacturer of the vehicle.

Since obtaining test reports means an enormous amount of money and time spent for a private person, BMW has developed a "Retrofit Catalog for BMW Motorcycles".

This contains all changes on BMW motorcycles approved by BMW. The retrofit catalog is on file with the test stations of the Technical Inspection Service as Specification No. 739.

The change is entered in the vehicle papers by the expert or examiner. The vehicle licensing office then licenses such a retrofitted vehicle. It can deny a license, giving its reasons therefore. He enters the change in the vehicle license. By this means a new operational permit is issued.

The basis for the vehicle tests are the "Licensing Regulations for Use in Traffic" (StVZO) and the "Vehicle Parts Regulation" (FTV). The expert or examiner is guided by these. Experts are the officially recognized experts of the Technical Inspetion Service (TUV). The changes can be expertly checked at any test station of the Technical Inspection Service by payment of a fee.

Legal consequences: The law makers have decreed that all unauthorized alterations made on a motor vehicle and resulting in a change of the production standards will result in the cancellation of the operational certificate (license) and also of insurance protection. Vehicles not covered by an operational certificate prototype, models or small production runs) have been marked with a key number 000 000 in the vehicle papers. These vehicles (or vehicle parts, such as sidecars) are inspected by means of a so-called "individual inspection", and the licensing office then issues a license for operation on the roads based on individual testing. These "individual inspections" Can be done at test stations of the Technical Inspection Service without limitation of numbers.

Licensing a motorcycle for use with a sidecar.

The motorcycle must be released by the manufacturer for use with a sidecar. If this is not the case, a remark is put in the vehicle papers to the effect that it "is not tested for use with a sidecar" or "is not suitable for use with a sidecar". In the latter case it has already been determined, in the opinion of the manufacturer, that the motorcycle is not suitable for use with a sidecar. In the former case, a "Certificate of Safety for Use with an Attached Sidecar", issued by the manufacturer, must be provided. The following should be contained in this certificate: manufacturer, type of vehicle, and chassis number. Technical data

must also be included, such as type of attachment (four point, three point), positioning of the connecting points, allowable total weight with use of a sidecar, top speed and other necessary alterations for use with a sidecar, such as change of the transmission, installation of heavier springs, etc. Further checks may be necessary which can be conducted by the test station of the Technical Inspection Service (hourly rates are fixed at about DM 45.00).

These may include extensive brake tests under different loads and hot brake tests, determination of the top speed, determination of the allowable total weight, and so forth.

It is up to the expert to license a motorcycle for use with a sidecar without having a "certificate of safety of use".

The following points are of special importance in connection with the licensing inspection by the Technical Inspection Service of a motorcycle with sidecar:

The allowable total weight is fixed by the vehicle manufacturer (see "certificate of Safety of use") or is determined by the expert or examiner. The data plate for the motorcycle (on the right side of the steering head) is changed accordingly or a second plate is affixed reading: allowable total weight with sidecar.

Sidecar connections are not subject to special manufacturing conditions although they are very

important connecting parts for a motorcyle with sidecar. It is up to the expert to pass on the suitability of the connections. Some manufacturers of sidecars supply the necessary connectors for the sidecar and motorcycle which are approved by the Technical Inspection Sevice.

Rules for the construction of sidecar connections are described in the DIN Standards 74 032 and 74 033 which date back to 1935! As a rule, sidecar connections should be made from steel. Aluminum (and durallium, too) should be rejected! As far as possible, sidecar connections should not be welded. Where welding must be done, the welded connections should be structurally formed in accordance with established welding techniques. Later inspection of a finished welded connection is always problematical - even the expert from the Technical Inspection Service cannot look beneath the weld. As a rule no welding should be done on the motorcycle frame. All connections to the motorcycle frame must be by clamps, screwed-on plates, auxillary frames, etc. Only qood quality bolts and screw securing devices (retaining rings, washers) should be used. The clamp handles of the clamp (ball connector) should be secured with small leather strips.

Transmission

Transmission (rear wheel or secondary transmission): In general, a higher numerical ratio rear wheel gearing is necessary for sidecar use. If it differs from the general operational certificate it must be listed as an alteration in the vehicle papers. The possible top speed of a motorcycle with sidecar depends on a correctly chosen transmission. Care should be taken to adjust the odometer for any change of transmission ratio if necessary.

Tires

Tires: Front tires generally remain unchanged. For the rear wheel, a tire of size 4.00 x 18 (or corresponding tire of low cross section) is usually required. Such a tire has the higher load capability (carrying capacity) necessary for use with a sidecar. For motorcycles with sidecars with a top speed of 100 mph, the tires can be changed to normal tires (so-called line tires) licensed for speeds of 100 mph. Such line tires are correspondingly cheaper than "S" or "H" tires.

With automobile tires of the sizes 125SR15 or 135SR15 and corresponding wheels, often used today, a certificate of safety for the use such tires in connection with sidecars is necessary from the manufacturer of the vehicle. A certificate, issued by the manufacturer of the wheels, is also necessary, guaranteeing the stability of his wheels for

use with sidecars. Since the rolling circumference is changed, the odometer must again be adjusted if necessary. In accordance with Paragraph 36(2a) of the Licensing Regulations (StVZO), a motorcycle with sidecar may only be equipped with either bias ply or radial tires. A mix of the two is not allowed! It is up to the expert or examiner to license a motorcycle with sidecar having mixed tires, since the difference between the different tire constructions has little effect on the asymmetrical motorcycle/sidecar combination.

Sidecar brakes

Sidecar brakes: For the past few years sidecar brakes have no longer been required, as long as the brakes of the motorcycle slow it sufficiently. In accordance with section 6 of paragraph 41 of the Licensing Regulations (StVZO), each operational brake must deliver a minimal slowing down of 8.2 ft persec with hot brakes and under full load. These values are always attained with disc brakes; with drum brakes, such as in the BMW rocker models or Moto Guzzi up to GT 850, a sidecar brake may be required. The adjustment of a sidecar brake is always difficult, but for repeated trips with a fully-loaded motorcycle and especially in rainy weather, it makes a lot of sense and is necessary for safety.

Construction and type of sidecar brakes is not regulated, it does not matter whether it is hydraulic or mechanical, a disc or drum brake, has a second brake lever or is combined with the brake system of the motorcycle. The only determination is the effect and the safe operation of the brake. A sidecar brake is required when a trailer is used with the motorcycle with sidecar (Sect 2,Par. 42 StVZO). Top speed is limited to no more than 40 mph when pulling a trailer.

Maximum weight that can be towed is equal to one-half the empty weight, plus 165 Ibs.

Steering damper

Steering damper: For motorcycles with sidecars, especially for solo motorcycles which have had a sidecar installed later and where the front wheel geometry (trail.) has not been adjusted for the particular use with a sidecar, the installation of a steering damper is highly recommended. This prevents low speed wobble which may occur in the lower speed range of about 13 to 20 mph.

In older motorcycles adjustable friction dampers had been routinely installed.

Hydraulically operated steering dampers may be retrofitted. The installation and operation of a steering damper must be inspected by an expert or examiner and must be entered in the vehicle papers.

Steering

Steering: Since steering forces while turning with a sidecar are considerably larger - especially with solo motorcycles with a subsequently installed sidecar, having a correspondingly larger trail - the handlebars must have a correspondingly minimal width. In general, a minimum width of 26.52" is required. Stub-type handlebars and the like are not suitable for use with sidecars. Wider handlebars will give more leverage!.

Lighting system for a motorcycle with sidecar in accordance with par. 51 and par. 53 of the Licensing Regulation (StVZO):

Brake lights

Brake lights: No brake light is required by the regulations for a motorcycle. A brake light may be installed on a motorcycle, but it is not required! A brake light is required on the sidecar if a brake-light has been installed on the motorcycle. If there is no brake light on the motorcycle, no brake light is required on the sidecar, in fact it is not even permitted (see Par. 53 StVZO, Sect. 2).

For reasons of safety, a motorcycle with sidecar today will be equipped with two brake lights. Exception: (in accord, with Par. 72 StVZO under Par. 53, Sect.2, first sentence) for motorcycles - with sidecars, too- licensed for the first time before July i, 1961, one brake light is sufficient, two are permitted. Color of the brake light: Red for

vehicles licensed for the first time before January i, 1983, brake lights with yellow light will continue to be permitted. (Par. 72 StVZO under Par. 53, Sect. 2) Running lights: Color-white, positioned on the right front of the sidecar.

Headlights

Headlights are not permitted on the sidecar.

Rear lights

Rear lights: Color-red, positioned on the right rear of the sidecar

Blinkers

Blinkers: Either a blinker in the middle of the sidecar and the motorcycle (vehicle length not more than 16-1/2 feet) or a blinker each at the front and the back. Color-yellow or red, but always in pairs either yellow or red. The wattage of the blinkers must correspond with the blinker relay, otherwise the frequency of blinking is changed.

Rear reflectors

Rear reflectors: Required at the right rear of the sidecar. Minimum area: 3.1 sq in. The corresponding diameter for round reflectors is 1.9".

General rules:

General rules: the lights and reflectors should always be installed vertically with respect to the road surface. All lights must be licensed parts! This is shown by a wavy line with an inspection

number or an "E" in a circle (European Standard). Japanese or English lights may not be used if they do not conform to the above standards. An "instruction sheet" must be included with every light available and licensed for sale. This sheet contains drawings and dimensions to show how the light is to be installed on a vehicle. The "instruction sheet" contains the statement: "Installation or attachment of the light must be done in accordance with the enclosed sketch and must be inspected by an officially recognized expert during the the inspection of the vehicle, Para. 20 of the STVZO, or the individual inspection under Par. 21 of the STVZO, or during inspection under Par. 19 of the STVZO, by an officially recognized expert or examiner. The validity of the type licensing depends on this. The extent of the inspection should encompass all data on the sketch which is important in connection with the functioning of the light. When retrofitting, the vehicle owner must request a revised license for the vehicle from the appropriate office (licensing office), while submitting the report as to the conformance of the vehicle with the regulation (Par. 19 STVZO)".

Fees for Technical Inspection Service:

Fees are federally set. As of 1980 they were:

Single Inspection of a motorcycle sidecar

(Par. 13 FTV and Par. 22a STVZO) [IM 59.50

Entry of a sidecar in the vehicle papers

(Par. 19 STVZO) [IM 21.30

Entry of different wheels or tires in

(Par. 19 STVZO) [IM 21.30

Entry of a fairing, handlebars, etc.

(Par. 19 STVZO) [IM 21.30

Repeat of the inspection (within 4 weeks)

EM 5.30 or EM 7.10

Note: No special testing of the sidecar is required in the United States except as required by State authorities for the motorcycle itself. This applies to lights, horns, brakes, exhaust system, noise regulations, emission controls, and so forth. Changes to the motorcycle, such as changing the trail, changing the transmission ratio, changing the tires or wheels, fitting a steering damper or other modifications are left entirely to the descretion of the vehicle owner. - HAK

A CRITICAL LOOK AT THE SIDECAR

If you are looking for a motorcycle for a new combination you will find only a small selection available. Sidecars are available for a multitude of requirements.

You should not choose your sidecar for its rakish appearance. That you can only appreciate as long as you are standing next to it. Once you are seated on the motorcycle, you can no longer see the form of the sidecar. To transport that sale of pork loin from the supermarket or your tent, that rakish appearance will cause no difficulty. But, if you want to stow your two cases of beer, you might have some small problems.

Bigger problems might arise when you take your beloved or spouse and child for a ride. She stands in front of the rakish car, probably does not weigh more than 110 lbs and was never any good at gymnastics. She is willing, gets in, and takes the child on her lap. You like that and take off. As soon as she has settled the child, she has time for contemplation: Why is it that manufacturers of motorcycles grant their customers a spring travel of more than 4", while designers of sidecars are of the opinion that it is good to torture the vertebrae! But your darling - she will be sitting there for a long time - first stretches luxuriously. That is, she would like to, but she hits her elbow against the side. Why is there no arm cushion? The distance to the wheel is 4". Why is there only room for the air rushing by? Steib already did that !

As it happens in summer, there is a warm rain and water forms in the driver's seat. The driver stops. "Please get out, I have to put on my rain gear! Here, hand me the little one, I'll put him down in the grass for the time being."

Mama, child, and seat are removed from the sidecar. That makes it simple to take the rain gear out of the luggage space. The best you can do with such a design is to test the mettle of your passenger; it does not correspond with the state of the art.

What should be considered in choosing a sidecar? Never think that your sidecar will only be holding your duds. It always happens that people will ride with you. People take long trips these days. It is more pleasant for the rider when the springs of motorcycle and sidecar match.

A good suspension requires some expense; it cannot be replaced by rubber elements which will age, or by trailer axles. The spring travel of the sidecar does not have to be so long. But, it has to retain its full length under different loads. An air-assisted strut or a torsion bar with shock absorber is suitable.

You cannot have too much space in a sidecar. It always comes in handy. The distance between the right leg of the rider and the inner edge of the sidecar wheel in an average combination is 30.42". About 2.3" are needed for the spring strut and a little distance from the tire. The rider

should have a clear space of 2.76" next to his leg. If you deduct 0.39" on each side for the thickness of the wall and insulation of the sidecar, 32.7" remain for the passenger. Why don't you measure the sidecar of your choice?

You cannot expect that someone, who sells twenty sidecars a year, takes them into a wind tunnel and squeezes out a drag coefficient value of 0.4. But unused space between sidecar and sidecar wheel, through which only the air whistles, can be avoided. To make the nose of the sidecar very tapered only leads to your legs falling asleep. The frontal area, on which the air resistance depends, remains.

You need a height of 35" to accommodate a seated adult; this can also be utilized for stowing luggage. A luggage space accessible from the outside is not asking too much. Even Steib was able to construct a water-proof flap.

You cannot do without a windshield and a cover. A wet air mattress is only unpleasant, but you cannot expose your wife and child to the rain. It is possible to make a cover usable for going on vacation with small children. Added to this should be a windshield wiper and a chance to get in or out without unusual contortions. There are manufacturers of sidecars who recognize these problems and try, taking small steps, to do what is technically possible.

10. Critical Look at the Sidecar

Do you have an idea of how many hours of labor are involved before the smallest change is ready for production? And how long it takes before this can be recouped through the sale of a corresponding number of vehicles?

Everybody knows that you can spend up to DM 12,000 for a motorcycle, but for sidecars everybody likes to consult the 1954 Steib price lists. All sidecars manufactured in Germany are made by hand only! What is the hourly rate in a shop?

Before you buy a Fifties-style sidecar for an enormous price, consider:

A Steib LS200 was designed for a motorcycle of 13 to 17 kW power output, an S 500 for up to 26 kW. That as all you could get in those days. Even so it was possible to "rip up" an S 500 mounted on a KS.

It is up to you what you are going to ask of your passenger, and there are strength limits to size 32 frame tubing - especially when it has started to rust from the inside. No one considered, when designing it, that a sidecar would last 30 years. I have seen some problems during the last few years with these antiques, especially when they were connected to heavy motorcycles. Furthermore, there are officers of the Technical Inspection Service wise in the ways of the world, who will reject an LS 200 on a Guzzi.

CONNECTING THE SIDECAR

i. Connecting the sidecar

You have a motorcycle that you are sure that a sidecar can be connected to it. Before you spend even one cent for connecting parts, write a letter to the office of the Technical Inspection Service of your choice. Explain what you are about to do and you would like to have their advice in order not to break any regulations.

After a suitable interval, you will receive an appointment with a gentlemen who has studied the problem "Attachment of a Sidecar".

Take all documents needed to show the suitability of your motorcycle for the attachment of a sidecar. You should prove to the gentleman that what you intend to build is correct. If you can convince him, he will say "Yes", then you can build. But remember: an oral approval is no stamp from the Technical Inspection Service! It is not possible within the space of this pamphlet to give exact instructions for attaching all kinds of sidecars; we can only offer general tips.

A sidecar should be attached at four points to a motorcycle of more than about 20 hp. BMW prescribed that when they still built motorcycles suitable for sidecar use. The same was done in 1967 with the first Guzzi V7. Guzzi did not prescribe anything. It was no different with the new Guzzi models. When there were quite a few Guzzi motorcycles with sidecars, but still no general

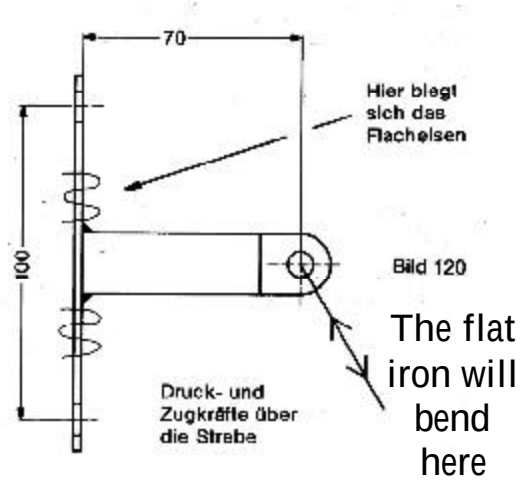
operational certificate, Guzzi took a look at the connection parts- after much persuasion.

They were satisfied with design and construction and described the attachment of a sidecar in more detail in the "Certificate of Suitability for Sidecar use of December 2, 1977".

There is seldom a chance to connect an attachment part to a modern motorcycle, even one declared to be suitable for use with a sidecar by the manufacturer. It is not advisable to weld ball pins or sleeves for flat bolts to the thin and high-grade frame tubing. If the frame tubing appears to be rigid enough, you will have to attach the parts with clamps. Clamps are available in all sorts of designs and all sizes. If that does not work, you will have to use plates with ball pins welded to them. If even that does not work, auxiliary frames are needed.

Before starting, consider how you will make the several connections and which parts are best suited for this. This will save you making unnecessary mistakes.

Select flat and ball pins, as short as possible. I once saw a 2-1/2" bolt welded to a 0.2" x 1.17" piece of flat iron. It was a Guzzi, distance between screws about 4". The flat iron was bent; in left turns the bolt turned up, in right turns it straightened out again. See over.



Pushing and pulling forces on the strut.

If you use flat bolts for the lower attachments, put them vertically and at right angles to the axis of the motorcycle. They are to act as hinges when adjusting the leanout, otherwise there will be bending tensions. Screws of the type M 12 x 40 should be used in the connection between flat bolt and fork head. But since, in accordance with DIN, they have threads up to the head, these threads become stripped very quickly. It is better to use longer screws and washers. A thread cutter needs to be used on 8.8 type screws to lengthen the thread. Then it seems to be better if you buy size 40 screws with a thread length of .66". You can get these from the manufacturer of the connection parts.

You start the attachment at the lower part of the back frame. You will already have to consider track width and sidecar wheel lead. At the front lower connection the toe-in will have to be set. Since it may easily take an afternoon to adjust two flat bolts correctly, you are better off to use balls at the lower mounts for the motorcycle. The tubing to be welded to the ball mouth has at least one bend. If you do not have a bending machine, it is easy to flatten the tubing or to weaken the wall. We have a broken piece of tubing of this kind here in our shop. If, for an old sidecar, you need to use tubing of size 27 or smaller, which sometimes has to be bent twice, solid material is easier to work and safer.

At the third connection, the one under the seat, the most important point should be noted: There are sidecars which invite you to connect all attachments to the left frame tubing. Riders of motorcycles with sidecars have cxxne to me, especially after IFMA '80, who have had difficulties with this. Because of these damages I want to warn you: Connect at least one strut in such a way that a triangular connection (dotted line) results! Attach the upper struts at an angle of 90° to the longitudinal axis of the motorcycle! This is of special importance with "soft" sidecar frames; otherwise the frame can get even more twisted. To make it absolutely clear: An S 500 does not belong with a Guzzi!

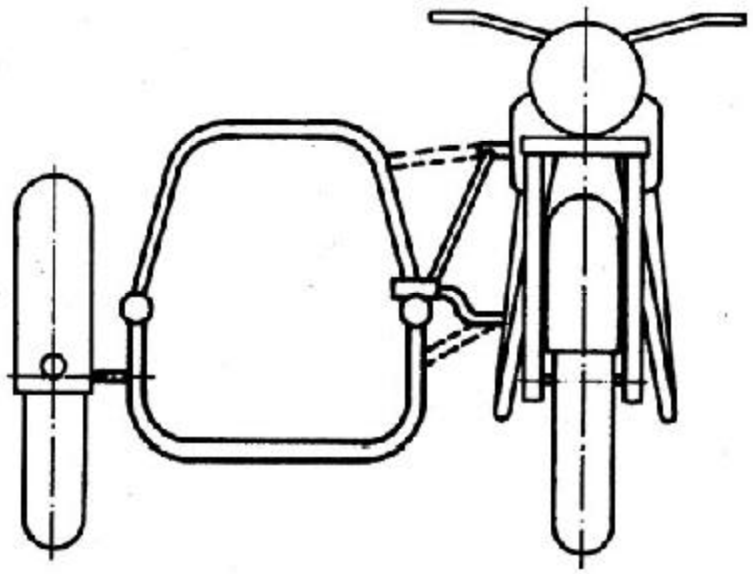


Bild 111: So muß ein Seitenwagen angeschlossen werden: **Eine** Strebe **muß** - wie gestrichelt - an einem Rahmenverbindungsbügel besfestigt werden.

Even if this has been done by a skilled shop, do not accept this!

1. The clamps can twist on the tubing which results in lean-out changes. The motorcycle and sidecar can become undriveable in seconds.
2. The struts are loaded with bending forces.
3. The left longitudinal tubing of the sidecar, already heavily stressed, is additionally subjected to torque forces.

11. Connecting the Sidecar

If you have a small motorcycle with sidecar, you may think twice about the necessity of attaching at four points. According to geometry, three should suffice. However, it can be stated that the frame tubing of most sidecars is too thin and therefore oscillates. I was able to measure that once on a Guzzi Falcone; the left piece of longitudinal tubing fluttered to the extent of 4 to 6", and that at 20 mph! This helps neither the tubing nor the riding quality.

The most important reason, then, for the fourth connection is safety. Into every design there are incorporated safeties for extraordinary loads and unforeseeable faults in the material. Since the actual chassis loads are unknown, especially for a motorcycle with sidecar, you should not skimp with this.

What good is it when the manufacturer of the sidecar offers a calculation for the stability of his chassis? If this is to mean something, it would have to be made after attachment, together with the motorcycle! Who has the necessary experience with this? And who is ready to pay for it?

You will not believe how easily it can happen in the dark that you place a ball mouth not behind the ball, but on the thickest part of the ball. With three connections you will notice this only when the sidecar disengages during the trip. Then it is too late!

If the upper connection (mostly near the seat) is well placed, the lean-out can be set by means of a worm-gear spindle easily, correctly and immovably, so that the motorcycle and sidecar run straight. The last attachment is the fourth connection. Never use a ball mouth for this since it cannot be adjusted to be tension-free at the fourth connection! Now you can attach everything else, such as brake, stabiliser, steering damper, lights.

This sounds easy. If you use appropriate parts, it is. If you do not have them, go to a place that builds every part and attaches every type of sidecar. They have a large inventory of semi-finished and finished parts, many years of experience and the machinery and the material to make the needed part quickly. But- every inventory has its limits. If someone needs connecting parts for a '37-model Condor and a left-side sidecar he cannot expect to find them in their original package on the upper right shelf. There are three possibilities to obtain such parts!

i. Take motorcycle and sidecar to the shop.

2. Make drawings.

3. Ask the company.

For problems with motorcycle and sidecars, you can also try the Federal Motorcycle Riders Association Section for riders of motorcycles with sidecars. They have much material and experience and know people who know even more. Their telephone number is 02 02/74 09 83.

11. Connecting the Sidecar

MAKING A FAST TRIP

Most riders wish for a large and fast motorcycle with sidecar but only a few know that you can make very fast and extensive trips with a small one.

For many years my wife, our three children, and myself, took trips on a ZUNDAPP motorcycle with sidecar and a MAICO solo motorcycle. The children grew and were no longer easily seated on the motorcycle during long trips. We therefore bought a car and I kept the MAICO for solo riding.

At that time we lived outside of town and, since my wife can neither drive a car nor ride a solo motorcycle, the day arrived when she offered me the choice: "You either buy me another motorcycle with sidecar or you can do the shopping yourself from now on!".

I bought an MZ ES motorcycle with sidecar with the sneaky thought: the small motorcycle with sidecar is enough for Mama to do her shopping, and I can ride the MZ solo. I did not believe, at that time, that it would be possible to have a nice motorcycle/sidecar operation with only 19 hp.

But after the first 300 miles or so, when the motor freed up, I had to adjust my premature opinion. If the motorcycle with sidecar carries only the rider, you can ride fast in town, especially on narrow streets.

When I washed it the first time, my friend Hartmut appeared with his NORTON. He opened the sidecar of the MZ and was amazed by the space. "That is big enough for my large leather case!".

"What is the connection between me and your case?" I asked.

"Simple", he said. "Both of us have vacation time coming. Come on, we'll go to Czechoslovakia for the cross-country six-day race at Spidleruv! I'll ride the NORTON with Petra and you ride your motorcycle with sidecar and take my case along."

I liked the idea and begun to calculate: If I were to visit Czechoslovakia, I might as well visit relatives in my old hcme, The Altvatergebirge. From Remscheid the distance is 800 miles - a little far for a short vacation. My first day of vacation was Thursday. If I would start at 2 o'clock in the morning, I could be there in the evening. I could spend Friday with my relatives and on Saturday I would have to back-track to the West 235 miles to Roudnice, to the North of Prague. Hartmut and Petra would start in Remscheid on Saturday. At 4 p.m. we would meet at the station in Roudnice, spend the night and would ride together to Spindleruv on Sunday, where the six-day race began on Monday.

I left at 2 o'clock as planned with the large case and my own luggage. After 63 miles the first mishap: the red warning light came on. The battery quickly lost its power and I made the rest stop at

Siegerland with the last spark. Remove the sidecar, investigate. There, the wire from the carbon brush had been torn off!

No spare, no chance for repair. There was not much I could do here during the night. I did what was best in this situation. I lay down in a quiet corner and tried to sleep after connecting the battery to the battery charger at the service station.

The ABOSCH service in Siegen did not open until 9 a.m. Of course, they did not have a suitable carbon brush on hand, and I reduced a larger one by filing it down. By 11 a.m. the generator finally generated juice and the sidecar was quickly re-attached. My wonderful schedule was not without meaning since I had lost seven hours.

The new schedule: If I stay overnight on the way, I will reach my relatives on Friday afternoon and will have to leave for Roudnice on Saturday morning again. That was not worth it! I will therefore have to do the whole distance non-stop. That meant 300 miles of Czech roads at night - an endless "pleasure"! And probably no gas station open. I will have to carry gas.

The engine now had 800 miles on it and was completely broken-in. I got to the border as quickly as possible by way of Gersfeld, Bad-Neustadt, Coburg, Bad-Berneck, and Schirnding. I reached the last German gas station at 6 p.m. So far, motorcycle and sidecar had used over 2 gallongs for each 65 miles - a lot for a 250 cc motor.

12. Making a Fast Trip

Assuming that I will be able to gas up in Prague for the last time, I will need almost 5 gallons of gas to reach my destination. Since the MZ tank holds almost three gallons, I bought a gallon gas can and filled it.

I had some bad luck at the border. A large bus in front of me delayed me another hour. It started to get dark-very quickly at 7 p.m. If I rode faster than 40 mph the warning lamp would flicker (a carbon spring has burned through). But you cannot ride any faster at night on these roads. There are too many road construction sites and too many unlit vehicles.

Shortly after passing the border I found an open gas station and topped off my tank. Twenty miles this side of Prague someone was trying to push-start his car. I helped him and he asked whether I would ride ahead of him to Prague. He could drive without lights and save his nearly flat battery or else the car would stall again. He would show me an open gas station in Prague.

We shared the tiny light of the MZ. I had disconnected the sidecar illumination, brake lights, and parking lights to save my generator.

The gas station attendant in Prague asked "Kolik" (how much). Based on past experience I figured 2-i/2 gallons. It was useless to explain that the motor needed a mixture of 1:33. I let the attendant pour half a quart of viscous oil in the tank as he used to do with the JAWA. I was surprised

that it took only I-1/2 gallon to fill the tank. The MZ had not used more because of the slow driving. It pays to be familiar with your vehicle.

It was now 10 pm. The traffic in Prague was like that in Dusseldorf. Now what?

All of a sudden the MZ ran as if all the rollers had dropped out of the connecting rod bearing! A bang at every revolution! I had to keep the engine revved or it would stop.

Should I try to make it home with the broken bearing?

Uneasily I looked around. Behind me was a huge, impenetrable gray cloud! I had fogged in the whole of Prague!

The scales fell from my eyes. The thick oil had not mixed with the gas and had fallen into the carburetor practically as a "clump".

The police were already there. The fog was too thick, even for Eastern conditions. I tried to explain the matter to the keepers of the peace and finally succeeded. They found an empty can (mine were still full). I took gas out of the tank and poured it from the can and back so it would mix. The officers helped me to push-start the motorcycle and, thank God, the thick smoke stopped.

Now occurred what always happens in Prague - and in all big cities of Europe. I could not find any sign pointing out the direction of my travel to "Hradec - Kralove". I got thoroughly lost!

12. Making a Fast Trip

At 1 o'clock in the morning I found a bus driver counting his money and he was very cautious when I spoke to him. He showed me on the map where I was. I had gotten to the South of Prague and it was comparatively easy to get to the Northeast.

The streets were empty - time to think: You have now been on the road for 24 hours, had troubles, but you are still fairly fresh. If you deduct the many delays, the cruising range is very good for 14 k W! On the ZUNDAPP motorcycle with sidecar my shoulders would be sore by now. The good performance was therefore possible only because of the chassis! The MZ sidecar was especially designed for the ES chassis. It has very soft springs and a spring travel of about 3.2". The combination is kept upright with a cross stabiliser. Steering was very easy because of the short trail of the front wheel rocker. This saves the driver and keeps him fresh. This way you can travel even long distances safely and without discomfort.

The connection between chassis, riding comfort and riding safety is old hat (Carl Hertweck knew this 30 years ago), but apparently this has been forgotten by the designers of todays motorcycles !

Later, in the mountains, I had to fight dense fog. From time to time I had to shine my flashlight on the road signs in order to find my way. But around 5 o' clock I had reached my goal.

Since then I have travelled over 65,000 miles with the MZ motorcycle and sidecar, and I have undertaken several "forced trips".

You can make extensive and quick trips even with a small engine output. The vehicle, the motorcycle with sidecar, has to be "right". In addition, good preparation is necessary. A strip map is essential, so that you do not have to spend too much time looking at the map, even on a trip over a distance of 650 miles. Spare gas and two-cycle oil in the sidecar reduce the number of gas station stops. If you carry food and drink for a day, you can save much time, trouble and hunger. The only thing left to desire is a motorcycle with sidecar which needs no repairs on the way.

You can educate an MZ to be that!