

NOSTALGIC MOTOR CARS UNLOCKS THE HISTORY & MYSTERIES OF THE 1963-1985 AVANTIS

Brake Fluid

What do you have to do to convert, or restore a non ABS-brake system to DOT 5 silicone brake fluid?

I have heard and read for many years, that DOT 5 Silicone brake fluid is not compatible with DOT 3, DOT 4 and DOT5.1 brake fluids. There are a variety of opinions on how to convert a system that has DOT 3, DOT 4, or DOT5.1 or restore a system that has a mixture of DOT 5 silicone with DOT3, DOT 4 or DOT 5.1 to DOT 5 silicone.

The opinions vary, from taking the entire system apart and cleaning everything with alcohol, and then install all new cylinder parts. Others state that you can flush the system with alcohol, before installing DOT 5 silicone brake fluid.

The others state you have to replace all they cylinders with new ones after the system was flushed with alcohol.

According to the information I have, DOT 5 silicone brake fluid is compatible with DOT 3, and DOT 4 brake fluids. I will let you read it and then you can make up your own mind.

My practice, since 1976, per Avanti Motros instructions, to convert a non ABS brake system to DOT 5 silicone brake fluid or restore a system that has a mixture of DOT 5 silicone brake fluid, with DOT 3 or DOT 4 brake fluid, is as follows:

First remove the brake fluid from the master cylinder. Clean the inside of the master cylinder with a clean, lint free, cloth. Fill the master cylinder with purple DOT 5 silicone brake fluid. Then bleed the system until you get purple DOT 5 silicone coming out of the system at all the bleeders. If you have concerns of trace amounts of DOT 3, Dot 4 or DOT 5.1 in the system, then just re-bleed the system following the same procedure, at a later date.

I am not instructing you on how to convert or restore a brake system to DOT 5 silicone. I am only trying to supply you with information that you might not be

BY DAN BOOTH

NOSTALGIC MOTOR CARS

Dan Booth has over 46 years of exclusive, hands on Avanti sales, service, collision and parts, not Studebaker cars or trucks, just 1963-1985 Avantis.

aware of, that was supplied to me, by Avanti Motors. So you can decide what's best for you.

There seems to be a lot of rhetoric and confusion over the use of DOT 5, silicone brake fluid, in the Avanti community and other older cars and trucks. Some of these articles state DOT 5 silicone brake fluid is not compatible with Dot 3 or Dot 4, both of which are glycol-ether based brake fluids. To confuse matters more, there is now a DOT 5.1 brake fluid, which is synthetic-polyglycol based. Some of the advantages of DOT 3, DOT 4 and DOT 5.1 is price. It's less expensive than DOT 5 silicone brake fluid and much easier to find. The two big disadvantages are they will attack the paint finish and they absorb moisture. This absorbed moisture lowers the boiling point of the brake fluid. but the big problem is the absorbed moisture can lead to rust in the bore of the cylinders, and lines.



Some of the advantages of using DOT 5 Silicone brake fluid, it does not attack the paint. It has a higher boiling point than DOT 3 or DOT 4, but the biggest advantage is it does not absorb moisture. It acts as a weather barrier for your brake system. Some of the disadvantages of using DOT 5 silicone brake fluid ; availability, its still somewhat hard to find. It seems to not have a odor, like the other DOT fluids. You may also experience a little softer pedal. By far is the cost, which has always been more than DOT 3 and or DOT 4. It use to be 4-5 times the cost over DOT 3. But never from Nostalgic. We have always sold in at a very reasonable cost. The initial additional cost is more than justified, as you should not have to have master cylinders and or wheel cylinders bored and sleeved or have to replace them, due to rust.

I don't mix DOT 5 silicone fluid with DOT 3, DOT 4 or DOT 5.1. If a vehicle has mixed brake fluid, I normally change it to DOT 5 silicone as I don't want rusted cylinder bores, that may show up later. I have switched most of my personal vehicles over to DOT 5 silicone since 1975, when Avanti Motors introduced me to it. I have never had to replace a wheel cylinder on any of those vehicles.. The master cylinders are a different story, they seem to have a shorter life. No matter which fluid is used. They simply go to bypass (brake pedal will slowly go to the floor) Most likely from dirt, turned seal and/or the seals just wear, or dry out.

Avanti Motors purchased DOT 5 silicone brake fluid from Dow Corning, in 55 gallon drums. They informed me in 1975 that they were now installing DOT 5 brake fluid in the new Avantis. I could purchase it from them for service. It was impossible to find anywhere, in 1975

I have always sold a lot of DOT 5 silicone brake fluid, normally in quart (32 oz.) bottles. I would purchase in very large quantities, to get the price way down and pass on the savings to my customers. This helps attract new customers and reward my existing customers. I

now sell it in 12 oz. bottles. It's easier to find in 12 oz. bottles, and easier for you to compare prices to to others who are selling it. **You should instantly recognize its a real bargain at \$7.00 per 12 oz bottle, compared to \$11.00 - \$13.00 like others sell it for.**



12 oz. DOT 5 silicone brake fluid \$7.00 ea.

Avanti Motors most likely switched to DOT 5 silicone brake fluid for safety reasons, which is heat generated by the front rotors. From what I have read, front rotors could get to temperatures of about 400 degrees and that is probably for the ventilated type, which came in about 1965 on the Corvette. The non ventilated style, like Avanti used from 1963-1983, would possibly have a higher temperature.. Since the dry boiling point of DOT 3 brake fluid is about 400 degrees fahrenheit, and DOT 4 is about 450 degrees fahrenheit. The wet boiling point (brake fluid which has absorbed moisture) is considerably lower. Avanti Motors engineering most likely thought that the boiling point of DOT 3 brake fluid wet or dry was a to the close to the temperatures their front rotors might climb to. The Dow Corning DOT 5 silicone brake fluid, dry boiling point was about 500 degree fahrenheit. There is no wet boiling point for DOT 5, since it doesn't absorb moisture. The DOT 5 also minimizes the rust problems that might develop as the brake systems with DOT 3 absorbs moisture.

The DOT 5 silicone brake fluid could also prolong (which it did) the service life of the brake cylinders and lines for it's customers.

Avanti Motors was the first ,if not the only, American automobile company to use DOT 5 silicone brake fluid in their new car production. This started in 1975, or 1976 and continued through to the last 1985 produced. I have no knowledge of what Kelly or Cafaro used

From 1975-1985 Avanti Motors installed an informational warning sticker on the top of the power brake boosters. Which sadly, nobody seemed to read or know what DOT 5 brake fluid was, back in the 1970's, 80's and etc.

If you read the DOT5 sticker, you will notice nothing was stated of not being compatible with other brake fluids. They did instruct you to "use only DOT 5 Fluid", but no mention that DOT 5 was silicone. The 1975 Avanti owners manual in the brake system section , on page #14, states only Heavy - Duty brake fluid should be used." Most of the 1976 owner manuals state in the brake system section on page #15 " when adding brake fluid to the system, use a silicone brake fluid only"

WARNING: Clean filler cap before removing. Use only D.O.T. 5 fluid from a sealed container. Do not allow water into reservoir.

N.O.S. DOT 5 sticker \$4.00



is usually yellow or amber, DOT 4 is light blue, and DOT 5 silicone is purple and DOT 5.1 is clear to amber.

Since the late 70's, when I removed the master cylinder lid, on some Avantis that had been serviced by somebody else. I would not see a clear liquid in the reservoir, but a murky liquid. If you put this murky liquid in a clear container, it looks very strange. It looked like a lava lamp, you could tell it was a liquid, suspended within a different liquid. I converted them back to DOT 5 silicone fluid.

First I would like to start out with stating I am an avid collector. I still have my very first car, which I have owned for over 63 years, last October. I am also a real advocate of the use of DOT 5 silicone brake fluid in old cars and trucks. It does exactly what it's supposed to

do. It stops the vehicle. It doesn't seem to evaporate from the master cylinders of vehicles that aren't driven much. but above all it does not absorb moisture.

I have never experienced a brake problem, on my personal cars or the cars I serviced as Nostalgic Motor Cars from the use of DOT 5 silicone brake fluid. This included the cars that were not originally born with DOT 5 silicone brake fluid that I converted to DOT 5. Other than an occasional master cylinder, which seems to be the norm. Even the Avantis that came in for any type of service. When I would check the level of brake fluid in the master cylinder. I might notice that DOT 3 or DOT 4 had been mixed with DOT 5 in the master cylinder that originally contained DOT 5 and still had the DOT 5 warnings sticker on the top of the power brake booster.

When I drive these Avantis with mixed brake fluid in the master cylinder, I didn't experience abnormal braking.

The owners manuals, from 1977 up through 1983, stated basically the same thing. 1984 Avanti Owner Manual on Page #19 states "Dow Corning silicone fluid- DOT 5"

But on page #35 recommended fluids and lubricants brake system " Delco supreme II Fluid, (which is DOT 3) fluid" The 1985 Owners manual is the same as the 1984 Owners manual.

No warning of Dot 5 silicone fluid not being mixed with other DOT fluids.

From what I have read, DOT brake fluids are color coded. DOT 3

When I would bring this to my customers attention, they were unaware of the mixture of fluids, but experienced no abnormal braking. They would normally say it has been that way for years, since their last brake job by other shops. I converted them back to DOT 5 before they left.

This article for "Nostalgic Motor Cars Unlock the History & the Mysteries of the 1963-1985 Avantis." Curiosity was getting the best of me. I decide to take the front wheel cylinders apart on 3 different Avantis, all three Avantis had their factory correct brake parts intact. The one that did not have DOT 5 silicone brake fluid in the master cylinder. All 4 front wheel cylinders had rusty bores and would have to be sleeved or replaced. The one with DOT 5 silicone in the master cylinder were all perfect, no rust at all, to my surprise the one with a mixture of Dot 5 and what ever other type of DOT 3, 4, or 5.1 the cylinders were not pitted. I have no idea how long the mixture had been in the Avanti. The owner said probably forever.

Avanti Motors always kept me well informed, of things that might need attention. They never sent out a letter to explain, what they need me to do. They just called me , out of all the phone calls to and from Avanti Motors, there was never once a phone conversation about DOT 5 being mixed with DOT 3 or any other DOT fluids that caused a braking problem and not being compatible.

I also never heard of any Avanti with DOT 5 silicone brake fluid that also had DOT 3 or DOT 4 silicone brake fluid mixed together in the same braking system ever have a braking problem failure. If Avanti Motors would have been aware of such a problem. They surely would have made it public information. Now for the over 46 years that have past without, to the best of my knowledge, any Avanti ever experiencing a braking problem from Dot 3 that was mixed with Dot 5 has ever occurred. You might ask yourself why didn't Avanti Motors know

about the compatibility issues. To answer that question, I have included some copies of original material sent to Avanti Motors by Dow Corning, in 1975. Which I then received from Avanti Motors. To save space for the Avanti Magazine. I will only include part of some of this brochure. 1st a simply beautiful brochure, published by Dow Corning, containing 12 pages (includes both covers) page 3 is the only page significant to this article.

MATERIALS NEWS

from DOW CORNING / Sept./Dec. 1975



Silicone brake fluid on the road with Avanti—p. 3

Please note the paragraph I have highlighted, on page 3, below.

Avanti specifies new brake fluid, other silicones on production cars



Avanti Motor Corp., South Bend, Ind., is the first OEM automotive customer to specify silicone brake fluid.

Improved quality and greater reliability were the major reasons for the switch from traditional brake fluids, according to Avanti spokesmen. Although Avanti hand-builds only 150-175 cars annually, each is equipped with a sophisticated braking system, producing up to 40 percent more stopping power than conventional brakes.

The silicone brake fluid, developed by Dow Corning, meets the performance requirements established by the National Highway Traffic Safety Ad-

ministration under Federal Motor Vehicle Safety Standard No. 116, DOT 5 grade brake fluid.

When compared with conventional brake fluids, the new silicone fluid offers dramatic reductions in long-term auto and light truck maintenance as well as substantial improvement in service reliability and performance.

Of extreme importance is the silicone fluid's nonhygroscopic characteristic . . . tendency not to absorb water. Absorbed water is the major cause of metal corrosion in braking systems. It contributes to deterioration of elastomer parts, increases low temperature viscosity and lowers the boiling point of the brake fluid. In tests, the silicone out-performed conventional fluids substantially.

Other benefits of the silicone brake fluid is chemical and thermal stability. Performance in extreme temperatures from -40 F to 560 F is excellent, assuring constant operating characteristics. In contrast, conventional fluid can boil at much lower temperatures—a potential problem in high speed stop-and-go driving—and becomes very viscous in sub-zero weather.

The silicone fluid is compatible with plastics, natural rubber and synthetic elastomers including EPDM, neoprene and SBR. It is nontoxic, has high dielectric strength and is compatible with conventional brake fluids. And, important to the automobile

industry, the silicone brake fluid does not attack acrylic paints used in automobile finishes.

Other silicones too . . .

Avanti engineers, in taking great care to produce a superior product, have specified components with high standards of performance. Other silicone materials are used in these applications on the Avanti:

- Fluid is used as a damping medium for instruments.
- Fluid is used in the bumper shock system to provide even performance at all temperatures.
- Still another fluid is used in the fan clutch to provide high air flow at low driving speeds. Again, the fluid withstands engine temperatures and maintains a relatively flat viscosity slope over a wide temperature range.
- Silicones lubricate weather stripping and the starter motor.
- The EGR diaphragm, the ignition wire and spark plug boots are manufactured with silicone rubber.
- Corners of the oil pan are sealed with silicone rubber formed-in-place gasket material.
- The high energy ignition system and the alternator/regulator module are potted with silicone gel to provide more dependable performance. (MN 543)

The 2nd, is an 8 page brochure, published by Dow Corning, which is important to read in it's entirety.

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SILICONE BRAKE FLUIDS — A NONCONVENTIONAL SOLUTION TO A CONVENTIONAL PROBLEM

By: E. R. Jakubczak
G. W. Holbrook

DOW CORNING

SILICONE BRAKE FLUIDS – A NONCONVENTIONAL SOLUTION TO A CONVENTIONAL PROBLEM

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ABSTRACT

The successful development and application of Dow Corning silicone based brake fluid is presented. Investigation of earlier nonconventional fluids exposed deficiencies which could not be overcome. Silicone fluids eliminate these deficiencies and improve on the marginal nature of conventional fluid.

Silicone brake fluids compared to conventional fluids reduce system corrosion, improve rubber and metal compatibility, do not attack painted surfaces, give higher vapor formation temperatures, and do not absorb water which can degrade brake systems and fluid. Service testing of the fluids has borne out the advantages expected from a silicone fluid.

As a result, Dow Corning silicone based brake fluid offers improved performance, safety and reliability to present as well as future brake systems, and gives the design engineer superior brake fluid.

INTRODUCTION

Brake fluid is a very special chemical. Any item associated with the brake system of an automobile is of paramount importance and a Class I safety item. Fluids offered for sale for use in brake systems should possess superior physical and chemical properties throughout the intended life of a brake system to insure safe and reliable operation.

Many may ask: Why a new brake fluid? The answer is that the automobile is taxing the limits of present, conventional fluids! Brake operating temperatures are increasing for a multitude of reasons: anti-pollution devices, car streamlining, power brakes, lining improvements, automatic transmissions, noise abatement insulation, and in some cases, increasing car weight – all combine to increase brake fluid temperatures. The water-loving nature of present fluids cause degradation of properties in the form of reduced vapor lock temperature, increased low temperature viscosity, and decreased corrosion resistance.

This paper was presented at the Chemical Specialties Manufacturers Association Meeting held December 4, 1973 at the Shoreham Hotel in Washington, D.C.

So, in response to a need for improved fluids, Dow Corning has developed a nonconventional silicone brake fluid: Nonconventional because it is based on a nonhygroscopic base – polydimethylsiloxane. This new breed of brake fluid can be employed in past, present, and future hydraulic brake systems.

The technical advantages of a silicone-based brake fluid can best be seen by comparison to conventional brake fluid. The comparative data may be divided into two categories for ease of handling – Physical Property Comparison and Performance Requirements.

Table A gives physical property comparison data.

A review of the data contained in Table A shows that Dow Corning silicone brake formulation at least equals, and in most cases, far exceeds the properties of conventional brake fluid. Furthermore, the physical property advantage of silicone-based fluids are maintained throughout the lives of the system and vehicle. The comparison of physical properties is all well and good. However, brake design engineers are interested more in how well these improved physical properties relate to performance of a brake system. A second section entitled Performance Properties addresses itself to this aspect of a motor vehicle brake fluid.

PERFORMANCE PROPERTIES OF BRAKE FLUIDS

H₂O Absorption

The most serious complaint against present brake fluids is their water-attracting character – hygroscopicity. The water attracting tendency is not solved by sealed systems. As long as brake systems contain junctions and covers employing rubber seals and gaskets, this water attracting capacity can cause degradation in the performance of conventional brake fluid. The degradation manifests itself in the form of reduced vapor lock temperatures, increased viscosity at low temperatures and decreased corrosion resistance.

The silicone brake fluids developed by Dow Corning are non-hygroscopic and hence do not suffer this degradation of properties with time.

TABLE A PHYSICAL PROPERTY COMPARISON

	Typical Conventional Brake Fluid	Dow Corning® Silicone Brake Fluid	
	Vapor Lock Temperature ①		
Dry	~ 500°F	> 500°F	
Humidified ②	~ 250°F	> 500°F	
Flash Point	260°F	> 400°F	
Viscosity ③			
212°F	2 - 8 CS	15 - 30	
-40°F	1100 - 1500 CS	300 - 600	
Corrosion Resistance:			
	Wt. Change ④	Wt. Change ③	
	MG/CM ²	Humidified	50/50 Mix
Tinned Iron	0	0	0
Steel	0	0	0
Aluminum	0	+ .01	0
Cast Iron	+ .45	+ .01	+ .16
Brass	- .02	+ .01	+ .06
Copper	- .02	+ .01	+ .06
Fluidity and Appearance			
-40° (144 Hrs.)	Pass	Pass	
-58° (6 Hrs.)	Pass	Pass	
Evaporation (72 Hrs. 212°F)	~ 8.5%	< 1%	
Simulated Service Performance ⑤	Pass	Pass	

① As determined on Markey vapor lock device

② Humidified via MVSS 116 procedure

③ As per silicone based brake fluid recommended practice, SAE XJ1705

④ As per J1703 d. motor vehicle brake fluid standard

⑤ As per J1703 revised stroke procedure

Figure 1 compares the water-absorbing character of a typical conventional brake fluid and the nonhygroscopic silicone brake fluids. The silicone line is illustrative of a H₂O content value equal to 0.05%.

The increase in corrosion protection employing silicone based brake fluid was described by Aberdeen Proving Ground in their CCL Report No. 306 entitled "Chloride and Water Permeability of Automotive Brake Hose" (1). Their findings can best be summarized by quoting from the abstract of the report:

"It was found that sufficient chloride and water will permeate brake hoses to initiate corrosion of metal parts in conventional brake systems. The extent of permeability is greatly reduced in systems containing silicone fluids."

The increased corrosion protection of silicone based materials has allowed reduction in maximum permissible corrosion limits in the proposed Silicone Based Brake Fluid Recommended Practice, SAE XJ1705. The decrease in permissible weight change allowed is about 1/2 the values spelled out in SAE J1703d which covers conventional brake fluid.

The vapor lock temperature depression of a conventional (polyglycol) brake fluid is represented by Figure 2.

FIGURE 1

WATER PICKUP VS. EXPOSURE TIME FOR CONVENTIONAL AND SILICONE BRAKE FORMULATION

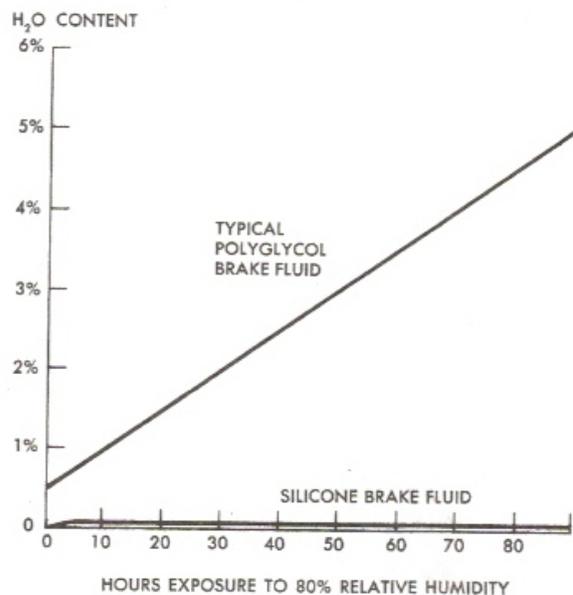
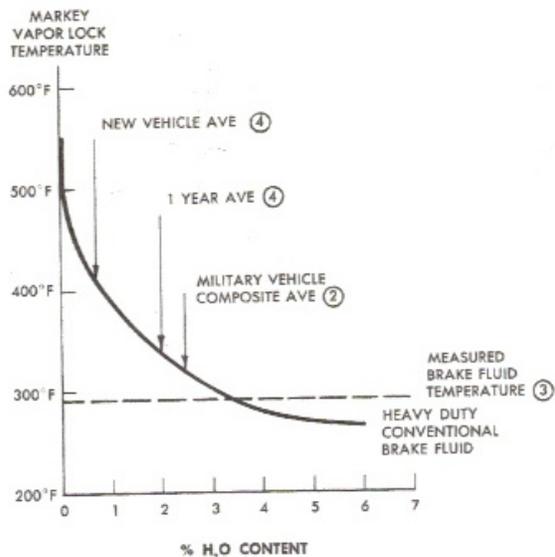


FIGURE 2

VAPOR LOCK VS. H₂O CONTENT FOR CONVENTIONAL BRAKE FLUIDS.

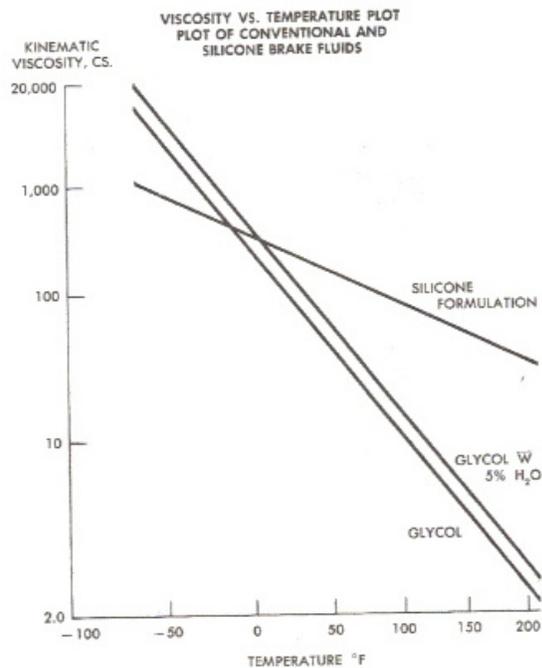


As can be seen, the water pickup depresses the vapor lock temperature to below 320°F if the fluid H₂O content is greater than 2.5%. You may ask: How long does it take a fluid in service to arrive at a given water content? The answer is dependent on parameters such as system type, geography, weather conditions, sealed or unsealed master cylinder, etc. However, test data from the SAE R11 Field Evaluation Program and internal Dow Corning fleet test data give values for new and 1 year vehicles. Figure 2 further shows a 2% water level is easily obtainable in a 1 year old brake system. This level of H₂O lowers the reported 550°F Vapor Lock Temperature to a level of 330°F which is within 35°F of brake fluid temperatures obtained in normal in-service use (3).

Dramatic proof of the non-water absorbing nature of Dow Corning silicone brake fluids was obtained in the SAE R11 Test Program. A non-hygroscopic silicone was run for 2 years and 56,000+ miles with 0.00% H₂O detected in the fluid (5). No deterioration of physical properties of the fluid was detected after the 2 year test.

Viscosity is paramount to a brake engineer. He finds distasteful any sacrifice in or any deleterious effect on low temperature viscosity. Again, the water absorption character of conventional fluids increases the marginal low temperature viscosities to values which are far from those of ideal brake fluid. Figure 3 compares the viscosity/temperature properties of a typical silicone-

FIGURE 3



based fluid and a conventional brake fluid. An additional plot of the same polyglycol containing 5% H₂O shows how the low temperature viscosity is increased. The accompanying Table B better illustrates the comparison.

TABLE B

EFFECT OF WATER ON VISCOSITY

Centistokes Viscosity	Typical Conventional Brake Fluid		Dow Corning® Silicone Brake Fluid	
	New	Humidified ①	New	Humidified ①
210F°	2	2	28	28
77°F	12	13	90	90
-40°F	1190	2175	584	590
-65°F	9540	23,460	1200	1220

① Humidified according to MVSS 116 (S6.2.1 - S6.2.5) for 90 hours.

The humidification procedure will produce a level of 5% water in the conventional fluid after 90 hours which nearly doubles the low temperature viscosities of conventional fluid. The Dow Corning nonhygroscopic silicone brake fluid shows very little H₂O absorption and hence no such increase in low temperature viscosity. You might say it approaches the "Ideal Brake Fluid" in this respect (6).

Compatibility

Any new, nonconventional brake fluid will require compatibility with present brake system elastomers, fluids and metals. Such is the case with silicone-based brake fluids — they are universally compatible. The proposed Silicone-Based Brake Fluid Recommended Practice, SAE XJ1705, has conscientiously addressed itself to this problem. Fluids meeting this practice will be subjected to tighter corrosion specification with metals, improved vapor lock temperatures, and tighter viscosity requirements.

In addition, the effect of such fluids will be checked against an expanded list of elastomers which include natural, EPDM, and neoprene, as well as the present SBR. This list of rubbers takes into account future as well as present brake system elastomers.

Compatibility of silicone based brake fluid and conventional fluid will be checked by means of a mixed fluid corrosion test on brake system metals.

Silicone brake fluid is not soluble in conventional fluid, but poses no serious problem since it neither suffers nor imparts a deleterious effect on system fluids, metals or rubbers. Service data collected over the last 3 years by Dow Corning shows no problems in systems employing 50/50 mixtures of conventional and silicone brake fluids. In addition, simulated service testing of mixtures as specified in J1703d give adequate performance.

Chemical Stability

Silicone brake fluids possess excellent chemical and oxidative resistance. SAE XJ1702 specifies that the fluids will be checked for adverse effect on system elastomers, metals, and fluids by the expanded compatibility testing previously mentioned. The chemical stability of silicones allow this brake fluid to retain — over extended periods — important characteristics built into the fluid.

High Temperature Stability

Silicones possess superior high temperature stability. The data in the Table A shows the improved higher vapor lock temperatures, percent evaporation, and flash point. In addition, test data shows no adverse effect in high temperature stability when silicone

fluids are mixed with conventional brake fluids and checked by J1703d Equilibrium Reflux Boiling Point. In fact, the straight ERBP check on 100% silicone is meaningless due to the high boiling range of the silicone based-brake fluids.

Effect on Paint

Unlike conventional polyglycol based fluid, silicone brake fluid will not attack painted metal surfaces. This feature alone may justify a higher priced fluid (6). The non-paint-attack would allow safer shipment of vehicles and paint protection against accidental spillage in the manufacturing area.

Any foreign material on a clean metal surface will affect paint application. The effect of silicone on a clean metal panel has been shown to be about as severe as grease, oil or fingerprint contamination. It has been shown that metal panels wet with silicone fluid can be cleaned by conventional methods. The subject of paintability and silicone contamination will be objectively discussed in a paper by Dow Corning personnel at an SAE Brake Fluid Symposium in February of 1974 (7).

Storage Stability

Storage stability is synonymous with safety when discussing brake fluids. Brake fluid must retain the characteristics built into it whether in or out of the vehicle for long periods of time. Failure to do so could result in loss of brakes or a marginally or totally inoperative brake system.

The initial chemical and physical properties of a silicone are superior and suffer no detectable deterioration during long periods of climate exposure or system storage. Precautions must be made, however, to protect the silicone fluid from contamination by motor oil, gasoline, water, transmission fluid, etc. of course, these precautions should normally be taken with any brake fluid.

The improved storage characteristics and universal properties of silicone based fluid is being looked at closely by the U.S. Army for replacement of heavy duty brake fluid, arctic brake fluid, and brake storage fluid with one universal brake fluid.

Electrical Properties

The electrical properties of a brake fluid do not contribute in any way to braking efficiency. However preliminary testing of an electrical brake warning switch immersed in conventional polyglycol fluid proved impractical due to the water absorption character of present fluid. However, because of the excellent dielectric properties of the silicone fluid, a failure warning system could be immersed directly in the fluid.

Availability

There appears to be no long range supply problems in the raw materials used in the production of polydimethylsiloxane. Quartzite (SiO_2), methanol, and hydrochloric acid are all readily available. Dow Corning is the world's largest producer of silicone materials and has the capability of developing sufficient production capacity to meet needs for the domestic as well as the international market.

Environmental Aspects

Dow Corning has addressed itself conscientiously to this topic and a formal presentation of the findings will be presented in February 1974 at the SAE symposium on brake fluids (7). A brief comment on toxicity and effect on biosphere:

Toxicology – Dow Corning polydimethylsiloxane has been shown to be essentially nontoxic.

Effect on Biosphere – Polydimethylsiloxane has been shown to be nonbiodegradable. Disposal of the fluid can be achieved by proper incineration to produce SiO_2 , CO_2 , and water.

Application

The use of silicone brake fluid would require no change in present hydraulic system filling and bleed procedures. Amateurs in brake system work have successfully installed the brake fluid given only the fluid and Motor's Manual procedure for installation.

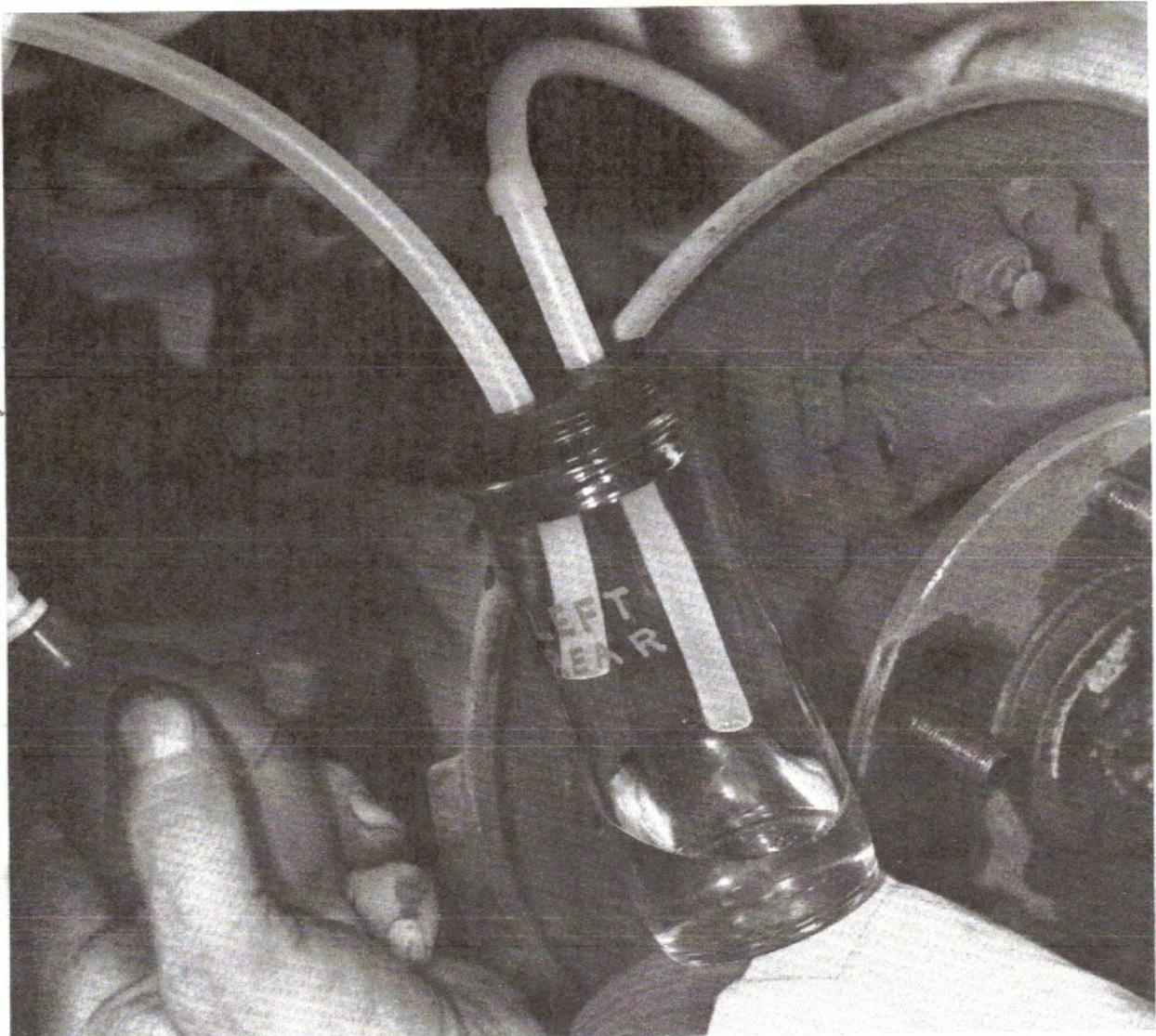


Figure 4. Note clarity of silicone brake fluid drained from Dow Corning test car after 2 years service and 56,000 plus miles.

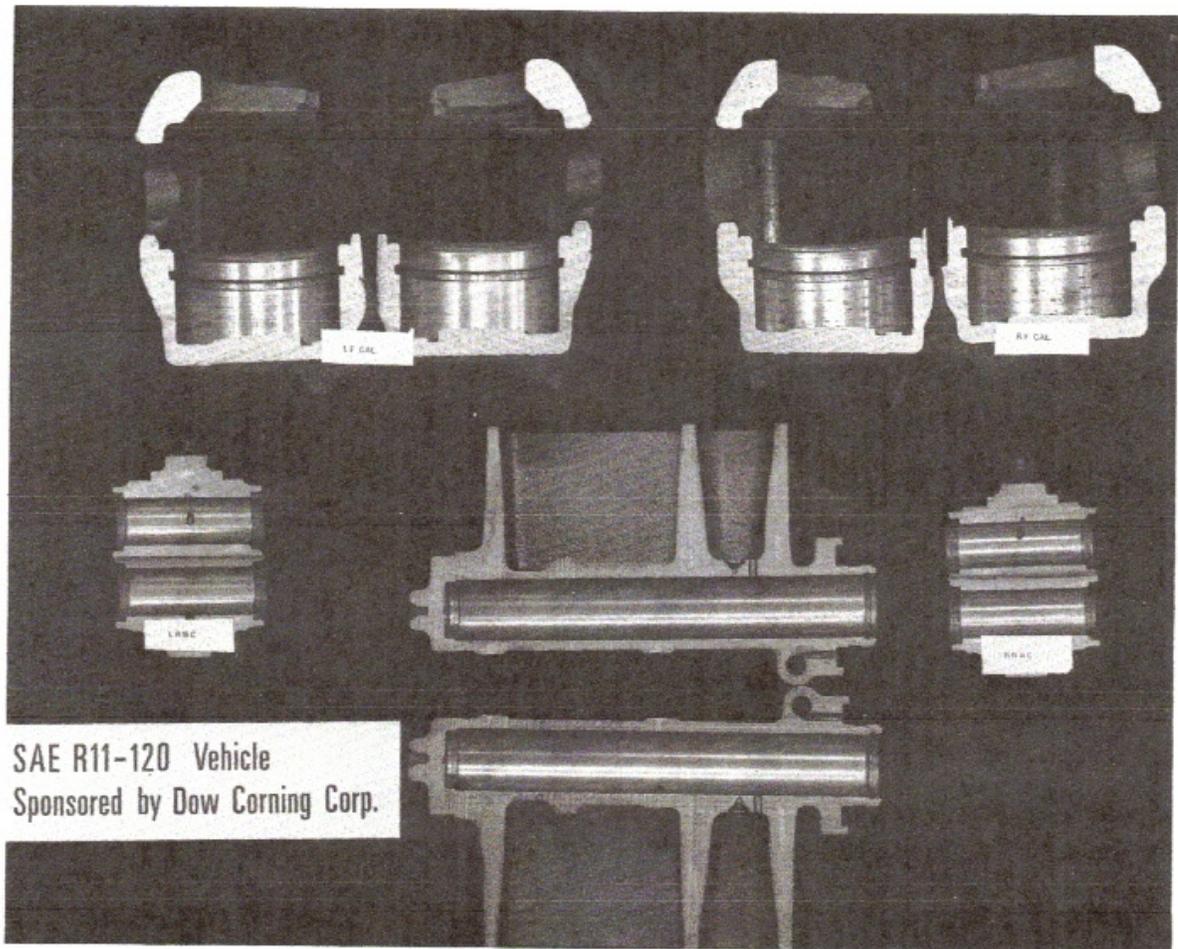


Figure 5. Cutaway sections of brake system cylinders of Dow Corning test car after two years service and 56,000 plus miles.

Service Data

Dow Corning has accumulated approximately 0.5+ million miles of service data with a multitude of vehicles. These test vehicles are running with no reported problems on 100% silicone as well as mixtures of silicone and present conventional brake fluid.

A vehicle in the SAE R11 Test Program contained a non-hygroscopic Dow Corning silicone brake formulation and was run 2 years and 56,295 miles. The brake performance was trouble free. The fluid showed no evidence of degradation and had 0.00% water content at the end of the test period (See Figure 4 and 5 for fluid and system condition after testing.)

The race arena has been a very good test media to demonstrate the high performance of silicone brake fluid. Brake fluid temperatures have been measured in excess of 600°F. When the rotors of a race car are glowing red hot, you can be sure the brake fluid is seeing a very high temperature.

The U.S. Army has Dow Corning brake fluids on test in a variety of climatic conditions. They are testing in the humid regions of Panama, the hot deserts of Arizona, and the low temperatures of Alaska and report no problems with the silicone brake fluid after six months of operation. The test will run for one year and a full report will be issued at that time.

SUMMARY

A brake system is no better than its weakest component. Upgrading of brake performance via new type brakes, higher temperature elastomers, better linings, corrosion resistant alloy, etc. has kept pace with the increasing demands on brake systems.

These design changes were made to provide better braking for the life of automobiles. The lifeblood of the brake system, the fluid, has changed somewhat to keep up with demands; however, it still suffers degradation in properties in storage as well as in the brake system (8).

The nonhygroscopic, silicone-based brake fluids developed by Dow Corning offer improved physical properties and performance and maintain those properties with time. It is the feeling of the authors, that silicone based brake fluids offer a better performing, more reliable and safer fluid for conventional hydraulic brake systems.

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7. G. W. Holbrook, E. J. Hobbs, E. R. Jakubczak, "Silicone Brake Fluids; Friend or Foe?" Dow Corning Corporation, to be presented at SAE Automotive and Engineering Congress, Detroit, Mich., February 1974.
8. J. L. Harvey, L. T. Milliken, and R. J. Forthofer, "Trends in Motor Vehicle Brake Fluids and Their Standards." Society of Automotive Engineers, Inc., Report No. 710251, January 1971.

The third is just a single page, Avanti Motors sent me from the SAE, (Society of Automotive Engineers), dated October 1975. Announcing that Avanti Motors was the first OEM to install silicone Dot 5 in their new car production.

NEWS AND NEW PRODUCTS



automotive
engineering 



The 1975 line of Avanti II automobiles features the first OEM application of silicone brake fluid in the U.S. The silicone brake fluid, manufactured by Dow Corning Corp., meets the performance requirements for use as a hydraulic brake system fluid established by the National Highway Traffic Safety Administration under Federal Motor Vehicle Safety Standard #116, DOT 5 grade brake fluid.

Until recently the use of silicone brake fluid had been limited to

Silicone Brake Fluid In Avanti II

automotive racing teams, snowmobilers and antique car buffs. Its reported ability to withstand high and low temperatures without deterioration lies behind its popularity with racers and snowmobilers. Because silicones are relatively inert, they are said not to lose their effectiveness over long periods of time — a feature that is essential for seldom-driven antique cars.

For further details, contact Dow Corning, or circle 2 on Reader Service Card.

The significance of this article, from the SAE show is I used to have an Avanti Customer that was a retired engineer from Bendix Corporation. Bendix supplied the brake systems and other components to Studebaker and Avanti Motors for the Avanti. After retiring Wendal, the retired engineer, did a lot of road testing and wrote reports for Bendix. He lived about 30 miles away, but would stop in a lot when he was testing. He would stop in to look at all the Avantis in for service, of course I serviced his Avanti. One day when he stopped in, he said his big boss knew he drove an Avanti. His big boss asked him to ask me if they could borrow one of my 2 new Avantis from my show room floor. They wanted it for their Bendix display at the SAE (Society of Automotive Engineers) show, in Detroit. I said yes.

Every year, somebody from Bendix would drop Wendell off, he would personally drive my new Avanti to the SAE show. He would display a sign stating that Nostalgic Motor Cars was the participating dealer and the Bendix brake system had Dow Corning Dot 5 silicone brake fluid installed, from the factory. As you may have guessed by now Avanti Motors, and I, liked the free publicity. Bendix really liked it as the Avanti would attract customers to their booth.

During my writing process, for this article, I decided to go to an auto parts store. I wanted to read the current labels on the Dot 3, DOT 4, and DOT 5.1 There was no mention of not being compatible with DOT 5 silicone brake fluid. The 12 oz. bottle of DOT 5 silicone brake fluid that I sell it states "compatible with all other DOT 5 silicone brake fluid. Use in all vehicles where DOT 5 is recommend by the vehicle manufacturer."

Avanti Motors was a manufacturer that recommended DOT 5 silicone brake fluid in their 1975-1985 automobiles. Since the 1963-1975 Avanti was a Bendix system and basically the same, you could conclude that they were also DOT 5 silicone brake fluid acceptable.

Also on the cans: DOT 5 silicone brake fluid should not be used in brake systems containing DOT 3, or DOT 4 brake fluids. No mention of not adding to a brake system containing DOT 5.1, like DOT 3 and DOT 4. Also, no mention of being non compatible with DOT 3, DOT 4, or DOT 5.1

Avanti Motors produced about 1800 cars from 1975-1985 with DOT 5 silicone brake fluid. They have been in public hands, and on the road for 37-45 years. I find it uncanny that I have never read or hear that an Avanti that had mixed brake fluids DOT 5 mixed with Dot 3, DOT 4 or DOT 5.1, in it's system suffered any abnormal brake problems or an Avanti that was converted or restored to DOT 5 silicone

I also find it interesting that I have never read an article that scientifically denounces Dow Corning statement that "DOT 5 silicone brake fluid is compatible with conventional brake fluids".

From Dow Corning article:

"Compatibility of silicone based brake fluids and conventional fluid will be checked by means of a mixed fluid corrosion test on brake system metals."

"Silicone brake fluid is not soluble in conventional fluid, but poses no serious problem, since it neither suffers nor imports a deleterious effect on system fluids, metals or rubbers. Service data collected over the last 3 years, by Dow Corning, shows no problem in systems employing 50/50 mixtures of conventional and silicone brake fluids. In addition, simulated service testing of mixtures as specified in J1703D gave adequate performance" Please read the entire brochure presented 12/04/1973"

I wrote this article about silicone DOT 5 brake fluid, so you might be able to decide for yourself if it is necessary to totally disassemble a brake system that previously had DOT 3, DOT 4, DOT 5.1, or a mixture of DOT 3, 4 or 5.1 with DOT 5 silicone in it's system (like you read and hear) or can you just flush the system with DOT 5 silicone without taking it apart. I have included printed information that you were probably not aware of. DOT 5 silicone brake fluid has always had a mystique about it. Probably from lack of advertising and factual information available. Maybe facts have changed, since 1973 about the use of DOT 5 silicone brake fluid, but I have not been aware of them. The safeguard of DOT 5 silicone brake fluid against rust is legendary!

As I've mentioned, in this article, since 1976 I have always sold DOT 5 silicone brake fluid at a very reasonable price. I purchase it in very large quantities, to get the price way down and pass the savings on to my customers. This helps attract new customers and rewards my existing customers. This affords my customers to convert to DOT 5 and just maybe prolong the life of their brake system cylinders, bores and lines.

All prices subject to change, without notice.