Monsanto

Fluids

For Specialized Engineering

In today's rapidly developing technology—engineering design in many fields requires special functional fluids that will solve a variety of problems. In applied hydraulics, aerodynamics, electronics, nucleonics, and mechanical engineering, special liquids are needed for critical tasks. Fluids must be found to dissipate heat or to convey heat; to transmit pressure or to neutralize pressure by lubrication; to slow neutrons without absorption; to withstand extreme cold; to resist vaporization and remain stable under high heat. For each application, varied combinations of properties are necessary.



The key to providing fluids "tailored" for the job is synthesis—the *chemical* building of basic compositions of matter designed for special *physical* properties. Monsanto has pioneered in the development of specialized functional fluids. For the past 10 years, Monsanto's half-century of experience in organic chemical synthesis has been called on again and again to provide liquids with special combinations of properties—for dielectric uses, coolants, specialized hydraulics, lubrication. Today, over twenty of these fluids are in commercial use—and many more are available.

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Here is a summary of the general physical properties of 20 selected Monsanto functional fluids. These represent the *range* of products now available in commercial or semi-commercial quantities. In reviewing the table in the light of your own fluid, lubricant, or dielectric applications, may we call your attention to these facts:

- The products shown were developed for particular applications; their properties were carefully designed for that specific use. Often these properties can be modified through synthesis or formulation.

- Although developed for particular uses, in many cases the products have been found to be admirably suited to entirely different applications. For example: Fluid *OS-45 III* (Coolanol 45) designed for use as a high temperature hydraulic fluid, is also now being used extensively as an insulant-coolant in electronic equipment.

- In addition to the products listed in this table, a number of other commercial, development and research products are available. Among these are fluids designed for use as steam turbine lubricants; automobile automatic transmission fluids; high-temperature aircraft and missile fluids stable above 800°F.

Others are completely new chemical liquids with interesting physical properties in search of a use.

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SUMMARY OF GENERAL PROPERTIES OF SELECTED FUNCTIONAL FLUIDS

Present major uses	FIRE-RESISTANT HYDRAULIC FLUIDS AND LUBRICANTS								HIGH-TEMPERATURE HYDRAULIC FLUIDS AND DIELECTRIC-COOLANTS			FIRE-RESISTANT DIELECTRICS, COOLANTS HEAT TRANSFER FLUIDS					NUCLEAR REACTOR MODERATOR-COOLANTS			
PROPERTIES *Product*	SKYDROL* 7000	SKYDROL 500	PYDRAUL 60	PYDRAUL 150	PYDRAUL F 9	PYDRAUL 675	PYDRAUL AC	OS 81	COOLANOL 45 OS-45-III	OS-45 IV	OS 58	AROCLOR* 1221	AROCLOR 1232	AROCLOR 1242	AROCLOR 1248	AROCLOR 1254	BIPHENYL	SANTOWAX* R	SANTOWAX OM	ISOPROPYL BIPHENYL
Viscosity, Centistokes @ 100 F	15 5	11 5	11 1	39 8	47	135	88 2	35 25	17.2	12.0	6 8	4 6	6 9	17 2	45 3	46 4	—	—	—	4 7
@ 210 F	3 85	3 92	2 65	8 0	5 5	6 1	5 15	3 18	3 95	3 95	2 2	< 1 8	< 1 8	2 5	3 2	6 14	0 98	—	2 05	1 40
Pour Point, F	− 70	< − 85	− 70	− 55	− 5	20	20	15	< − 85	< − 85	< − 85	34	− 32	2	20	50	156	413	150	− 65
Maximum Bulk Temperature, F	200	225	200	200	300	300	300	300	400	550	600	600	600	600	600	600	750	> 750	> 750	> 700
Boiling Point @ 760 mm Hg, F	709	—	707	617	644	714	668	> 600	> 700	> 700	> 700	527	554	617	644	689	491	687	662	570
Coefficient of Thermal Expansion, per F, at use temp	0 00042	0 00045	—	0 00042	0 00041	—	0 00040	—	0 00048	0 00048	0 00046	0 00071	0 00073	0 00068	0 00070	0 00066	0 00050	0 00052	0 00052	0 00096
Specific Heat @ 25 C, or M. Pt., BTU/lb/° F	0 42	0 38	0 42	0 40	0 32	—	—	0 31	0 45	0 45	0 45	0 33	0 31	0 29	0 27	0 26	0 40	0 50	0 42	0 42
Thermal Conductivity, BTU/hr/ft²/ft/° F	0 0477	0 0377	0 047	0 070	0 067	0 065	—	—	0 080	0 080	0 080	0 067	0 063	0 058	0 057	0 054	0 076	0 063	0 065	0 07
Bulk Modulus, psi	328,000	308,000	328,000	319,000	387,000	375,000	—	—	253,000	253,000	253,000	—	—	—	428,000	—	—	—	—	—
Specific Gravity @ 25°/25 C, or M. Pt.	1 08	1 07	1 09	1 13	1 28	1 36	1 35	1 40	0 89	0 89	0 88	1 18	1 23	1 38	1 45	1 54	0 984	0 955	1 06	0 979
Resistivity, ohm — cm	5 0 x 10⁹	0 4 x 10⁹	—	—	1 5 x 10⁹	—	—	—	2 x 10¹⁰	—	6 7 x 10¹⁰	> 5 x 10¹⁴	> 5 x 10¹⁴	> 5 x 10¹⁴	> 5 x 10¹⁴	> 5 x 10¹⁴	1 x 10¹⁴	1 x 10¹⁴	1 x 10¹⁴	1 x 10¹⁴
Dielectric Strength @ 60 cps, 0 1 in., 25 C	—	—	—	—	32 KV	—	—	—	27 KV	—	44 KV	> 35 KV	> 35 KV	> 35 KV	> 35 KV	35 KV	35 KV	> 35 KV	> 35 KV	> 40 KV
Dielectric Constant @ 1000 cps, 25 C	8 87	—	—	—	6 25	—	—	—	2 69	—	2 47	4 6	5 4	5 8	5 6	5 0	2 5	2 58	2 6	2 66
Power Factor, per cent @ 1000 cps, 25 C	0 49	—	—	—	2 2	—	—	—	1 6	—	0 03	< 0 1	< 0 1	< 0 1	< 0 1	< 0 1	< 0 1	< 0 1	< 0 1	< 0 07
Flash Point, F, Cleveland Open Cup	425	360	435	380	430	465	470	—	370	370	370	295	308	350	382	690	235	375	340	282
Fire Point, F, Cleveland Open Cup	475	425	460	470	675	745	650	—	430	430	435	349	460	> 610	> 640	690	255	460	390	306
Autogeneous Ignition Temperature, F	1050	1100	1000	> 1100	> 1100	> 1100	1100	> 1100	660	700	705	> 1000	> 1100	> 1200	> 1200	> 1200	1000	> 1000	> 1000	845
Fire Resistant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Radiation Resistant	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes

*SKYDROL, PYDRAUL, OS 45, AROCLOR, SANTOWAX, MONSANTO THERMINOL, BIPHENYL, & ISOPROPYL BIPHENYL ARE TRADE MARKS

THE INFORMATION ... USE OF OUR MATERIALS ARE ACCURATE AND RELIABLE. HOWEVER, SINCE THE CONDITIONS OF USE ARE BEYOND OUR CONTROL, WITH NO FINANCIAL LIABILITY ARISING FROM THE USE OF THE DATA

FIELDS OF USE FOR FLUIDS

The following is all designed to indicate the variety of fields for which Monsanto already is supplying specialized fluids —

Aircraft Hydraulic Systems

SKYDROL* 7000 was the first fire-resistant hydraulic fluid developed for propelling aircraft that has been accepted by the CAA. SKYDROL 500 is now available for the higher altitude, low temperature operation of jets. It will be used in all the turbo-jet fliers now being built in America.

Dielectric-Coolants

Stable Coolanol 45, a broad temperature range, specialized coolant ideally suited for a variety of electronic cooling applications, is now available. Vacuum switching, wave tubes, amplifiers, power supplies, etc.

Missilery

Fluid OS-45-III is a high viscosity index fluid for reliable power transmission operation from −65° to 300 F in guided missiles and high speed aircraft. Fluid OS-45 Type IV is a high temperature fluid operable to 550 F.

Applied Hydraulics

PYDRAUL* F-9 is a fire-resistant hydraulic fluid for equipment such as die-casting machines, conveying equipment handling molten metals, and many other hydraulic operations near ignition sources. PYDRAUL 60 and PYDRAUL 150 are special viscosity fluids for precision regulating equipment.

Nuclear Reactor Moderation, Cooling

Monsanto's polyphenyls and alkyl derivatives have extreme resistance to thermal and radiation damage — for application as coolant-moderators in severe environments.

Lubrication

Monsanto supplies several types of specialized fire-resistant lubricants suitable for high temperature operation. Among these — PYDRAUL AC, air compressor lubricant that curtails carbonizing and deposits responsible for flash fires and explosions — and OS-81, new turbine lubricant that shows much promise in use.

Fluid Drives

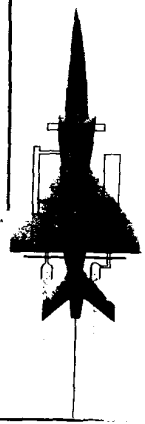
Monsanto supplies a number of specialized fluids suitable for the specialized needs of power transmission and fluid drives.

Heat Transfer

AROCLOR* heat transfer fluids are chemically stable and fire-resistant heating media which permit non-pressurized heating systems to deliver 600 F. processing heat.

Transformers, Capacitors

For 25 years Monsanto has supplied the dielectrics for transformers and capacitors ranging in size and application from home-sized utility transformers to thumb-sized capacitors in hi-fi sets.



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FUNCTIONAL FLUIDS

TECHNOLOGY OF FLUIDS

Fluids for specialized engineering uses usually must be chemically synthesized. From knowledge of the desired end properties—candidate compositions-of-matter are examined that chemically and physically meet the general requirements. Rarely will a "pure" compound match highly stringent specifications. The proper "pure" compound, however, that closely approximates the needs is selected as the "base" stock; it is then modified with additives that further modify its viscosity index, its lubricity, pourpoint, or other properties.

Monsanto has available the facilities for making the widest variety of "base" stocks and additive modifiers of any chemical manufacturer. The Monsanto base stocks include the phosphate esters, many of which are unique to Monsanto, diphenyl and terphenyl and chlorinated derivatives, silicate esters and others. Available additives include corrosion inhibitors, viscosity index improvers, flow temperature depressants, and many other polyfunctional modifiers.

AUTOMATION	LUBRICATION	ELECTRONICS
RADAR	INSULATION	GUIDANCE
TRACKING	MECHANICS	PREHEATING
ATOMICS	AERODYNAMICS	POWER GENERATION
HEATING	LAUNCHING	POWER TRANSMISSION
KINETICS	LIFTING	HEAT EXCHANGE
BALLISTICS	PRESSURIZING	POWER STORAGE
COOLING		

WHEN NO EXISTING FLUID WILL DO THE JOB YOU NEED...

....Monsanto will work with you to create a fluid that does exactly what you want.

Write or Call...

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St. Louis 24, Missouri

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