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.

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 designed for use as a high temperature hydraulic fluid, is also now being used extensively as an insulant-coolant in radar 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.

0360992

TOWOLDMON0030595

SUMMARY OF GENERAL PROPERTIES OF S

Present major uses / PROPERTIES / Product	FIRE-RESISTANT HYDRAULIC FLUIDS AND LUBRICANTS								HIGH-TEMPERATURE HYDRAULIC FLUIDS AND DIELECTRIC-COOLANTS			FIRE
	SKYDROL* 7000	SKYDROL 500	PYDRAUL* 60	PYDRAUL 150	PYDRAUL F-9	PYDRAUL 625	PYDRAUL AC	OS-81	OS-45*	OS-45-IV	OS-59	OCI 12
Viscosity, Centistokes @ 100°F.	15.5	11.5	11.1	30.8	47	135	88.2	35.25	12.2	12.0	6.8	4.
@ 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
Pour Point, °F.	−70°	<−85°	−70°	−55°	−5°	20°	20°	15°	<−85°	<−85°	<−85°	
Maximum Bulk Temperature — Long Term, °F.	200°	225°	200°	200°	300°	300°	300°	300°	400°	400°	600°	6(
Boiling Point @ 760 mm. Hg., °F.	709°	—	707°	617°	644°	724°	688°	—	> 700°	> 700°	> 700°	52
Coefficient of Thermal Expansion, per °F.	0.00042	0.00045	—	0.00042	0.00041	—	0.00040	—	0.00048	0.00048	0.00046	0.00
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.
Thermal Conductivity, BTU/hr/ft²/ft/°F.	0.0477	0.0777	0.047	0.070	0.067	0.065	—	—	0.080	0.080	—	0.0
Bulk Modulus, psi	328,000	308,000	328,000	319,000	387,000	375,000	—	—	253,000	253,000	—	—
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.
Resistivity, ohm — cm.	5.0×10^8	0.4×10^8	—	—	1.5×10^7	—	—	—	2×10^{10}	—	6.7×10^{13}	> 5 x
Dielectric Strength @ 60 cps, 0.1 in., 25°C.	—	—	—	—	33 KV	—	—	—	27 KV	—	44 KV	> 3
Dielectric Constant @ 1000 cps, 25°C.	8.87	—	—	—	6.25	—	—	—	2.69	—	2.47	4.
Power Factor, per cent @ 1000 cps, 25°C.	0.49	—	—	—	2.2	—	—	—	1.6	—	0.03	<
Flash Point, °F., Cleveland Open Cup	425°	360°	435°	380°	430°	465°	420°	—	370°	370°	370°	2
Fire Point, °F., Cleveland Open Cup	475°	425°	460°	470°	675°	745°	650°	—	430°	430°	435°	3
Autogeneous Ignition Temperature, °F.	1050°	> 1100°	> 1000°	> 1100°	> 1100°	> 1100°	1100°	> 1100°	660°	700°	—	> 1
Fire Resistant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Ye
Radiation Resistant	No	No	No	No	No	No	No	No	No	No	No	N

*SKYDROL, PYDRAUL, OS-45, AROCLOR, SANTOWAX: MONSANTO TRADEMARKS, REGISTERED U. S. PATENT OFFICE.

THE INFORMATION ABOVE IS, TO THE BEST OF OUR KNOWLEDGE, ACCURATE AND RELIABLE. HOWEVER, SIN

FIELDS OF USE FOR FLUIDS

The following will describe 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 propeller aircraft that has been accepted by the C.A.A. SKYDROL 500 is now available for the higher-altitude, low-temperature operation of jets; it will be used in all the turbo-jet fleets now being built in America.

Dielectric-Coolants

Stable OS-45* Coolant is a broad temperature range insulating coolant ideally suited for "black box" miniaturization and fluid cooled tubes used in tracking, guidance systems, and counter measures.

Missilery

Fluid OS-45 is a high viscosity index fluid for reliable power transmission operation from −65° to 400°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 Moo

Monsanto biphenyl, isopr high carbon and hydroge down neutrons and cooli

Lubrication

Monsanto supplies sev resistant lubricants suita tion. Among these is PYL cant that curtails carboni flash fires and ex)ons

Fluid Drives

Monsanto supplies a num

0360993

TOWOLDMON0030596

.ECTED FUNCTIONAL FLUIDS

ISTANT DIELECTRICS, COOLANTS, HEAT TRANSFER FLUIDS				NUCLEAR REACTOR MODERATOR-COOLANTS			
AROCLOR 1232	AROCLOR 1242	AROCLOR 1248	AROCLOR 1254	BIPHENYL	SANTOWAX® R	SANTOWAX OM	ISOPROPYL-BIPHENYL
6.9	17.2	45.3	46.4	—	—	—	4.7
< 1.8	2.5	3.2	6.14	0.98	—	2.05	1.40
– 32°	2°	20°	50°	156°	413°	150°	– 65°
600°	600°	600°	600°	> 750°	> 750°	> 750°	700°
554°	617°	644°	689°	491°	687°	662°	570°
0.00073	0.00068	0.00070	0.00066	0.00050	0.00052	0.00052	0.00096
0.31	0.29	0.27	0.26	0.40	0.50	0.42	0.42
0.063	0.058	0.057	0.054	0.076	0.063	0.065	0.07
—	—	428,000	—	—	—	—	—
1.23	1.38	1.45	1.54	0.984	0.955	1.06	0.979
$> 5 \times 10^{12}$	$> 5 \times 10^{12}$	$> 5 \times 10^{12}$	$> 5 \times 10^{12}$	$> 1 \times 10^{12}$	$> 1 \times 10^{13}$	$> 1 \times 10^{12}$	$> 1 \times 10^{13}$
> 35 KV	> 35 KV	> 35 KV	> 35 KV	> 35 KV	> 35 KV	> 35 KV	> 40 KV
5.4	5.8	5.6	5.0	2.5	2.58	2.6	2.66
< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.07
308°	350°	382°	> 690°	235°	375°	340°	282°
460°	> 610°	> 640°	> 690°	255°	460°	390°	306°
> 1100°	> 1200°	> 1200°	> 1200°	> 1000°	> 1000°	> 1000°	845°
Yes	Yes	Yes	Yes	No	No	No	No
No	No	No	No	Yes	Yes	Yes	Yes

NDITIONS OF USE ARE BEYOND OUR CONTROL, MONSANTO CHEMICAL COMPANY DISCLAIMS ANY LIABILITY ARISING FROM THE USE OF THE DATA.

on, Cooling

phenyl, and terphenyls are ent fluids used for slowing clear fission cells.

ypes of specialized fire- r high temperature opera- AC, air compressor lubri- nd deposits responsible for

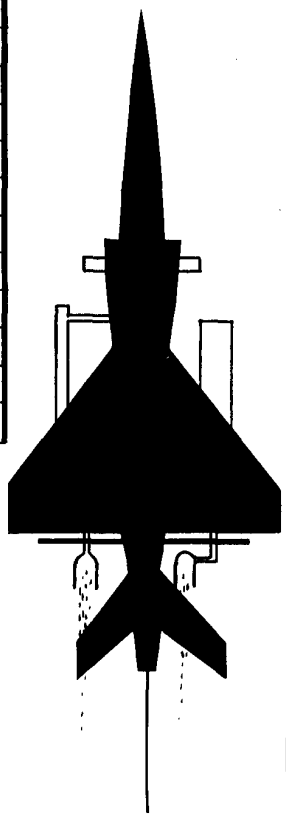
specialized fluids suitable for the specialized needs of power transmission and fluid drives.

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 house-sized utility transformers to thumb-sized capacitors in high-fi sets.



0360994
TOWOLDMON0030597

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		

0360995

TOWOLDMON0030598