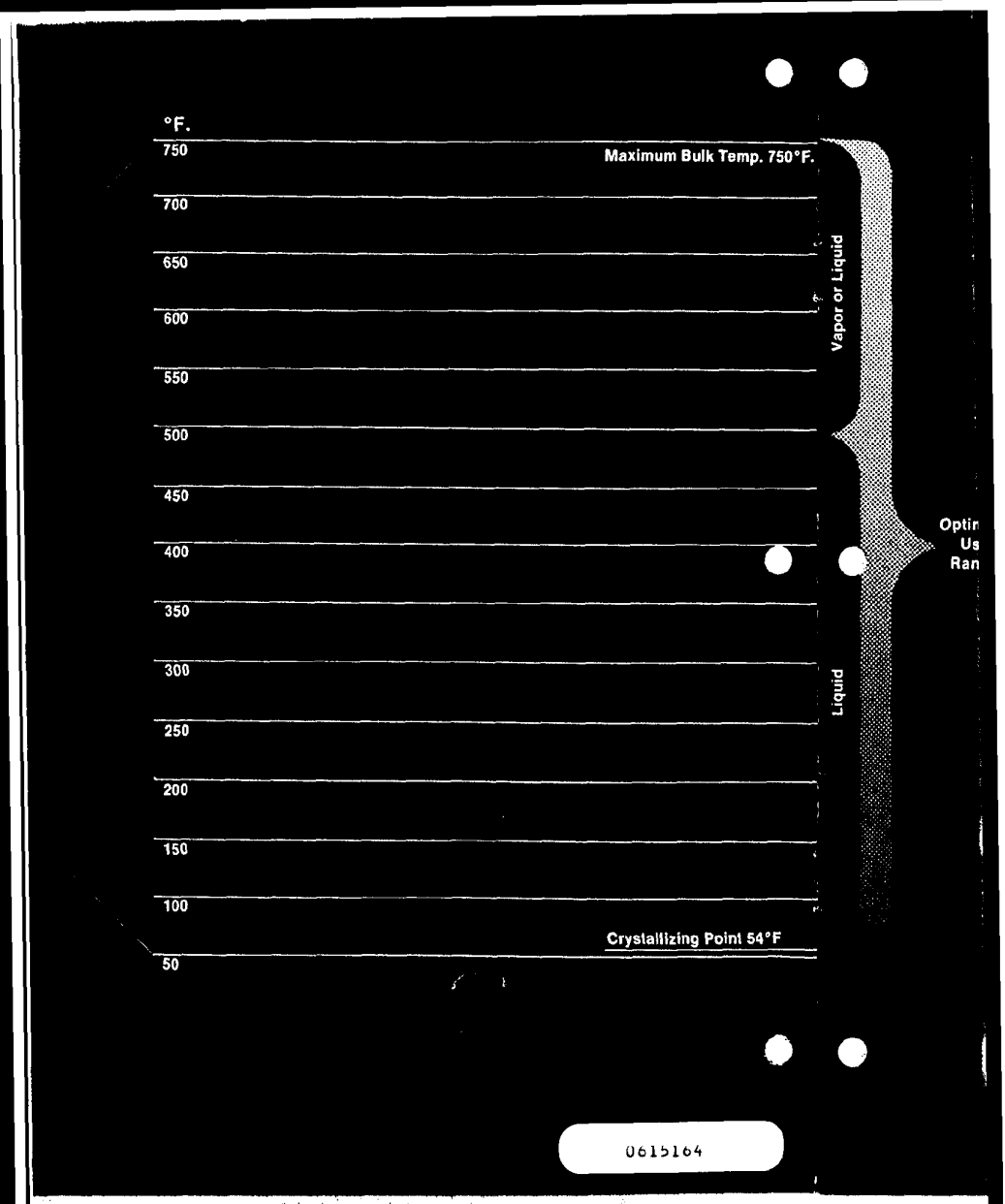
Bulletin No. IC/FF-52

High Temperature Liquid/Vapor Phase Heat Transfer Fluid

0615163

Monsanto

TOWOLDMON0039234
WATER_PCB-00023703



TOWOLDMON0039235
WATER_PCB-00023704

Heat transfer fluids are intended only for indirect heating purposes. Under no circumstances should this product contact or in any way contaminate food, animal feed, food products, food grade chemicals, food packaging materials, pharmaceuticals or any items which may directly or indirectly be ultimately ingested by humans. Any contact may contaminate these items to the extent that their destruction may be required. Precautions against ignitions and fires should be taken with this product.

Monsanto

Notice:

"Nothing contained herein is to be construed as a recommendation to use any product in conflict with any patent. MONSANTO MAKES NO WARRANTIES FOR A PARTICULAR PURPOSE AS TO THE FITNESS OR MERCHANTABILITY OF ANY PRODUCT REFERRED TO, no guarantee of satisfactory results from reliance upon contained information or recommendations, and disclaims all liability for any resulting loss or damage."

Monsanto Industrial Chemicals Co.
A Unit of Monsanto Company
800 N. Lindbergh Blvd., St. Louis, Mo. 63166

• In certain countries of Western Europe and the Far East, Monsanto sells Therminol Heat Transfer Fluids under the brand name "Santotherm® Heat Transfer Fluids". Corresponding Therminol and Santotherm fluids are identical in composition.

0615165

TOWOLDMON0039236
WATER_PCB-00023705

THERMINOL VP-1 liquid/vapor phase heat transfer fluid is a stable, high temperature medium that delivers process heat to 750°F for precise control of processing temperatures. It is an important addition to Monsanto's family of Therminol fluids, the most complete line of heat transfer fluids available.

Therminol VP-1 fluid is a eutectic mixture of 73.5% diphenyl oxide, 26.5% biphenyl. It can be used in existing systems for top-up or replacement of Dowtherm*A, Thermex**, or other heat transfer fluids of the same composition as Therminol VP-1. For new installations, system design can be based on the tables presented in this bulletin.

Therminol VP-1 fluid operates within the broad temperature range of 60°F to 750°F as a liquid and 500°F to 750°F as a vapor. It can be used as both a liquid and a vapor phase medium in a single system.

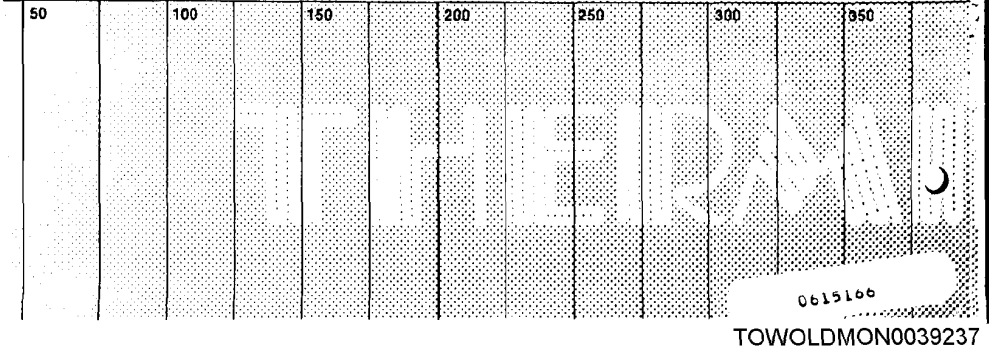
Therminol VP-1 is a colorless to pale yellow liquid with a crystallizing point of 54°F. It is chemically stable and non-corrosive to metals. Use life is dependent upon the design and operating conditions of the system.

Typical Properties[1] of Therminol® VP-1 Fluid

Normal Boiling Point @ 760mm Hg	495°F
Crystallizing Point	54°F
Moisture	250 ppm
Flash Point (COC)	225°F
Fire Point (COC)	275°F
Autogenous Ignition Temperature (ASTM)	1,150°F
Pounds Per Gallon @ 25°C	8.86
Specific Resistivity @68°F	6.4×10^{11} ohm-cm
Critical Temperature	930.3°F
Critical Pressure	480.3 psia
Critical Volume	.05153 cu. ft./lb.

[1]These data are based upon samples tested in the laboratory and are not guaranteed for all samples. Write to Monsanto Company for complete sales specifications for Therminol VP-1 heat transfer fluid.

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*Trademark of Dow Chemical Company
**Trademark of ICI Ltd.



0615166

TOWOLDMON0039237
WATER_PCB-00023706

Therminol VP-1 Fluid for Top-up or Initial Fill

Field tests have shown that Therminol VP-1 heat transfer fluid can be used to top-up or replace Dowtherm A in an existing system.

Replacement:

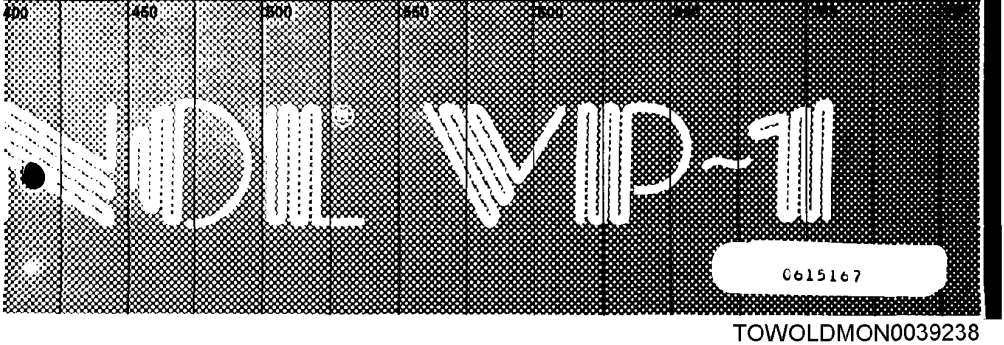
Therminol VP-1 was used as replacement fill for Dowtherm A in a continuous polymerization Nylon 6/6 tire cord spinnerette operating in the normal melt spinning temperature range for this fiber (500°-600°F). Process performance and control continued unchanged.

Top-up:

A test was run in a 13-million BTU vertical-coil, fired heater. Fluid temperature leaving the heater was 625°-645°F. The users consisted of process heat exchangers, five receiving the medium as a vapor and three receiving it as a liquid.

This system has been operated on Dowtherm A for many years. Periodically Dowtherm A was added to top up the fluid level. Top-up was made with Therminol VP-1 in place of Dowtherm A.

No changes in operating conditions were evident. Temperature, pressure, process control and venting were all identical to when only Dowtherm A was used.



TOWOLDMON0039238
WATER_PCB-00023707

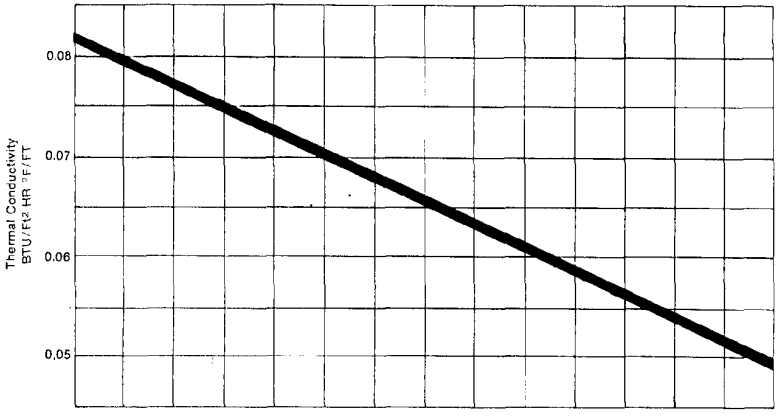
Saturation Properties of Therminol® VP-1 Fluid

Temperature		Abs. Vapor Pressure	Enthalpy		Heat of Vaporization	Specific Heat of Liquid	Thermal Conductivity	Density of Liquid	Viscosity of Liquid
			Liquid	Vapor					
°F	°C	Lb/In² Abs.	Btu/Lb.	Btu/Lb.	Btu/Lb.	Btu/Lb°F	Btu/Ft² Hr°F/Ft	Lb/Ft³	Lb/Hr Ft.
60	15.6	0.000	2.4	168.2	165.8	0.368	0.0815	66.47	12.83
80	26.7	0.001	9.9	174.1	164.2	0.376	0.0805	65.94	9.68
100	37.8	0.001	17.6	180.2	162.6	0.384	0.0793	65.41	7.50
120	48.9	0.003	25.4	186.5	161.1	0.391	0.0784	64.87	6.05
140	60.0	0.007	33.4	192.9	159.5	0.398	0.0775	64.33	4.60
160	71.1	0.014	41.5	199.5	158.0	0.405	0.0765	63.79	3.87
180	82.2	0.027	49.8	206.2	156.4	0.412	0.0755	63.23	3.17
200	93.3	0.051	58.2	213.0	154.8	0.419	0.0745	62.68	2.66
220	104.4	0.090	66.8	220.0	153.2	0.427	0.0736	62.12	2.27
240	115.6	0.154	75.5	227.1	151.6	0.434	0.0727	61.55	1.93
260	126.7	0.253	84.3	234.4	150.1	0.442	0.0718	60.97	1.69
280	137.8	0.404	93.3	241.8	148.5	0.449	0.0709	60.39	1.55
300	148.9	0.627	102.4	249.2	146.8	0.457	0.0700	59.80	1.36
320	160.0	0.948	111.7	256.9	145.2	0.463	0.0690	59.21	1.23
340	171.1	1.40	121.1	264.6	143.5	0.471	0.0680	58.60	1.14
360	182.2	2.01	130.6	272.4	141.8	0.477	0.0670	58.00	1.04
380	193.3	2.84	140.3	280.4	140.1	0.485	0.0661	57.37	0.944
400	204.4	3.93	150.2	288.4	138.2	0.492	0.0651	56.74	0.871
420	215.6	5.34	160.2	296.6	136.4	0.500	0.0641	56.10	0.823
440	226.7	7.15	170.3	304.8	134.5	0.507	0.0632	55.46	0.762
460	237.8	9.41	180.6	313.2	132.6	0.514	0.0623	54.80	0.714
480	248.9	12.21	191.0	321.6	130.6	0.522	0.0614	54.12	0.666
500	260.0	15.66	201.6	330.1	128.5	0.528	0.0605	53.44	0.617
520	271.1	19.82	212.3	338.6	126.3	0.536	0.0596	52.74	0.581
540	282.2	24.80	223.2	347.2	124.0	0.543	0.0587	52.03	0.544
560	293.3	30.70	234.2	355.9	121.7	0.550	0.0578	51.30	0.508
580	304.4	37.64	245.3	364.7	119.4	0.557	0.0569	50.55	0.474
600	315.6	45.72	256.6	373.5	116.9	0.564	0.0560	49.78	0.443
620	326.7	55.07	268.0	382.3	114.3	0.572	0.0551	48.99	0.426
640	337.8	65.80	279.5	391.2	111.7	0.579	0.0542	48.18	0.404
660	348.9	78.05	291.2	400.1	108.9	0.586	0.0533	47.34	0.387
680	360.0	91.95	303.0	409.0	106.0	0.593	0.0524	46.47	0.373
700	371.1	107.6	314.9	418.0	103.1	0.600	0.0515	45.57	0.363
720	382.2	125.3	327.0	427.0	100.0	0.607	0.0506	44.62	0.353
740	393.3	145.0	339.3	435.9	96.6	0.614	0.0497	43.64	0.339
760	404.4	167.0	351.8	444.8	93.0	0.621	0.0488	42.60	0.334

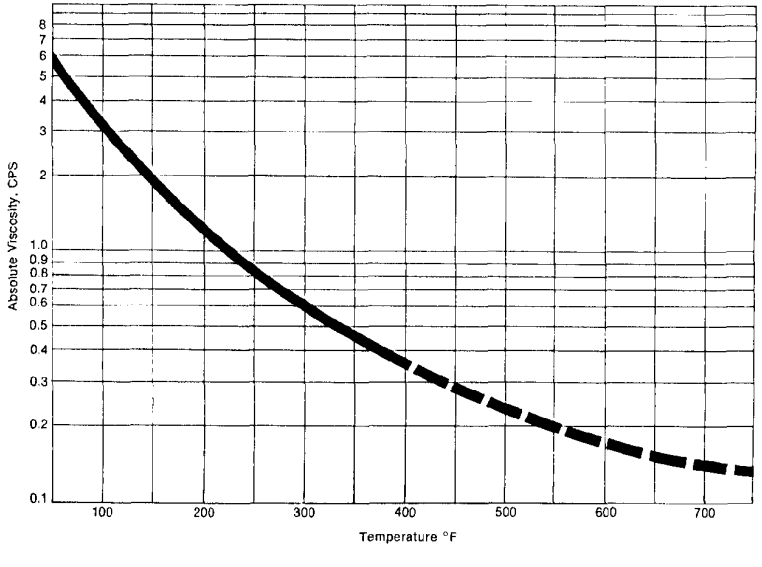
0615168

TOWOLDMON0039239
WATER_PCB-00023708

Thermal Conductivity of Liquid Therminol® VP-1



Viscosity of Liquid Therminol® VP-1



0615169

TOWOLDMON0039240
WATER_PCB-00023709

Thermal Stability

Laboratory test data have shown that thermal stability of Therminol VP-1 heat transfer fluid is equivalent to Dowtherm A.

Tests were run in a pressurized cylinder at 750°F for a period of 500 hours. Samples were taken at the beginning and end of this period and measurements made of the physical properties with the following results:

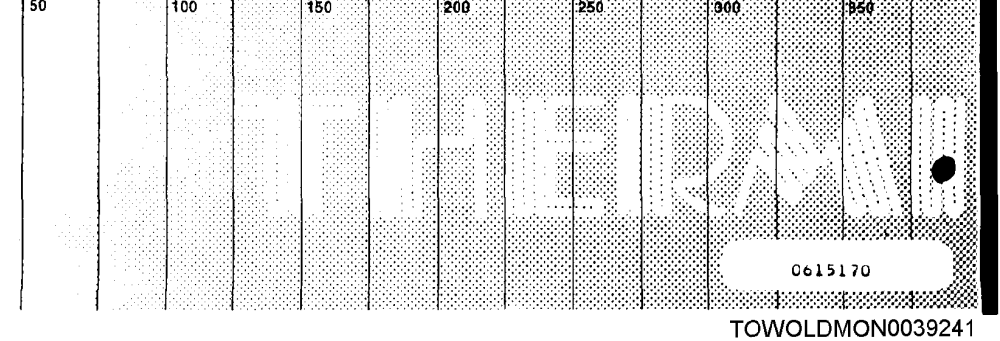
Thermal Stability Comparison at 750°F

	Therminol® VP-1			Dowtherm A			Mixture 50/50		
	@ 0 hr.	@ 500 hrs.	Difference	@ 0 hr.	@ 500 hrs.	Difference	@ 0 hr.	@ 500 hrs.	Difference
GLC ANALYSIS									
% Low Boilers	0.04	0.76	0.72	0.18	1.29	1.11	0.11	0.99	0.88
% High Boilers	0.21	1.33	1.12	0.23	2.52	2.29	0.22	1.76	1.54
% Decomposition			1.84			3.40			2.42
KINEMATIC VISCOSITY CS @ 100°F	2.58	2.68	0.10	2.59	2.73	0.14	2.62	2.70	0.08
% Change			3.9%			5.4%			3.1%
TOTAL ACID NUMBER	0.01	0.04	0.03	0.01	0.04	0.03	0.01	0.02	0.01

Therminol VP-1 fluid is thermally stable for long periods of time up to a bulk fluid temperature of 700-750°F. Operating at 650°F, the service life of the fluid can be many years in a well-designed, operated and maintained system. However, as operating temperatures increase, the rate of degradation of the fluid increases, and at bulk temperatures of 700-750°F use life of the fluid may be from one to a few years. Good circulation of the fluid and elimination of hot spots can greatly increase service life.

At high temperatures the fluid darkens in a relatively short period of time, but with no other appreciable effect on its physical properties. In time with high temperature use, high boiling polymers are formed which remain in solution and increase the viscosity of the fluid. Continued use of fluid containing a high polymer content can lead to viscosity-related system or process problems, and ultimately to carbon deposits in the heater and the danger of burn-out.

Depending upon the type of heater system and operating conditions, a polymer content in the range of 5 to 10% can be tolerated. Above this level the fluid should be considered unusable for continued service and should be reclaimed or replaced.



TOWOLDMON0039241
WATER_PCB-00023710

Flammability

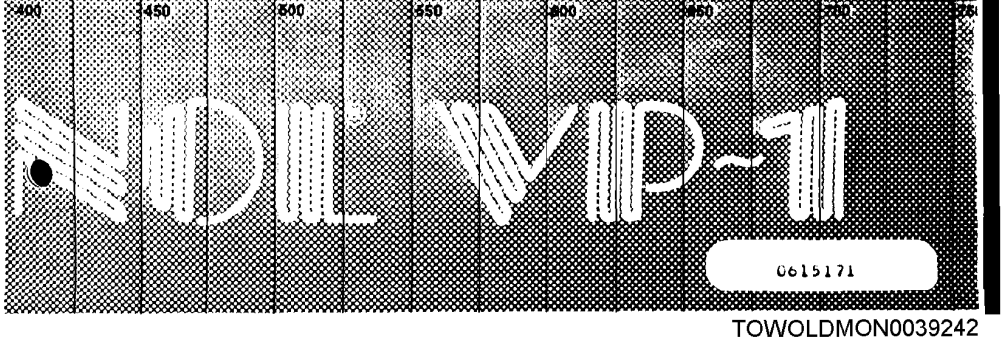
Although Therminol VP-1 can burn at elevated temperatures, its chemical nature is such that its use as heat transfer medium in a properly designed and operated system does not normally constitute a serious fire or explosion hazard. Vapor freed into the air rapidly cools to below the fire point. High pressure *mists*, however, can form an explosive mixture with air. In the fired zone of the heater, leaks may burn with the evolution of soot.

Leaks of Therminol VP-1 fluid that saturate pipe insulation should be treated as potential fire hazards and corrected immediately. Soaked insulation acts as a wick and process heat can initiate charring or ignition.

If Therminol VP-1 fluid is ignited, carbon dioxide or dry powder extinguishers may be used for control. Inside the heater, fire zone leaks can be extinguished with carbon dioxide or steam smothering to avoid thermal shock to the lining.

Safety of Handling

At room temperatures Therminol VP-1 heat transfer fluid has a very low order of toxicity and no special precautions in handling are necessary. Neither liquid nor the low concentrations of vapor in the air from opening containers cause appreciable irritation of the skin, eyes, or mucous membranes of the nose. However, as with any organic chemical, unnecessary skin contact should be avoided. Splashes on the skin should be removed with soap and water. Eye contact should be immediately irrigated and referred to a physician. At elevated temperatures, vapor concentrations should be maintained below the current TLV (Threshhold Limit Value) of 1 part per million (ppm).



TOWOLDMON0039242
WATER_PCB-00023711

Fluid

SAMPLE

available

A 16-ounce standard laboratory size sample of Therminol VP-1 heat transfer fluid is available from Monsanto without charge. To receive a sample for your own evaluation just complete and send in the enclosed SAMPLE REQUEST form. No envelope or postage necessary.

0615172

TOWOLDMON0039243
WATER_PCB-00023712

FOLD, SEAL AND MAIL. NO POSTAGE NECESSARY INSIDE UNITED STATES

THERMINOL® Heat Transfer Fluid
SAMPLE REQUEST

Name_____

Title_____

Company_____

Address_____

City_____ State_____ Zip_____

Telephone (_____) _____
Area Code Number

Please check one:

☐ Send standard 16-ounce laboratory sample.

☐ Contact me to arrange for a larger sample.

Sample amount required is _____.

So we can better serve you, please complete the following:

Therminol VP-1 heat transfer fluid will be evaluated for:

☐ Initial fill of a new system

☐ Top-up to Dowtherm A in an existing system

☐ Replacement of Dowtherm A

☐ Other:_____

The heat transfer system application is:_____

_____

_____

Operating Temperature Range: from_____ °F to _____ °F.

Manufacturer and type of heater_____

BTU Rating_____

Operating phase of the heat transfer fluid:

☐ Liquid Phase Only

☐ Vapor Phase Only

☐ Combined Liquid/ Vapor Phase

Approximate fluid capacity of the system:_____ Gallons

Estimated annual consumption rate:_____ Gallons

☐ Supply pricing information on the basis of (_____ 55-gallon drums, or

_____ gallons bulk) per month, estimated delivery beginning

_____ / _____.
Month Year

☐ Have a Monsanto fluids representative contact me.

Thank You!

Monsanto

0615173

TOWOLDMON0039244
WATER_PCB-00023713

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1401 Dove Street
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Tel. (714) 833-9150

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0615175

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WATER_PCB-00023715

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WATER_PCB-00023716