DRILL-WELL™ D294 Rheology Modifier for Oil Based Muds

DRILL-WELL™ D294 Rheology Modifier (RM) is a proprietary product used for rheology control in invert oil-based drilling fluids (OBM) including mineral, diesel and synthetic oils. Once dissolved in an oil based drilling fluid, this modifier displays "flat rheology" characteristics (upon evaluation by typical Fann methodology in Drilling Specialties Company laboratories). "Flat rheology" is nominally understood to be behavior such that values of "yield point" (YP), 6 and 3 rpm values and gel strength remain relatively constant over a wide range of temperature and pressure. "Flat rheology" maintains a fluid with good hole cleaning capabilities reducing the chance for stuck pipe and the formation of cutting beds. The use of rheology modifiers also allows the clay content to be reduced or eliminated altogether such that progressive gels do not cause surge/swab problems. This feature minimizes the fluid's equivalent circulating densities (ECDs) from exceeding the fracture gradient in the wellbore which helps to prevent losses of the drilling fluid to the substrata. DRILL-WELL™ D294 RM maybe used over a wide temperature range of 4.4 °C to 162.8 °C (40 °F to ±325 °F). DRILL-WELL™ D294 RM is a liquid product composed of active component (52%) in a diluent compatible with OBM fluid systems.

Advantages:

- Works at low concentrations to increase YP, 6 and 3 rpm readings and gel strengths in oil base muds
- Does not appreciably increase Plastic Viscosity (PV) even at higher concentrations of product or in low temperature environments
- Fan 35 data confirms good stability at 4.4 °C (40 °F) [Page 6]
- Works at lower concentrations than other rheology modifiers sold into the market today
- Minimizes the fluids ECD's
- Typical treatments range from 2.0 – 4.0 ppb of this liquid product
- Works in oil muds of any density
- Mixes easly at the mud plant or on the drilling rig; no high shear or heat cycle required to activate the product
- Does not increase the HTHP fluid loss of the drilling mud
- Is compatible with most other commonly used drilling mud additives
- Is compatible with DRILL-WELL™ D244 Polymeric Fluid Loss additive from Drilling Specialties Company

Table I

Comparison of Control; DRILL-WELL™ D294 RM and Thixatrol® DW treated samples in Escaid® 110 OBM. OBM a 14.0 pound per gallon (PPG) formulation of 75/25 oil/water ratio (OWR) prepared according to reference *1 below samples Hot Rolled 16 hours @ 148.9 °C (300 °F)			
	Control	(1)	(2)
Escaid OBM Control 422-91A	428g Hot rolled	428g Hot rolled	428g Hot rolled
DRILL-WELL™ D294 RM	-----	2 lbb	-----
Thixatrol® DW	-----	-----	2 lbb
Fann 35 Rheology @ 29.4 °C (85 °F)			
600 rpm	59	78	70
300 rpm	36	49	43
PV (cPs)	23	29	27
YP ($lb_f/100\ ft^2$)	13	20	16
200 rpm	27	38	32
100 rpm	17	26	20
6 rpm	6	11	7
3 rpm	5	10	6
Gels 10 sec, 10 min	7/9	16/28	12/24
Fann 35 Rheology @ 48.9 °C (120 °F)			
600 rpm	45	66	61
300 rpm	27	43	39
PV (cPs)	18	23	22
YP ($lb_f/100\ ft^2$)	9	20	17
200 rpm	19	34	29
100 rpm	12	24	20
6 rpm	4	11	8
3 rpm	3	10	7
Gels 10 sec, 10 min	4/8	16/24	12/21
Fann 35 Rheology @ 65.6 °C (150 °F)			
600 rpm	37	58	54
300 rpm	21	40	35
PV	16	18	19
YP	5	22	16
200 rpm	15	33	27
100 rpm	9	23	18
6 rpm	3	12	8.5
3 rpm	2.5	11	7.5
Gels 10 sec, 10 min	4/6	15/21	12/18
ES @ 65.6 °C (150 °F)	569	1002	712
HTHP@ 148.9 °C (300 °F)	21.0 ml	16.2 ml	18.2 ml

***1** Note: Escaid® 110 Oil Based Mud: Comparison of Control, DRILL-WELL™ D294 Rheology Modifier; and Thixatrol® DW Viscosifier in a 14.0 ppg formulation of 75/25 oil/water ratio prepared as follows: Escaid® 110 2120 g, Lime 75g, VG-69 Clay 87.5g. INVERMUL® Emulsifier 75g, EZMUL® Emulsifier 75g 30% $CaCl_2$ Brine 815 g, mixed approximately 30 minutes on the Silverson or 57.2 °C (135 °F) was obtained. Samples containing 208 g Escaid® 110 OBM, 212 g Barite, 8 g API clay and appropriate level of active polymer were mixed approximately 30 minutes via Multimixer and subsequently hot rolled at 148.9 °C (300 °F) for 16 hrs. This formula is used in all testing with mineral oil muds.

Escaid® 110 is a product from Exxon Chemical
Thixatrol® DW is a Polymeric Viscosifier from Elementis Specialties

VG-69 Clay is a product of M-I SWACO

Fig. 1

Comparison of DRILL-WELL™ D294 RM to Thixatrol® DW Viscosifier at 2 ppb Concentration

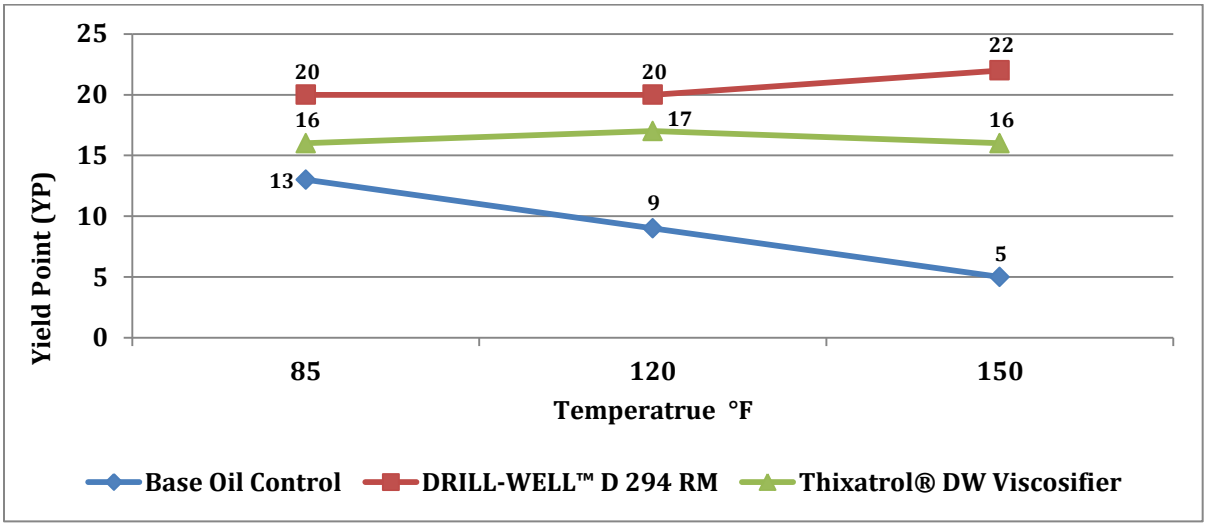
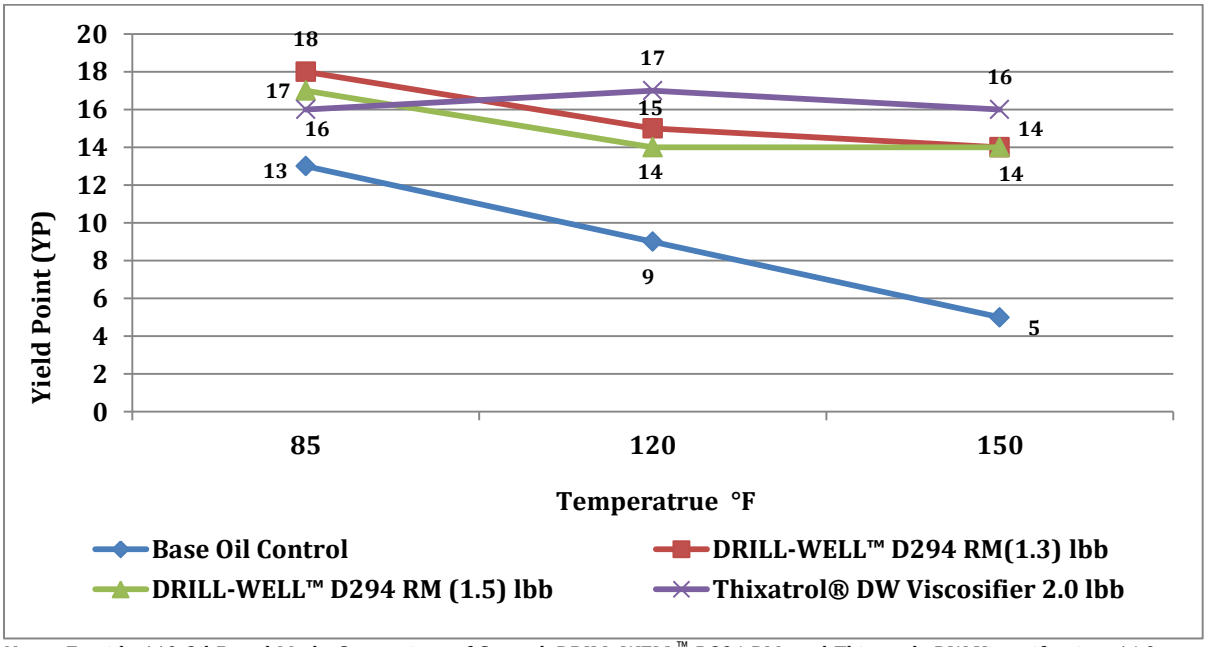


Fig. 2

Comparison of DRILL-WELL™ D294 RM to Thixatrol® DW Viscosifier Various Concentrations



Note: Escaid® 110 Oil Based Mud: Comparison of Control, DRILL-WELL™ D294 RM; and Thixatrol® DW Viscosifier in a 14.0 ppg formulation of 75/25 oil/water ratio prepared as follows: Escaid® 110 2120 g, Lime 75g, VG-69 Clay 87.5g. INVERMUL® Emulsifier 75g, EZMUL® Emulsifier 75g 30% $CaCl_2$ Brine 815 g, mixed approximately 30 minutes on the Silverson or 57.2 C° (135 °F) was obtained. Samples containing 208g Escaid® 110 OBM, 212 g Barite, 8 g API clay and appropriate level of active polymer were mixed approximately 30 minutes via Multimixer and subsequently hot rolled at 148.9 °C (300 °F) for 16 hrs. This formula is used in all testing with mineral oil muds.

Fig 3

Comparison of DRILL-WELL™ D294 RM to Thixatrol® DW Viscosifier at 2 ppb

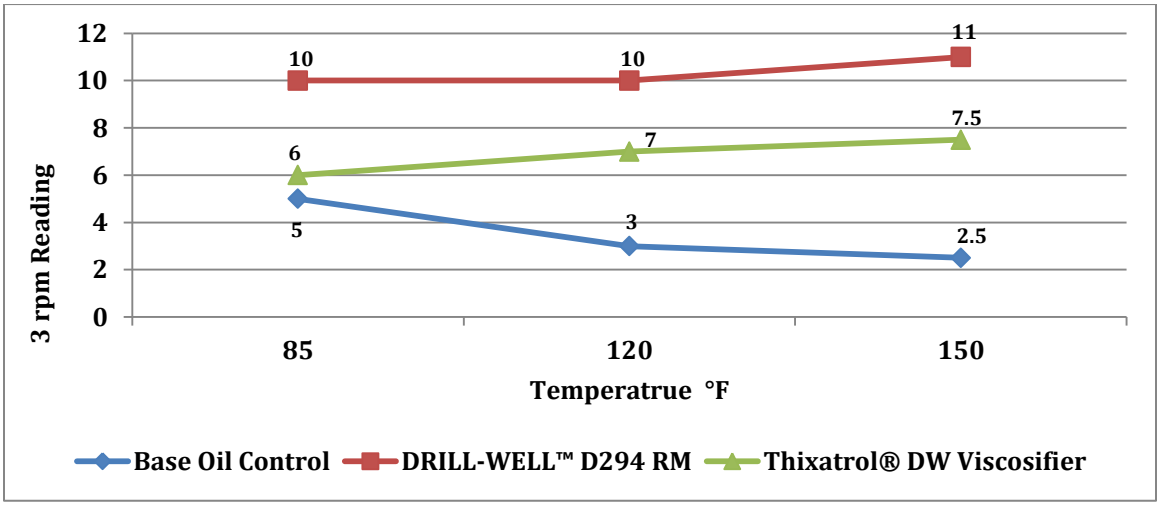
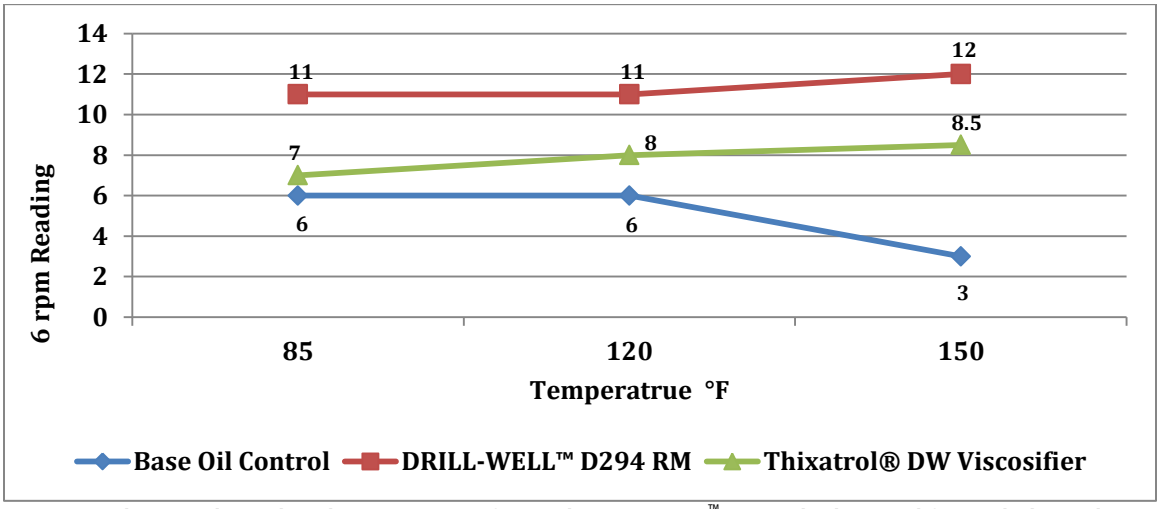


Fig 4

Comparison of DRILL-WELL™ D294 RM to Thixatrol® DW Viscosifier at 2 ppb



Note: Escaid® 110 Oil Based Mud: Comparison of Control; DRILL-WELL™ D294 Rheology Modifier; and Thixatrol® DW Viscosifier in a 14.0 ppg formulation of 75/25 oil/water ratio prepared as follows: Escaid® 110 2120 g, Lime 75g, VG-69 Clay 87.5g. INVERMUL® Emulsifier 75g, EZMUL® Emulsifier 75g 30% $CaCl_2$ Brine 815 g, mixed approximately 30 minutes on the Silverson or 57.2 °C (135 °F) was obtained. Samples containing 208 g Escaid® 110 OBM, 212 g Barite, 8 g API clay and appropriate level of active polymer were mixed approximately 30 minutes via Multimixer and subsequently hot rolled at 148.9 °C (300 °F) for 16 hrs. This formula is used in all testing with mineral oil muds.

Conclusions:

Figures 1-4 shows that it takes less DRILL-WELL™ D294 RM to achieve the same viscosity or higher rheological properties as it does with Thixatrol® DW. This allows for less product usage saving money for the oil and gas operator.

Table II

Fann 35 Rheology: IO 15/16 OBM with DRILL-WELL™ D294 RM (NO Clay)

	Control	1	2	3	4
Control	xxxx				
DRILL-WELL™ D294 RM	-----	0.5 lbb			
DRILL-WELL™ D294 RM	-----	-----	1.0 lbb		
DRILL-WELL™ D294 RM	-----	-----	-----	1.5 lbb	
DRILL-WELL™ D294 RM	-----	-----	-----	-----	2.0 lbb
Fann 35 Rheology @ 29.4 °C (85 °F)					
600 rpm	51	77	108	119	125
300 rpm	27	46	67	75	82
PV	24	31	41	44	43
YP ($lb_f/100\ ft^2$)	3	15	26	31	39
200 rpm	19	34	51	60	66
100 rpm	10	22	35	42	48
6 rpm	2	10	20	25	29
3 rpm	1	9	19	24	28
Gels 10sec / 10 min.	2/2	14/20	26/32	30/35	31/38
Fann 35 Rheology @ 48.9 °C (120 °F)					
600 rpm	37	68	87	94	131
300 rpm	20	42	54	60	80
PV	17	26	33	34	51
YP	3	16	21	26	29
200 rpm	13	32	42	48	65
100 rpm	7	22	30	36	49
6 rpm	1	11	18	22	30
3 rpm	1	10	17	21	29
Gels 10sec / 10 min	1/2	13/18	20/25	22/27	30/36
ES @ 120 °F	400	820	820	850	700
Fann 35 Rheology @ 65.6 °C (150 °F)					
600 rpm	28	60	70	78	85
300 rpm	16	40	45	50	56
PV	12	20	25	28	29
YP	4	20	20	22	27
200 rpm	10	32	35	40	48
100 rpm	6	23	25	30	38
6 rpm	1	12	13	18	25
3 rpm	1	11	12	17	24
Gels 10sec/10 min	3/4	12/14	16/20	18/22	23/27

Base Formulation: IO-154.8g, VG69-0g (100% CLAY REDUCTION), Lime-6g, SURE-MUL® 8g, 30% $CaCl_2$-94.1g Barite-220g, API Clay 9g Samples hot rolled 16 hours @ 148.9 °C (300 °F). Recipe for 13 ppg IO OBM.

Table III

Fann Rheology: IO 15/16 OBM with DRILL-WELL™ D294 RM (100% reduction in Clay) Low temperature Fann Rheology 4.4 °C (40 °F)

Control 428-7A	Control	1	2	3	4
DRILL-WELL™ D294 RM		0.5 lbb			
DRILL-WELL™ D294 RM			1.0 lbb		
DRILL-WELL™ D294 RM				1.5 lbb	
DRILL-WELL™ D294 RM					2.0 lbb
Fann 35 Rheology @ 4.4 °C (40 °F)					
600 rpm	84	122	171	177	180
300 rpm	44	71	103	107	113
PV	40	51	68	77	67
YP	4	20	35	30	46
200 rpm	30	52	77	80	86
100 rpm	17	31	49	50	57
6 rpm	3	10	24	23	28
3 rpm	2	9	22	22	26
Gels: 10 sec/10 min	3/3	19/22	44/33	35/38	35/37
Base Formulation: IO-154.8g, VG69-0g (100% CLAY REDUCTION), Lime-6g, SURE-MUL® 8g, 30% $CaCl_2$-94.1g Barite 220g, API Clay-9g Samples hot rolled 16 hours @ 148.9 °C (300 °F). Recipe for 13.0 ppg IO OBM.					

Table IV

Fann 35 Rheology: DRILL-WELL™ D294 RM VS Thixatrol® DW/ in Diesel OBM

Comparison of Control; DRILL-WELL™ D294 RM and Thixatrol® DW in Diesel OBM. OBM is a 14.0 PPG formulation of 75/25 OWR prepared according to reference *1 below.			
All samples Hot-Rolled for 16 hrs. @ 148.9 °C (300 °F)	Control Hot-Rolled	(1) Hot-Rolled	(2) Hot-Rolled
Diesel OBM Control 422-89A	428g	428g	428g
DRILL-WELL™ D294 RM	-----	2 lbb	-----
Thixatrol® DW	-----	-----	2 lbb
Fan 35 Rheology @ 29.4 °C (85 °F)			
600 rpm	101	137	144
300 rpm	66	92	96
PV	35	45	48
YP	31	47	48
200 rpm	53	76	79
100 rpm	38	56	55
6 rpm	7	31	30
3 rpm	6	30	26
Gels 10 sec, 10 min	18/25	37/48	38/56
Fan 35 Rheology @ 48.9 °C (120 °F)			
600 rpm	78	128	140
300 rpm	51	87	106
PV	27	41	34
YP	24	46	72
200 rpm	41	70	87
100 rpm	30	52	64
6 rpm	14	29	37
3 rpm	13	27	34
Gels 10 sec, 10 min	15/20	34/44	44/58
Fan 35 Rheology @ 65.6 °C (150 °F)			
600 rpm	60	113	144
300 rpm	42	80	110
PV	18	33	34
YP	24	47	76
200 rpm	34	67	90
100 rpm	24	52	69
6 rpm	11	30	44
3 rpm	10	28	42
Gels 10 sec, 10 min	12/17	34/41	47/56
ES @ 150 °F = HTHP@ 148.9 °C (300 °F)/500 psi	811 14.4 ml	1546 17.2 ml	1486 -------

*1 Diesel OBM prepared via recipe: #2 Diesel 2120g, Lime 75g, VG-69 Clay 87.5g, Invermul® Surfactant 75g, Ezmul® Surfactant 75g, 30% $CaCl_2$ Brine 815g…mixed approximately 30 minutes on the Silverson or until 57.2 °C (135 °F) was obtained. Samples containing 208g Diesel OBM, 212g Barite, 8g API clay and appropriate level of active polymer were mixed approximately 30 minutes via multi-mixer and subsequently hot-rolled at 148.9 °C (300 °F) for 16 hours.

Thixatrol® DW is a Polymeric Viscosifier from Elementis Specialties

Fig. 5

Comparison of DRILL-WELL™ D294 RM to Thixatrol® DW Viscosifier at 2 ppb Concentration

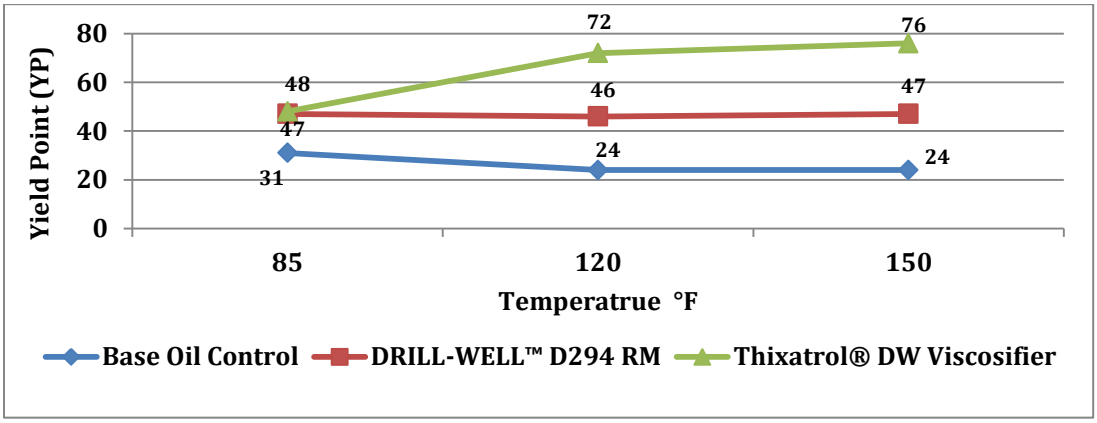


Fig. 6

Comparison of DRILL-WELL™ D294 RM to Thixatrol® DW Viscosifier at 2 ppb

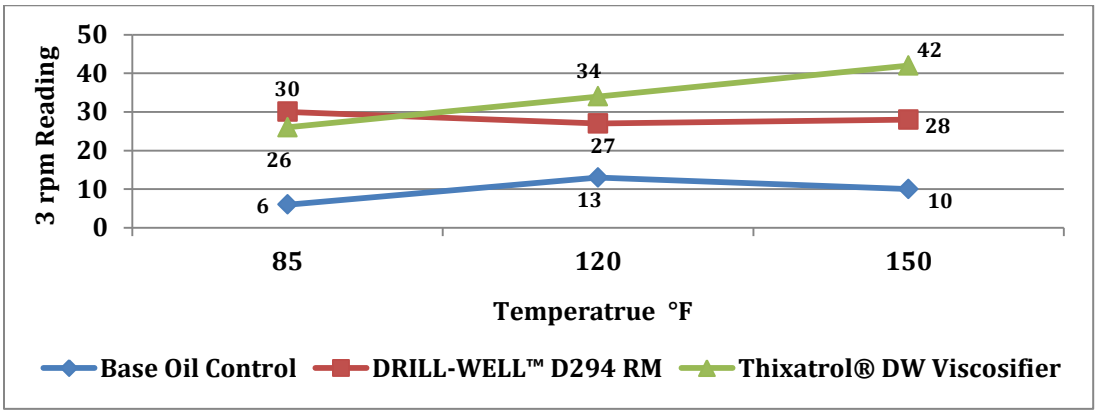
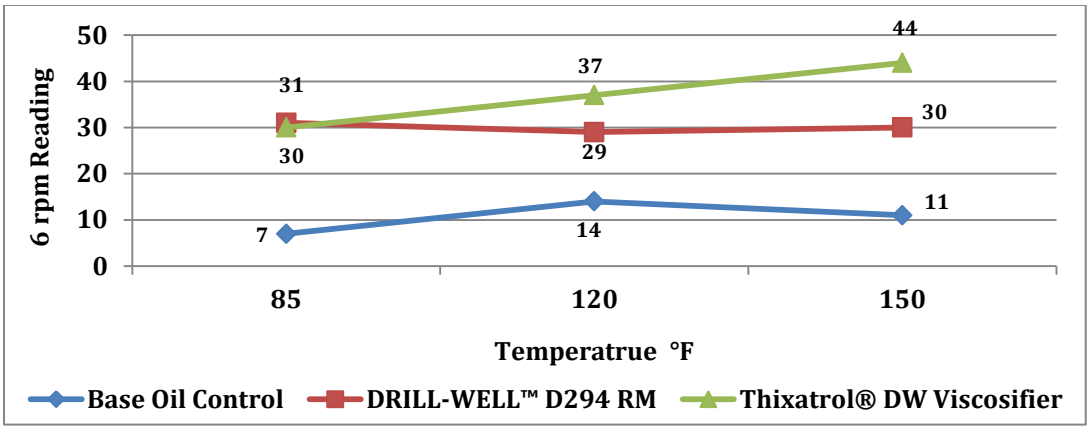


Fig. 7

Comparison of DRILL-WELL™ D294 RM to Thixatrol® DW Viscosifier at 2 ppb



Data for figures 5 – 7 taken from table #4 on page 7

Conclusions:

The Graphs 5-7 show that DRILL-WELL™ D294 RM is a much better flat rheology modifier across the normally tested temperature ranges than Thixatrol® DW.

Packaging:

- Standard packaging is in 275 gallon non-returnable totes
- product may be special ordered in 5 gallon pails 40lb/pail 32 pails to the pallet or
- 55 gallon drums 4 drums to the pallet.

For more information on Drilling Specialties Company products visit our web site at **www.drillingspecialties.com**