



API CERTIFICATION DATA

BIOSYNTHETIC TECHNOLOGIES' SE-7B BASE OIL

BLENDED WITH

SK YUBASE (GROUP III) BASE OIL

5W-20 and 5W-30

January 8, 2014

5W-30 Formulation and Inspections

SAE Viscosity Grade	SAE 5W-30
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Formulation	Type	Mass %	Volume %
LUBRIGREEN 7B	SYN	35.000	34.033
YUKONG BASE 4	BS	22.950	24.099
YUKONG BASE 6	BS	25.200	26.307

API License Information

Analytical Inspections	Test Method	Results	Limits
SAE J300			
TBN D2896	ASTM D2896	8.6	Report
Viscosity at 100 °C	ASTM D445	9.68	9.3 - < 12.5
Viscosity at 40 °C	ASTM D445	54.16	Report
HTHS Viscosity, mPa-s	ASTM D4683	3.2	≥2.9
CCS at -30°C	ASTM D5293	6370	≤6600
MRV at -35°C, cP	ASTM D4684	27800	≤ 60000
MRV at -35°C, Yield Stress	ASTM D4684	NYS	NYS
NOACK	ASTM D5800	8	≤ 15%

Elementals, Mass %	Test Method	Results	Typicals
Barium	ASTM D5185	<0.0001	0
Boron	ASTM D5185	0.004	0.003
Calcium	ASTM D5185	0.218	0.218
Copper	ASTM D5185	<0.0001	0
Magnesium	ASTM D5185	0.001	0.001
Molybdenum	ASTM D5185	0.011	0.011
Phosphorus	ASTM D5185	0.077	0.075
Silicon	ASTM D5185	0.0006	0.0006
Sulphur	ASTM D5185	0.249	0.243
Zinc	ASTM D5185	0.084	0.082
Sulphur	ASTM D2622	0.218	0.243

5W-20 Formulation and Inspections

SAE Viscosity Grade	SAE 5W-20		
Formulation	Type	Mass %	Volume %
LUBRIGREEN7B	SYN	35.000	33.933
YUKONG BASE 4	BS	48.150	50.413
YUKONG BASE 6	BS	1.500	1.561
API/ACEA License Information			
Analytical Inspections	Test Method	Results	Limits
SAE J300			
TBN, mg KOH/g	ASTM D2896	8.3	Report
Viscosity at 100 °C	ASTM D445	8.0	< 9.3
Viscosity at 40 °C	ASTM D445	42.19	Report
HTHS Viscosity, mPa-s	ASTM D4683	2.7	≥2.6
CCS at -30°C	ASTM D5293	4252	≤6600
MRV at -35°C, cP	ASTM D4684	27800	≤ 60000
MRV at -35°C, Yield Stress	ASTM D4684	NYS	NYS
NOACK	ASTM D5800	11	≤ 15%
Elementals, Mass %	Test Method	Results	Typicals
Barium	ASTM D5185	<0.0001	0
Boron	ASTM D5185	0.004	0.003
Calcium	ASTM D5185	0.217	0.218
Copper	ASTM D5185	<0.0001	0
Magnesium	ASTM D5185	0.001	0
Molybdenum	ASTM D5185	0.011	0.011
Phosphorus	ASTM D5185	0.076	0.075
Silicon	ASTM D5185	0.0006	0.0006
Sulphur	ASTM D5185	0.252	0.23
Zinc	ASTM D5185	0.081	0.082
Sulphur	ASTM D2622	0.212	0.23

Engine Test Data

Viscosity Grade, SAE	SAE 5W-30	SAE 5W-20	
Sequence IIIG (ASTM D7320)	Pass	VGRA	Limit1
Viscosity increase at 40°C, %	56	56	≤150
Weighted Piston Deposits, merit	8.5	8.5	≥4.0
Hot Stuck Rings	0	0	None
Cam + Lifter wear average, μm	12	12	≤60
Sequence IIIG A (Sequence IIIG A)	Pass	VGRA	Limit1
MRV, 100hr. used oil per D4485, cP	24600	24600	≤60000 only for ILSAC grades
MRV, Temp., 100hr. used oil per D4485, °C	-30	-30	Report (only for ILSAC grades)
MRV, Yield Stress, 100hr. used oil per D4485, Pa	<35	<35	< 35 (only for ILSAC grades)
Sequence IVA (ASTM D6891)	RA	RA/VGRA	Limit1
Cam wear average, μm	1	1	≤90
Sequence VG (ASTM D6593-00)	RA	RA/VGRA	Limit1
Engine sludge average, merit	8.8	8.8	≥8.0
Rocker arm cover sludge, merit	9.5	9.5	≥8.3
Piston skirt varnish rating average, merit	8.3	8.3	≥7.5
Engine varnish average, merit	9.3	9.3	≥8.9
Oil screen clogging, %	1	1	≤15
Hot stuck rings	0	0	None
Cold stuck rings	0	0	Report
Oil ring clogging, %	0	0	Report
Oil screen debris, %area	2	2	Report
Sequence VIII (ASTM D6709)	RA	RA/VGRA	Limit1
Bearing weight loss, mg	20.5	20.5	≤26
Stripped Viscosity 100°C, cSt	9.5	9.5	Stay in Grade

Bench Test Data

Viscosity Grade, SAE	SAE 5W-30	SAE 5W-20	
BRT (ASTM D6557)	Pass	VGRA	Limit
Gray Value average	145	145	≥100
Volatility (ASTM D5800)	Pass	Pass	Limit
Evaporative loss at 250°C, %	8	11	15 max
Volatility (ASTM D6417)	Pass	Pass	Limit
Evaporative loss at 371°C, %	2	4	≤10
GMEOFT (ASTM D6795)	Pass	Pass	Limit
% Flow Change	-1	-1	≤50
EOWT (ASTM D6794)	Pass	VGRA	Limit
% Flow Change w/ 0.6% water	-3	-3	≤ 50
% Flow Change w/ 1.0% water	-7	-7	≤ 50
% Flow Change w/ 2.0% water	-7	-7	≤ 50
% Flow Change w/ 3.0% water	-6	-6	≤ 50
Phosphorus (ASTM D4951, D5185)	Pass	Pass	Limit
Phosphorus D4951, %m	0.08	0.08	0.06-0.08(ILSAC Grades); 0.06 min (others)
Sulphur (ASTM D2622)	Pass	Pass	Limit
Sulphur D2622, %m	0.2	0.2	0.5max(0W-XX,5W-XX); 0.6 max (10W-30)
Homogeneity & Miscibility	Pass	VGRA	Limit
Performance	Pass	Pass	Pass
Shear Stability (Kurt Orbahn 30 cycle D6278) (ASTM D6278)	Pass	Pass	Limit
Viscosity at 100°C after shear, cSt	9.4		8.5 cSt min (xW-30)
Viscosity at 100°C after shear, cSt		7.9	5.6 cSt min (xW-20)
MTEOS (ASTM D7097)	Pass	VGRA	Limit
Total Deposit level, mg	8	8	35 max(ILSAC Grades), 45 max for others
Scanning Brookfield (ASTM D5133)	Pass	Pass	Limit
Gellation Index	<6.0	9	12 max (ILSAC Grades only)

Bench Test Data, Cont.

Viscosity Grade, SAE	SAE 5W-30	SAE 5W-20	
Foaming Characteristics (D892 opt A) (ASTM D892(A))	Pass	Pass	Limit
Sequence I after 5 min BLOWING	0	0	≤10
Sequence I after 1 min Settling, mL	0	0	0
Sequence II after 5 min BLOWING	0	0	≤50
Sequence II after 1 min Settling, mL	0	0	0
Sequence III after 5 min BLOWING, mL	0	0	≤10
Sequence III after 1 min Settling, mL	0	0	0
Foaming Characteristics (HTFT-D6082 opt A) (ASTM D6082(A))	Pass	Pass	Limit
Sequence IV Tendency, Static Foam, mL	10	10	≤100
Sequence IV Stability, 1 min settling, mL	0	0	0
Nitrile (ASTM D7216)	Pass	VGRA	Limit
Volume change, %	0	0	-5, 10
Hardness	0	0	-10, 5
Tensile strength, %	1	1	-20, 15
Polyacrylate (ASTM D7216)	Pass	VGRA	Limit
Volume change, %	1	1	-5, 9
Hardness	4	4	-10, 10
Tensile strength, %	-4	-4	-40, 40
Fluorocarbon (ASTM D7216)	Pass	VGRA	Limit
Volume change, %	1	1	-2, 3
Hardness	2	2	-6, 6
Tensile strength, %	-19	-19	-65, 10
Ethylene Acrylic GF-5 (D7216) (ASTM D7216)	Pass	VGRA	Limit
Volume change, %	22	22	-5, 30
Hardness	-11	-11	-20, 10
Tensile strength, %	-2	-2	-30, 30
Silicone (ASTM D7216)	Pass	VGRA	Limit
Volume change, %	19	19	-5, 40
Hardness	-13	-13	-30, 10
Tensile strength, %	-15	-15	-50, 5