EN 14214:2003 (E) AUTOMOTIVE FUELS - FATTY ACID METHYL ESTERS (FAME) FOR DIESEL ENGINES - REQUIREMENTS AND TEST METHODS

TABLE 1 - GENERALLY APPLICABLE REQUIREMENTS AND TEST METHODS

PROPERTY	UNIT	MINIMUM	MAXIMUM	TEST METHOD
ESTER CONTENT	% (M/M)	96.5		PREN 14103
DENSITY @ 15°C	KG/M3	860	900	EN ISO 3675 EN ISO 12185
VISCOSITY @ 40°C	MM2	3.5	5.0	EN ISO 310
FLASH POINT	°C	ABOVE 101		ISO / CD 3679
SULFUR CONTENT	MG/KG		10	
CARBON RESIDUE (10% BOTTOMS)	% (M/M)		0.3	EN ISO 10370
CETANE NUMBER		51.0		EN ISO 5165
SULPHATED ASH CONTENT	% (M/M)		0.02	ISO 3987
WATER CONTENT	MG/KG		500	EN ISO 12937
TOTAL CONTAMINATION	MG/KG		24	EN 12662
COPPER STRIP CORROSION (3HR @ 50°C)	RATING	CLASS 1	CLASS 1	EN ISO 2160
THERMAL STABILITY				
OXIDATION STABILITY, 110°C	HOURS	6		PR EN 14112
ACID VALUE	MG KOH/G		0.5	PR EN 14104
IODINE VALUE			120	PR EN 14111
LINOLENIC ACID METHYL ESTER	% (M/M)		12	PR EN 14103
POLYUNSATURATED (>= 4 DOUBLE BONDS) METHYL ESTERS	% (M/M)		1	
METHANOL CONTENT	% (M/M)		0.2	PR EN 14110
MONOGLYCERIDE CONTENT	% (M/M)		0.8	PR EN 14105
DIGLYCERIDE CONTENT	% (M/M)		0.2	PR EN 14105
TRIGLYCERIDE CONTENT	% (M/M)		0.2	PR EN 14105
FREE GYLCEROL	% (M/M)		0.02	PR EN 14105 PR EN 14106
TOTAL GYLCEROL	% (M/M)		0.25	PR EN 14105
ALKALINE METALS (NA + K)	MG/KG		5	PR EN 14108 PR EN 14109
PHOSPHORUS CONTENT	MG/KG		10	PR EN 14107

Data on Cold Flow Properties

Pour points

(Abbreviations defined below)

BIODIESEL CONCENTRATION	SME	CME	LME	ETME	ITME	LYGME	HYGME
0%	-27	-27	-27	-27	-27	-27	-27
0.25%	-27	-21	-24	-24	-24	-24	-24
0.50%	-27	-24	-24	-24	-24	-24	-24
1%	-24	-24	-24	-21	-24	-24	-24
3%	-24	-24	-21	-21	-21	-21	-21
5%	-21	-21	-18	-18	-15	-18	-18
10%	-18	-21	-15	-12	-12	-18	-18
20%	-18	-18	-9	-9	-9	-9	-12
35%	-15	-18	0	-6	-3	-6	-6
50%	-9	-15	3	3	3	0	-3
100%	-1	-4	11	13	8	12	8

CLOUD POINTS

BIODIESEL CONCENTRATION	SME	CME	LME	ETME	ITME	LYGME	HYGME
0%	-18	-18	-18	-18	-18	-18	-18
0.25%	-20	-18	-18	-16	-16	-15	-18
0.50%	-17	-18	-17	-16	-17	-14	-15
1%	-16	-18	-17	-15	-17	-16	-15
3%	-16	-17	-16	-13	-14	-16	-15
5%	-16	-17	-15	-12	-13	-16	-14
10%	-15	-17	-14	-9	-10	-13	-13
20%	-14	-15	-3	-2	-6	-6	-8
35%	-9	-12	-3	0	0	5	-6
50%	-9	-10	-2	3	4	13	-3
100%	2	-3	14	20	23	42	8

FROM: “PRODUCTION OF BIODIESEL FROM MULTIPLE FEEDSTOCKS AND PROPERTIES OF BIODIESELS AND BIODIESEL/DIESEL BLENDS,” FINAL REPORT TO NATIONAL RENEWABLE ENERGY LABORATORY FROM GAS TECHNOLOGY INSTITUTE, DES PLAINES, IL, SEPT. 2001.

SME = SOY METHYL ESTER
CME = CANOLA METHYL ESTER
LME = LARD METHYL ESTER
ETME = EDIBLE TALLOW METHYL ESTER

ITME = INEDIBLE TALLOW METHYL ESTER
LYGME = LOW FREE FATTY ACID YELLOW GREASE
HYGME = HIGH FREE FATTY ACID YELLOW GREASE
SOURCE:
HTTP://WWW.ME.IASTATE.EDU/BIODIESEL/PAGES/BIODIESEL23.HTML

OIL YIELDS AND CHARACTERISTICS

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QUALITY STANDARD FOR RAPESEED OIL FUEL
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-- STANDARD TESTING
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FUEL PROPERTIES OF ESTERS
FATS AND OILS -- RESOURCES

QUALITY STANDARD FOR RAPESEED OIL

QUALITY STANDARD FOR RAPESEED OIL AS A FUEL (RK-QUALITÄTSSTANDARD)				
PROPERTIES /CONTENTS	**UNIT**	**LIMITING VALUE**		**TESTING METHOD**
		MIN.	MAX.	
CHARACTERISTIC PROPERTIES FOR RAPESEED 0IL				
DENSITY (15ºC)	KG/M^3	900	930	DIN EN ISO 3675 DIN EN ISO 12185
FLASH POINT BY P.-M.	ºC	220	-	DIN EN 22719
CALORIFIC VALUE	KJ/KG	35000	-	DIN 51900-3
KINEMATIC VISCOSITY (40ºC)	MM^2/S	-	38	DIN EN ISO 3104
LOW TEMPERATURE BEHAVIOUR	-	-	-	ROTATIONAL VISCOMETER (TESTING CONDITIONS WILL BE DEVELOPED)
CETANE NUMBER	-	-	-	TESTING

				METHOD WILL BE REVIEWED
CARBON RESIDUE	MASS-%	-	0.40	DIN EN ISO 10370
IODINE NUMBER	G/100 G	100	120	DIN 53241-1
SULPHUR CONTENT	MG/KG	-	20	ASTM D5453-93
VARIABLE PROPERTIES				
CONTAMINATION	MG/KG	-	25	DIN EN 12662
ACID VALUE	MG KOH/G	-	2.0	DIN EN ISO 660
OXIDATION STABILITY (110ºC)	H	5.0	-	IS0 6886
PHOSPHORUS CONTENT	MG/KG	-	15	ASTM D3231-99
ASH CONTENT	MASS-%	-	0.01	DIN EN ISO 6245
WATER CONTENT	MASS-%	-	0.075	PR EN ISO 12937

ABTEILUNG TECHNOLOGIE NACHWACHSENDER ROHSTOFFE
ARBEITSGRUPPE PFLANZENÖLE
DEPARTMENT OF TECHNOLOGY, REGENERATING RAW MATERIALS
WORKING GROUP ON VEGETABLE OILS
DR. BERNHARD WIDMANN

LTV-WORK-SESSION ON DECENTRAL VEGETABLE OIL PRODUCTION, WEIHENSTEPHAN
HTTP://DEC2.TEC.AGRAR.TU-MUENCHEN.DE/PFLANZOEL/RKSTANDARD_E.HTML

SEE ALSO: **VEGETABLE OIL STANDARD**: COMMENTS BY **ELSBETT TECHNOLOGY**

COMPARISON OF PROPERTIES OF DIESEL, CANOLA OIL AND COMMERCIAL US BIODIESEL			
	DIESEL	**CANOLA OIL**	**BIODIESEL**
DENSITY KGL-^{1} @ 15.5 DEG C	0.84	0.92	0.88
CALORIFIC VALUE MJL-^{1}	38.3	36.9	33-40

VISCOSITY MM^2S^{-1} @ 20 DEG C	4-5	70	4-6
VISCOSITY MM^2S^{-1} @ 40 DEG C	4-5	37	4-6
VISCOSITY MM^2S^{-1} @ 70 DEG C	-	10	-
CETANE NUMBER	45	40-50	45-65

FROM "WASTE VEGETABLE OIL AS A DIESEL REPLACEMENT FUEL" BY PHILLIP CALAIS, ENVIRONMENTAL SCIENCE, MURDOCH UNIVERSITY, PERTH, AUSTRALIA, AND A.R. (TONY) CLARK, WESTERN AUSTRALIAN RENEWABLE FUELS ASSOCIATION INC.
HTTP://WWW.SHORTCIRCUIT.COM.AU/WARFA/PAPER/PAPER.HTM

1. SIMS, R. *YIELDS, COSTS AND AVAILABILITY OF NATURAL OILS/FATS AS DIESEL FUEL SUBSTITUTES*, REPORT NO LF2021 FOR THE LIQUID FUELS TRUST BOARD, WELLINGTON (NZ) 1982
2. ENVIRONMENT AUSTRALIA (NATIONAL HERITAGE TRUST) (2000B). *SETTING NATIONAL FUEL QUALITY STANDARDS - PAPER 2 - PROPOSED STANDARDS FOR FUEL PARAMETERS (PETROL AND DIESEL)*, CANBERRA
3. BEER, T., GRANT, T., BROWN, R., EDWARDS, J., NELSON, P., WATSON, H., WILLIAMS, D. (2000) *LIFE-CYCLE EMISSION ANALYSIS OF ALTERNATIVE FUELS FOR HEAVY VEHICLES*. CSIRO, AUSTRALIA

CETANE NUMBERS

CETANE NUMBERS RATE THE IGNITION PROPERTIES OF DIESEL FUELS, JUST AS OCTANE NUMBERS DETERMINE THE QUALITY AND VALUE OF GASOLINE (PETROL). IT'S A MEASURE OF A FUEL'S WILLINGNESS TO IGNITE WHEN IT'S COMPRESSED. THE HIGHER THE CETANE NUMBER, THE MORE EFFICIENT THE FUEL. BIODIESEL HAS A HIGHER CETANE NUMBER THAN PETRODIESEL BECAUSE OF ITS OXYGEN CONTENT.

FROM THE LUBRIZOL CORPORATION:
HTTP://WWW.LUBRIZOL.COM/DIESELENGINES/DEFAULT.ASP

IGNITION QUALITY OR CETANE NUMBER -- THIS FACTOR INFLUENCES EASE OF STARTING, DURATION OF WHITE SMOKING AFTER START-UP, DRIVABILITY BEFORE WARM-UP AND INTENSITY OF DIESEL KNOCK AT IDLE. STUDIES HAVE CORRELATED IGNITION QUALITY WITH ALL REGULATED EMISSIONS. AS IGNITION DELAY IS REDUCED, THE COMBUSTION PROCESS STARTS EARLIER AND EMISSIONS (PRIMARILY CARBON MONOXIDE AND HYDROCARBONS) ARE REDUCED.

IGNITION DELAY IS MEASURED BY THE CETANE NUMBER (CN) TEST (ASTM D 613), WHICH USES A SINGLE-CYLINDER, VARIABLE COMPRESSION RATIO ENGINE ANALOGOUS TO THE OCTANE NUMBER ENGINE. IN THIS CASE, THE IGNITION DELAY OF THE TEST FUEL IS MEASURED AT A FIXED COMPRESSION RATIO. THIS RESULT IS COMPARED WITH THE RESULTS FROM STANDARD REFERENCE FUELS CONSISTING OF BLENDS OF N-CETANE AND HEPTAMETHYLNONANE.

DIESEL ENGINES VARY WIDELY IN THEIR CETANE REQUIREMENTS, AND THERE IS NO COMMONLY RECOGNIZED WAY TO MEASURE THIS VALUE. IN GENERAL, THE LOWER AN ENGINE'S OPERATING SPEED, THE LOWER THE CN OF THE FUEL IT CAN USE. LARGE MARINE ENGINES CAN TOLERATE

FUELS WITH CNS AS LOW AS 20, WHILE SOME MANUFACTURERS OF HIGH-SPEED PASSENGER CAR DIESEL ENGINES SPECIFY 55 CN FUEL.

NATIONAL STANDARDS FOR BIODIESEL

COMPARISON OF DIFFERENT NATIONAL STANDARDS FOR BIODIESEL							
	EUROPE	**AUSTRIA**	**CZECH REPUBLIC**	**FRANCE**	**GERMANY**	**ITALY**	**SWEDEN**
STANDARD / SPECIFICATION	EN 14214	ON C1191	CSN 65 6507	JOURNAL OFFICIEL	DIN V 51606	UNI 10635	SS 155436
DATE	2003	JULY 1997	SEP 1998	SEP 1997	SEP 1997	APRIL 1997	NOV 1996
APPLICATION	FAME	FAME	RME	VOME	FAME	VOME	VOME
DENSITY 15°C G/CM	0.86 -0.90	0.85 - 0.89	0.87 - 0.89	0.87 - 0.90	0.875 - 0.90	0.86 - 0.90	0.87 - 0.90
VISCOS. 40°C MM^2/S	3.5-5.0	3.5-5.0	3.5-5.0	3.5-5.0	3.5-5.0	3.5-5.0	3.5-5.0
DISTILLAT. 95% °C	-	-	-	<360	-	<360	-
FLASHPOINT °C	>120	>100	>110	>100	>110	>100	>100
CFPP °C (COLD FILTER PLUGGING POINT)	*COUNTRY SPECIFIC	0/-15	-5	-	0/-10/-20	-	-5
POUR POINT °C	-	-	-	<-10	-	<0/ <-15	-
SULFUR % MASS	<10 MG/KG	<0.02	<0.02	-	<0.01	<0.01	<0.001
CCR 100% % MASS	-	<0.05	<0.05	-	<0.05	-	-
10% DIST. RESID. % MASS	<0.3	-	-	<0.3	-	<0.5	-
SULFATED ASH % MASS	<0.02	<0.02	<0.02	-	<0.03	-	-
(OXID) ASH % MASS	-	-	-	-	-	<0.01	<0.01
WATER MG/KG	<500	-	<500	<200	<300	<700	<300

TOTAL CONTAM. MG/KG	<24	-	<24	-	<20	-	<20
CU-CORROS. 3H/50°C	1	-	1	-	1	-	-
OXIDATION STABILITY HRS;110°C	6 HOURS MIN	-	-	-	-	-	-
CETANE NO.	>51	>49	>48	>49	>49	-	>48
NEUTRAL. NO. (ACID VALUE) MGKOH/G	<0.5	<0.8	<0.5	<0.5	<0.5	<0.5	<0.6
METHANOL % MASS	<0.20	<0.20	-	<0.1	<0.3	<0.2	<0.2
ESTER CONTENT % MASS	>96.5	-	-	>96.5	-	>98	>98
MONOGLYCERIDE. % MASS	<0.8	-	-	<0.8	<0.8	<0.8	<0.8
DIGLYCERIDE % MASS	<0.2	-	-	<0.2	<0.4	<0.2	<0.1
TRIGLYCERIDE % MASS	<0.2	-	-	<0.2	<0.4	<0.1	<0.1
FREE GLYCEROL % MASS	<0.02	<0.02	<0.02	<0.02	<0.02	<0.05	<0.02
TOTAL GLYCEROL % MASS	<0.25	<0.24	<0.24	<0.25	<0.25	-	-
IODINE NO.	<120	<120	-	<115	<115	-	<125
LINOLENIC ACID ME %MASS	<12	-	-	-	-	-	-
C18:3 AND HIGH. UNSAT.ACIDS % MASS	-	<15	-	-	-	-	-
C(X:4) & GREATER UNSATURATED ESTERS % MASS	<1	-	-	-	-	-	-
PHOSPHOR MG/KG	<10	<20	<20	<10	<10	<10	<10
RAMSBOTTOM	-	-	-	-	-	-	-

CARBON RESIDUE, % MASS							
CARBON RESIDUE	-	-	-	-	-	-	-
GP I METALS (NA,K) MG/KG	<5	-	-	-	-	-	-
GP II METALS (CA,MG) MG/KG	<5	-	-	-	-	-	-
ALKALINITY MG/KG	-	-	<10	<5	<5	-	<10

RME: RAPESEED OIL METHYL ESTER
FAME: FATTY ACID METHYL ESTER
VOME: VEGETABLE OIL METHYL ESTER
FAMAE: FATTY ACID MONO ALKYL ESTER

US STANDARD -- D6751-02 STANDARD SPECIFICATION FOR BIODIESEL FUEL (B100) BLEND STOCK FOR DISTILLATE FUELS. DOWNLOAD FROM THE ASTM SITE, COSTS $30 (PDF):
HTTP://WWW.ASTM.ORG/CGI-BIN/SOFTCART.EXE/STORE/FILTREXX40.CGI?U+MYSTORE+MOFC8213+-L+D6751+/USR6/HTDOCS/ASTM.ORG/DATABASE.CART/PAGES/D6751.HTM

EU STANDARD -- DIN EN 14214, PUBLICATION DATE:2003-11 AUTOMOTIVE FUELS - FATTY ACID METHYL ESTERS (FAME) FOR DIESEL ENGINES - REQUIREMENTS AND TEST METHODS. ORDER FROM BEUTH VERLAG GMBH ("SEARCH" FOR "EN 14214")
HTTP://WWW.BEUTH.DE/INDEX_EN.PHP

CEN DIESEL FUEL SPECIFICATION (EN 590:1993):
HTTP://JOURNEYTOFOREVER.ORG/ENERGIAWEB/EN590EN.HTM

AUSTRALIAN STANDARD:
HTTP://WWW.DEH.GOV.AU/ATMOSPHERE/BIODIESEL/INDEX.HTML

STANDARDS AND THE HOMEBREWER:
"MOST OF THE STANDARDS CAN BE MET SIMPLY BY PREPARING AND WASHING THE FUEL WELL," SAYS **TODD SWEARINGEN OF APPAL ENERGY**.

STANDARD TESTING:
BIODIESEL FUEL TESTING FOR THE US ASTM D-6751 STANDARD:

ANALYTICAL TESTING SERVICES, INC.
HTTP://WETESTIT.COM/

HARRIS TESTING LABORATORIES, INC.
HTTP://WWW.HARRISTESTINGLAB.COM/QUOTE/D6751.HTM

FUEL PROPERTIES OF FATS AND OILS

FUEL-RELATED PROPERTIES AND IODINE VALUES OF VARIOUS FATS AND OILS

OIL OR FAT	IODINE VALUE	CN	HG (KJ/KG)	VISCOSITY (MM 2/S)	CP (DEG C)	PP (DEG C)	FP (DEG C)
BABASSU	10-18	38	-	-	-	-	-
CASTOR	82-88	?	39500	297 (38 C)	-	-31.7	260
COCONUT	6-12	-	-	-	-	-	-
CORN	103-140	37.6	39500	34.9 (38 C)	-1.1	-40.0	277
COTTONSEED	90-119	41.8	39468	33.5 (38 C)	1.7	-15.0	234
CRAMBE	93	44.6	40482	53.6 (38 C)	10.0	-12.2	274
LINSEED	168-204	34.6	39307	27.2 (38 C)	1.7	-15.0	241
OLIVE	75-94	-	-	-	-	-	-
PALM	35-61	42	-	-	-	-	-
PEANUT	80-106	41.8	39782	39.6 (38 C)	12.8	-6.7	271
RAPESEED	94-120	37.6	39709	37.0 (38 C)	-3.9	-31.7	246
SAFFLOWER	126-152	41.3	39519	31.3 (38 C)	18.3	-6.7	260
HIGH-OLEIC SAFFLOWER	90-100	49.1	39516	41.2 (38 C)	-12.2	-20.6	293
SESAME	104-120	40.2	39349	35.5 (38 C)	-3.9	-9.4	260
SOYBEAN	117-143	37.9	39623	32.6 (38 C)	-3.9	-12.2	254
SUNFLOWER	110-143	37.1	39575	37.1 (38 C)	7.2	-15.0	274
TALLOW	35-48	-	40054	51.15 (40 C)	-	-	201
NO. 2 DF	-	47	45343	2.7 (38 C)	-15.0	-33.0	52

CN = CETANE NUMBER; CP = CLOUD POINT, PP = POUR POINT, FP = FLASH POINT.
IODINE VALUES COMBINED FROM APPLEWHITE, T.H., IN KIRK-OTHMER, *ENCYCLOPEDIA OF CHEMICAL TECHNOLOGY*; THIRD ED.; JOHN-WILEY & SONS: NEW YORK, NY, 1980, VOL. 9; PP. 795-811; AND GUNSTONE, F.D.; HARWOOD, J.L.; PADLEY, F.B. *LIPID HANDBOOK*; SECOND ED.; CHAPMAN & HALL: LONDON, 1994.
FUEL PROPERTIES FROM GOERING, C.E.; SCHWAB, A.W.; DAUGHERTY, M.J.; PRYDE, E.H.; HEAKIN, A.J. *TRANS. ASAE* 1982, 25, 1472-1477 & 1483.
ALL TALLOW VALUES FROM ALI, Y.; HANNA, M.A.; CUPPETT, S.L. *J. AM. OIL CHEM. SOC*. 1995, 72, 1557-1564 (NO CN GIVEN, CALCD. CETANE INDEX 40.15).

(*FROM*: **BIODIESEL: THE USE OF VEGETABLE OILS AND THEIR DERIVATIVES AS ALTERNATIVE DIESEL FUELS**, G. KNOTHE, R.O. DUNN, AND M.O. BAGBY, IN *FUELS AND CHEMICALS FROM BIOMASS*, WASHINGTON, D.C.: AMERICAN CHEMICAL SOCIETY. DOWNLOAD

FULL-TEXT ARTICLE:
ACROBAT FILE, 912KB
MS WORD FILE, 212KB

FUEL PROPERTIES OF ESTERS

FUEL-RELATED PHYSICAL PROPERTIES OF ESTERS OF OILS AND FATS						
ESTER	**CN**	**HG** (KJ/KG)	**VISCOSITY** (MM2/S)	**CP** (DEG C)	**PP** (DEG C)	**FP** [1] (DEG C)
METHYL						
COTTONSEED [2]	51.2	-	6.8 (21DEG)	-	-4	110
RAPESEED [3]	54.4	40449	6.7 (40DEG)	-2	-9	84
SAFFLOWER [4]	49.8	40060	-	-	-6	180
SOYBEAN [5]	46.2	39800	4.08 (40DEG)	2	-1	171
SUNFLOWER [6]	46.6	39800	4.22 (40DEG)	0	-4	-
TALLOW [7]	-	39949	4.11 (40DEG)	12	9	96
ETHYL						
PALM [8]	56.2	39070	4.5 (37.8DEG)	8	6	19
SOYBEAN [5]	48.2	40000	4.41 (40DEG)	1	-4	174
TALLOW [9]	-	-	-	15	12	-

SOURCE: HTTP://JOURNEYTOFOREVER.ORG/BIODIESEL_YIELD2.HTML