



ASTM INTERNATIONAL
Manual

Guide to ASTM Test Methods for the Analysis of Petroleum Products, Liquid Fuels, and Lubricants 3rd Edition

R.A. Kishore Nadkarni

Guide to ASTM Test Methods for the Analysis of Petroleum Products, Liquid Fuels, and Lubricants

3rd Edition

R. A. Kishore Nadkarni
ASTM Stock No. MNL44-3RD



ASTM International
100 Barr Harbor Drive
PO Box C700
West Conshohocken, PA 19428-2959
e-mail: service@astm.org
website: <http://www.astm.org>

Printed in U.S.A.

Library of Congress Cataloging-in-Publication Data

This publication has been registered with the Library of Congress.

Copyright © 2020 ASTM International, West Conshohocken, PA. All rights reserved. This material may not be reproduced or copied, in whole or in part, in any printed, mechanical, electronic, film, or other distribution and storage media, without the written consent of the publisher.

Photocopy Rights

Authorization to photocopy item for internal, personal, or educational classroom use, or the internal, personal, or educational classroom use of specific clients, is granted by ASTM International, provided that the appropriate fee is paid to the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, Tel: (978) 646-2600; <http://www.copyright.com/>

Publisher:
ASTM International
100 Barr Harbor Drive
PO Box C700
West Conshohocken, PA 19428-2959
Phone: (610) 832-9585 Fax: (610) 832-9555

ISBN: 978-0-8031-7122-0
ISBN-EB: 978-0-8031-7123-7

ASTM Stock Number: MNL44-3RD
DOI: 10.1520/MNL44-3RD-EB

ASTM International is not responsible, as a body, for the statements and opinions advanced in the publication. ASTM International does not endorse any products represented in this publication.

Printed in Hanover, PA
April 2020

How to Use This Manual

Table 1 lists the specifications given for petroleum products, liquid fuels, and lubricants. As can be seen, a variety of product specifications use multiple properties to characterize the products.

Table 2 lists the test methods with their equivalent IP, ISO, DIN, JIS, and AFNOR designations. The top of each page listing the test summary also references these equivalent standards. If you are considering using any standard that has equivalent standards, you should determine the full scope of each standard and identify any differences between. Although these standards are listed as equivalent, in many cases, they will not be exactly the same.

Table 3 lists the ASTM test methods alphanumerically by ASTM designation. If you know the ASTM designation, this is the easiest way to find what you need. The top of each page listing the test summary also references these equivalent standards.

Foreword

THE PUBLICATION, *Guide to ASTM Test Methods for the Analysis of Petroleum Products, Liquid Fuels, and Lubricants: 3rd Edition*, was sponsored by ASTM Committee D02 on Petroleum Products and Lubricants and edited by R. A. Kishore Nadkarni, East Brunswick, NJ. This is Manual 44 of ASTM’s manual series.

This manual originally published in 2000 has proved to be a useful reference book for technologists and others in the Petroleum Products and Lubricants industry. This enlarged third edition is updated to include ASTM D02 Committee test methods published through 2018. Since first being published, this edition has grown to include more than 300 D02 standards.

Edition	Year	Standards	Properties
1	2000	363	160
2	2007	403	243
3	2018	524	311

The author and the publisher hope that this third edition will prove to be as useful as the first two to the oil industry researchers, analysts, marketers, and regulators.

Dedication

In memory of my beloved wife Nancy Joanne Nadkarni.

CONTENTS

Introduction	1
Table 1 Product Specifications	1
Explanation of Terms	2
Table 2 Test Method Equivalence	3
Table 3 Alphanumeric Index of Standards	6

Analysis

Reference ASTM Standard

ACID NUMBER		
by color indicator titration—see also Base number, p. 45	D974	21
by potentiometric titration	D664	21
by semimicro color indicator titration	D3339	23
by semiquantitative micro determination of acid number of lube oils during oxidation testing	D5770	23
ACIDITY		
in aviation turbine fuel	D3242	24
of hydrocarbon liquids and their distillation residues	D1093	24
in ethanol and ethanol blends by titration	D7795	25
ACID NUMBER OF CRUDE OILS AND PETROLEUM PRODUCTS BY CATALYTIC THERMOMETRIC TITRATION	D8045	25
ACTIVE SULFUR		
in cutting oils	D1662	26
in fuels and solvent doctor test	D4952	26
ADHESION OF SOLID FILM LUBRICANTS	D2510	27
AEROBIC MICROBIAL CONTENT OF FUELS AND ASSOCIATED WATER BY THIXOTROPIC GEL CULTURE METHOD	D7978	27
AIR RELEASE PROPERTIES OF OILS	D3427	28
ALKYL NITRATE IN DIESEL FUELS	D4046	28
AMYL NITRATE IN DIESEL FUELS	D1839	29
ANALYSIS OF LIQUEFIED PETROLEUM (LP) GASES AND PROPANE/PROPENE MIXTURES BY GAS CHROMATOGRAPHY	D2163	29
ANILINE AND MIXED ANILINE POINT	D611	30
ANTIOXIDANT CONTENT IN LUBRICATING GREASES BY LINEAR SWEEP VOLTAMETRY	D7527	30
REMAINING PRIMARY ANTIOXIDANT CONTENT OF IN-SERVICE INDUSTRIAL LUBRICATING OILS BY LINEAR SWEEP VOLTAMMETRY	D7590	31
APPARENT VISCOSITY BY CAPILLARY VISCOMETER AT HIGH TEMPERATURE HIGH SHEAR	D4624	31
MEASURING VISCOSITY		
of new and used engine oils at high shear rate and high temperature by tapered bearing simulator viscometer at 150°C	D4683	32
at high temperature and high shear rate by tapered-plug viscometer	D4741	32
APPARENT VISCOSITY		
using cold cranking simulator	D5293	33
at high temperature high shear by multicell capillary viscometer	D5481	33
of lubricating greases	D1092	34
yield stress and apparent viscosity at low temperature	D4684	34

APPLIED COATING WAX IN CORRUGATED BOARD FACING	D3522	35
AROMATICS		
and polynuclear aromatics in diesel and aviation turbine fuels by supercritical-fluid chromatography	D5186	35
in finished gasoline by gas chromatography	D4420	36
in finished gasoline by gas chromatography	D5580	36
in finished gasoline by gas chromatography/Fourier transform infrared spectroscopy	D5986	37
in gasolines by gas chromatography-mass spectrometry	D5769	38
in hydrocarbon oils by high resolution nuclear magnetic resonance	D5292	38
TOTAL AROMATICS AND TOTAL SATURATES IN LUBE BASESTOCKS USING HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY (HPLC) WITH REFRACTIVE INDEX DETECTION	D7419	39
SEPARATION AND DETERMINATION OF AROMATICS, NONAROMATICS, AND FAME FRACTIONS IN MIDDLE DISTILLATES BY GAS CHROMATOGRAPHY	D8144	39
ASH		
in coal tar and pitch	D2415	40
in petroleum coke	D4422	40
from petroleum products	D482	41
sulfated ash from lubricating oils and additives	D874	41
ASPHALTENES (HEPTANE INSOLUBLES) IN CRUDE PETROLEUM AND PETROLEUM PRODUCTS	D6560	42
VISIBLE SPECTRUM OF ASPHALTENES IN HEAVY FUEL OILS AND CRUDE OILS BY SPECTROSCOPY IN A MICROFLUIDIC PLATFORM	D7996	43
BASE NUMBER BY COLOR INDICATOR TITRATION	D974	45
in lubricants by color indicator titration	D5984	45
potentiometric perchloric acid titration	D2896	46
by potentiometric HCl titration	D4739	46
AEROBIC, AQUATIC BIODEGRADABILITY OF LUBRICANTS IN A CLOSED RESPIROMETER	D6731	47
EFFICIENT BASICITY BY POTENTIOMETRIC HYDROCHLORIC ACID TITRATION	D8126	47
BENZENE/TOLUENE		
in gasoline by gas chromatography	D3606	48
in gasoline by infrared IR spectroscopy	D4053	48
in engine fuels using mid-infrared spectroscopy	D6277	49
BENZENE AND TOTAL AROMATICS IN DENATURED FUEL ETHANOL BY GAS CHROMATOGRAPHY	D7576	49
BIODIESEL CONTENT IN DIESEL FUEL OIL USING MID INFRARED SPECTROSCOPY	D7371	50
BIODEGRADABILITY OF LUBRICANTS USING A BIOKINETIC MODEL	D7373	50
BLOCKING AND PICKING POINTS OF PETROLEUM WAX	D1465	51
BOILING RANGE DISTRIBUTION		
of crude petroleum by gas chromatography	D5307	51
of gasoline by wide-bore capillary gas chromatography	D7096	52
of petroleum distillates by gas chromatography	D7213	53

of gasoline fractions by gas chromatography	D3710	54
of petroleum distillates by gas chromatography	D6352	55
BOILING POINT DISTRIBUTION		
of samples with residues such as crude oils and atmospheric and vacuum residues by high temperature gas chromatography	D7169	55
BOILING RANGE DISTRIBUTION		
of fatty acid methyl esters (FAME) in the boiling range from 100°C to 615°C by gas chromatography	D7398	56
of distillates and lubricating base oils in the boiling range from 100°C to 735°C by gas chromatography	D7500	57
of petroleum distillates with final boiling points up to 538°C by ultra fast gas chromatography (UF GC)	D7798	57
of hydrocarbon and sulfur components of petroleum distillates by gas chromatography and chemiluminescence detection	D7807	58
BORDERLINE PUMPING TEMPERATURE		
of engine oils	D3829	59
BROMINE NUMBERS		
of petroleum distillates and commercial aliphatic olefins by electrometric titration	D1159	59
BROMINE INDEX		
of petroleum hydrocarbons by electrometric titration	D2710	60
BURNING QUALITY OF KEROSENE	D187	60
BUTANOL AND ACETONE CONTENT OF BUTANOL FOR BLENDING WITH GASOLINE BY GAS CHROMATOGRAPHY	D7875	61
BUTYLENE ANALYSIS BY GAS CHROMATOGRAPHY	D4424	61
CARBON NUMBER DISTRIBUTION	D2887	62
CARBON RESIDUE		
(micro method)	D4530	63
CARBONIZABLE SUBSTANCES		
in paraffin wax	D612	63
in white mineral oil	D565	63
CARBONYLS IN C₄ HYDROCARBONS	D4423	64
TRACE CARBONYL SULFIDE IN PROPYLENE BY GAS CHROMATOGRAPHY	D5303	64
CELLULAR ADENOSINE TRIPHOSPHATE IN FUEL AND FUEL-ASSOCIATED WATER WITH SAMPLE CONCENTRATION BY FILTRATION	D7687	65
DERIVED CETANE NUMBER (DCN) OF DIESEL FUELS OILS FIXED RANGE INJECTION PERIOD, CONTAST VOLUME COMBUSTION CHAMBER METHOD	D7170	65
DERIVED CETANE NUMBER (DCN) OF DIESEL FUEL OILS—IGNITION DELAY AND COMBUSTION DELAY USING A CONSTANT VOLUME COMBUSTION CHAMBER METHOD	D7668	66
CHEMICAL SPECIES IN MARINE FUEL OIL BY MULTIDIMENSIONAL GAS CHROMATOGRAPHY/ MASS SPECTROMETRY	D7845	67
CHLORINE		
in new and used petroleum products (high pressure decomposition device method)	D808	67
in used petroleum products (field test kit method)	D5384	68

ORGANIC CHLORINE CONTENT IN CRUDE OIL	D4929	68
ORGANIC CHLORIDE CONTENT IN CRUDE OIL BY DISTILLATION FOLLOWED BY DETECTION USING COMBUSTION ION CHROMATOGRAPHY	D8150	69
CHLORIDE CONTENT DETERMINATION OF AVIATION TURBINE FUELS USING CHLORIDE TEST STRIP	D7959	70
CONDITION MONITORING OF PHOSPHATE ANTIWEAR ADDITIVES IN IN-SERVICE PETROLEUM AND HYDROCARBON BASED LUBRICANTS BY TREND ANALYSIS USING FOURIER TRANSFORM-INFRARED (FT-IR) SPECTROMETRY	D7412	70
CONDITION MONITORING OF OXIDATION IN IN-SERVICE PETROLEUM AND HYDROCARBON BASED LUBRICANTS BY TREND ANALYSIS USING FOURIER TRANSFORM-INFRARED (FT-IR) SPECTROMETRY	D7414	71
CONDITION MONITORING OF PHOSPHATE ANTIWEAR ADDITIVES IN IN-SERVICE PETROLEUM AND HYDROCARBON BASED LUBRICANTS BY TREND ANALYSIS USING FOURIER TRANSFORM-INFRARED (FT-IR) SPECTROMETRY	D7415	71
ANALYSIS OF IN-SERVICE LUBRICANTS USING A PARTICULAR FIVE- PART INTEGRATED TESTER	D7416	72
ANALYSIS OF IN-SERVICE LUBRICANTS USING PARTICULAR FOUR- PART INTEGRATED TESTER	D7417	72
SET-UP AND OPERATION OF FOURIER TRANSFORM-INFRARED (FT-IR) SPECTROMETERS FOR IN-SERVICE OIL CONDITION MONITORING	D7418	73
CONDITION MONITORING OF NITRATION IN PETROLEUM AND HYDROCARBON BASED LUBRICANTS BY TREND ANALYSIS USING FOURIER TRANSFORM-INFRARED (FT-IR) SPECTROMETRY	D7624	73
PRACTICAL LUBRICANT CONDITION DATA TREND ANALYSIS	D7669	73
PROCESSING IN-SERVICE FLUID SAMPLES FOR PARTICULATE CONTAMINATION ANALYSIS USING MEMBRANE FILTERS	D7670	74
MICROSCOPIC CHARACTERIZATION OF PARTICLES FROM IN-SERVICE LUBRICANTS	D7684	74
IN-LINE, FULL FLOW, INDUCTIVE SENSOR FOR FERROMAGNETIC AND NON-FERROMAGNETIC WEAR DEBRIS DETERMINATION AND DIAGNOSTICS FOR AERO-DERIVATIVE AND AIRCRAFT GAS TURBINE ENGINE BEARINGS	D7685	74
FIELD-BASED CONDITION MONITORING OF SOOT IN IN-SERVICE LUBRICANTS USING A FIXED-FILTER INFRARED (IR) INSTRUMENT	D7686	75
MICROSCOPIC CHARACTERIZATION OF PARTICLES FROM IN-SERVICE LUBRICANTS BY ANALYTICAL FERROGRAPHY	D7690	75
CONDITION MONITORING OF SOOT IN IN-SERVICE LUBRICANTS BY TREND ANALYSIS USING FOURIER TRANSFORM-INFRARED (FT-IR) SPECTROMETRY	D7844	76
FIELD DETERMINATION OF IN-SERVICE FLUID PROPERTIES USING IR SPECTROSCOPY	D7889	76
LUBRICATION AND HYDRAULIC FILTER DEBRIS ANALYSIS (FDA) FOR CONDITION MONITORING OF MACHINERY	D7898	77
MERIT OF DISPERSANCY OF IN-SERVICE ENGINE OILS WITH BLOTTER SPOT METHOD	D7899	77

INDUCTIVE WEAR DEBRIS SENSORS IN GEARBOX AND DRIVETRAIN APPLICATIONS	D7917	78
FLOW PROPERTIES AND EVALUATION OF WEAR, CONTAMINANTS, AND OXIDATIVE PROPERTIES OF LUBRICATING GREASE BY DIE EXTRUSION METHOD AND PREPARATION	D7918	78
FILTER DEBRIS ANALYSIS (FDA) USING MANUAL OR AUTOMATIC PROCESSES	D7919	79
FERROUS DEBRIS QUANTIFICATION	D8120	79
FERROUS WEAR DEBRIS MONITORING IN IN-SERVICE FLUIDS USING A PARTICLE QUANTIFIER INSTRUMENT	D8184	80
CLOUD POINT OF PETROLEUM PRODUCTS AND LIQUID FUELS		
optical detection stepped cooling method	D5771	81
linear cooling rate method	D5772	81
constant cooling rate method	D5773	81
manual	D2500	82
(miniaturized optical method)	D7397	82
(small test jar method)	D7683	83
(mini method)	D7689	83
COEFFICIENT OF FRICTION OF LUBRICANTS USING THE FOUR-BALL WEAR TEST MACHINE	D5183	84
FRICTION AND WEAR PROPERTIES OF LUBRICATING GREASE USING A HIGH-FREQUENCY, LINEAR-OSCILLATION (SRV) TEST MACHINE	D5707	84
COEFFICIENT OF KINETIC FRICTION FOR WAX COATINGS	D2534	85
COKING VALUE OF TAR AND PITCH (ALCAN)	D4715	85
COLD-CRANKING SIMULATOR		
apparent viscosity using cold cranking simulator—see p. 33	D2602	86
COLD FILTER PLUGGING POINT OF DIESEL AND HEATING FUELS	D6371	86
COLOR		
ASTM color of petroleum products (ASTM color scale)	D1500	87
of dyed aviation gasolines	D2392	89
of transparent liquids (Gardner Color Scale)	D1544	89
of clear liquids (platinum-cobalt scale)	D1209	89
of petroleum products by the automatic tristimulus method	D6045	90
EVALUATING COMPATIBILITY OF MIXTURES OF HYDRAULIC FLUIDS	D7752	90
CONE PENETRATION		
of lubricating grease	D217	91
of lubricating grease using one-quarter and one-half scale cone equipment	D1403	91
of petrolatum	D937	92
CONGEALING POINT		
of petroleum waxes, including petrolatum	D938	92
CONRADSON CARBON RESIDUE		
of petroleum products	D189	93
coking value of tar and pitch (modified conradson)	D2416	95
COOLING CHARACTERISTICS OF QUENCH OILS BY COOLING CURVE ANALYSIS	D6200	95
COOLING CHARACTERISTICS OF AQUEOUS POLYMER QUENCHANTES FOR ALUMINUM ALLOYS BY COOLING CURVE ANALYSIS	D7646	96

COPPER IN JET FUELS BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROMETRY	D6732	96
COPPER CORROSION CORROSIVENESS TO COPPER FROM PETROLEUM PRODUCTS BY COPPER STRIP TEST	D130	97
COPPER STRIP CORROSION		
by industrial aromatic hydrocarbons	D849	97
by liquefied petroleum (LP) gases	D1838	98
from lubricating grease	D4048	98
CORROSIVENESS TO COPPER FROM PETROLEUM PRODUCTS USING A DISPOSABLE COPPER FOIL STRIP	D7095	98
CORROSION CHARACTERISTICS OF SOLID FILM LUBRICANTS	D2649	99
CORROSIVENESS OF DIESEL ENGINE OIL AT 135°C	D6594	99
ACCELERATED IRON CORROSION IN PETROLEUM PRODUCTS	D7548	100
ACCELERATED IRON CORROSION RATING OF DENATURED FUEL ETHANOL AND ETHANOL FUEL BLENDS	D7577	100
CORROSIVENESS TO SILVER BY AUTOMOTIVE SPARK-IGNITION ENGINE FUEL (THIN SILVER STRIP METHOD)	D7667	101
CORROSIVENESS TO SILVER BY AUTOMOTIVE SPARK-IGNITION ENGINE FUEL (SILVER STRIP METHOD)	D7671	101
CORROSION PREVENTIVE PROPERTIES		
corrosiveness and oxidation stability of hydraulic oils, aircraft turbine engine lubricants, and other highly refined oils	D4636	102
CORROSIVENESS OF LUBRICATING FLUID		
to bimetallic couple	D6547	102
CORROSION PREVENTIVE PROPERTIES		
corrosiveness of lubricating fluid to bimetallic couple	D1743	103
CORROSION-PREVENTIVE PROPERTIES		
of lubricating greases in presence of dilute synthetic sea water environments	D5969	103
CORROSION-PREVENTIVE PROPERTIES		
of lubricating greases under dynamic wet conditions (Emcor test)	D6138	104
CRYSTALLITE SIZE (L_c) OF CALCINED		
petroleum coke by x-ray diffraction	D5187	104
DEMULSIBILITY CHARACTERISTICS OF LUBRICATING OILS	D2711	105
DENSITY, RELATIVE DENSITY, AND SPECIFIC GRAVITY		
real density of calcined petroleum coke	D2638	105
vibrated bulk density of calcined petroleum coke	D4292	106
VIBRATED BULK DENSITY OF CALCINED PETROLEUM COKE USING A SEMI-AUTOMATED APPARATUS	D7454	107
BULK DENSITY FOR SPECIFIC SIZE FRACTIONS OF CALCINED PETROLEUM COKE USING A TRANSAXIAL PRESSURE PYCNOMETER	D8097	107
DENSITY AND RELATIVE DENSITY		
real density of calcined petroleum coke by xylene displacement	D5004	108
DENSITY, RELATIVE DENSITY, AND API		
gravity of crude oils by digital density analyzer	D5002	108
DENSITY, RELATIVE DENSITY, AND API GRAVITY OF LIQUIDS		
by digital density meter	D4052	108
DENSITY OR RELATIVE DENSITY		
of light hydrocarbons by pressure thermohydrometer	D1657	109

DENSITY AND RELATIVE DENSITY (SPECIFIC GRAVITY)		
of liquids by Bingham pycnometer	D1217	109
DENSITY, RELATIVE DENSITY, OR API		
gravity of crude petroleum and liquid petroleum products by hydrometer method	D1298	110
DENSITY (RELATIVE DENSITY)		
of solid pitch (pycnometer method)	D2320	110
DENSITY		
of solid pitch (helium pycnometer method)	D4892	111
DENSITY AND RELATIVE DENSITY		
of solid pitch and asphalt (displacement method)	D71	111
DENSITY, RELATIVE DENSITY, OR API GRAVITY OF LIQUID PETROLEUM BY PORTABLE DIGITAL DENSITY METER	D7777	111
DYNAMIC VISCOSITY AND DENSITY		
of liquids by Stabinger viscometer (and the calculation of kinematic viscosity)	D7042	112
DYNAMIC VISCOSITY AND DERIVED KINEMATIC VISCOSITY OF LIQUIDS BY CONSTANT PRESSURE VISCOMETER	D7945	112
DENSITY, RELATIVE DENSITY, AND API GRAVITY		
of crude petroleum and liquid petroleum by thermohydrometer method	D6822	113
DENSITY AND RELATIVE DENSITY		
(specific gravity) of viscous materials by Bingham pycnometer	D1480	114
(specific gravity) of viscous materials by Lipkin bicapillary pycnometer	D1481	114
DEPENTANIZATION		
of gasoline and naphthas	D2001	115
DIESEL FUEL DILUENT		
in used diesel engine oils by gas chromatography	D3524	115
DISTILLATION OF PETROLEUM PRODUCTS		
DISTILLATION		
of crude petroleum (15-theoretical plate column)	D2892	116
of heavy hydrocarbon mixtures (vacuum potstill method)	D5236	116
of petroleum products and liquid fuels at atmospheric pressure	D86	117
DISTILLATION OF PETROLEUM PRODUCTS AND LIQUID FUELS	D7344	118
DISTILLATION OF PETROLEUM PRODUCTS AND LIQUID FUELS AT ATMOSPHERIC PRESSURE (MICRO DISTILLATION METHOD)	D7345	119
DISTILLATION		
at reduced pressure	D1160	120
of pitch	D2569	122
DIMETHYLFORMAMIDE-INSOLUBLE (DMF-1) CONTENT OF TAR AND PITCH	D2764	122
DROPPING POINT		
of lubricating grease	D566	123
of lubricating grease over wide temperature range	D2265	123
DUST CONTROL MATERIAL		
on calcined petroleum coke	D4930	123
ELASTOMER COMPATIBILITY		
of lubricating greases and fluids	D4289	124
ELECTRICAL CONDUCTIVITY		
of aviation and distillate fuels	D2624	124
of liquid hydrocarbons by precision meter	D4308	125

ABILITY OF ENGINE OIL TO EMULSIFY WATER AND SIMULATED Ed85 FUEL	D7563	126
ENGINE OIL VOLATILITY		
by capillary gas chromatography	D6417	127
ETHANOL AND METHANOL CONTENT		
in fuels containing greater than 20% ethanol by gas chromatography	D5501	127
ETHYL MERCAPTAN		
in LP-Gas vapor	D5305	128
ETHYL TERT-BUTYL ETHER (ETBE) BY GAS CHROMATOGRAPHY	D7796	128
ETHYLENE GLYCOL		
in used engine oil	D4291	129
EVAPORATION LOSSES BY VOLATILITY		
ENGINE OIL VOLATILITY		
by gas chromatography	D5480	130
EVAPORATION LOSS		
of lubricating greases over wide temperature range	D2595	130
of lubricating greases and oils	D972	131
of lubrication oils by the Noack method	D5800	131
of lubrication oils by thermogravimetric analysis (TGA) Noack method	D6375	132
EXPLOSIVE REACTIVITY		
of lubricants with aerospace alloys under high shear	D3115	132
EXTREME-PRESSURE PROPERTIES OF FLUID LUBRICANTS (FALEX PIN AND VEE BLOCK METHOD)	D3233	133
EXTREME-PRESSURE PROPERTIES OF LUBRICATING FLUIDS (TIMKEN METHOD)	D2782	133
EXTREME-PRESSURE PROPERTIES OF LUBRICATING FLUIDS (FOUR-BALL METHOD)	D2783	134
EXTREME-PRESSURE PROPERTIES		
of lubricating grease (four-ball method)	D2596	134
of lubricating greases using high-frequency, linear-oscillation (SRV) test machine	D5706	134
EXTREME-PRESSURE PROPERTIES OF LUBRICATING OILS USING A HIGH-FREQUENCY, LINEAR-OSCILLATION (SRV) TEST MACHINE	D7421	135
EXTREME-PRESSURE PROPERTIES OF SOLID BONDED FILMS USING A HIGH-FREQUENCY, LINEAR-OSCILLATION (SRV) TEST MACHINE	D7217	135
EXTRACTABLES		
solvent extractables in petroleum waxes	D3235	136
FATTY ACID METHYL ESTERS CONTENT OF AVIATION TURBINE FUEL USING FLOW ANALYSIS BY FOURIER TRANSFORM INFRARED SPECTROSCOPY—RAPID SCREENING METHOD	D7797	136
FATTY ACID METHYL ESTER (FAME) CONTENT OF A BLEND OF BIODIESEL AND PETROLUM-BASED DIESEL FUEL OIL USING MID-INFRARED SPECTROSCOPY	D7806	137
FATTY ACID METHYL ESTER (FAME) IN DIESEL FUEL BY LINEAR VARIABLE FILTER (LVF) ARRAY BASED MID-INFRARED SPECTROSCOPY	D7861	138
FATTY ACID METHYL ESTERS IN MIDDLE DISTILLATE AND RESIDUAL FUELS USING FLOW ANALYSIS BY FOURIER TRANSFORM INFRARED SPECTROSCOPY—RAPID SCREENING METHOD	D7963	138

FARNESANE, SATURATED HYDROCARBONS, AND HEXAHYDROFARNESOL CONTENT OF SYNTHESIZED ISO-PARAFFINS (SIP) FUEL FOR BLENDING WITH JET FUEL BY GAS CHROMATOGRAPHY	D7974	139
FILTER PLUGGING TENDENCY	D2068	140
FUEL FILTER BLOCKING POTENTIAL OF BIODIESEL (B100) BLEND STOCK BY COLD SOAK FILTRATION TEST (CSFT)	D7501	140
FILTERABILITY OF AVIATION TURBINE FUEL	D6824	141
FILTERABILITY OF DIESEL FUELS by low-temperature flow test (LTFT)	D4539	141
FILTERABILITY OF MIDDLE DISTILLATE FUEL OILS	D6426	142
FILTERABILITY OF ENGINE OILS AFTER TREATMENT WITH VARIOUS AMOUNTS OF WATER AND LONG (6 H) HEATING TIME	D6794	142
FILTERABILITY OF ENGINE OILS AFTER TREATMENT WITH WATER AND DRY ICE AND A SHORT (30 MIN) HEATING TIME	D6795	143
DISCRIMINATION BETWEEN FLAMMABILITY RATINGS of $F = 0$ and $F = 1$	D6668	143
FUEL INJECTOR SHEAR STABILITY TEST (FISST) for polymer containing fluids	D5275	144
FLASH POINT by continuously closed cup (CCFP) tester	D6450	145
FLASH AND FIRE POINTS by Cleveland open cup tester	D92	146
FLASH POINT by modified continuously closed cup (MCCFP) tester	D7094	146
by small scale closed cup tester (ramp method)	D7236	147
by Pensky-Martens closed cup tester	D93	148
small scale closed cup tester	D3828	148
tag closed cup tester	D56	149
MAXIMUM FLOCCULATION RATIO AND PEPTIZING POWER IN RESIDUAL AND HEAVY FUEL OILS (OPTICAL DETECTION METHOD)	D7060	149
FLUORINE, CHLORINE, AND SULFUR IN LIQUID PETROLEUM GAS (LPG) BY OXIDATIVE PYROHYDROLYTIC COMBUSTION FOLLOWED BY ION CHROMATOGRAPHY DETECTION (COMBUSTION ION CHROMATOGRAPHY–CIC)	D7994	150
FOAMING TENDENCY in aqueous media (blender test and bottle test)	D3519 and D3601	151
FOAMING CHARACTERISTICS of lubricating oils	D892	151
FOAMING TENDENCY high temperature foaming characteristics of lubricating oils	D6082	152
FREEZING POINT of aviation fuels	D2386	153
FREEZING POINT of aviation fuels (automatic fiber optical method)	D7154	154
of aviation fuels (automatic laser method)	D7153	154
FREEZING POINT OF AVIATION FUELS (automated optical method)	D5901	155
FREEZING POINT OF AVIATION FUELS (automatic phase transition method)	D5972	155

FREEZING POINTS		
of high-purity hydrocarbons	D1015	156
FRETTING WEAR PROTECTION		
by lubricating greases	D4170	156
FRETTING WEAR RESISTANCE OF LUBRICATING GREASES UNDER HIGH HERTZIAN CONTACT PRESSURES USING A HIGH-FREQUENCY LINEAR-OSCILLATION (SRV) TEST MACHINE	D7594	156
FRICTION AND WEAR PROPERTIES		
of extreme pressure (EP) lubricating oils using SRV test machine	D6425	157
FUEL SYSTEM ICING INHIBITORS (ETHER TYPE) IN AVIATION FUELS	D5006	157
GAUGE VAPOR PRESSURE OF LIQUEFIED PETROLEUM (LP) GASES (LP-GAS METHOD)	D1267	158
GASOLINE DILUENT IN USED GASOLINE ENGINE OILS BY distillation	D322	158
GASOLINE DILUENT IN USED ENGINE OILS		
by gas chromatography	D3525	159
FUEL DILUTION FOR IN-SERVICE ENGINE OILS BY GAS CHROMATOGRAPHY	D7593	159
FUEL DILUTION OF IN-SERVICE LUBRICANTS USING SURFACE ACOUSTIC WAVE SENSING	D8004	160
FREE AND TOTAL GLYCERIN IN B-100 BIODIESEL METHYL ESTERS		
by gas chromatography	D6584	160
GLYCOL-BASE ANTIFREEZE		
in used lubricating oils	D2982	161
GLYCOL FOR IN-SERVICE ENGINE OILS BY GAS CHROMATOGRAPHY	D7922	161
FREE AND TOTAL GLYCERIN IN BIODIESEL BLENDS BY ANION EXCHANGE CHROMATOGRAPHY	D7591	162
GRAIN STABILITY		
of calcined petroleum coke	D6791	163
GRAVITY, API		
of crude petroleum and petroleum products (hydrometer method)	D287	163
GUM CONTENT IN FUELS		
by jet evaporation	D381	164
hardgrove grindability index (HGI) of petroleum coke	D5003	164
HAZE IN FUELS, SPECTROSCOPIC DETERMINATION	D8148	165
HEAT OF COMBUSTION OF PETROLEUM PRODUCTS		
net heat of combustion of aviation fuels	D1405	165
NET HEAT OF COMBUSTION		
of aviation fuels	D3338	166
NET HEAT OF COMBUSTION		
of aviation fuels	D4529	166
NET HEAT OF COMBUSTION		
(specific energy) of aviation fuels	D6446	166
net and gross heat of combustion of burner and diesel fuels	D4868	167
HEAT OF COMBUSTION		
heating values of liquids and solids (differential Mackey test)	D3523	167
HEAT OF COMBUSTION		
of liquid hydrocarbon fuels by bomb calorimeter	D240	168

HEAT OF COMBUSTION		
of liquid hydrocarbon fuels by bomb calorimeter (precision method)	D4809	168
HEAT OF COMBUSTION		
liquid heat capacity of petroleum distillate fuels	D2890	168
HEAT OF COMBUSTION		
specific heat of aircraft turbine fuels by thermal analysis	D4816	169
SEPARABILITY NUMBER OF HEAVY FUEL OILS		
by optical scanning device	D7061	169
SEPARABILITY NUMBER OF n-HEPTANE INDUCED PHASE	D7827	170
SEPARATION OF ASPHALTENE FROM HEAVY FUEL OILS BY AN OPTICAL DEVICE		
high-temperature deposits by thermo-oxidation engine oil simulation test	D6335	171
high temperature stability of middle distillate fuels	D6468	171
HIGH TEMPERATURE UNIVERSAL OXIDATION TEST FOR TURBINE OILS	D6514	172
hindered phenolic and aromatic amine antioxidant content in non-zinc turbine oils by linear sweep voltammetry	D6971	172
hindered phenolic antioxidant content in non-zinc turbine oils by linear sweep voltammetry	D6810	173
HOMOGENITY AND MISCIBILITY		
of automotive engine oils	D6922	174
HYDROCARBON ANALYSIS OF PETROLEUM PRODUCTS		174
HYDROCARBON TYPES		
characteristic groups in rubber extender and processing oils and other petroleum-derived oils by clay-gel absorption chromatographic method	D2007	174
aromatics and nonaromatics fractions of high-boiling oils by emulsion chromatography	D2549	175
in liquid petroleum products by fluorescent indicator adsorption	D1319	176
in gasoline by gas chromatography	D2427	177
in high-purity ethylene by gas chromatography	D2505	177
oxygenated compounds, and benzene in spark ignition engine fuels by gas chromatography	D6839	178
and benzene in light petroleum distillates by gas chromatography	D7753	179
light hydrocarbons and cut point intervals in live crude oils and condensates by gas chromatography	D8003	180
and select hydrocarbon and oxygenate compounds in automotive spark-ignition engine fuels using gas chromatography with vacuum ultraviolet adsorption spectroscopy detection (GC-VUV)	D8071	181
analysis of gas-oil saturates fractions by high ionizing voltage mass spectrometry	D2786	182
aromatics types analysis of gas-oil aromatic fractions by high ionizing voltage mass spectrometry	D3239	182
aromatic hydrocarbon types in aviation fuels and petroleum distillates—high performance liquid chromatography method with refractive index	D6379	183
AROMATIC HYDROCARBON TYPES IN MIDDLE DISTILLATES		
by high performance liquid chromatography method with refractive index detection	D6591	184
in middle distillates by mass spectrometry	D2425	185
in low olefinic gasoline by mass spectrometry	D2789	186

LIGHT HYDROCARBONS IN STABILIZED CRUDE OILS BY GAS CHROMATOGRAPHY	D7900	187
HYDROCARBON TYPE ANALYSIS IN PETROLEUM DISTILLATES THROUGH 200°C BY MULTI-DIMENSIONAL GAS CHROMATOGRAPHY	D5443	188
HYDROGEN CONTENT OF FUELS – GENERAL		
of aviation fuels	D3343	189
of aviation turbine fuels by low resolution nuclear magnetic resonance spectrometry	D3701	189
of light distillates, middle distillates, gas oils, and residua by low-resolution nuclear magnetic resonance spectroscopy	D4808	189
of middle distillate petroleum products by low-resolution pulsed nuclear magnetic resonance spectroscopy	D7171	190
in petroleum fractions	D1018	191
HYDROLYTIC STABILITY OF HYDRAULIC FLUIDS (BEVERAGE BOTTLE METHOD)	D2619	191
HYDROGEN SULFIDE		
in liquefied petroleum (LP) gases (lead acetate method)	D2420	191
in residual fuels by multiple headspace extraction and sulfur specific detection	D6021	192
in the vapor phase above residual fuel oils	D5705	192
in fuel oils by rapid liquid phase extraction	D7621	193
HYDROPEROXIDE NUMBER		
of aviation turbine fuels by voltammetric analysis	D6447	193
HYDROXYL VALUE OF FATTY OIL AND ACIDS	D1957	194
INDIVIDUAL COMPONENTS IN SPARK IGNITION ENGINE FUELS		
by 100-meter capillary high resolution gas chromatography	D6729	194
100-meter capillary (with precolumn) high-resolution gas chromatography	D6730	195
by 50-meter capillary high-resolution gas chromatography	D6733	197
INITIAL pH (I-pH) VALUE OF PETROLEUM PRODUCTS	D7946	197
INSOLUBLE CONTAMINATION OF HYDRAULIC FLUIDS BY GRAVIMETRIC ANALYSIS	D4898	198
PENTANE INSOLUBLES		
by membrane filtration	D4055	198
INSOLUBLES		
in used lubricating oils	D893	199
coagulated pentane insolubles in used lubricating oils by paper filtration (LMOA method)	D7317	199
LUBRICANT GENERATED INSOLUBLE COLOR BODIES IN IN-SERVICE TURBINE OILS USING MEMBRANE PATCH COLORIMETRY	D7843	200
IODINE VALUE OF FATTY QUATERNARY AMMONIUM CHLORIDES	D2078	200
IRON CHIP CORROSION		
for water-miscible metalworking fluids	D4627	201
LEAD DETERMINATION IN GASOLINE – GENERAL		
by atomic absorption spectrometry	D3237	201
iodine monochloride method	D3341	202
in gasoline by x-ray spectroscopy	D5059	202
LEAD DETERMINATION RAPID FIELD TEST FOR TRACE LEAD IN UNLEADED GASOLINE (COLORIMETRIC METHOD)	D3348	203

LEAKAGE TENDENCIES		
of automotive wheel bearing greases	D1263	203
of automotive wheel bearing grease under accelerated conditions	D4290	204
LIFE PERFORMANCE OF AUTOMOTIVE WHEEL BEARING GREASE	D3527	204
LINEAR FLAME PROPAGATION RATE		
of lubricating oils and hydraulic fluids	D5306	205
LITHIUM AND SODIUM		
in lubricating greases by flame photometer	D3340	205
LOAD-CARRYING CAPACITY OF LUBRICATING GREASES (TIMKEN METHOD)	D2509	206
LOAD-CARRYING CAPACITY OF LUBRICANTS USED IN HYPOID FINAL-DRIVE AXLES OPERATED UNDER LOW-SPEED AND HIGH-TORQUE CONDITIONS	D8165	206
LOW TEMPERATURE FLUIDITY AND APPEARANCE		
of hydraulic fluids	D6351	207
LUBRICATING GREASE, ANALYSIS OF	D128	207
OBTAINING IN-SERVICE SAMPLES OF LUBRICATING GREASE	D7718	207
LUBRICITY OF AVIATION TURBINE FUELS BY THE BALL-ON-CYLINDER LUBRICITY EVALUATOR (BOCLE)	D5001	208
LUBRICITY OF DIESEL FUELS		
by high-frequency reciprocating rig (HFRR)	D6079	208
LUBRICITY OF DIESEL FUELS BY HIGH-FREQUENCY RECIPROCATING RIG (HFRR) WITH VISUAL OBSERVATION	D7688	209
LUMINOMETER NUMBERS		
of aviation turbine fuels	D1740	209
MANGANESE IN GASOLINE		
by atomic absorption spectroscopy	D3831	210
MELTING POINT OF PETROLEUM WAX (COOLING CURVE)	D87	210
DROP MELTING POINT OF PETROLEUM WAX, INCLUDING PETROLATUM	D127	211
THIOL MERCAPTAN SULFUR		
in gasoline, kerosine, aviation turbine, and distillate fuels (potentiometric method)	D3227	211
ADENOSINE TRIPHOSPHATE (ATP) CONTENT OF MICROORGANISMS IN FUEL, FUEL/WATER MIXTURES, AND FUEL ASSOCIATED WATER	D7463	212
MANUAL SAMPLING OF LIQUID FUELS, ASSOCIATED MATERIALS, AND FUEL SYSTEM COMPONENTS FOR MICROBIOLOGICAL TESTING	D7464	212
SCREENING OF FUELS AND FUEL ASSOCIATED AQUEOUS SAMPLES FOR MICROBIAL CONTAMINATION BY LATERAL FLOW IMMUNOASSAY	D8070	212
MISTING PROPERTIES OF LUBRICATING FLUIDS	D3705	213
METAL ANALYSIS BY SPECTROSCOPY		213
TRACE METALS IN GAS TURBINE FUELS BY ATOMIC ABSORPTION AND FLAME EMISSION SPECTROSCOPY	D3605	214
METAL ANALYSIS OF BARIUM, CALCIUM, MAGNESIUM, AND ZINC		
in unused lubricating oils by atomic absorption spectroscopy	D4628	215
METAL ANALYSIS		
of aluminum and silicon in fuel oils by ashing, fusion, inductively coupled plasma atomic emission spectrometry, and atomic absorption spectrometry	D5184	215
TRACE ELEMENTS IN MIDDLE DISTILLATE FUELS		
by inductively coupled plasma atomic emission spectrometry (ICP-AES)	D7111	216

METAL ANALYSIS		
of nickel, vanadium, iron, and sodium in crude oils and residual fuels by flame atomic absorption spectrometry	D5863	217
OPTIMIZATION, CALIBRATION, AND VALIDATION OF ATOMIC ABSORPTION SPECTROMETRY FOR METAL ANALYSIS OF PETROLEUM PRODUCTS AND LUBRICANTS	D7740	218
OPTIMIZATION, CALIBRATION, AND VALIDATION OF INDUCTIVELY COUPLED PLASMA ATOMIC EMISSION SPECTROMETRY (ICP-AES) FOR ELEMENTAL ANALYSIS OF PETROLEUM PRODUCTS AND LUBRICANTS	D7260	218
CONTAMINANTS IN GAS TURBINE AND DIESEL ENGINE FUELS BY ROTATING DISC ELECTRODE ATOMIC EMISSION SPECTROMETRY	D6728	219
METAL ANALYSIS OF ADDITIVE ELEMENTS IN LUBRICATING OILS BY inductively coupled plasma atomic emission spectrometry	D4951	220
METAL ANALYSIS OF USED AND UNUSED LUBRICATING OILS AND BASE OILS BY inductively coupled plasma atomic emission spectrometry (ICP-AES)	D5185	221
METALS IN LUBRICATING GREASES BY inductively coupled plasma atomic emission spectrometry	D7303	222
METAL ANALYSIS in crude oils and fuels by inductively coupled plasma atomic emission spectrometry	D5708	223
MULTIELEMENT ANALYSIS OF CRUDE OILS USING inductively coupled plasma atomic emission spectrometry (ICP-AES)	D7691	224
MULTIELEMENT ANALYSIS OF DISTILLATE PRODUCTS by inductively coupled plasma–mass spectrometry (ICP-MS)	D8110	224
PHOSPHORUS IN ILSAC GF 4 AND SIMILAR GRADE ENGINE OILS by inductively coupled plasma atomic emission spectrometry	D7040	225
METAL ANALYSIS in petroleum coke by atomic absorption	D5056	226
METAL ANALYSIS in petroleum coke by inductively coupled plasma atomic emission spectrometry (ICP-AES)	D5600	226
METAL ANALYSIS in petroleum coke by wavelength dispersive x-ray fluorescence spectroscopy	D6376	227
WEAR METALS AND CONTAMINANTS in used oils or hydraulic fluids by rotating disc electrode atomic emission spectrometry	D6595	228
METAL ANALYSIS of lubricant and additive components—barium, calcium, phosphorus, sulfur, and zinc by wavelength-dispersive x-ray fluorescence spectrometry	D4927	229
METAL ANALYSIS calcium, chlorine, copper, magnesium, phosphorus, sulfur, and zinc in unused lubricating oils and additives by wavelength dispersive x-ray fluorescence spectrometry (mathematical correction procedure)	D6443	229
METALS IN LUBRICATING OILS by energy dispersive x-ray fluorescence spectroscopy	D6481	230
COUPLED PARTICULATE AND ELEMENTAL ANALYSIS USING X-RAY FLUORESCENCE (XRF) FOR IN-SERVICE LUBRICANTS	D8127	231

SAMPLING, STORAGE, AND HANDLING OF HYDROCARBONS FOR MERCURY ANALYSIS	D7482	232
TOTAL MERCURY IN CRUDE OIL USING COMBUSTION AND DIRECT COLD VAPOR ATOMIC ADSORPTION METHOD WITH ZEEMAN BACKGROUND CORRECTION	D7622	232
TOTAL MERCURY IN CRUDE OIL USING COMBUSTION-GOLD AMALGAMATION AND COLD VAPOR ATOMIC ABSORPTION METHOD	D7623	233
ADDITIVE METALS IN LUBRICATING OILS BY ED-XRF ANALYSIS	D7751	233
SILICON IN GASOLINE AND RELATED PRODUCTS BY MONOCHROMATIC WAVELENGTH DISPERSIVE X-RAY FLUORESCENCE SPECTROMETRY	D7757	234
METHANOL IN CRUDE OILS		
by multidimensional gas chromatography	D7059	234
TRACES OF METHANOL IN PROPYLENE CONCENTRATES		
by gas chromatography	D4864	235
FUEL METHANOL (M99) AND METHANOL FUEL BLENDS (M10 TO M99) BY GAS CHROMATOGRAPHY	D7920	235
APPARENT VAPOR PRESSURES AND MOLECULAR WEIGHTS		
of lubricating oils	D2878	236
RELATIVE MOLECULAR MASS (MOLECULAR WEIGHT)		
of hydrocarbons by thermoelectric measurement of vapor pressure	D2503	236
MEAN RELATIVE MOLECULAR WEIGHT		
of petroleum oils from viscosity	D2502	237
MOISTURE CORROSION RESISTANCE		
of automotive gear lubricants	D7038	237
MOISTURE OF GREEN PETROLEUM COKE	D4931	238
MOISTURE IN NEW AND IN-SERVICE LUBRICATING OILS AND ADDITIVES BY RELATIVE HUMIDITY SENSOR	D7546	238
METHYL TERT-BUTYL ETHER (MTBE)		
by gas chromatography	D5441	239
MTBE, ETBE, TAME, DIPE, TERTIARY-AMYL ALCOHOL AND C ₂ TO C ₄ ALCOHOLS IN GASOLINE BY GAS CHROMATOGRAPHY	D4815	240
MTBE, ETBE, TAME, DIPE, METHANOL, ETHANOL, AND TERT-BUTANOL IN GASOLINE BY INFRARED SPECTROSCOPY	D5845	241
NAPHTHALENE HYDROCARBONS		
in aviation turbine fuels by ultraviolet spectrophotometry	D1840	241
NEEDLE PENETRATION OF PETROLEUM WAXES	D1321	242
NITROGEN DETERMINATION		
trace nitrogen in liquid petroleum hydrocarbons by syringe/inlet oxidative combustion and chemiluminescence detection	D4629	242
NITROGEN DETERMINATION IN LIQUID HYDROCARBONS, PETROLEUM AND PETROLEUM PRODUCTS		
by boat-inlet chemiluminescence	D5762	243
NITROGEN DETERMINATION		
of carbon, hydrogen, and nitrogen in petroleum products and lubricants	D5291	243
NITROGEN DETERMINATION		
in lubricating oils and fuel oils by modified Kjeldahl method	D3228	244
ODOR OF PETROLEUM WAX	D1833	244

AUTOMOTIVE ENGINE OIL COMPATABILITY		
with typical seal elastomers	D7216	245
OIL CONTENT OF PETROLEUM WAXES	D721	245
OIL SEPARATION FROM LUBRICATING GREASE		
by centrifuging (Koppers method)	D4425	246
OIL SEPARATION FROM LUBRICATING GREASE (CONICAL SIEVE METHOD)	D6184	246
TOTAL OLEFINS IN SPARK-IGNITION ENGINE FUELS		
by multidimensional gas chromatography	D6296	247
OLEFIN CONTENT OF GASOLINES		
by supercritical-fluid chromatography	D6550	247
OLEFIN CONTENT IN DENATURED ETHANOL BY SUPERCRITICAL FLUID CHROMATOGRAPHY	D7347	248
OXIDATION INDUCTION TIME OF LUBRICATING GREASES		
by pressure differential scanning calorimetry	D5483	249
OXIDATION INDUCTION TIME OF LUBRICATING OILS		
by pressure differential scanning calorimetry (PDSC)	D6186	249
OXIDATION OF USED LUBRICANTS		
by FT-IR using peak area increase calculation	D7214	250
OXIDATION STABILITY		
of aviation fuels (potential residue method)	D873	250
of distillate fuels (accelerated method)	D2274	251
OXIDATION STABILITY OF SPARK IGNITION FUEL—RAPID SMALL SCALE OXIDATION TEST (RSSOT)	D7525	251
OXIDATION STABILITY OF MIDDLE DISTILLATE FUELS—RAPID SMALL SCALE OXIDATION TEST (RSSOT)	D7545	252
OXIDATION STABILITY AND INSOLUBLES FORMATION OF INHIBITED TURBINE OILS AT 120°C WITHOUT THE INCLUSION OF WATER (DRY TOST METHOD)	D7873	252
OXIDATION STABILITY		
of gasoline automotive engine oils by thin-film oxygen uptake (TFOUT)	D4742	253
OXIDATION CHARACTERISTICS		
of extreme-pressure lubrication oils	D2893	253
OXIDATION STABILITY		
of gasoline (induction period method)	D525	254
OXIDATION AND THERMAL STABILITY CHARACTERISTICS		
of gear oils using universal glassware	D5763	255
OXIDATION CHARACTERISTICS		
of inhibited mineral oils	D943	255
OXIDATION STABILITY		
of lubricating greases by the oxygen pressure vessel method	D942	256
OXIDATION STABILITY OF LUBRICATING GREASES—RAPID SMALL-SCALE OXIDATION TEST (RSSOT)	D8206	256
OXIDATION TEST		
for hydraulic and turbine oils using the universal oxidation test apparatus	D5846	257
OXIDATION STABILITY OF STEAM TURBINE OILS		
by rotating pressure vessel	D2272	257
OXYGEN IN GASOLINE AND METHANOL FUELS		
by reductive pyrolysis	D5622	258

OXYGENATES		
in gasoline by gas chromatography and oxygen selective flame ionization detection	D5599	258
OXYGENATES AND PARAFFIN, OLEFIN, NAPHTHENE, AROMATIC (O-PONA)		
hydrocarbon types in low-olefin spark ignition engine fuels by gas chromatography	D6293	259
OXYGENATES		
in C ₂ , C ₃ , C ₄ , and C ₅ hydrocarbon matrices by gas chromatography and flame ionization detector	D7423	260
TRACE OXYGENATES IN AUTOMOTIVE SPARK-IGNITION ENGINE FUEL BY MULTIDIMENSIONAL GAS CHROMATOGRAPHY	D7754	261
PARTICULATE CONTAMINATION		
in aviation fuels by laboratory filtration	D5452	261
in aviation fuel by line sampling	D2276	262
in middle distillate fuels by laboratory filtration	D6217	262
PARTICLE COUNTING AND PARTICLE SHAPE CLASSIFICATION OF OILS USING A DIRECT IMAGING INTEGRATED TESTER	D7596	263
SIZING AND COUNTING PARTICLES IN LIGHT AND MIDDLE DISTILLATE FUELS BY AUTOMATIC PARTICLE COUNTER	D7619	263
AUTOMATIC PARTICLE COUNTING OF LUBRICATING AND HYDRAULIC FLUIDS USING DILUTION TECHNIQUES TO ELIMINATE THE CONTRIBUTION OF WATER AND INTERFERING SOFT PARTICLES BY LIGHT EXTINCTION	D7647	264
PROCESSING IN-SERVICE FLUID SAMPLES FOR PARTICULATE CONTAMINATION ANALYSIS USING MEMBRANE FILTERS	D7670	265
CONCENTRATION, COUNT, AND SIZE DISTRIBUTION OF SOLID PARTICLES AND WATER IN LIGHT AND MIDDLE DISTILLATE FUELS BY DIRECT IMAGING ANALYZER	D8049	265
SIZING AND COUNTING PARTICULATES IN LIGHT AND MIDDLE DISTILLATE FUELS AND BIODIESEL BLEND (B ₆ TO B ₂₀) USING CONTINUOUS FLOW AND BOTTLE SAMPLER AUTOMATIC PARTICLE COUNTERS	D8166	266
PERMANENT GASES IN C ₂ and C ₃ HYDROCARBON PRODUCTS BY GAS CHROMATOGRAPHY AND PULSE DISCHARGE HELIUM IONIZATION DETECTOR	D8098	267
PEROXIDES IN BUTADIENE	D5799	267
POLYCHLORINATED BIPHENYLS (PCBs) IN WASTE MATERIALS		
by gas chromatography	D6160	268
HYDROPEROXIDE NUMBER		
of aviation turbine fuels, gasoline and diesel fuels	D3703	268
PEROXIDE NUMBER		
of petroleum wax	D1832	269
ANALYSIS OF PETROLEUM WAXES		
by gas chromatography	D5442	269
PHOSPHORUS DETERMINATION IN PETROLEUM PRODUCTS		
PHOSPHORUS		
in gasoline	D3231	270
in lubricating oils and additives	D1091	271
in lubricating oils and additives by quinoline phosphomolybdate method	D4047	273

MODERATELY HIGH TEMPERATURE PISTON DEPOSITS		
by thermo-oxidation engine oil simulation test—TEOST MHT	D7097	274
CONCENTRATION OF PIPELINE DRAG REDUCER ADDITIVE IN AVIATION TURBINE FUELS	D7862	274
POUR POINT		
of crude oils	D5853	275
POUR POINT OF PETROLEUM PRODUCTS	D97	276
(automatic air pressure method)	D6749	276
(automatic pressure pulsing method)	D5949	277
(automatic tilt method)	D5950	277
by robotic tilt method	D6892	278
(rotational method)	D5985	278
NO FLOW POINT AND POUR POINT OF PETROLEUM PRODUCTS AND LIQUID FUELS	D7346	279
PRECIPITATION NUMBER OF LUBRICATING OILS	D91	279
PUMPABILITY OF INDUSTRIAL FUEL OILS	D3245	280
SOLIDS CONTENT IN PYROLYSIS LIQUIDS	D7579	280
BY FILTRATION OF SOLIDS IN METHANOL		
QUENCHING TIME OF HEAT-TREATING FLUIDS (MAGNETIC QUENCHOMETER METHOD)	D3520	281
QUINOLINE INSOLUBLE (QI) CONTENT		
of tar and pitch	D2318	281
QUINOLINE INSOLUBLE (QI) IN TAR AND PITCH		
by pressure filtration	D4746	282
RAMSBOTTOM CARBON		
residue of petroleum products	D524	282
RED DYE CONCENTRATION AND ESTIMATION OF ASTM COLOR OF DIESEL FUEL AND HEATING OIL USING A PORTABLE VISIBLE SPECTROPHOTOMETER	D6756	283
RED DYE CONCENTRATION AND ESTIMATION OF SAYBOLT COLOR OF AVIATION TURBINE FUELS AND KEROSENE USING A PORTABLE VISIBLE SPECTROPHOTOMETER	D7058	284
REFRACTIVE INDEX AND REFRACTIVE DISPERSION		
of hydrocarbon liquids	D1218	285
REFRACTIVE INDEX		
of viscous materials	D1747	285
RESIDUES IN LIQUEFIED PETROLEUM (LP) GASES	D2158	286
RESIDUES IN LIQUEFIED PETROLEUM (LP) GAS BY GAS CHROMATOGRAPHY WITH LIQUID, ON-COLUMN INJECTION	D7756	286
RESIDUE COMPOSITION IN LIQUEFIED PETROLEUM GAS (LPG) USING AUTOMATED THERMAL DESORPTION/GAS CHROMATOGRAPHY (ATD/GC)	D7828	287
ROLL STABILITY OF LUBRICATING GREASES	D1831	288
ROLL STABILITY OF LUBRICATING GREASE IN PRESENCE OF WATER (WET ROLL STABILITY TEST)	D8022	288
RUST PREVENTIVE CHARACTERISTICS		
of automotive engine oils	D6557	289

of inhibited mineral oil in the presence of water	D665	289
of steam turbine oil in the presence of water (horizontal disk method)	D3603	290
SALTS IN CRUDE OIL		
(electrometric method)	D3230	290
(potentiometric method)	D6470	291
SAPONIFICATION NUMBER OF PETROLEUM PRODUCTS	D94	291
SEDIMENT TESTS		
sediment in crude oils and fuel oils by the extraction method	D473	292
in crude oil by membrane filtration	D4807	293
SEDIMENT AND WATER DETERMINATION IN CRUDE OIL	D7829	293
SEDIMENT TESTS		
in trace sediment in lubricating oils	D2273	293
total sediment in residual fuels	D4870	294
water and sediment in crude oil	D96	294
water and sediment in middle distillate fuels by centrifuge	D2709	294
LUBRICITY OF DIESEL FUELS BY SCUFFING LOAD	D6078	295
BALL-ON-CYLINDER LUBRICITY EVALUATOR		
SONIC SHEAR STABILITY		
shear stability index	D3945	296
SHEAR STABILITY		
of polymer containing fluids using a European diesel injector apparatus	D6278	296
SONIC SHEAR STABILITY		
of hydraulic fluid	D5621	297
of polymer-containing oils	D2603	297
SHEAR STABILITY OF POLYMER-CONTAINING FLUIDS USING A	D7109	298
EUROPEAN DIESEL INJECTOR APPARATUS		
AT 30 CYCLES AND 90 CYCLES		
SLUDGING AND CORROSION TENDENCIES		
of inhibited mineral oils	D4310	299
SMOKE POINT		
of kerosene and aviation turbine fuel	D1322	299
SOFTENING POINT		
of asphalt and pitch		300
SOFTENING POINT OF ASPHALT AND PITCH		
(Mettler cup-and-ball method)	D3461	300
SOFTENING POINT OF PITCHES		
(cube-in-water method)	D61	300
SOFTENING POINT OF PITCH		
(cube-in-air method)	D2319	301
(Mettler softening point method)	D3104	301
SOLIDIFICATION POINT OF PETROLEUM WAX	D3944	301
SOLVENT RED 164 DYE CONCENTRATION IN DIESEL FUELS	D6258	302
STABILITY AND COMPATIBILITY OF HEAVY FUEL OILS AND CRUDE	D7112	302
OILS BY HEAVY FUEL OIL STABILITY ANALYZER (OPTICAL		
DETECTION)		
STABILITY, STORAGE		
middle distillate fuel storage stability at 43°C (110°F)	D4625	303
middle distillate fuel storage stability by oxygen overpressure	D5304	304

INTRINSIC STABILITY OF ASPHALTENE-CONTAINING RESIDUES, HEAVY FUEL OILS, AND CRUDE OILS (n-HEPTANE PHASE SEPARATION; OPTICAL DETECTION)	D7157	304
CLEANLINESS AND COMPATABILITY		
of residual fuels by spot test	D4740	305
STABILITY, STORAGE		
storage stability of water-in-oil emulsions by the oven test method	D3707	306
stability of water-in-oil emulsions under low to ambient temperature cycling conditions	D3709	306
STORAGE STABILITY AND COMPATIBILITY IN AUTOMOTIVE GEAR OILS	D7603	307
STATIC DISSIPATER ADDITIVES (SDA) IN AVIATION TURBINE FUEL AND MIDDLE DISTILLATE FUELS—HIGH-PERFORMANCE LIQUID CHROMATOGRAPH (HPLC) METHOD	D7524	307
EXISTENT INORGANIC SULFATE IN ETHANOL BY POTENTIOMETRIC TITRATION	D7318	308
EXISTENT AND POTENTIAL SULFATE AND INORGANIC CHLORIDE IN FUEL ETHANOL AND BUTANOL BY DIRECT INJECTION SUPPRESSED ION CHROMATOGRAPHY	D7319	308
EXISTENT AND POTENTIAL INORGANIC SULFATE AND TOTAL INORGANIC CHLORIDE IN FUEL ETHANOL BY ION CHROMATOGRAPHY USING AQUEOUS SAMPLE INJECTION	D7328	309
OIL-SOLUBLE SULFONATES BY LIQUID CHROMATOGRAPHY	D3712	310
SULFUR DETERMINATION		
in petroleum products		311
in petroleum products (general high pressure decomposition device method)	D129	311
by high temperature combustion and infrared (IR) detection or thermal conductivity detection (TCD)	D1552	314
in petroleum products by hydrogenolysis and rateometric colorimetry	D4045	314
in petroleum products (lamp method)	D1266	315
in liquid petroleum gases (oxy-hydrogen burner or lamp)	D2784	315
SULFUR IN GASOLINE, DIESEL FUEL,		
jet fuel, kerosine, biodiesel, biodiesel blends, and gasoline-ethanol blends by monochromatic wavelength dispersive x-ray fluorescence spectrometry	D7039	316
SULFUR IN LIQUID HYDROCARBONS AND HYDROCARBON- OXYGENATE BLENDS		
by gas chromatography with flame photometric detection	D7041	317
SULFUR DETERMINATION		
by oxidative combustion and electrochemical detection	D6428	317
SULFUR IN PETROLEUM PRODUCTS		
by oxidative combustion with electrochemical detection	D6920	318
SULFUR IN AUTOMOTIVE FUELS		
by energy dispersive x-ray fluorescence spectrometry using a low background proportional counter	D7212	318
SULFUR		
in automotive, heating, and jet fuels by monochromatic energy dispersive x-ray fluorescence spectrometry	D7220	319
SULFUR DETERMINATION		
in light liquid petroleum hydrocarbons by oxidative microcoulometry	D3120	319
in petroleum gas by oxidative microcoulometry	D3246	320

in light petroleum liquids by gas chromatography and sulfur selective detection	D5623	320
in light hydrocarbons, spark ignition engine fuel, diesel engine fuel, and engine oil by ultraviolet fluorescence	D5453	321
TOTAL SULFUR		
in liquid hydrocarbon based fuels by continuous injection, air oxidation, and ultraviolet fluorescence detection	D7620	321
TOTAL VOLATILE SULFUR		
in gaseous hydrocarbons and liquefied petroleum gases by ultraviolet fluorescence	D6667	322
SULFUR DETERMINATION		
sulfur in petroleum products by wavelength dispersive x-ray fluorescence spectrometry	D2622	323
in petroleum and petroleum products by energy dispersive x-ray fluorescence spectrometry	D4294	323
in gasoline by energy-dispersive x-ray fluorescence spectrometry	D6445	324
in gasoline by wavelength dispersive x-ray fluorescence	D6334	324
OXIDATION STABILITY OF LUBRICANTS		
by thin-film oxygen uptake test (TFOUT) catalyst B	D7098	325
SURFACE WAX COATING ON CORRUGATED BOARD	D3521	325
SURFACE WAX ON WAXED PAPER OR PAPERBOARD	D2423	326
THERMAL CONDUCTIVITY OF LIQUIDS	D2717	326
THERMAL OXIDATION STABILITY		
of aviation turbine fuels	D3241	327
THERMAL STABILITY		
of aviation turbine fuels under turbulent flow conditions (HiReTS method)	D6811	327
THERMAL STABILITY OF ORGANIC		
heat transfer fluids	D6743	328
THERMAL STABILITY		
of hydraulic oils	D2070	329
INSTABILITY		
of middle distillate fuels caused by the presence of phenalenes and phenalenones (rapid method by portable spectrophotometer)	D6748	329
THERMAL SHOCK SENSITIVITY		
of solid film lubricants	D2511	330
THERMAL STABILITY		
of way lubricants	D6203	330
TOLUENE-INSOLUBLE (TI) CONTENT OF TAR AND PITCH	D4072 and D4312	331
TORQUE, LOW-TEMPERATURE		
of ball-bearing grease	D1478	331
of grease-lubricated wheel bearings	D4693	331
TOTAL INHIBITOR CONTENT (TBC)		
of light hydrocarbons	D1157	332
TRANSITION TEMPERATURES OF PETROLEUM WAXES BY DIFFERENTIAL SCANNING CALORIMETRY (DSC)	D4419	332
TRIBOCHEMICAL PROPERTIES OF GREASE LUBRICATED PLASTIC SOCKET SUSPENSION JOINTS USING A HIGH-FREQUENCY, LINEAR-OSCILLATION (SRV) TEST MACHINE	D7420	333

ULTRAVIOLET ABSORBANCE AND ABSORPTIVITY OF PETROLEUM PRODUCTS	D2008	334
UNSULFONATED RESIDUE		
of petroleum plant spray oils	D483	334
VANADIUM IN HEAVY FUEL OIL	D1548	335
VAPOR-LIQUID RATIO		
of spark-ignition engine fuels	D2533	335
VAPOR-LIQUID RATIO		
temperature determination of fuels (evacuated chamber and piston based method)	D5188	336
VAPOR PRESSURE		
of crude oil: $VPCR_x$ (expansion method)	D6377	336
of gasoline and gasoline-oxygenate blends (dry method)	D4953	337
of liquefied petroleum gas (LPG) (expansion method)	D6897	337
of petroleum products (automatic method)	D5190	338
of petroleum products and liquid fuels (mini method)	D5191	338
of petroleum products (mini method—atmospheric)	D5482	339
of petroleum products (Reid method)	D323	339
(VP_x) of petroleum products hydrocarbons, and hydrocarbon-oxygenate mixtures (triple expansion method)	D6378	340
VAPOR PRESSURE OF CRUDE OIL: $WPCR_x-F(T_m^\circ C)$ (MANUAL EXPANSION FIELD METHOD)	D7975	340
STANDARD GUIDE FOR IN-SERVICE LUBRICANT VISCOSITY MEASUREMENT	D8185	341
VISCOSITY, APPARENT		
of hot melt adhesives and coating materials	D3236	341
of petroleum waxes compounded with additives (hot melts)	D2669	342
YIELD STRESS AND APPARENT		
viscosity of used engine oils at low temperature	D6896	343
VISCOSITY		
of automatic transmission fluids, hydraulic fluids and lubricants using a rotational viscometer Brookfield viscosity	D2983	343
SCANNING BROOKFIELD VISCOSITY	D5133	344
KINEMATIC VISCOSITY OF TRANSPARENT AND OPAQUE LIQUIDS BY AUTOMATED HOUILLON VISCOMETER	D7279	345
VISCOSITY		
at high shear rate by tapered bearing simulator viscometer at 100°C	D6616	345
VISCOSITY INDEX		
from kinematic viscosity at 40°C and 100°C	D2270	346
VISCOSITY AND VISCOSITY CHANGE		
after standing at low temperature of aircraft turbine lubricants	D2532	346
VISCOSITY, KINEMATIC		
of transparent and opaque liquids (and calculation of dynamic viscosity)	D445	347
of volatile and reactive liquids	D4486	348
DYNAMIC VISCOSITY AND DERIVED KINAMATIC VISCOSITY OF LIQUIDS BY OSCILLATING PISTON VISCOMETER	D7483	348
FIELD DETERMINATION OF KINEMATIC VISCOSITY USING A MICROCHANNEL VISCOMETER	D8092	349

VISCOSITY, SAYBOLT	D88	349
LOW TEMPERATURE VISCOSITY OF		
drive line lubricants in a constant sheer stress viscometer	D6821	350
ROTATIONAL VISCOSITY OF HEAVY DUTY		
diesel drain oils at 100°C	D6895	350
VISCOSITY, KINEMATIC		
to saybolt universal viscosity or to saybolt fural viscosity	D2161	351
VISCOSITY, SHEAR		
of coal-tar and petroleum pitches	D5018	351
VISCOSITY-TEMPERATURE RELATIONSHIP OF USED AND SOOT- CONTAINING ENGINE OILS AT LOW TEMPERATURES	D7110	351
VOLATILES		
contaminants from used engine oils by stripping	D3607	352
matter in green petroleum coke quartz crucible procedure	D6374	352
matter in petroleum coke	D4421	353
pitch volatility	D4893	353
VOLATILITY		
of liquefied petroleum (LP) gases	D1837	354
WATER		
in petroleum products		354
in crude oils by coulometric Karl Fischer titration	D4928	356
in crude oil by distillation	D4006	356
in crude oils by potentiometric Karl Fischer titration	D4377	357
FREE WATER, PARTICULATES, AND OTHER CONTAMINANTS		
in aviation fuels (visual inspection procedures)	D6986	357
WATER		
free water and particulate contamination in distillate fuels (visual inspection procedures)	D4176	358
free water in and particulate contamination in middle distillate fuels (clear and bright numerical rating)	D4860	359
in petroleum products, lubricating oils, and additives by coulometric Karl Fischer titration	D6304	359
WATER IN ETHANOL AND HYDROCARBON BLENDS BY KARL FISCHER TITRATION	D7923	360
WATER		
in petroleum products and bituminous materials by distillation	D95	360
in liquid petroleum products by Karl Fischer reagent	D1744	361
reaction of aviation fuels	D1094	361
resistance of lubricating grease to water spray	D4049	361
and sediment in fuel oils by the centrifuge method (laboratory procedure)	D1796	362
and sediment in crude oil by the centrifuge method (laboratory procedure)	D4007	362
WATER SEPARATION CHARACTERISTICS OF DIESEL FUELS BY PORTABLE SEPARATOMETER	D7261	363
WATER		
separation characteristics of aviation turbine fuels by portable separometer	D3948	363
separability of petroleum oils and synthetic fluids	D1401	364

WATER SEPARATION CHARACTERISTICS OF KEROSENE-TYPE AVIATION TURBINE FUELS CONTAINING ADDITIVES		
by portable separometer	D7224	365
WATER SEPARATION PROPERTIES OF LIGHT AND MIDDLE DISTILLATE, AND COMPRESSION AND SPARK IGNITION FUELS	D7451	366
WATER SEPARATION CHARACTERISTICS OF AVIATION TURBINE FUEL BY SMALL SCALE WATER SEPARATION INSTRUMENT	D8073	366
WATER,		
solubility of, in hydrocarbons and aliphatic ester lubricants	D4056	367
in volatile solvents (Karl Fischer titration method)	D1364	367
tolerance (phase separation) of gasoline-alcohol blends	D6422	368
undissolved, in aviation turbine fuels	D3240	368
washout characteristics of lubricating greases	D1264	369
WAX APPEARANCE POINT		
of distillate fuels	D3117	369
WAX APPLIED DURING CURTAIN		
coating operation	D3708	369
WAX CONTENT OF CORRUGATED PAPERBOARD	D3344	370
WEAR CHARACTERISTICS OF PETROLEUM		
hydraulic fluids in a high pressure constant volume vane pump	D6973	370
WEAR CHARACTERISTICS		
of non-petroleum and petroleum hydraulic fluids in a constant volume vane pump	D7043	371
WEAR PREVENTIVE CHARACTERISTICS		
of lubricating fluid (four-ball method)	D4172	371
WEAR PREVENTIVE PROPERTIES		
of lubricating greases using the (Falex) block on ring test machine in oscillating motion	D3704	372
WEAR PREVENTIVE CHARACTERISTICS		
of lubricating grease (four-ball method)	D2266	372
WEAR CHARACTERISTICS		
of petroleum and non-petroleum hydraulic fluids in constant volume vane pump	D2882	373
WEAR LIFE		
of solid film lubricants in oscillating motion	D2981	374
WEAR CHARACTERISTICS		
of tractor hydraulic fluids	D4998	374
WEAR VOLUME ON STANDARD TEST PIECES USED BY HIGH- FREQUENCY, LINEAR-OSCILLATION (SRV) TEST MACHINE	D7755	375
PROLONGED WORK STABILITY OF LUBRICATING GREASES IN PRESENCE OF WATER (WATER STABILITY TEST)	D7342	375



Dr. R.A. Kishore Nadkarni received his Ph.D. in analytical chemistry at the University of Bombay. Since then he has worked as a research associate at the University of Kentucky, manager of the Materials Science Center Analytical Facility at Cornell University, and analytical leader in the ExxonMobil Company. In his last position he was responsible for technical quality management of the Paramins Division's global plant laboratories.

He has authored more than 140 technical publications, including 21 new ASTM standards in the area of analytical chemistry and quality management. He is a member of the American Chemical Society and ASTM International. He is very active in ASTM and ISO in the petroleum products and lubricant field, holding the position of immediate past chairman of ISO/TC28, chairman of ASTM's D02.03 on Elemental Analysis, vice-chairman of D02.92 on Proficiency Testing Programs, D02.94 Coordinating Subcommittee on Quality Assurance and Statistics.

Dr. Nadkarni has received the Award of Appreciation (1991) and Awards for Excellence (1998, 1999, and 2013) from ASTM's D02 Committee for his contribution to the oil industry, the Award of Merit (2005), Scroll of Achievement award (2005), the George V. Dyroff Award of Honorary Committee D02 membership (2006), the Sydney D. Andrews D02 Scroll of Achievement Award (2009), D02 Eagle Award (2016), and the Charles B. Dudley ASTM Award (2017).

He is the author or editor of STP 1109, Modern Instrumental Methods of Elemental Analysis of Petroleum Products and Lubricants (1991); STP 1468, Elemental Analysis of Fuels and Lubricants (2005); Manual 44, Guide to ASTM Test Methods for the Analysis of Petroleum Products and Lubricants-2nd (2007); Manual 61, Guide to ASTM Test Methods for the Analysis of Coal and Coke (2008); Monograph 9, Spectroscopic Analysis of Petroleum Products and Lubricants (2011); Monograph 10, Elemental Analysis of Fossil Fuels and Related Materials (2014); Monograph 11, Sulfur: Chemistry Analysis of Fossil Fuel Products (2014) and this present publication.

ASTM INTERNATIONAL
Helping our world work better

ISBN: 978-0-8031-7122-0
Stock #: MNL44-3RD
ISBN-EB: 978-0-8031-7123-7
Stock#: MNL44-3RD-EB

www.astm.org