Honeywell Solstice® N40 Refrigerant (R-448A)

000000017419

Version 2.1 | Revision Date 12/07/2015 | Print Date 03/10/2017

SECTION 1. PRODUCT AND COMPANY IDENTIFICATION

Product name	:	Honeywell Solstice® N40 Refrigerant (R-448A)
Number	:	000000017419
Product Use Description	:	Refrigerant
Manufacturer or supplier's details	:	Honeywell International Inc. 115 Tabor Road Morris Plains, NJ 07950-2546
For more information call	:	800-522-8001 +1-973-455-6300 (Monday-Friday, 9:00am-5:00pm)
In case of emergency call	:	**Medical: 1-800-498-5701 or +1-303-389-1414**
	:	**Transportation (CHEMTREC): 1-800-424-9300 or +1-703-527-3887**
	:	
	:	(24 hours/day, 7 days/week)

SECTION 2. HAZARDS IDENTIFICATION

Emergency Overview

Form	:	Liquefied gas
Color	:	clear colourless
Odor	:	slight ether-like

Classification of the substance or mixture

Classification of the substance or mixture	:	Gases under pressure, Liquefied gas Simple Asphyxiant

GHS Label elements, including precautionary statements

Symbol(s) :

Signal word	:	Warning
Hazard statements	:	Contains gas under pressure; may explode if heated. May displace oxygen and cause rapid suffocation.
Precautionary statements	:	**Prevention:** Use personal protective equipment as required. **Storage:** Protect from sunlight. Store in a well-ventilated place.
Hazards not otherwise classified	:	May cause frostbite. May cause cardiac arrhythmia. May cause eye and skin irritation.

Carcinogenicity

No component of this product present at levels greater than or equal to 0.1% is identified as a known or anticipated carcinogen by NTP, IARC, or OSHA.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical nature : Mixture

Chemical Name	CAS-No.	Concentration
Difluoromethane	75-10-5	26.00 %
Pentafluoroethane	354-33-6	26.00 %
1,1,1,2-Tetrafluoroethane	811-97-2	21.00 %
2,3,3,3-Tetrafluoroprop-1-ene	754-12-1	20.00 %
trans-1,3,3,3-Tetrafluoroprop-1-ene	29118-24-9	7.00 %

SECTION 4. FIRST AID MEASURES

Inhalation : Move to fresh air. If breathing is irregular or stopped,

administer artificial respiration. Use oxygen as required, provided a qualified operator is present. Call a physician. Do not give drugs from adrenaline-ephedrine group.

Skin contact : After contact with skin, wash immediately with plenty of water. If there is evidence of frostbite, bathe (do not rub) with lukewarm (not hot) water. If water is not available, cover with a clean, soft cloth or similar covering. If symptoms persist, call a physician.

Eye contact : Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. In case of frostbite water should be lukewarm, not hot. If symptoms persist, call a physician.

Ingestion : Unlikely route of exposure. As this product is a gas, refer to the inhalation section. Do not induce vomiting without medical advice. Call a physician immediately.

Notes to physician

Treatment : Because of the possible disturbances of cardiac rhythm, catecholamine drugs, such as epinephrine, should be used with special caution and only in situations of emergency life support. Treatment of overexposure should be directed at the control of symptoms and the clinical conditions. Treat frost-bitten areas as needed.

SECTION 5. FIREFIGHTING MEASURES

Suitable extinguishing media : The product is not flammable.
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Specific hazards during firefighting : Contents under pressure.
This product is not flammable at ambient temperatures and atmospheric pressure.
However, this material can ignite when mixed with air under pressure and exposed to strong ignition sources.
Container may rupture on heating.
Cool closed containers exposed to fire with water spray.
Do not allow run-off from fire fighting to enter drains or water courses.
Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.
In case of fire hazardous decomposition products may be produced such as:

Hydrogen halides
Hydrogen fluoride
Carbon monoxide
Carbon dioxide (CO2)
Carbonyl halides

Special protective equipment for firefighters : In the event of fire and/or explosion do not breathe fumes.
Wear self-contained breathing apparatus and protective suit.
No unprotected exposed skin areas.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Personal precautions : Immediately evacuate personnel to safe areas.
Keep people away from and upwind of spill/leak.
Wear personal protective equipment. Unprotected persons must be kept away.
Remove all sources of ignition.
Avoid skin contact with leaking liquid (danger of frostbite).
Ventilate the area.
After release, disperses into the air.
Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.
Avoid accumulation of vapours in low areas.
Unprotected personnel should not return until air has been tested and determined safe.
Ensure that the oxygen content is >= 19.5%.

Environmental precautions : Prevent further leakage or spillage if safe to do so.
The product evapourates readily.

Methods for cleaning up : Ventilate the area.

SECTION 7. HANDLING AND STORAGE

Handling

Handling : Handle with care.
Avoid inhalation of vapour or mist.
Do not get in eyes, on skin, or on clothing.
Wear personal protective equipment.
Use only in well-ventilated areas.
Pressurized container. Protect from sunlight and do not expose to temperatures exceeding 50 °C.
Follow all standard safety precautions for handling and use of compressed gas cylinders.
Use authorized cylinders only.

Protect cylinders from physical damage.
Do not puncture or drop cylinders, expose them to open flame or excessive heat.
Do not pierce or burn, even after use. Do not spray on a naked flame or any incandescent material.
Do not remove screw cap until immediately ready for use.
Always replace cap after use.

Advice on protection against fire and explosion : The product is not flammable.
Can form a combustible mixture with air at pressures above atmospheric pressure.

Storage

Requirements for storage areas and containers : Pressurized container: protect from sunlight and do not expose to temperatures exceeding 50 °C. Do not pierce or burn, even after use.
Keep containers tightly closed in a dry, cool and well-ventilated place.
Storage rooms must be properly ventilated.
Ensure adequate ventilation, especially in confined areas.
Protect cylinders from physical damage.

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Protective measures : Do not breathe vapour.
Avoid contact with skin, eyes and clothing.
Ensure that eyewash stations and safety showers are close to the workstation location.

Engineering measures : General room ventilation is adequate for storage and handling.
Perform filling operations only at stations with exhaust ventilation facilities.

Eye protection : Wear as appropriate:
Safety glasses with side-shields
If splashes are likely to occur, wear:
Goggles or face shield, giving complete protection to eyes

Hand protection : Leather gloves
In case of contact through splashing:
Protective gloves
Neoprene gloves
Polyvinyl alcohol or nitrile- butyl-rubber gloves

Skin and body protection : Avoid skin contact with leaking liquid (danger of frostbite).
Wear cold insulating gloves/ face shield/ eye protection.

Respiratory protection : In case of insufficient ventilation, wear suitable respiratory equipment.
Wear a positive-pressure supplied-air respirator.
Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing.
For rescue and maintenance work in storage tanks use self-contained breathing apparatus.

Hygiene measures : Handle in accordance with good industrial hygiene and safety practice.
Ensure adequate ventilation, especially in confined areas.
Avoid contact with skin, eyes and clothing.
Remove and wash contaminated clothing before re-use.
Keep working clothes separately.

Exposure Guidelines

Components	CAS-No.	Value	Control parameters	Update	Basis
Difluoromethane	75-10-5	TWA : Time weighted average	2,200 mg/m3 (1,000 ppm)	2007	WEEL:US. OARS. WEELs Workplace Environmental Exposure Level Guide
Difluoromethane	75-10-5	TWA : Time weighted average	(1,000 ppm)	1994	Honeywell:Limit established by Honeywell International Inc.
Pentafluoroethane	354-33-6	TWA : Time weighted average	(1,000 ppm)		Honeywell:Limit established by Honeywell International Inc.
1,1,1,2-Tetrafluoroethane	811-97-2	TWA : Time weighted average	(1,000 ppm)		Honeywell:Limit established by Honeywell International Inc.
1,1,1,2-Tetrafluoroethane	811-97-2	TWA : Time weighted average	4,240 mg/m3 (1,000 ppm)	2007	WEEL:US. OARS. WEELs Workplace Environmental Exposure Level Guide

2,3,3,3-Tetrafluoroprop-1-ene	754-12-1	TWA : Time weighted average	(500 ppm)	2009	WEEL:US. OARS. WEELs Workplace Environmental Exposure Level Guide
2,3,3,3-Tetrafluoroprop-1-ene	754-12-1	TWA : Time weighted average	(500 ppm)	03 15 2010	Honeywell:Limit established by Honeywell International Inc.
2,3,3,3-Tetrafluoroprop-1-ene	754-12-1	STEL : Short term exposure limit	(1,500 ppm)	03 15 2010	Honeywell:Limit established by Honeywell International Inc.
trans-1,3,3,3-Tetrafluoroprop-1-ene	29118-24-9	TWA : Time weighted average	(800 ppm)	2012	WEEL:US. OARS. WEELs Workplace Environmental Exposure Level Guide
trans-1,3,3,3-Tetrafluoroprop-1-ene	29118-24-9	TWA : Time weighted average	(800 ppm)	31.03.11	Honeywell:Limit established by Honeywell International Inc.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state	:	Liquefied gas
Color	:	clear colourless
Odor	:	slight ether-like
pH	:	Note: neutral
Melting point/range	:	Note: no data available
Boiling point/boiling range	:	-45.9 - -39.8 °C
Flash point	:	Note: Not applicable

Lower explosion limit	:	Note: None
Upper explosion limit	:	Note: None
Vapor pressure	:	1,120 kPa at 21.1 °C(70.0 °F) 2,588 kPa at 54.4 °C(129.9 °F)
Vapor density	:	2.98 Note: (Air = 1.0)
Density	:	1.11 g/cm3
Water solubility	:	Note: no data available
Partition coefficient: n-octanol/water	:	Note: no data available
Auto-ignition temperature	:	628 °C
Decomposition temperature	:	> 250 °C Note: To avoid thermal decomposition, do not overheat.

SECTION 10. STABILITY AND REACTIVITY

Chemical stability	:	Stable under normal conditions.
Possibility of hazardous reactions	:	Hazardous polymerisation does not occur.
Conditions to avoid	:	Pressurized container. Protect from sunlight and do not expose to temperatures exceeding 50 °C. Decomposes under high temperature. Some risk may be expected of corrosive and toxic decomposition products. Can form a combustible mixture with air at pressures above atmospheric pressure. Do not mix with oxygen or air above atmospheric pressure.

Incompatible materials to avoid	:	Potassium Calcium Powdered metals Finely divided aluminium Finely divided magnesium Zinc
Hazardous decomposition products	:	Halogenated compounds Hydrogen fluoride Carbonyl halides Carbon oxides

SECTION 11. TOXICOLOGICAL INFORMATION

Acute inhalation toxicity		
Difluoromethane	:	LC50: > 520000 ppm Exposure time: 4 h Species: Rat
Pentafluoroethane	:	> 769000 ppm Exposure time: 4 h Species: Rat
1,1,1,2-Tetrafluoroethane	:	LC50: > 500000 ppm Exposure time: 4 h Species: Rat
2,3,3,3-Tetrafluoroprop-1-ene	:	LC50: > 400000 ppm Exposure time: 4 h Species: Rat Method: OECD Test Guideline 403
trans-1,3,3,3-Tetrafluoroprop-1-ene	:	100000 ppm Species: Mouse Note: Acute (4-Hour) Inhalation Toxicity Screening Study (mouse): No lethality at >100,000 ppm. LC50: > 207000 ppm Exposure time: 4 h Species: Rat
Skin irritation		
2,3,3,3-Tetrafluoroprop-1-ene	:	Note: Not applicable Study technically not feasible.
trans-1,3,3,3-	:	Species: Rabbit

Tetrafluoroprop-1-ene		Result: No skin irritation Method: OECD Test Guideline 404
Eye irritation		
2,3,3,3-Tetrafluoroprop-1-ene	:	Note: Not applicable Study technically not feasible.
Sensitisation		
Difluoromethane	:	Cardiac sensitization Species: dogs Note: No-observed-effect level >350 000 ppm
Pentafluoroethane	:	Cardiac sensitization Species: dogs Note: No-observed-effect level 75 000 ppm Lowest observed effect level 100 000 ppm
1,1,1,2-Tetrafluoroethane	:	Cardiac sensitization Species: dogs Note: No-observed-effect level 50 000 ppm Lowest observed effect level 75 000 ppm
2,3,3,3-Tetrafluoroprop-1-ene	:	Dermal Note: Not applicable, as this product is a gas. Study technically not feasible.
trans-1,3,3,3-Tetrafluoroprop-1-ene	:	Cardiac sensitization Species: dogs Note: Did not cause sensitisation on laboratory animals.
Repeated dose toxicity		
Difluoromethane	:	Species: Rat Application Route: Inhalation Exposure time: (90 d) NOEL: 50000 ppm Subchronic toxicity
Pentafluoroethane	:	Species: Rat Application Route: Inhalation Exposure time: (4 Weeks) NOEL: 50000 ppm Subchronic toxicity

1,1,1,2-Tetrafluoroethane	:	Species: Rat NOEL: 40000 ppm
2,3,3,3-Tetrafluoroprop-1-ene	:	Species: Rat Application Route: Inhalation Exposure time: (2 Weeks) No-observed-effect level: 50000 ppm Method: OECD Test Guideline 412 Species: Rat Application Route: Inhalation Exposure time: (4 Weeks) NOAEL (No observed adverse effect level): 50000 ppm Method: OECD Test Guideline 412 Species: Rat Application Route: Inhalation Exposure time: (13 Weeks) NOAEL (No observed adverse effect level): 50000 ppm Method: OECD Test Guideline 413 Species: Rabbit, male Application Route: Inhalation Exposure time: (28 d) No-observed-effect level: 500 ppm Method: OECD Test Guideline 412 There are no observed toxicological effects, which result in classification as a specific target organ toxicant. Species: Rabbit, female Application Route: Inhalation Exposure time: (28 d) No-observed-effect level: 1000 ppm Method: OECD Test Guideline 412 There are no observed toxicological effects, which result in classification as a specific target organ toxicant. Species: Mini-pig Application Route: Inhalation Exposure time: (28 d) NOAEL (No observed adverse effect level): 10000 ppm highest exposure tested
trans-1,3,3,3-Tetrafluoroprop-1-ene	:	Species: Rat Application Route: Inhalation Exposure time: (13 Weeks) NOEL: 5000 ppm Causes mild effects on the heart.

Genotoxicity in vitro

Difluoromethane	:	Test Method: Ames test Result: negative
Pentafluoroethane	:	Test Method: Ames test Result: negative
1,1,1,2-Tetrafluoroethane	:	Note: In vitro tests did not show mutagenic effects
2,3,3,3-Tetrafluoroprop-1-ene	:	Test Method: Ames test Result: 20% and higher, positive in TA 100 and e. coli WP2 uvrA, negative in TA98, TA100, and TA1535. Method: OECD Test Guideline 471
trans-1,3,3,3-Tetrafluoroprop-1-ene	:	Test Method: Chromosome aberration test in vitro Cell type: Human lymphocytes Result: negative
	:	Cell type: Human lymphocytes Result: negative Method: Mutagenicity (in vitro mammalian cytogenetic test)
	:	Test Method: Chromosome aberration test in vitro Result: negative
	:	Cell type: Human lymphocytes Result: negative
	:	Cell type: Chinese Hamster Ovary Cells Result: negative
	:	Test Method: Chromosome aberration test in vitro Cell type: Human lymphocytes Result: negative Method: OECD Test Guideline 473 Note: Dose 760,000 ppm
	:	Test Method: Ames test Result: negative

Genotoxicity in vivo

Difluoromethane	:	Species: Mouse Cell type: Bone marrow Method: Mutagenicity (micronucleus test) Result: negative
2,3,3,3-Tetrafluoroprop-1-ene	:	Species: Mouse Cell type: Micronucleus Dose: up to 200,000 ppm (4 hour)

Method: OECD Test Guideline 474
Result: negative

: Test Method: Unscheduled DNA synthesis
Dose: up to 50,000 ppm (4 weeks)
Method: OECD Test Guideline 486
Result: negative

: Species: Rat
Cell type: Micronucleus
Dose: up to 50,000 ppm (4 weeks)
Method: OECD Test Guideline 474
Result: negative

trans-1,3,3,3-Tetrafluoroprop-1-ene : Test Method: Mutagenicity (in vivo mammalian bone-marrow cytogenetic test, chromosomal analysis)
Species: Mouse
Cell type: Micronucleus
Application Route: Inhalation
Result: negative

Carcinogenicity

2,3,3,3-Tetrafluoroprop-1-ene : Species: Rat
Note: Not classified as a human carcinogen. Substance not expected to be a carcinogen based on available data.

Teratogenicity

Difluoromethane : Species: Rat
Dose: NOEL - 50,000 ppm
Note: Did not show teratogenic effects in animal experiments.

Species: Rabbit
Dose: NOEL - 50,000 ppm
Note: Did not show teratogenic effects in animal experiments.

Pentafluoroethane : Species: Rabbit
Application Route: Inhalation exposure
NOAEL,Teratog: 50,000 ppm
NOAEL,Maternal: 50,000 ppm
Note: Did not show teratogenic effects in animal experiments.

Species: Rat
Application Route: Inhalation exposure
NOAEL,Teratog: 50,000 ppm
NOAEL,Maternal: 50,000 ppm
Note: Did not show teratogenic effects in animal experiments.

trans-1,3,3,3-Tetrafluoroprop-1-ene	:	Species: Rabbit Method: Prenatal Developmental Inhalation Toxicity Study Note: Did not show teratogenic effects in animal experiments. Species: Rat Method: Prenatal Developmental Inhalation Toxicity Study Note: Did not show teratogenic effects in animal experiments.
Further information 1,1,1,2-Tetrafluoroethane	:	Note: Vapours are heavier than air and can cause suffocation by reducing oxygen available for breathing. Rapid evaporation of the liquid may cause frostbite. Avoid skin contact with leaking liquid (danger of frostbite).

SECTION 12. ECOLOGICAL INFORMATION

Toxicity to fish 2,3,3,3-Tetrafluoroprop-1-ene	:	LC50: > 197 mg/l Exposure time: 96 h Species: Cyprinus carpio (Carp) Method: OECD Test Guideline 203 Note: No demonstrable toxic effect in saturated solution.
trans-1,3,3,3-Tetrafluoroprop-1-ene	:	NOEC: > 117 mg/l Exposure time: 96 h Species: Cyprinus carpio (Carp)
Toxicity to daphnia and other aquatic invertebrates 2,3,3,3-Tetrafluoroprop-1-ene	:	EC50: > 83 mg/l Exposure time: 48 h Species: Daphnia magna (Water flea) Method: OECD Test Guideline 202
trans-1,3,3,3-Tetrafluoroprop-1-ene	:	EC50: > 160 mg/l Exposure time: 48 h Species: Daphnia magna (Water flea)
Toxicity to algae 2,3,3,3-Tetrafluoroprop-1-ene	:	EC50: > 100 mg/l Species: Scenedesmus capricornutum (fresh water algae) Method: OECD Test Guideline 201
trans-1,3,3,3-	:	Growth inhibition

Tetrafluoroprop-1-ene		NOEC: > 170 mg/l Exposure time: 72 h Species: Algae
Bioaccumulation		
2,3,3,3-Tetrafluoroprop-1-ene	:	Note: Due to the distribution coefficient n-octanol/water, accumulation in organisms is not expected.
Biodegradability		
Difluoromethane	:	Note: Minimal
Pentafluoroethane	:	Result: Not readily biodegradable. Value: 5 % Method: OECD 301 D
2,3,3,3-Tetrafluoroprop-1-ene	:	Result: Not readily biodegradable. Method: OECD Test Guideline 301F
trans-1,3,3,3-Tetrafluoroprop-1-ene	:	aerobic Result: Not readily biodegradable.

Further information on ecology

Additional ecological information	:	This product is subject to U.S. Environmental Protection Agency Clean Air Act Regulations at 40 CFR Part 82. This product contains greenhouse gases which may contribute to global warming. Do NOT vent to the atmosphere. To comply with provisions of the U.S. Clean Air Act, any residual must be recovered.

SECTION 13. DISPOSAL CONSIDERATIONS

Disposal methods	:	Observe all Federal, State, and Local Environmental regulations.

SECTION 14. TRANSPORT INFORMATION

DOT	UN/ID No.	:	UN 3163
	Proper shipping name	:	LIQUEFIED GAS, N.O.S. (Pentafluoroethane, Difluoromethane, 1,1,1,2-Tetrafluoroethane)
	Class		2.2
	Packing group		
	Hazard Labels		2.2

IATA	UN/ID No.	:	UN 3163
	Description of the goods	:	LIQUEFIED GAS, N.O.S. (Pentafluoroethane, Difluoromethane, 1,1,1,2-Tetrafluoroethane)
	Class	:	2.2
	Hazard Labels	:	2.2
	Packing instruction (cargo aircraft)	:	200
	Packing instruction (passenger aircraft)	:	200
IMDG	UN/ID No.	:	UN 3163
	Description of the goods	:	LIQUEFIED GAS, N.O.S. (PENTAFLUOROETHANE, DIFLUOROMETHANE, 1,1,1,2-TETRAFLUOROETHANE)
	Class	:	2.2
	Hazard Labels	:	2.2
	EmS Number	:	F-C, S-V
	Marine pollutant	:	no

SECTION 15. REGULATORY INFORMATION

Inventories

US. Toxic Substances Control Act	:	On TSCA Inventory
Australia. Industrial Chemical (Notification and Assessment) Act	:	On the inventory, or in compliance with the inventory
Canada. Canadian Environmental Protection Act (CEPA). Domestic Substances List (DSL)	:	All components of this product are on the Canadian DSL.
Japan. Kashin-Hou Law List	:	On the inventory, or in compliance with the inventory
Korea. Toxic Chemical Control Law (TCCL) List	:	On the inventory, or in compliance with the inventory
Philippines. The Toxic Substances and Hazardous and Nuclear Waste Control Act	:	Not in compliance with the inventory
China. Inventory of Existing	:	Not in compliance with the inventory

Chemical Substances

New Zealand. Inventory of Chemicals (NZIoC), as published by ERMA New Zealand : Not in compliance with the inventory

TSCA 12B : US. Toxic Substances Control Act (TSCA) Section 12(b) Export Notification (40 CFR 707, Subpt D)

2,3,3,3-Tetrafluoroprop-1-ene 754-12-1

National regulatory information

US. Toxic Substances Control Act (TSCA) Section 5(a)(2) Final Significant New Use Rules (SNURs) (40 CFR 721, Subpt E) :

: Issued.

: 2,3,3,3-Tetrafluoroprop-1-ene 754-12-1

SARA 302 Components : No chemicals in this material are subject to the reporting requirements of SARA Title III, Section 302.

SARA 313 Components : This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

SARA 311/312 Hazards : Sudden Release of Pressure Hazard
Acute Health Hazard

California Prop. 65 : WARNING! This product contains a chemical known to the State of California to cause cancer.
Dichloromethane 75-09-2

: WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.
Chloromethane 74-87-3

Massachusetts RTK : Dichloromethane 75-09-2

Pennsylvania RTK : Difluoromethane 75-10-5

WHMIS Classification : A: Compressed Gas
This product has been classified according to the hazard criteria of the CPR and the MSDS contains all of the information required by the CPR.

SECTION 16. OTHER INFORMATION

		HMIS III	NFPA
Health hazard	:	1	2
Flammability	:	1	1
Physical Hazard	:	0	
Instability	:		0

Hazard rating and rating systems (e.g. HMIS® III, NFPA): This information is intended solely for the use of individuals trained in the particular system.

Further information

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text. Final determination of suitability of any material is the sole responsibility of the user. This information should not constitute a guarantee for any specific product properties.

Changes since the last version are highlighted in the margin. This version replaces all previous versions.
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