

# Luperox® Ketone Peroxides

## A Guide to Selection , Use , and Safe Handling

	Standard Formulations				Fire-Resistant Formulation
	Luperox® DDM-9	Luperox® Delta X-9	Luperox® DHD-9	Luperox® DDM-30	Luperox® 224
Description:	Methyl Ethyl Ketone Peroxide Solutions (C.A.S. Registry No. 1338-23-4)				2,4-Pentanedione Peroxide Solution (C.A.S. Registry No. 37187-22-7)
SPECIFICATIONS: Active Oxygen, %	8.7 - 9.0	8.7 - 9.0	8.7 - 9.0	5.5-6.1	4.0-4.2
Typical Properties:					
Form	Clear Liquid	Clear Liquid	Clear Liquid	Clear Liquid	Light Yellow Liquid
Specific Gravity, 25°C / 25°C	1.006	1.006	1.006	0.9827	1.071
Refractive Index @ 25°C	1.4356	1.4344	1.4356	1.4355	1.4330
Viscosity, cps @ 25°C	13.8	14.9	14.6	9.9	17.8
Freezing Point °C	Below 0	Below 0	Below 0	Below 0	Below 0
Flash Point (SETA), °F/°C	203/95	>212/>100	165/74	172/78	183/84
SADT* °F/°C	167/75 Burning	185/85 Burning	185/85 No Sign of Fire	Above 185/85	130/54 Mild Gassing
Solubility @ 25°, %					
Ethyl Acetate	CM	CM	CM	CM	CM
Methyl Ethyl Ketone	CM	CM	CM	CM	CM
Dimethyl Phthalate	CM	CM	CM	CM	CM
Diallyl Phthalate	CM	CM	CM	CM	CM
Water	Insoluble	Insoluble	Insoluble	Insoluble	CM

\*Self-Accelerating Decomposition Temperature CM = Completely Miscible

Note: Most standard ketone peroxides are available in red dye, and disappearing red dye. Please consult the product MSDS for changes in typical properties when using ketone peroxides containing dye.

### Luperox® DDM-9

Phthalate-free MEKP offers the greatest flexibility in terms of useful concentration range and pot-life thus finds use in a wide variety of ambient temperature cure applications. Used by most UPR (unsaturated polyester resin) producers for resin standardization because of its consistent lot-to-lot catalytic activity. Low residual hydrogen peroxide content makes Luperox® DDM-9 ideal for use in gel coats.

### Luperox® Delta X-9

Phthalate-free MEKP formulated to give faster gel and cure times in a wide variety of ortho and isophthalic resin systems.

### Luperox® DHD-9

Another faster form of phthalate-free MEKP peroxide characterized by outstanding performance in certain vinyl ester and isophthalic resins.

### Luperox® DDM-30

A dilute form of Luperox® DDM-9 to ensure metering accuracy, particularly during high ambient temperature periods.

### Luperox® 224

Key features are the rapid propagation from gel to peak exotherm in many resin systems and long pot lives (relative to MEKP peroxide) in unpromoted resins. The latter feature is particularly attractive in those operations utilizing two-pot systems. Not recommended for use in gel coats or certain vinyl ester resins.

## APPLICATIONS

### Introduction

Luperox® Ketone Peroxides are used for the cure of promoted unsaturated polyester resins and vinyl ester resins at ambient temperatures. The function of the promoter, usually a transition metal salt such as cobalt naphthenate or octoate, is to activate decomposition of the peroxide or initiator.\*



The cobaltic ion generated in (1) is reduced back to the original cobaltous form by reaction with more undissociated peroxide:



Excessive concentrations of promoters actually waste free radicals by converting them to ionic species:



Most resins are supplied premixed, however, if promoter (or accelerator) is required, it should be mixed thoroughly into the resin followed by the peroxide. Initiator concentrations typically run from 0.5 to 2.0% by weight based on resin; the most effective cobalt promoter range is 0.05 to 0.5% based on 6% metal content solutions (also available in 12% metal solutions). Enhanced activation is possible by adding tertiary amines such as dimethyl aniline (DMA) to "cobalted" resins.

No one ketone peroxide will provide optimum results in all resin systems. Proprietary inhibitors and other additives used by resin producers can influence peroxide performance thus significant variations in catalytic activity will occasionally be encountered among competing resins which are otherwise similar chemically—and formulation wise. It is therefore important for the user to thoroughly evaluate each ketone peroxide on a small scale prior to incorporation in a manufacturing

process. Arkema Inc. will be happy to provide the necessary samples and technical input to assist in commercialization.

Tables I and II illustrate the effects of varying peroxide\* and promoter levels in typical orthophthalic resin. Table III illustrates SPI cure activity.

\*Although often referred to as "catalysts", organic peroxides are more correctly termed polymerization initiators since the free radicals generated become chemically bonded to the crosslinked resin.

TABLE 1

#### EFFECTS OF VARYING PEROXIDE CONCENTRATION RESIN: Orthophthalic resin with 0.05% of 6% Cobalt solution, Temperature 25°C

Gel Time (Min.)

Peroxide Conc. (%)	Luperox® DDM-9	Luperox® DHD-9	Luperox® Delta X-9	Luperox® 224	Luperox® DDM-30
1.0	24.4	18.3	12.8	15.0	43.5
1.25	22.8	16.0	10.2	12.9	36.6
1.50	19.8	12.7	9.4	10.5	24.9

TABLE 2

#### EFFECTS OF VARYING PROMOTER CONCENTRATION RESIN: Orthophthalic resin, 1% Peroxide, Temperature 25°C

Gel Time (Min.)

Promoter Conc. (%)	Luperox® DDM-9	Luperox® DHD-9	Luperox® Delta X-9	Luperox® 224	Luperox® DDM-30
0.050	24.4	18.3	12.8	15.0	43.5
0.075	18.9	13.9	9.1	13.5	33.0
0.10	15.5	12.1	7.4	10.4	29.5

TABLE III

	Luperox® DDM-9	Luperox® DHD-9	Luperox® Delta X-9	Luperox® 224	Luperox® DDM-30
1% Peroxide. Resin: Orthophthalic, 0.05% of 6% Cobalt solution					
Gel Time (Min)	24.4	18.3	12.8	15.0	43.5
Cure Time (Min)	35.7	30.4	22.0	20.7	63.9
Peak Ex (°F)	301	296	311	320	266
Barcol 934 Hardness	42	35	42	42	33
1.5% Peroxide. Resin: Isophthalic (prepromoted)					
Gel Time (Min)	27.8	37.2	23.8	18.2	47.4
Cure Time (Min)	33.1	44.7	28.8	22.1	55.7
Peak Ex (°F)	364	375	362	396	348
Barcol 934 Hardness	30	28	38	20	30
1.0% Peroxide. Resin: Vinyl Ester, 0.2% of 6% Cobalt solution, 0.08% DMA					
Gel Time (Min)	15.2	12.6	16.6	>60	18.7
Cure Time (Min)	26.4	20.1	28.7	—	40.7
Peak Ex (°F)	311	327	304	—	131
Barcol 935 Hardness	95	98	88	0	0

## STORAGE

- Storage Temp. Recommended 65-85°F  
Maximum 100°F
- Separate storage (isolated for large quantities) away from flammables, strong oxidizing and reducing agents, in particular, promoters such as cobalt compounds.
- **NEVER** store in refrigerators containing food and drink.
- Store only in original containers. DO NOT return material to original containers.
- Leaking containers – Remove and isolate in a safe area. Repackage or dispose (see later section) as soon as possible.
- Post “No Smoking” and “Flammable Storage – Keep Fires Away” signs.

## HANDLING

- Wear safety glasses or goggles and gloves.
- Bring in only enough peroxide for one working shift.
- Keep away from hot steam lines and radiators, sparks and open flames.
- Do not add to hot (over 120°F) solutions.
- Drain and discard catalyst vessel contents if operation is to be shut down for one or more working shifts.

- Dilution: Use only high purity solvents, e.g., MEK, ethyl acetate. **NEVER DILUTE WITH ACETONE.** Shock-sensitive acetone peroxide crystals can form.
- **NEVER** add ketone peroxides directly to promoters such as cobalt octoate or vice versa. Violent decomposition can take place.

## SPILLAGE

- Absorb on inert material.
- Wet with water, sweep into clean polyethylene bags and transfer to disposal area (See “DISPOSAL”)

## DISPOSAL

- Dispose in accordance with federal, state and local regulations.
- MEK Peroxide is specifically listed as a Hazardous Waste in 40CFR Part 261.33, with an EPA Waste No. of U160. Treatment or disposal should only be performed by a properly permitted facility. The preferred method of disposal is dilution followed by incineration. Dilution ratio of 10:1 in a clean, compatible, combustible solvent will reduce reactivity hazard during transportation and incineration. Arkema Inc. representatives can provide guidance to your waste treatment/disposal company, and can also assist with locating such a firm in your area.

## FIRE

- Standard ketone peroxides ignite readily and burn vigorously.
- Fire resistant ketone peroxides ignite with difficulty, however, prolonged exposure to flame will result in sustained mild burning.
- Small fires—carbon dioxide, water.
- Large fires—Water (spray, fog or foam) applied from a safe distance with special attention to containers not immediately involved.

RESIN CATALYZATION GUIDE*						STANDARD FORMULATIONS				ADD TO							
For a Catalyst Conc. (wt. % of:		1 Qt. of Resin (2.24 lbs)				1 Gallon of Resin (9 lbs)				5 Gallons of Resin (45 lbs)				55 Gallons of Resin (500 lbs)			
		DDM-9	DX-9	DHD-9	DHD-30	DDM-9	DX-9	DHD-9	DHD-30	DDM-9	DX-9	DHD-9	DHD-30	DDM-9	DX-9	DHD-9	DHD-30
0.5%	g.	5.1				20.4				102.0				1,135			
	Oz.	0.2				0.2				3.6				40 (2.5 lb.)			
	cc.	5.1	5.1	5.1	5.2	20.3	20.3	20.4	20.8	102	101	102	104	1,130	1,129	1,136	1,160
1.0%	g.	10.2				40.8				204.0				2,270			
	Oz.	0.4				1.4				7.2				80 (5 lb.)			
	cc.	10.2	10.1	10.2	10.4	40.6	40.6	40.8	41.7	203	203	204	208	2,261	2,259	2,272	2,321
1.5%	g.	15.3				61.2				306.0				3,405			
	Oz.	0.5				2.2				10.8				120 (7.5 lb.)			
	cc.	15.2	15.2	15.3	15.6	61.0	60.9	61.3	62.6	305	304	306	313	3,391	3,388	3,408	3,482
2.0%	g.	20.4				81.6				408.0				4,540			
	Oz.	0.7				2.9				14.4				160 (10 lb.)			
	cc.	20.3	20.3	20.4	20.8	81.3	81.2	81.7	83.4	406	406	408	417	4,522	4,517	4,545	4,642

\* Calculations based on resin weight of 9 pounds per gallon and catalyst specific gravities (25/25°C) as follows:  
 Luperox® DDM-9.....1.004    Luperox® DHD-9.....0.999    Luperox® Delta-X-9...1.005    Luperox® DDM-30....0.978  
 Example: To catalyze 5 gallons (45 lbs.) of resin at 1% by weight of Luperox® Delta-X-9 add 204 g., 7.2 oz. or 203 cc.  
 g = grams    cc. = cubic centimeters    oz. = ounces    lb. = pounds

RESIN CATALYZATION GUIDE*					
For a Catalyst Conc. (wt. %) of		1 Qt of Resin (2.24 lb.)	1 Gallon of Resin (9 lbs.)	5 Gallons of Resin (45 lbs.)	55 Gallons of Resin (500 lbs.)
		224	224	224	224
0.5%	g.	5.1	20.4	102.0	1,135
	Oz.	0.2	0.7	3.6	40 (2.5 lb.)
	cc.	4.8	19.1	96	1,064
1.0%	g.	10.2	40.8	204.0	2,270
	Oz.	0.4	1.4	7.2	80 (5 lb.)
	cc.	9.5	38.2	191	2,127
1.5%	g.	15.3	61.2	306.0	3,405
	Oz.	0.5	2.2	10.8	120 (7.5 lb.)
	cc.	14.3	57.3	287	3,191
2.0%	g.	20.4	81.6	408.0	4,540.
	Oz.	0.7	2.9	14.4	160 (10 lb.)
	cc.	19.1	76.5	382	4,254

#### FIRE RESISTANT FORMULATIONS ADD TO

\* Calculations based on resin weight of 9 pounds per gallon and catalyst specific gravities (25/25°C) as follows:  
 Luperox® 224...1.0672  
 Example: To catalyze 5 gallons (45 lbs.) of resin at 1% by weight of Luperox® 224, add 204 g., 7.2 oz. or 191 cc.  
 g = grams    cc. = cubic centimeters    oz. = ounces    lb. = pounds

## FIRST AID

- **IF IN EYES**, immediately flush with plenty of water for at least 15 minutes. Get medical attention immediately.
- **IF ON SKIN**, immediately flush the area with plenty of water. Remove contaminated clothing and shoes. Get medical attention. Wash clothing before reuse.
- **IF SWALLOWED**, do not induce vomiting. Get medical attention immediately. Never give anything by mouth to an unconscious person.

## SHELF LIFE

- 65-85°F – 6 months
- 86-100°F – 3 months
- Container dating recommended.

## EQUIPMENT

- Recommended materials of construction: 304 and 316 stainless, Teflon®, Nylon, Kynar® and Kel-F.
- **AVOID** materials such as copper, brass, mild steel, aluminum alloys, natural and synthetic rubbers.
- Grounded, bonded electrical installations of approved explosion proof construction (NEMA Class I, Group D, Division 2).
- Keep scrupulously clean and protect from accidental contamination, e.g., dust, overspray.
- Pumping/Metering – Low speed, positive displacement pumps recommended. Diaphragm and centrifugal pumps are satisfactory provided that fluid transfer does not result in excessive heat build-up.

## PACKAGING

- Standard—1 gal. (8 lb.) polyethylene container, 4 per case.
- Available—5 gal. (40 lb.) polyethylene container.

## AVAILABILITY

Marketed worldwide by specialized distributors serving the reinforced plastics industry. For the location of your nearest distributor, contact the Arkema Functional Additives Sales Department:

Region	Contact Name	Contact Phone #	Contact E-mail
North America	Customer Service	1 800 331 7654	arkema.usph-fa-cs@arkema.com
Central America	Ma. Eugenia Torres	+52 55 5002 7118	eugenia.torres@arkema.com
South America	Patricia Gomez	+55-11-2148-8560	patricia.gomez@arkema.com
Europe	Melanie LaFarge	+33 149 007 140	melanie.lafarge@arkema.com
China	Zou Shenglin	+86 21 6147 6888	shenglin.zou@arkema.com
India	C KR Krishnamurthy	+91-44-42197522	cr.krishnamurthy
Korea	Heekil Lee	+82 55 587 8060	heekil.lee@arkema.com
Southeast Asia	Ngee Kiat Sim		ngee.kiat.sim@arkema.com

## REFERENCES

For environmental, safety and toxicological information, contact our Customer Service Department at 1-800-331-7654 to request a Material Safety Data Sheet or visit our website at [www.Luperox.com](http://www.Luperox.com).

\*Prior to handling specific ketone peroxides, the Material Safety Data Sheet for that product should be consulted for current information.

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