Metathesis Catalysts
Strem Chemicals has been providing fine chemicals for research and commercial production for over fifty years. In this booklet you will find our selection of molybdenum and ruthenium metathesis catalysts as well as related kits for screening purposes. These catalysts can be used in a variety of metathesis applications including olefin metathesis, ring-closing metathesis, ring-opening polymerization and cross-metathesis.

At Strem, we also offer a wide variety of ligands, nanomaterials and CVD/ALD precursors. Most of our products are of high purity, typically at 99%, while some are as high as 99.9999% metals purity. We continually seek to provide new technologies from around the globe and add to our product line. We have licensing agreements with industry and academia, which allow easier access to these patent-protected products for our customers. We look forward to continued growth in order to best serve our customers’ needs with the quality and service they can trust from Strem.

As part of our ongoing commitment to quality, we have achieved ISO 9001 certification for the Quality Management System (QMS) at our corporate headquarters in Newburyport, Massachusetts.

In addition, custom synthesis services are provided on a contract basis. For pharmaceutical applications, manufacturing is conducted under current Good Manufacturing Practices (cGMP) in FDA inspected kilo-lab suites. Complete documentation is available, including validation and stability studies. Active Drug Master Files (DMF’s) are maintained in North America and Europe.

Our other booklets, which focus on applications and product classes, are available in print per request and also on our website. Below is a list of current booklet titles that are available. Please also check our Product Resources section online to find additional literature offerings, such as the Strem Chemiker, our technical publication, and product literature sheets.

- Biocatalysts
- Buchwald Ligands and Precatalysts
- Carbon-Base Nanomaterials & Elemental Forms
- Catalysts & Ligands
  Sold in Collaboration with Takasago
- Chiral Phosphoric Acids
- Gold Elements & Compounds
- Heterogeneous Catalysts
- High Purity Chiral Reagents
- Kits
- Materials for Energy Applications
- Metal Catalysts for Organic Synthesis
- Metathesis Catalysts
- MOCVD, CVD & ALD Precursors
- MOFs and Ligands for MOF Synthesis
- Nanomaterials
- New Products
- Other Ligands
- Phosphorous Ligands and Compounds
- Photocatalysts
- PURATREM: High Purity Inorganics
**Glossary of Terms**

- **[α]_D**
- **AAS**
- **ACS**
- **air sensitive**
- **amp**
- **b.p.**
- **d.**
- **dec.**
- **elec. gr.**
- **f.p.**
- **gran.**
- **heat sensitive**
- **hydrate**
- **hygroscopic**
- **light sensitive**
- **liq.**
- **m.p.**
- **moisture sensitive**
- **NMR grade**
- **optical grade**
- **pwdr.**
- **primary standard**
- **PURATREM**
- **purified**
- **P. Vol.**
- **pyrophoric**
- **reagent**
- **REO**
- **SA**
- **store cold**
- **subl.**
- **superconductor grade**
- **tech. gr.**
- **TLC**
- **v.p.**
- **xtl.**

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**About Purity**

- **Chemical purity**
- **Metals purity**

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**[α]_D**: Specific rotation

**AAS**: Atomic Absorption Standard

**ACS**: Conforms to American Chemical Society specifications

**air sensitive**: Product may chemically react with atmospheric oxygen or carbon dioxide at ambient conditions. Handle and store under an inert atmosphere of nitrogen or argon.

**amp**: Ampouled

**b.p.**: Boiling point in °C at 760mm, unless otherwise noted

**d.**: Density

**dec.**: Decomposes

**elec. gr.**: Electronic Grade, suitable for electronic applications

**f.p.**: Flash point in °F

**gran.**: Granular

**heat sensitive**: Product may chemically degrade if stored for prolonged periods of time at ambient temperatures or higher. Store at 5°C or lower.

**hydrate**: Unspecified water content which may vary slightly from lot to lot

**hygroscopic**: Product may absorb water if exposed to the atmosphere for prolonged periods of time (dependent on humidity and temperature). Handle and store under an inert atmosphere of nitrogen or argon.

**light sensitive**: Product may chemically degrade if exposed to light

**liq.**: Liquid

**m.p.**: Melting point in °C

**moisture sensitive**: Product may chemically react with water. Handle and store under an inert atmosphere of nitrogen or argon.

**NMR grade**: Suitable as a Nuclear Magnetic Resonance reference standard

**optical grade**: For optical applications

**pwdr.**: Powder

**primary standard**: Used to prepare reference standards and standardize volumetric solutions

**PURATREM**: Product has a minimum purity of 99.99% (metals basis)

**purified**: A grade higher than technical, often used where there are no official standards

**P. Vol.**: Pore volume

**pyrophoric**: Product may spontaneously ignite if exposed to air at ambient conditions

**reagent**: High purity material, generally used in the laboratory for detecting, measuring, examining or analyzing other substances

**REO**: Rare Earth Oxides. Purity of a specific rare-earth metal expressed as a percentage of total rare-earths oxides.

**SA**: Surface area

**store cold**: Product should be stored at -18°C or 4°C, unless otherwise noted (see product details)

**subl.**: Sublimes

**superconductor grade**: A high purity, analyzed grade, suitable for preparing superconductors

**tech. gr.**: Technical grade for general industrial use

**TLC**: Suitable for Thin Layer Chromatography

**v.p.**: Vapor pressure mm of Hg

**xtl.**: Crystalline

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**Chemical purity**

- is reported after the chemical name, e.g. Ruthenium carbonyl, 99%

**Metals purity**

- is reported in parentheses with the respective element, e.g. Gallium (III) bromide, anhydrous, granular (99.999%-Ga) PURATREM where 100% minus the metal purity is equal to the maximum allowable percentage of trace metal impurity
MOLYBDENUM (Compounds)

42-0575  [2,6-bis(1-methylethyl)benzenaminato(2-)]
   bis(1,1,3,3,3-hexafluoro-2-methyl-2-propanolo-
   lato-kO)(2-methyl-2-phenylpropylidene)-, (T-4)
   molybdenum, paraffin pellet (139220-25-0)
   C_{30}H_{35}F_{12}MoNO_{2}; FW: 763.53; paraffin pellet
   air sensitive, moisture sensitive
   Note: Developed by XiMo. Sold under license from
   XiMo for research purposes only.

Technical Notes:
1. General metathesis of many ordinary olefins, especially
   terminal olefins, and will ROMP many norbornene or substituted
   norbornadiene monomers to give all cis, and often isotactic, polymers.
2. Useful for the “ring-closing” of dienes or the coupling of terminal olefins.
3. Highly active and most commonly used in cross metathesis of aliphatic alkenes with 2-vinyl aromatics.

42-0575

References:

42-0530  [2,6-bis(1-methylethyl)benzenaminato(2-)]
   [(1R)-3,3'-dibromo-2'-[(1,1-dimethylethyl)
   dimethylsilyloxy]-5,5',6,6',7,7',8,8'-octahy-
   dro[1,1'-binaphthalen]-2-olato-kO](2,5-dimethyl-
   1H-pyrrol-1-yl)(2-methyl-2-phenylpropylidene)
   molybdenum (VI) (1103220-99-0)
   C_{54}H_{70}BrMoNO_{2}Si; FW: 1063; orange pwdr.
   air sensitive, moisture sensitive
   Note: Developed by XiMo. Sold under license from
   XiMo for research purposes only.

Technical Notes:
1. Catalyst used in Z-selective cross metathesis.\textsuperscript{1}
2. Catalyst used in enantio- or diastereo-selective ene-yne ring closing metathesis.\textsuperscript{1,3}

References:
MOLYBDENUM (Compounds)

42-0530 (continued) [2,6-bis(1-methylethyl)benzenaminato(2-)][(1R)-3,3'-dibromo-2'-[[1,1-dimethylethyl]dimethylsilyl]oxy]-5,5',6,6',7,7',8,8'-octahydro[1,1'-binaphthalen]-2-olato-kO](2,5-dimethyl-1H-pyrrol-1-yl)(2-methyl-2-phenylpropyliidine) molybdenum (VI) (1103220-99-0)

References:

42-0535 [2,6-bis(1-methylethyl)benzenaminato(2-)][(1R)-3,3'-dibromo-2'-[[1,1-dimethylethyl]dimethylsilyl]oxy]-5,5',6,6',7,7',8,8'-octahydro[1,1'-binaphthalen]-2-olato-kO](2,5-dimethyl-1H-pyrrol-1-yl)(2-methyl-2-phenylpropyliidine) molybdenum (VI), paraffin pellets (75980-60-8)

C_6H_3BrMoN_2O_2Si; FW: 1063; paraffin pellet
air sensitive, moisture sensitive, (store cold)
Note: Developed by XiMo. Sold under license from XiMo for research purposes only. Patents: U.S. 9,687,834, EP2242578.

Technical Note:
1. See 42-0530 (page 1)

42-0520 [2,6-bis(1-methylethyl)benzenaminato(2-)](2,5-dimethyl-1H-pyrrol-1-yl)(2-methyl-2-phenylpropyliidine)(1,1':3',1''-terphenyl)-2'-olato molybdenum(VI) (1703808-70-1)

C_{46}H_{50}MoN_2O; FW: 742.86; yellow pwdr.
air sensitive, moisture sensitive, (store cold)
Note: Developed by XiMo. Sold under license from XiMo for research purposes only. Patents: US20140309466, WO14139679.

Technical Note:
1. Catalyst for general metathesis reactions including cross metathesis and endo-selective ene-yne ring closing metathesis.¹

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MOLYBDENUM (Compounds)

42-0525

[2,6-bis(1-methylethyl)benzenaminato(2-)](2,5-dimethyl-1H-pyrrol-1-yl)
(2-methyl-2-phenylpropyliedene)[(1',1''-terphenyl]-2'-olato)molybdenum(VI),
paraffin formulated pellet (1703808-70-1)
C₉H₄MoN₂O; FW: 742.86; paraffin pellet
air sensitive, moisture sensitive, (store cold)
Note: Developed by XiMo. Sold under license from XiMo for research purposes only.

Technical Note:
1. See 42-0520 (page 2)

42-0510

[2,6-Bis(1-methylethyl)benzenaminato(2-)]
(2,5-dimethyl-1H-pyrrol-1-yl)(4',6'-diphenyl[1,1':3',1''-terphenyl]-2'-olato)
(2-methyl-2-phenylpropyliedene)molybdenum(VI)
(1572180-69-8)
C₉H₄MoN₂O; FW: 895.05; orange powdr.
air sensitive, moisture sensitive, (store cold)
Note: Developed by XiMo. Sold under license from XiMo for research purposes only.

Technical Note:
1. Catalyst for general metathesis reactions including cross metathesis and ring closing metathesis.¹

\[
\text{O} \quad \text{Ph} \quad \text{= 42-0510, 5 mol\%}, \\
\text{3h, 67\% yield} \quad \text{O} \quad \text{Ph} \\
\text{>98\% endo product}
\]

References:

42-0515

[2,6-Bis(1-methylethyl)benzenaminato(2-)](2,5-dimethyl-1H-pyrrol-1-yl)
(4',6'-diphenyl[1,1':3',1''-terphenyl]-2'-olato)(2-methyl-2-phenylpropyliedene)
molybdenum(VI) in paraffin formulated pellet
C₉H₄MoN₂O; FW: 895.05; paraffin pellet
air sensitive, moisture sensitive, (store cold)
Note: Developed by XiMo. Sold under license from XiMo for research purposes only.

Technical Note:
1. See 42-0510 (page 3)

42-0560

(S)-1-((3,3'-dibromo-2'-(tert-butyldimethylsilyl))oxy)-5,5',6,6',7,7',8,8'-octahydro-[1,1'-binaphthalen]-
2-yl)oxy)-N-(2,6-diisopropylphenyl)-1-(2,5-dimethyl-1H-pyrrol-1-yl)-1-(2-methyl-2-phenylpropyliedene)
molybdenum(VI) (1196674-83-5)
C₉H₂Br₂MoN₂O₂Si; FW: 1063; red powdr.
air sensitive, moisture sensitive, (store cold)
Note: Developed by XiMo. Sold under license from XiMo for research purposes only.

Technical Notes:
1. Z-selective cross metathesis.²
2. Enantio- or diastereoselective en-yne ring closing metathesis.¹,³

References:
Metathesis Catalysts

MOLYBDENUM (Compounds)

42-0565

(S)-1-((3,3’-dibromo-2’-((tert-butyldimethylsilyl)oxy)-5,5’,6,6’,7,7’,8,8’-octahydro-
[1,1’-binaphthalen]-2-yl)oxy)-N-(2,6-diisopropylphenyl)-1-(2,5-dimethyl-1H-
pyrrol-1-yl)-1-(2-methyl-2-phenylpropylidene)molybdenum (VI) paraffin pellets

(1916674-83-5)

C_{19}H_{34}Br_{2}MoN_{2}O_{2}Si; FW: 1063; paraffin pellet

air sensitive, moisture sensitive, (store cold)

Note: Developed by XiMo. Sold under license from XiMo for research purposes only.


Technical Note:

1. See 42-0560 (page 3)

42-0540

(R)-1-((3,3’-dibromo-2’-((tert-butyldimethylsilyl)oxy)-5,5’,6,6’,7,7’,8,8’-octahydro-
[1,1’-binaphthalen]-2-yl)oxy)-1-(2,5-dimethyl-1H-pyrrol-1-yl)-N-(2,6-dimethylphenyl)-1-(2-
methyl-2-phenylpropylidene)molybdenum (VI) paraffin pellets

(1300026-28-1)

C_{20}H_{32}Br_{2}MoN_{2}O_{2}Si; FW: 1006.89; orange pwdr.

air sensitive, moisture sensitive, (store cold)

Note: Developed by XiMo. Sold under license from XiMo for research purposes only.


Technical Note:

1. Catalyst used for:
   a. Enantio-selective ring opening/cross metathesis.
   b. Ring closing metathesis.
   c. Enantio- and endo-selective ene-yne ring closing metathesis.

2,6-Diisopropylphenylimidoneophylidene molybdenum(VI) bis(hexafluoro-t-butoxide)

SCHROCK’S CATALYST (139220-25-0)

Mo(C_{10}H_{12})(C_{12}H_{17}N)(OC(CH_{3})(CF_{3})_{2})_{2};

FW: 765.53; yellow to orange pwdr.

air sensitive, moisture sensitive, (store cold)

Note: Developed by XiMo. Sold under license from XiMo for research purposes only. Patents: U.S. 9,687,834, EP2242578.

Technical Note:

1. See 42-0540 (page 4)

42-1205

2,6-Diisopropylphenylimidoneophylidene molybdenum(VI) bis(hexafluoro-t-butoxide)

SCHROCK’S CATALYST (139220-25-0)

Mo(C_{10}H_{12})(C_{12}H_{17}N)(OC(CH_{3})(CF_{3})_{2})_{2};

FW: 765.53; yellow to orange pwdr.

air sensitive, moisture sensitive, (store cold)

Technical Notes:

1. Unlike Mo(C_{10}H_{12})(C_{12}H_{17}N)(OC(CH_{3})(CF_{3})_{2})_{2}, the bis(hexafluoro-t-butoxide) (MoF_{6}) derivative will metathesize many ordinary olefins, especially terminal olefins, and will ROMP many norbornene or substituted norbornadiene monomers to give all cis, and often isotactic, polymers.
2. Useful for the “ring-closing” of dienes or the coupling of terminal olefins.
3. Useful for cross-metathesis of aliphatic alkenes with 2-vinyl aromatics.

References:


Technical Note (1)

Ref. (2)

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**MOLYBDENUM (Compounds)**

**42-1205**

2,6-Diisopropylphenylimidoneophyldenede molybdenum(VI) bis(hexafluoro-t-butoxide)

**SCHROCK’S CATALYST (139220-25-0)**

![Chemical structure of molybdenum catalyst](image)

References:

**42-0550**

(2,5-Dimethyl-1H-pyrrol-1-yl)

amp

![Chemical structure of molybdenum catalyst](image)

Technical Notes:
1. Z-selective alkenyl halide synthesis by cross metathesis.
2. Stereoselective macrocyclic ring closing metathesis.

References:
# Metathesis Catalysts

## Molybdenum (Compounds)

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Formula</th>
<th>Molecular Weight</th>
<th>Purity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>42-0555</td>
<td>(2,5-Dimethyl-1H-pyrrol-1-yl)(2,2&quot;&quot;,4,4&quot;&quot;,6,6&quot;&quot;-hexamethyl[1,1'':3',1'&quot;&quot;-terphenyl]-2'-olato)(2-methyl-2-phenylpropyldiene)[2,3,4,5,6-pentafluorobenzenaminato(2-)]κN,(T-4) molybdenum(VI), paraffin pellets</td>
<td>C₆₆H₅₅MoN₂O; FW: 832.81</td>
<td>paraffin pellet</td>
<td>air sensitive, moisture sensitive, (store cold)</td>
<td>Developed by XiMo. Sold under license from XiMo for research purposes only. Patent: U.S. 9,441,059.</td>
</tr>
</tbody>
</table>

**Technical Note:**
1. See 42-0550 (page 5)

## Ruthenium (Compounds)

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Formula</th>
<th>Molecular Weight</th>
<th>Purity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>96-0440</td>
<td>Apeiron Ammonium Catalysts Kit</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>96-0420</td>
<td>Apeiron Bulky Catalysts Kit</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>96-0410</td>
<td>Apeiron nitro-Grela Catalysts Kit</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>96-0430</td>
<td>Apeiron Polymerization Catalysts Kit</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>96-0400</td>
<td>Apeiron Ruthenium Metathesis Catalyst Kit</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Technical Note:**
1. Highly selective versatile cross metathesis catalyst leading to terminal and internal olefins, such as ethenolysis via ring closing metathesis (including challenging macrocyclization), cross metathesis (involving electron deficient partners like acrylates), or ene-yne metathesis. These transformations are highly selective and take place at exceptionally low catalyst loadings.

References:

## References


**Technical Note:**
1. FixCat is a stable olefin metathesis initiator with very good solubility in neat water. The product efficiently promotes ring-closing, cross, and enyne metathesis reactions of water soluble substrates. Suitable for homogeneous and heterogeneous in batch or flow setup.
RUTHENIUM (Compounds)

Metathesis Catalysts

44-0759 (continued) (1,3-Bis(2,6-diisopropylphenyl)-4-((4-ethyl-4-methyl)piperazin-1-ium-1-yl)methyl)imidazolidin-2-ylidene)]2-isopropoxybenzylidene)ruthenium(II)dichloride dihydrate FixCat (1799947-97-9)

The Fixcat structure was also optimized to serve as a versatile and very stable catalyst, easily immobilized on solid supports. In its SCA-15 supported version, it showed exceptional efficiency in promoting ring-closing and cross-metathesis reactions, in both batch and continuous flow setups. Fix Cat is also applicable as a homogeneous catalyst, where compatible solvents include alcohols and halogenated solvents.

\[
\begin{align*}
\text{Toluene, 1.0M} & \quad \text{FixCat (20ppm)} \\
\text{45°C, 71%} & \quad \text{Tons} \\
\text{10 min} & \quad \text{1590 min}^{-1}
\end{align*}
\]

References:

44-0055 [1,3-Bis(2,6-di-i-propylphenyl)-4,5-dihydroimidazol-2-ylidene)-[2-i-propoxy-5-(trifluoroacetamido)phenyl]methylenerruthenium(II) dichloride M71-S1Pr (1212008-99-5)

C_{39}H_{50}Cl_{2}F_{3}N_{3}O_{2}Ru; FW: 821.80; green pwdr.
Note: Sold under license from Omega Cat System for research purposes only WO 2008/065187, PCT/EP2008/054901, Fr n°08/05403.

Technical Note:
1. Enhanced activity ruthenium “boomerang” pre-catalyst used in the olefin metathesis, enyne metathesis, and cross metathesis reactions, that can be recycled, and leaves reduced ruthenium in the product after silica gel chromatography.

\[
\begin{align*}
\text{catalyst (0.3 mole %)} & \quad \text{CH}_{2}Cl_{2}, 0.75 \text{ h, 0.1M, rt} \\
\text{>98%, 1.8 ppm Ru after silica gel}
\end{align*}
\]

References:

44-0750 [1,3-Bis(2,6-di-i-propylphenyl)imidazolidin-2-ylidene)]2-[[1-(methoxy(methyl)amino)-1-oxopropan-2-yl]oxy]benzylidene)ruthenium(II) dichloride GreenCat (1448663-06-6)

C_{39}H_{53}Cl_{2}N_{3}O_{3}Ru; FW: 783.33; green pwdr.

Technical Note:
1. Efficient, durable and reuseable olefin metathesis catalyst with a high affinity to silica gel.

\[
\begin{align*}
\text{GreenCat (0.1 mol%)} & \quad \text{40 °C, 1.5 h} \\
\text{non-degassed, non-dried} \\
\text{ACS grade AcOEt} & \quad \text{92%}
\end{align*}
\]
Metathesis Catalysts

RUTHENIUM (Compounds)

44-0750 (continued)

[1,3-Bis(2,6-di-i-propylphenyl)imidazolidin-2-ylidene][2-[1-(methoxy(methyl)amino)-1-oxopropan-2-yl]oxy]benzylidene)ruthenium(II) dichloride GreenCat (1448663-06-6)

MeOOC \(-\rangle + \overset{\text{GreenCat (0.5 mol%)}}{\text{O}}\overset{40 \degree C, 1.5 h}{\text{O}}\overset{\text{MeOOC \(-\rangle}}{\text{O}}\)

tech. note (1)
ref. (1)
88%, E/Z 9/1

References:

44-0748

[1,3-Bis(2,6-di-i-propylphenyl)imidazolidin-2-ylidene][2-((1-methoxy(methyl)amino)-1-oxopropan-2-yl)oxy]benzylidenediodoruthenium(II) GreenCat-I2

C_{39}H_{53}I_{2}N_{3}O_{3}Ru; FW: 966.74; green solid
air sensitive, (store cold)

Note: Recommended storage 2-8°C. Sold in collaboration with Apeiron Synthesis, Inc.

Technical Note:
1. Catalyst for metathesis applications.

References:

44-0770

[1,3-Bis(2,6-di-i-propylphenyl)imidazolidin-2-ylidene)(2-i-propoxy-5-nitrobenzylidene) ruthenium(II) diiodide nitro-Grela SiPr

C_{37}H_{49}I_{2}N_{3}O_{3}Ru; FW: 938.68; olive brown pwdr.
air sensitive, (store cold)

Note: Recommended storage 2-8°C. Sold in collaboration with Apeiron Synthesis, Inc.

Technical Note:
1. Catalyst for metathesis applications.

References:

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**RUTHENIUM (Compounds)**

44-0793  
**[1,3-Bis(2,6-di-1-propylphenyl)imidazolidin-2-yldiene](tricyclohexylphosphine)-(2-oxobenzylidene)ruthenium(II) chloride LatMet SPr** (1544328-59-7)  
C₃₀H₂₇ClIN₂OPRu; FW: 913.68; dark green xtl.  
*air sensitive, (store cold)*  
Note: Recommended storage 2-8°C. Sold in collaboration with Apeiron Synthesis, Inc.  

Technical Notes:  
1. Catalyst for metathesis applications.

References:  

44-0073  
**Bis(tricyclohexylphosphine)[(phenylthio)methylene]ruthenium(II) dichloride, min. 97%** (219770-99-7)  
RuCl₂(CHSC₆H₅)[P(C₆H₁₁)₃]₂; FW: 855.02; purple pwdr.

Technical Notes:  
1. Metathesis catalyst, stable in air and can be used in aqueous media.  
2. Catalyst of choice for the ring-opening metathesis polymerization of cycloolefins.  
3. Catalyst concentration 2-3 times lower than comparable phenyl and vinyl substituted ruthenium carbenes.  
4. Excellent initiator for solvent-free polymerization and control of initiation rates and gelation times.  
5. Highly selective catalyst for the ring opening/cross-metathesis of norbornene derivatives.

References:  
3. Organometallics, 2003, 22, 586

44-0063  
**Bis(tricyclohexylphosphine)-3-phenyl-1H-inden-1-ylideneruthenium(II) dichloride (250220-36-1)**  
RuCl₂(C₁₅H₁₀)[P(C₆H₁₁)₃]₂; FW: 923.07; brown pwdr.  
Note: Sold in collaboration with Umicore for research purposes only.

Technical Notes:  
1. Highly active, air-stable catalyst used for the ring closing metathesis of dienes.  
2. Used in cross-metathesis.

References:  
Metathesis Catalysts

RUTHENIUM (Compounds)

44-0755 1,3-Bis(2,4,6-trimethylphenyl)-4-[(trimethylammonio)methyl]imidazolidin-2-ylidene-(2-i-propoxybenzylidene) dichlororuthenium(II) hexafluorophosphate StickyCat PF6

C₂₇H₂₄Cl₂F₆N₂OPRu; FW: 843.72; green pwdr.
air sensitive, (store cold)
Note: Recommended storage 2-8°C. Sold in collaboration with Apeiron Synthesis, Inc.

Technical Note:
1. Catalyst for metathesis applications.

Reference:

44-0795 1,3-Bis(2,4,6-trimethylphenyl)-4-[(trimethylammonio)methyl]imidazolidin-2-ylidene-(2-i-propoxy-5-nitrobenzylidene) dichlororuthenium(II) chloride nitro-StickyCat Cl (1415661‑45‑8)

C₂₇H₂₃Cl₂N₄O₂Ru; FW: 779.20; green pwdr.
air sensitive, (store cold)
Note:Recommended storage 2-8°C. Sold in collaboration with Apeiron Synthesis, Inc.

Technical Note:
1. Catalyst for olefin metathesis applications.

References:

44-0083 1,3-Bis(2,4,6-trimethylphenyl)-4,5-dihydroimidazol-2-ylidene[2-(i-propoxy)-5-(N,N-dimethyl aminosulfonyl)phenyl] methyleneruthenium(II) dichloride (resin supported) Zhan Catalyst II

FW: >1000; black solid; Loading: 0.5 mmol/g

Technical Notes:
1. Efficient, air-stable metathesis catalyst.
2. Used in cross-metathesis/Friedel-Crafts Cascade reaction.

References:

44-0082 1,3-Bis(2,4,6-trimethylphenyl)-4,5-dihydroimidazol-2-ylidene[2-(i-propoxy)-5-(N,N-dimethylamino sulfonfonyl)phenyl] methyleneruthenium (II) dichloride, Zhan Catalyst-1B, min 96% (918870-76-5)

RuCl₂[C₂₁H₁₇N₃][C₁₇H₁₇NO₃S]; FW: 733.75; green solid

Technical Notes:
1. See 44-0083 (page 10)

Visit strem.com for new product announcements.
RUTHENIUM (Compounds)

44-0768

[1,3-Bis(2,4,6-trimethylphenyl)-4-[[4-ethyl-4-methylpiperazin-1-ium-1-yl)methyl]imidazolidin-2-ylidene]-2-i-propoxybenzylidene)dichlororuthenium(II)cloride AquaMet (1414707-08-6)

C₂₉H₂₂Cl₂N₆O₇Ru; FW: 803.31; green pwdr. 

Note: Sold in collaboration with Apeiron Synthesis, Inc. 


Aperion Ruthenium Metathesis Catalyst Kit component. 

Technical Notes: 

1. This is an highly active catalyst for olefin metathesis in water. 
2. This catalyst is used as linker free heterogeneous metathesis catalysts after immobilization on silica or siliceous mesoporous molecular sieves. TON of ~16000 for the RCM of (-)-β-citronellene are reported. 

\[
\begin{align*}
\text{Cl}^- & \quad \text{AquaMet (2.5 mol\%)} \\
& \quad D_2O, rt, 2.5h \\
\text{Cl}^- & \quad 96\% 
\end{align*}
\]

\[
\begin{align*}
\text{Cl}^- & \quad \text{AquaMet (5 mol\%)} \\
& \quad D_2O, rt, 2.5h \\
\text{Cl}^- & \quad 46\% 
\end{align*}
\]

References: 

2. ACS Catal., 2014, 4, 3227

44-0047

[1,3-Bis(2,4,6-trimethylphenyl)-2-imidazolidinylidene]-2-[[4-methylphenyl imino][methyl][4-nitrophenyl][3-phenyl-1H-inden-1-ylidene]ruthenium(II)chloride (934538-04-2) 

C₃₀H₂₄Cl₂N₈O₅Ru; FW: 888.46; orange-brown solid 

Note: Sold in collaboration with Umicore for research purposes only. 


Technical Note: 

1. Highly active catalyst for ring opening polymerization and ring closing metathesis reactions. 

\[
\begin{align*}
\text{EtO}_2\text{C} & \quad \text{CO}_2\text{Et} \\
& \quad \text{cat} \\
\text{EtO}_2\text{C} & \quad \text{CO}_2\text{Et} \\
& \quad 100\% (20^\circ\text{C}, 60\text{ mins}) 
\end{align*}
\]

Ref. (1-3)

References: 

1. WO 2003062253. 
RUTHENIUM (Compounds)

44-0049

[1,3-Bis(2,4,6-trimethylphenyl)-2-imidazolidinylidene]-[2-[[2-methylphenyl imino] methyl][phenolyl]-[3-phenyl-1H-inden-1-ylidene]ruthenium(II) chloride (934538-12-2)

C_{26}H_{38}ClN_Ru; FW: 843.46; red-brown solid
Note: Sold in collaboration with Umicore for research purposes only.

Technical Note:
1. Highly active catalyst for ring opening and ring closing metathesis reactions.

\[
\begin{align*}
\text{EtO}_2\text{C}\ &\text{CO}_2\text{Et} \\
\text{cat} \\
\text{EtO}_2\text{C} &\text{CO}_2\text{Et} \\
\text{100\% (20\degree C, 60 mins)}
\end{align*}
\]

Ref. (1-3)

References:
1. WO 2003062253.

44-0026

1,3-Bis(2,4,6-trimethylphenyl)-2-imidazolidinylidene)(3-phenyl-1H-inden-1-ylidene)(4,5-dichloro-1,3-diethyl-1,3-dihydro-2H-imidazol-2-ylidene) ruthenium(II) dichloride (1228169-92-3)

C_{30}H_{36}Cl_2N_2Ru; FW: 861.73; orange-brown solid
Note: Sold in collaboration with Umicore for research purpose only.

Technical Note:
1. Catalyst used for RCM reactions leading to trisubstituted olefins.

\[
\begin{align*}
\text{EtO}_2\text{C} &\text{CO}_2\text{Et} \\
\text{[Ru catalyst]} &\text{toluene} \text{100\degree C, 24 h} \\
\text{EtO}_2\text{C} &\text{CO}_2\text{Et} \\
\text{Yield - 96\%}
\end{align*}
\]

Tech. Note (1)
Ref. (1)

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**RUTHENIUM (Compounds)**

### 44-0026 (continued)

**1,3-Bis(2,4,6-trimethylphenyl)-2-imidazolidinylidene)(3-phenyl-1H-inden-1-ylidene)
(4,5-dichloro-1,3-diethyl-1,3-dihydro-2H-imidazol-2-ylidene)ruthenium(II) dichloride**

(1228169-92-3)

![Diagram](image)

Ruthenium (Compounds)

**Tech. Note (1)**

**Ref. (1)**

**References:**
1. **Organometallics, 2010, 29, 2761**

### 44-0767

**[1,3-Bis(2,4,6-trimethylphenylimidazolidin-2-ylidene)-(2-i-propoxy-5-nitrobenzylidene) ruthenium(II) diiodide nitro-Grela I2**

(1874264-99-9)

**C₉H₆N₂IRu; FW: 854.52; olive brown pwdr. air sensitive, (store cold)**


**Technical Note:**
1. Catalyst for metathesis applications.

**References:**
1. **Beilstein Journal of Organic Chemistry 2015, 11, 1823-1832.**

### 44-0758

**[1,3-Bis(2,4,6-trimethylphenylimidazolidin-2-ylidene)-(2-i-propoxy-5-nitrobenzylidene) ruthenium(II) dichloride nitro-Grela**

(502964-52-5)

**C₉H₆N₂IRu; FW: 671.62; green pwdr.**


**Technical Notes:**
1. This catalyst is used for an efficient synthesis of HCV Protease Inhibitor, BILN 2061.
2. The nitro-Grela catalyst is a stable olefin metathesis initiator active in various ring-closing, cross, and enyne metathesis reactions. Its efficiency has been proven in numerous total syntheses of natural and biologically active compounds, and in material science (see Ref. 1-9)

**References:**
5. **Org. Lett., 2010, 12, 248**

---

**Metathesis Catalysts**

info@strem.com . order@strem.com . technical@strem.com . quotation@strem.com
RUTHENIUM (Compounds)

**44-0753**

[1,3-Bis(2,4,6-trimethylphenylimidazolidin-2-ylidene)](tricyclohexylphosphine)-(2-oxobenzylidene)ruthenium(II) chloride LatMet (1407229-58-6)

C_{36}H_{65}ClN_2OPRu; FW: 829.52; green pwdr.


Technical Note:
1. This catalyst is used for olefin metathesis polymerization.

\[
\begin{align*}
\text{LatMet (50 ppm)} & \quad \text{NO} \\
28^\circ\text{C}, 4 \text{ h} & \quad \text{CONVERSION} \\
\text{HCl, } 60^\circ\text{C} & \quad 10 \text{ min} \\
\end{align*}
\]

>_99%

References:

**44-0787**

[1,3-Bis(2,4,6-trimethylphenylimidazolidin-2-ylidene)](tricyclohexylphosphine)-(2-oxo-5-nitrobenzylidene)ruthenium(II) chloride Nitro-LatMet (1544328-53-1)

C_{36}H_{64}ClN_3O_3PRu; FW: 874.52; brown xtl.

air sensitive, (store cold)


Technical Note:
1. Catalyst for metathesis applications.

References:

**44-0765**

[1,3-Bis(2,4,6-trimethylphenyl)-4-[(trimethylammonio)methyl]imidazolidin-2-ylidene]- (2-i-propoxybenzylidene) dichlororuthenium(II) chloride StickyCat Cl (1452227-72-3)

C_{35}H_{48}Cl_N_3ORu; FW: 734.20; green pwdr.


Technical Note:
1. This is an easily removable olefin metathesis catalyst. It shows high activity at 40-110°C. Residual ruthenium metal is usually below 5 ppm.

\[
\begin{align*}
\text{TBSO} & \quad + \quad \text{O} \\
\text{StickyCat Cl (1 mol%)} & \quad \text{DCM, 40 }^\circ\text{C, 80 min} \\
\text{TBSO} & \quad \text{97%, Ru [ppm] = 1.7} \\
\end{align*}
\]

References:
### Metathesis Catalysts

#### RUTHENIUM (Compounds)

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>CAS</th>
<th>Formula</th>
<th>MW</th>
<th>Color</th>
<th>Storage</th>
<th>Notes</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>44-0760</td>
<td>Dichloro(1,3-bis(2,4,6-trimethylphenyl)imidazolidin-2-ylidene)(2-[(ethoxy-2-oxoethylidene)amino]benzylidene)ruthenium(II) HeatMet</td>
<td>C_{32}H_{37}Cl_{2}N_{3}O_{2}Ru; FW: 667.63; dark purple xtls. (store cold)</td>
<td>Note: Sold in collaboration with Apeiron Synthesis, Inc. U.S. Patent 14/443,034; PCT/IN2013/002543.</td>
<td>1. HeatMet catalyst is a highly efficient latent catalyst, requiring thermal activation to initiate catalytic activity. Its characteristics are especially suitable to mold polymerization of reactive monomers such as dicyclopentadiene (DCPD). The catalyst is soluble in toluene and dichloromethane.</td>
<td>1. ChemSus Chem., 2015, 8, 4139.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>44-0792</td>
<td>Dichloro(1,3-di-i-propylphenylimidazolidin-2-ylidene)(2-[(ethoxy-2-oxoethylidene)amino]benzylidene)ruthenium(II) HeatMet SPr (2097273-88-4)</td>
<td>C_{38}H_{49}Cl_{2}N_{3}O_{2}Ru; FW: 751.79; dark violet pwdr. (store cold)</td>
<td>Note: Recommended storage 2-8°C. Sold in collaboration with Apeiron Synthesis, Inc. U.S. Patent 14/443,034.</td>
<td>1. Catalyst for metathesis applications.</td>
<td>1. ACS Catalysis, 2017, 7(6), 4115-4121.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>44-0778</td>
<td>(1-(2,6-Diethylphenyl)-3,5,5-trimethyl-3-phenylpyrrolidin-2-ylidene)(2-isopropoxy-5-nitrobenzylidene)ruthenium(II) dichloride UltraNitroCat</td>
<td>C_{33}H_{40}Cl_{2}N_{2}O_{3}Ru; FW: 684.66; green pwdr. (store cold)</td>
<td>Note: Sold in collaboration with Apeiron Synthesis, Inc. Patent: PCT/IB2016/054486.</td>
<td>1. High turnover selective catalyst for cross metathesis in macrocyclization reactions.</td>
<td>1.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Metathesis Catalysts

RUTHENIUM (Compounds)

44-0778 (continued) (1-(2,6-Diethylphenyl)-3,5,5-trimethyl-3-phenylpyrrolidin-2-ylidene)(2-isoproxy-5-nitrobenzylidene)ruthenium(II) dichloride UltraNitroCat (2106819-64-9)

UltraNitroCat 30 ppm
Toluene 5 mM

GC yield = 90%; TON = 30000

References:
1. ACS Catal., 2017, 7, 5443-5449

44-0740 (1,3-Di-o-tolylimidazolidin-2-ylidene)(2-i-propoxy-5-nitrobenzylidene)dichlororuthenium(II) Nitro-Grela SI-o-Tolyl
C₂₇H₂₉Cl₂N₃O₃Ru; FW: 615.51; green pwd. air sensitive, (store cold)
Note: Recommended storage 2-8°C. Sold in collaboration with Apeiron Synthesis, Inc.

Technical Note:
1. Catalyst for metathesis applications.

References:

44-7778 3-Phenyl-1H-inden-1-ylidene[bis(i-butylphobane)] ruthenium(II) dichloride (894423-99-5)
C₃₀H₅₆Cl₂Ru; FW: 758.78; red pwd.
Note: Sold in collaboration with Umicore for research purposes only. Patent US 10,518,716.

Technical Note:
1. This catalyst exhibits high selectivity as a general purpose metathesis catalyst for applications other than polymerization. It has improved air, moisture and heat resistance.

References:

44-0078 [{[(2-(i-Proxy)-5-(N,N-dimethylamino sulfonyl) phenyl)methylene](tricyclohexylphosphine) ruthenium(II) dichloride Zhan Catalyst -1C (918871-44-0)
C₂₈H₅₀Cl₂NO₃PRuS; FW: 707.74; brown solid

Technical Notes:
1. Efficient, air-stable metathesis catalyst.
2. Used in cross-metathesis/Friedel-Crafts Cascade reaction.

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RUTHENIUM (Compounds)

44-0078  [(2-(i-Propoxy)-5-(N,N-dimethylamino sulfonyl)phenyl)methylene](tricyclohexylphosphine) ruthenium(II) dichloride Zhan Catalyst -1C (918871-44-0)

References:

44-7785  Tricyclohexylphosphine[1,3-bis(2,4,6-trimethylphenyl)imidazol-2-ylidene][2-thienylmethylene] ruthenium(II) dichloride, min. 95% [catMETium® RF 2] (1190427-49-6)
C44H61Cl2N2PRuS; FW: 852.98; brown pwd.
Note: Sold in collaboration with Evonik for research purposes only.
Patent US 6635768.

Technical Note:
1. Efficient catalyst for ring-closing metathesis.

44-7780  Tricyclohexylphosphine[1,3-bis(2,4,6-trimethylphenyl)-4,5-dihydroimidazol-2-ylidene][phenylthio)methylene] ruthenium(II) dichloride (1155422-69-7)
RuCl2[C21H26N2][C7H6S][P(C6H11)3]; FW: 881.04; purple-brown solid

Technical Notes:
1. Metathesis catalyst, stable in air and can be used in aqueous media.
2. Catalyst of choice for the ring-opening metathesis polymerization of cycloolefins.
3. Catalyst concentration 2-3 times lower than comparable phenyl and vinyl substituted ruthenium carbenes.
4. Excellent initiator for solvent-free polymerization and control of initiation rates and gelation times.
5. Highly selective catalyst for the ring opening/cross-metathesis of norbornene derivatives.
**Metathesis Catalysts**

**RUTHERNIUM (Compounds)**

[44-7780 (continued)]

![Ru-catalyst](image)

**Tech. Note (2)**

**Ref. (2)**

References:


---

**44-7775**

Tricyclohexylphosphine[1,3-bis(2,4,6-trimethylphenyl)-4,5-dihydroimidazol-2-ylidene] [3-phenyl-1H-inden-1-ylidene]ruthenium(II) dichloride, min. 95% [catMETium® RF1]

(254972-49-1)

RuCl₂[C₂₃H₂₂N₂][C₅H₃]P(C₆H₄)₃;
FW: 947.07; orange to brown pwdr.

Note: Sold in collaboration with Evonik for research purposes only. Patent US 6635768.

For use in pharmaceutical applications only. Other uses are unauthorized.

---

**Technical Note:**

1. Efficient catalyst for ring-closing metathesis.

---

**Reactions:**

1. **Ref. (1)**

- **Cat.**

  R = H
  88% (25 °C, 25 mins)
  R = CH₃
  20% (80 °C, 120 mins)

---

**References:**


---

**44-7795**

Tricyclohexylphosphine[2,4-dihydro-2,4,5-triphenyl-3H-1,2,4-triazol-3-ylidene] [2-thienylimethylene]ruthenium(II) dichloride, min. 95% [catMETium® RF 4] (1190427-51-0)

C₁₀H₁₅Cl₃N₅Prus; FW: 845.91; violet to brown pwdr.

Note: Sold in collaboration with Evonik for research purposes only. Patent US 6635768.

---

**Technical Note:**

1. See 44-7775 (page 18)

---

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<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Formula</th>
<th>MW</th>
<th>Color</th>
<th>Storage</th>
<th>Notes and References</th>
</tr>
</thead>
<tbody>
<tr>
<td>44-7790</td>
<td>Tricyclohexylphosphine[4,5-dimethyl-1,3-bis(2,4,6-trimethylphenyl)imidazol-2-ylidene][2-thienylmethylene] ruthenium(II) dichloride, min. 95% [catMETium® RF 3] (1190427-50-9)</td>
<td>C₆₅H₆₅Cl₂N₂PRuS; FW: 881.04; violet to brown pwdr.</td>
<td>881.04</td>
<td>Violet to brown</td>
<td>Store cold, recommended storage 2-8°C.</td>
<td>Sold in collaboration with Evonik for research purposes only. Patent US 6635768.</td>
</tr>
<tr>
<td>44-7777</td>
<td>Tricyclohexylphosphine[3-phenyl-1H-inden-1-ylidene][1,3-bis(2,4,6-trimethylphenyl)-4,5-dihydroimidazol-2-ylidene]ruthenium(II) dichloride, min. 95% (536724-67-1)</td>
<td>C₅₄H₆₉Cl₂N₂PRu; FW: 949.09; dark red pwdr.</td>
<td>949.09</td>
<td>Dark red</td>
<td>Store cold, recommended storage 2-8°C.</td>
<td>Sold in collaboration with Umicore for research purposes only. For use in lifescience applications and research purposes only.</td>
</tr>
</tbody>
</table>

Technical Note:
1. Catalyst used for the Atom Transfer Radical Polymerization (ATRP) of vinyl monomers.

References:
2. ACS Catalysis, 2017, 7(8), 5443-5449.
### RUTHENIUM (Compounds)

**44-7783**

Tri(i-propoxy)phosphine(3-phenyl-1H-inden-1-ylidene)[1,3-bis(2,4,6-trimethylphenyl)-4,5-dihydroimidazol-2-ylidene]ruthenium (II) dichloride, min. 95% cis-Caz-1

C$_{47}$H$_{57}$Cl$_2$N$_2$O$_3$PRu; FW: 876.89; brown pwd.

**Technical Note:**

1. Efficient catalyst for ring-closing metathesis.

![Chemical structure of cis-Caz-1](image)

Ruthenium complex with ligands.

**Chemical Reaction:**

![Reaction scheme](image)

\[
\text{cis-Caz-1 (0.02-0.5 mol%)} \quad \text{toluene (0.5M), reflux (or neat), 120°C}
\]

<table>
<thead>
<tr>
<th>R$^1$ R$^2$</th>
<th>X</th>
<th>cis-Caz-1 (mol%)</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ts EtOOC COOEt</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15h, 0.02 mol%</td>
<td>84%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15h, 0.05 mol%</td>
<td>91%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15h, 0.05 mol%</td>
<td>93%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15h, 0.075 mol%</td>
<td>&gt;99%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8h, 0.1 mol%</td>
<td>94%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8h, 0.1 mol%</td>
<td>98%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24h, 0.5 mol%</td>
<td>74%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**References:**

**KITS - Apeiron Ammonium Catalysts Kit**

**96-0440** Apeiron Ammonium Catalysts Kit

Sold in collaboration with Apeiron Synthesis, Inc. Complexes from our Ammonium Catalysts Kit can be applied to metathesis in neat water [44-0768 (AquaMet), 44-0765 (StickyCat Cl), 44-0795 (nitro-StickyCatCl)], ethyl acetate/dimethyl carbonate [44-0755 (StickyCat PF6), 44-0797 (FixCat PF6)] or heterogeneously after catalyst deposition on solid support [44-0768 (AquaMet), 44-0759 (FixCat)].

These catalysts are especially recommended for applications in which low levels of residual ruthenium is desired.

Components also available for individual sale. Contains the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>44-0755</td>
<td>1,3-Bis(2,4,6-trimethylphenyl)-4-[(trimethylammonio)methyl]imidazolidin-2-ylidene]-(2-i-propoxybenzylidene) dichlororuthenium(II) hexafluorophosphate StickyCat PF6</td>
<td>100mg</td>
<td>See page 10</td>
</tr>
<tr>
<td>44-0759</td>
<td>(1,3-Bis(2,6-diisopropylphenyl)-4-((4-ethyl-4-methylpiperazin-1-ium-1-yl)methyl)imidazolidin-2-ylidene) (2-isoproxybenzylidene)ruthenium(II)dichloride chloride dihydrate FixCat</td>
<td>100mg</td>
<td>See page 6</td>
</tr>
<tr>
<td>44-0765</td>
<td>[1,3-Bis(2,4,6-trimethylphenyl)-4-[(trimethylammonio)methyl]imidazolidin-2-ylidene]-(2-i-propoxybenzylidene) dichlororuthenium(II) chloride StickyCat Cl</td>
<td>100mg</td>
<td>See page 14</td>
</tr>
<tr>
<td>44-0768</td>
<td>[1,3-Bis(2,4,6-trimethylphenyl)-4-[(4-ethyl-4-methylpiperazin-1-ium-1-yl)methyl]imidazolidin-2-ylidene]-(2-i-propoxybenzylidene) dichlororuthenium(II) chloride AquaMet</td>
<td>100mg</td>
<td>See page 11</td>
</tr>
<tr>
<td>44-0795</td>
<td>1,3-Bis(2,4,6-trimethylphenyl)-4-[(trimethylammonio)methyl]imidazolidin-2-ylidene]-(2-i-propoxy-5-nitrobenzylidene) dichlororuthenium(II) chloride nitro-StickyCat Cl</td>
<td>100mg</td>
<td>See page 10</td>
</tr>
<tr>
<td>44-0797</td>
<td>Dichloro(1,3-Bis(2,6-di-i-propylphenyl)-4-((4-ethyl-4-methylpiperazin-1-ium-1-yl)methyl)imidazolidin-2-ylidene) (2-isoproxybenzylidene)ruthenium(II) hexafluorophosphate FixCat PF6</td>
<td>100mg</td>
<td>See page 15</td>
</tr>
</tbody>
</table>
**Metathesis Catalysts**

### KITS - Apeiron Bulky Catalysts Kit

**96-0420** Apeiron Bulky Catalysts Kit

Sold in collaboration with Apeiron Synthesis, Inc. Catalysts within the Bulky Catalysts Kit were designed to be less sensitive to minor impurities that are commonly present in metathesis substrates/solvents. The bulkiness of the ligands in this kit helps to reduce the risk of unwanted double-bond migration. These complexes are especially recommended for RCM and CM of sterically non-demanding substrates.

Components also available for individual sale. Contains the following:

![Chemical Structures](image_url)

**44-0748**

[1,3-Bis(2,6-di-i-propylphenyl)imidazolidin-2-ylidene]

[(2-((1-methoxy(methyl)amino)-1-oxopropan-2-yl)oxy)benzylidenediiodoruthenium(II) GreenCat-I2]

100mg  See page 8

**44-0750**

[1,3-Bis(2,6-di-i-propylphenyl)imidazolidin-2-ylidene]

[(2-[(1-methoxy(methyl)amino)-1-oxopropan-2-yl]oxy)benzylidene]ruthenium(II) dichloride GreenCat (1448663-06-6)

100mg  See page 7

**44-0770**

1,3-Bis(2,6-di-i-propylphenyl)imidazolidin-2-ylidene)

(2-i-propoxy-5-nitrobenzylidene) ruthenium(II) dichloride Nitro-Grela SiPr (928795-51-1)

100mg  See page 8

**44-0782**

[1,3-Bis(2,6-di-i-propylphenyl)imidazolidin-2-ylidene]

(2-i-propoxy-5-nitrobenzylidene) ruthenium(II) diiodide nitro-Grela I2 SIPr (1874265-00-5)

100mg  See page 8

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**KITS - Apeiron nitro-Grela Catalysts Kit**

- **96-0410**  
  **Apeiron nitro-Grela Catalysts Kit**  
  Sold in collaboration with Apeiron Synthesis, Inc. Our nitro-Grela catalysts kit contains complexes with wide-ranging activity and application profiles. These testing catalysts have excellent potential within the early stages of development. Components also available for individual sale. Contains the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Formula</th>
<th>Amount</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>44-0740</td>
<td>(1,3-Di-o-tolylimidazolidin-2-ylidene)(2-i-propoxy-5-nitrobenzylidene)dichlororuthenium(II) Nitro-Grela Si-o-Tolyl</td>
<td>100mg</td>
<td>See page 16</td>
</tr>
<tr>
<td>44-0758</td>
<td>[1,3-Bis(2,4,6-trimethylphenylimidazolidin-2-ylidene)]-(2-i-propoxy-5-nitrobenzylidene)ruthenium(II) dichloride nitro-Grela (502964-52-5)</td>
<td>100mg</td>
<td>See page 13</td>
</tr>
<tr>
<td>44-0763</td>
<td>Tricyclohexylphosphine(2-i-propoxy-5-nitrobenzylidene)dichlororuthenium(II) Nitro-Grela 1 gen. (625082-83-9)</td>
<td>100mg</td>
<td>See page 19</td>
</tr>
<tr>
<td>44-0767</td>
<td>[1,3-Bis(2,4,6-trimethylphenyl)imidazolidin-2-ylidene)-(2-i-propoxy-5-nitrobenzylidene) ruthenium(II) diiodide nitro-Grela I2 (1874264-99-9)</td>
<td>100mg</td>
<td>See page 13</td>
</tr>
<tr>
<td>44-0770</td>
<td>1,3-Bis(2,6-di-i-propylphenylimidazolidin-2-ylidene) (2-i-propoxy-5-nitrobenzylidene) ruthenium(II) dichloride Nitro-Grela SiPr (928795-51-1)</td>
<td>100mg</td>
<td>See page 8</td>
</tr>
<tr>
<td>44-0782</td>
<td>[1,3-Bis(2,6-di-i-propylphenylimidazolidin-2-ylidene) (2-i-propoxy-5-nitrobenzylidene) ruthenium(II) diiodide nitro-Grela I2 SiPr (1874265-00-5)</td>
<td>100mg</td>
<td>See page 8</td>
</tr>
</tbody>
</table>
Metathesis Catalysts

KITS - Apeiron Polymerization Catalysts Kit

96-0430 Apeiron Polymerization Catalysts Kit

Sold in collaboration with Apeiron Synthesis, Inc. The catalysts included in our Polymerization Catalysts Kit were specifically designed for ROMP of strained monomers such as dicyclopentadiene or norbornene. The latency of these catalysts allows for controlled preparation of formulation and curing within various conditions.

Components also available for individual sale. Contains the following:

- **44-0753**
  - [1,3-Bis(2,4,6-trimethylphenylimidazolidin-2-ylidene)](tricyclohexylphosphine)-(2-oxobenzylidene)ruthenium(II) chloride LatMet (1407229-58-6) 100mg See page 14

- **44-0760**
  - Dichloro(1,3-bis(2,4,6-trimethylphenyl)imidazolidin-2-ylidene)[2-[(ethoxy-2-oxoethylidene)amino]benzylidene] ruthenium(II) HeatMet 100mg See page 15

- **44-0787**
  - [1,3-Bis(2,4,6-trimethylphenylimidazolidin-2-ylidene)](tricyclohexylphosphine)-(2-oxo-5-nitrobenzylidene) ruthenium(II) chloride Nitro-LatMet (1544328-53-1) 100mg See page 14

- **44-0792**
  - Dichloro(1,3-di-i-propylphenylimidazolidin-2-ylidene) [2-[(ethoxy-2-oxoethylidene)amino]benzylidene] ruthenium(II) HeatMet SIPr (2097273-88-4) 100mg See page 15

- **44-0793**
  - [1,3-Bis(2,6-di-i-propylphenyl)imidazolidin-2-ylidene](tricyclohexylphosphine)-(2-oxobenzylidene)ruthenium(II) chloride LatMet SIPr (1544328-59-7) 100mg See page 9
**KITS - Apeiron Ruthenium Metathesis Catalyst Kit**

96-0400  Apeiron Ruthenium Metathesis Catalyst Kit
Sold in collaboration with Apeiron Synthesis, Inc. This kit also includes a metal scavenger (07-2203). Components also available for individual sale. Contains the following:

- **07-2203**
  1,4-Bis(2-isocyanopropyl)piperazine (SnatchCat Metal Scavenger) (51641-96-4)
  1g
  Visit strem.com

- **44-0750**
  [1,3-Bis(2,6-di-i-propylphenyl)imidazolidin-2-ylidene] 
  [2-[[1-(methoxy(methyl)amino)-1-oxopropan-2-yl]oxy]benzylidene]ruthenium(II) dichloride GreenCat (1448663-06-6)
  100mg
  See page 7

- **44-0753**
  [1,3-Bis(2,4,6-trimethylphenylimidazolidin-2-ylidene)] 
  (tricyclohexylphosphine)-(2-oxobenzylidene)ruthenium(II) chloride LatMet (1407229-58-6)
  100mg
  See page 14

- **44-0758**
  [1,3-Bis(2,4,6-trimethylphenylimidazolidin-2-ylidene)]-(2-i-propoxy-5-nitrobenzylidene)ruthenium(II) dichloride nitro-Grela (502964-52-5)
  100mg
  See page 13

- **44-0759**
  [1,3-Bis(2,4,6-trimethylphenylimidazolidin-2-ylidene)]-(2-i-propoxybenzylidene)ruthenium(II) chloride HeatMet (1414707-08-6)
  100mg
  See page 11

- **44-0760**
  Dichloro(1,3-bis(2,4,6-trimethylphenylimidazolidin-2-ylidene) 
  [2-[(ethoxy-2-oxoethylidene)amino]benzylidene]ruthenium(II) chloride FixCat (1452227-72-3)
  100mg
  See page 6

- **44-0765**
  Dichloro(1,3-bis(2,4,6-trimethylphenylimidazolidin-2-ylidene) 
  [2-((trimethylammonio)methyl)imidazolidin-2-ylidene]-(2-i-propoxybenzylidene) 
  dichlororuthenium(II) chloride StickyCat Cl (1452227-72-3)
  100mg
  See page 14

- **44-0768**
  [1,3-Bis(2,4,6-trimethylphenyl)imidazolidin-2-ylidene]-4-[(4-ethyl-4-methylpiperazin-1-yl)methyl]imidazolidin-2-ylidene]-(2-i-propoxybenzylidene) 
  dichlororuthenium(II) chloride AquaMet (1448663-06-6)
  100mg
  See page 15
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