Kuraray Co., Ltd. is the world leader in the production and development of EVOH (ethylene vinyl alcohol copolymer) barrier plastic raw materials. It is available worldwide under the name EVAL™, either in pellet form for coextrusion and coinjection, or as film for lamination.

1mm (39.37 mil) of EVAL™ has the same gas barrier as a 10 meter (32.8 feet) thick wall of LDPE. With such performance, very thin layers of EVAL™ add valuable barrier function to efficient multilayer structures. This barrier function works in both directions, keeping harmful oxygen and contamination away from sensitive products, while locking aroma and value inside.

Multilayer structures provide functional protection with a minimum amount of material. Polyolefins provide cost-effective structure and humidity barrier. PA can provide toughness and assist forming. Tie layers provide structural integrity. EVAL™ provides the necessary gas and migration barrier function to the entire structure.
Making structures more efficient, attractive and safe

The key is to let each component of the structure do what it does best, in an appropriate layer thickness. Different materials combined effectively may actually decrease the total amount of packaging materials required.

EVAL™ provides the functional gas, aroma and grease barrier in food, medical, pharmaceutical and cosmetic packaging, and as a gas and solvent barrier in industrial, construction, agricultural and automotive fuel system applications. All-plastic structures with EVAL™ offer a safe, lightweight, transparent and unbreakable alternative to glass and metal. Thin layers of EVAL™ add reliable barrier to renewable materials like paperboard and PLA. At end of life, structures containing EVAL™ can be recycled, or provide safe energy recovery without toxic emissions or metal residue.

METAL CAN

PLASTIC CUP/LID

LIGHTWEIGHT
TRANSPARENT
MICROWAVEABLE

GLASS BOTTLE

EFFICIENT BAG-IN-BOX

UNBREAKABLE
TRANSPORT MORE GOODS
LESS PACKAGING

GLASS JAR

ALL-PLASTIC BARRIER BOTTLE

LIGHTWEIGHT
SQUEEZABLE
USE WITH METAL DETECTORS

STEEL FUEL TANK

PLASTIC FUEL SYSTEM

LIGHTWEIGHT
FREEDOM OF DESIGN
SAFETY IN USE
Reliable and safe protective function in packaging

High gas barrier properties
Extended freshness, less waste
Without an effective gas barrier, oxygen may penetrate packaging and spoil the contents. EVAL™ keeps oxygen out and safeguards quality, extending shelf life and avoiding waste. This cost-saving function is commonly added to food, medical, pharmaceutical, cosmetic, agricultural and industrial packaging applications.

Migration barrier
Improving food safety
EVAL™ provides excellent functional barrier against organic solvents, protecting food against the migration of contamination like MOSH/MOAH mineral oils that can compromise food safety. EVAL™ also resists permeation of hydrocarbons and grease, maintaining packaging appearance. In addition to protecting food, this property also protects the environment, locking chemical substances inside safe and convenient plastic packaging.

Aroma barrier, no flavor scalping
Assuring quality in new forms of distribution
While keeping oxygen and other gases out, EVAL™ also effectively blocks odors, protecting product integrity. EVAL™ locks volatile fragrance and ingredients inside packaging without absorbing them, and preserves aroma until it can be enjoyed by the consumer.

Transparency
A clear and reliable alternative to aluminum foil
All-plastic EVAL™ barrier layers have excellent flex crack and pinhole resistance, even when flexed, folded and shaken during processing and distribution. EVAL™ offers a reliable barrier alternative to Al foil, with the addition of excellent transparency and safe and low-impact energy recovery at end of life.

Process efficiency
Reduce costs and waste in production and distribution
Plastic barrier structures with EVAL™ can be designed for aseptic filling, reducing energy use during processing. Lightweight structures with EVAL™ allow transporting more goods instead of unnecessarily heavy packaging. Inexpensive but functional packaging design helps bring quality products to new markets.

Food contact compliance
EVAL™ has been approved for use in direct food contact, indirect or multilayer food contact and for retort applications as outlined under the Food and Drug Administration regulations in the USA. EVAL™ is in compliance with the EC Directive on plastic materials intended to come into contact with food. EVAL™ has passed the specification/standard test of Official Notice No 370 (1959) from Japan’s Ministry of Health and Welfare.
Properties that create value for industry

Hydrophilic, anti-static and glossy appearance

More than just a gas barrier layer

EVAL™ is a hydrophilic polar material with anti-static properties and a glossy appearance when used as an outside layer. In addition to packaging, its unusual mix of properties leads to use as a technical plastic for industrial, electronic and medical components.

Avoiding energy waste and reducing emissions

Extended service life

Special pipe grades maintain cost-saving performance for decades

EVAL™ adds barrier function to structures that were previously not possible with plastics. Barrier plastic pipes for under-floor heating are easy to install and help avoid corrosion, extending service life.

Energy efficiency

Extending the performance of insulation

EVAL™ can replace Al foil in vacuum insulation panels, maintaining the vacuum and efficiency and generating savings. A thin layer of EVAL™ can maintain the insulation properties of Polyurethane foam, used in preinsulated heating and cooling pipes.

Fuel vapor barrier

Safety and environmental protection

Lightweight barrier plastic tanks and lines improve the performance and safety of automotive fuel systems. EVOH is the only conventional plastic that meets strict international emission standards.

Solvent resistance

Safe protection against permeation of solvents and agricultural chemicals

EVAL™ shows excellent physical resistance to solvents, and barrier against their permeation into the environment. Because of its resistance to absorption and swelling, EVAL™ is typically used as the inner contact layer in UN-approved chemical bottles. A safe way to transport chemical concentrates.

Less waste, improved safety for Agriculture

EVAL™ provides the barrier function in TIF™ (Totally Impermeable Film) mulch films. Agricultural chemicals stay where they are needed, reducing emissions and improving safety for workers and nearby residents. Barrier silage and land silo films protect feed and produce until they can be used or shipped to market. UN regulation compliant plastic chemical bottles block emissions from chemical concentrates.
About EVAL™, a Kuraray technology

The EVAL™ copolymer combines the humidity resistance and easy processing of ethylene with the exceptional gas barrier and resistance to organic solvents of polyvinyl-alcohol. By adjusting the balance of the copolymer, Kuraray has created the world’s widest range of EVOH grades. Our global development teams help determine the grade best suited for an application’s required converting and secondary processing.

### Types of EVAL™

**EVAL™ M type**
has the lowest ethylene content available, and provides the highest barrier for automotive and flexible applications.

**EVAL™ L type**
has a very low ethylene content and is suitable as an ultra-high barrier in flexible, bottle and sheet applications.

**EVAL™ F type**
offers superior barrier performance with long-term process stability, and is widely used as the standard grade for flexible, automotive, bottle and tube applications. Specific versions exist for coating and pipe applications.

**EVAL™ C type**
can be used for high-speed coextrusion coating and cast flexible applications.

**EVAL™ H type**
combines high-barrier properties and long-term run stability and thermoformability. The higher ethylene content allows easier processing and longer running times on older coextrusion equipment, especially for blown flexible structures.

**EVAL™ E type**
has a higher ethylene content that allows for greater flexibility and even easier processing.

**EVAL™ G type**
has the highest ethylene content, making it the best candidate among standard EVAL™ types for stretch and shrink film applications.
EVAL™ resin grades

1. Standard grades

<table>
<thead>
<tr>
<th>Grade</th>
<th>Et.Cont. (mol%)</th>
<th>Density*1 (g/cm³)</th>
<th>MFR*2 (g/10min)</th>
<th>Tm (°C)</th>
<th>Tg*3 (°C)</th>
<th>OTR*4 (cm³.20µm/m².day.atm)</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>L171B</td>
<td>27</td>
<td>1.21</td>
<td>4.0*5</td>
<td>190</td>
<td>63</td>
<td>0.1</td>
<td>high-barrier</td>
</tr>
<tr>
<td>F101B</td>
<td>32</td>
<td>1.19</td>
<td>1.6</td>
<td>183</td>
<td>60</td>
<td>0.3</td>
<td>fuel tank, bottle</td>
</tr>
<tr>
<td>F171B</td>
<td>32</td>
<td>1.19</td>
<td>1.6</td>
<td>183</td>
<td>60</td>
<td>0.3</td>
<td>bottle, sheet, film, tube</td>
</tr>
<tr>
<td>H171B</td>
<td>38</td>
<td>1.17</td>
<td>1.7</td>
<td>172</td>
<td>56</td>
<td>0.7</td>
<td>bottle, sheet, film, tube</td>
</tr>
<tr>
<td>E171B</td>
<td>44</td>
<td>1.14</td>
<td>1.7</td>
<td>165</td>
<td>53</td>
<td>1.9</td>
<td>sheet, film, tube</td>
</tr>
</tbody>
</table>

*1 20°C  *2 190°C, 2,160g  *3 Dry  *4 20°Cx65%RH, ISO 14663-2 annex C  *5 210°C, 2,160g

2. Grades for specific processing conditions

<table>
<thead>
<tr>
<th>Grade</th>
<th>Et.Cont. (mol%)</th>
<th>Density*1 (g/cm³)</th>
<th>MFR*2 (g/10min)</th>
<th>Tm (°C)</th>
<th>Tg*3 (°C)</th>
<th>OTR*4 (cm³.20µm/m².day.atm)</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>F104B</td>
<td>32</td>
<td>1.19</td>
<td>4.4</td>
<td>183</td>
<td>60</td>
<td>0.3</td>
<td>high MFR F-type</td>
</tr>
<tr>
<td>C109B</td>
<td>35</td>
<td>1.18</td>
<td>8.5</td>
<td>177</td>
<td>53</td>
<td>0.5</td>
<td>extrusion coating</td>
</tr>
<tr>
<td>E105B</td>
<td>44</td>
<td>1.14</td>
<td>5.5</td>
<td>165</td>
<td>53</td>
<td>1.9</td>
<td>high MFR E-type</td>
</tr>
<tr>
<td>G176B</td>
<td>48</td>
<td>1.12</td>
<td>6.5</td>
<td>157</td>
<td>50</td>
<td>3.7</td>
<td>oriented shrink film</td>
</tr>
</tbody>
</table>

*1 20°C  *2 190°C, 2,160g  *3 Dry  *4 20°Cx65%RH, ISO 14663-2 annex C

3. Special grades

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Comparison to standard grades</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermoforming grade</td>
<td>Improved EVAL™ layer distribution during deep draw thermoforming</td>
<td>SP521B, J171B, J102B</td>
</tr>
<tr>
<td>High orientation grade film</td>
<td>Highly improved orientation property for shrink film</td>
<td>SP292B</td>
</tr>
<tr>
<td>Soft grade</td>
<td>Improved flex-crack resistance with similar barrier</td>
<td>FS201B</td>
</tr>
<tr>
<td>High impact strength grade</td>
<td>Improved impact strength</td>
<td>LA170B</td>
</tr>
<tr>
<td>Fuel tank grade</td>
<td>Ultra high barrier</td>
<td>M100B</td>
</tr>
<tr>
<td>Pipe grade</td>
<td>Provides extended service life at high temperature</td>
<td>FP101B, FP201B, EP171B</td>
</tr>
<tr>
<td>Retort grade</td>
<td>Retort flexible grade. Improved retort performance for thin transparent structures.</td>
<td>FR101B, LR171B</td>
</tr>
<tr>
<td>Extrusion coating grade</td>
<td>High barrier extrusion coating grade</td>
<td>LT174B</td>
</tr>
</tbody>
</table>

Please contact us for more information concerning Special grades.

4. Processing agents for EVAL™ resin

We also offer the following processing agents, useful for specific EVAL™ resin applications and processing methods

- Recycling agent
- Purging agent

Please contact us for more information.

EVAL™ film grades

<table>
<thead>
<tr>
<th>Grade</th>
<th>Type</th>
<th>Thickness (µm)</th>
<th>Ethylene Content (mol%)</th>
<th>Density (g/cm³)</th>
<th>OTR*1 (cm³/m².day.atm) 20°Cx65%RH ISO 14663-2</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>EF-XL</td>
<td>Biaxially oriented</td>
<td>12</td>
<td>32</td>
<td>1.20</td>
<td>0.4</td>
<td>high barrier</td>
</tr>
<tr>
<td>EF-F</td>
<td>Non-oriented</td>
<td>12</td>
<td>32</td>
<td>1.20</td>
<td>0.6</td>
<td>high barrier, deep draw</td>
</tr>
<tr>
<td>EF-E</td>
<td>Non-oriented</td>
<td>30</td>
<td>44</td>
<td>1.14</td>
<td>1.0</td>
<td>sealable, deep draw</td>
</tr>
<tr>
<td>VM-XL</td>
<td>Biaxially oriented, Aluminium metalized.</td>
<td>15</td>
<td>32</td>
<td>1.20</td>
<td>&lt;0.05</td>
<td>ultra-high barrier</td>
</tr>
<tr>
<td>MF-M</td>
<td>Non-oriented</td>
<td>12</td>
<td>-</td>
<td>1.10</td>
<td>-</td>
<td>matt for wallpaper use</td>
</tr>
</tbody>
</table>
**Gas barrier properties of EVAL™**

EVAL™ gas barrier performance is affected by humidity and temperature, but even in extreme conditions it offers exceptional barrier properties.

What is important is the equilibrium relative humidity of the EVAL™ layer itself. EVOH is a hydrophilic polymer. But as an EVAL™ layer loses any humidity it may have absorbed, the barrier performance improves.

EVAL™ gas barrier is higher than that of any conventional polymer. Barrier performance is directly related to layer thickness.

Compared to other plastics, EVAL™ can usually offer higher barrier performance even while reducing the amount of material used.

---

### EVAL™ LAYER THICKNESS AND OXYGEN TRANSMISSION RATE

![Graph showing OTR (cm³/m².day.atm) at 20°C, 65%RH](image)

Data measured by OX-TRAN

### TRANSMISSION RATES OF OTHER GASES AT 0% RH

<table>
<thead>
<tr>
<th>Film type</th>
<th>H₂ (20°C)</th>
<th>N₂ (25°C)</th>
<th>CO₂ (25°C)</th>
<th>He (25°C)</th>
<th>Ar (35°C)</th>
<th>Ar (50°C)</th>
<th>Kr (35°C)</th>
<th>Kr (50°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F101B</td>
<td>30*</td>
<td>0.17</td>
<td>0.81</td>
<td>160</td>
<td>-</td>
<td>0.5</td>
<td>-</td>
<td>0.4</td>
</tr>
<tr>
<td>E105B</td>
<td>200</td>
<td>0.13</td>
<td>7.1</td>
<td>410</td>
<td>1.6</td>
<td>7.0</td>
<td>-</td>
<td>1.8</td>
</tr>
<tr>
<td>OPA</td>
<td>-</td>
<td>12</td>
<td>205</td>
<td>2,000</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CPA</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>60</td>
<td>150</td>
<td>23</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>OPET</td>
<td>-</td>
<td>8</td>
<td>110</td>
<td>3,100</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>OPP</td>
<td>10,000</td>
<td>730</td>
<td>9,100</td>
<td>-</td>
<td>8,100</td>
<td>28,000</td>
<td>6,900</td>
<td>23,000</td>
</tr>
<tr>
<td>LDPE</td>
<td>-</td>
<td>3,100</td>
<td>42,000</td>
<td>28,000</td>
<td>19,000</td>
<td>46,000</td>
<td>25,000</td>
<td>74,000</td>
</tr>
</tbody>
</table>

Measuring conditions: 0%RH cm³.20µm/m².day.atm  "F171B"
**Resistance and barrier against solvents and other chemicals**

**RESISTANCE OF EVAL™ TO VARIOUS ORGANIC SOLVENTS**

<table>
<thead>
<tr>
<th>Solvent</th>
<th>SP value (cal/m³)</th>
<th>20°C, 1 month</th>
<th>Weight increase (wt%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SP = Solubility parameter</td>
<td>F101B</td>
<td>PA6</td>
</tr>
<tr>
<td>Xylene</td>
<td>8.8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ethylacetate</td>
<td>9.1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Benzene</td>
<td>9.2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Acetone</td>
<td>9.9</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Pyridine</td>
<td>10.7</td>
<td>0.5</td>
<td>0.3</td>
</tr>
<tr>
<td>Ethanol</td>
<td>12.7</td>
<td>1.5</td>
<td>5.2</td>
</tr>
<tr>
<td>Salad oil</td>
<td>-</td>
<td>0</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Measurement conditions: swelling method. SP value of EVAL™ F = 19.0; the SP value of PA6 = 12.7. For best results, the difference between the material and solvent SP values should be as large as possible.

**EVAL™ barrier against solvent permeation**

<table>
<thead>
<tr>
<th>Film type</th>
<th>Chloroform</th>
<th>Xylene</th>
<th>Methyl ethyl ketone</th>
<th>Kerosene</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVAL F</td>
<td>0.20</td>
<td>&lt;0.04</td>
<td>0.09</td>
<td>&lt;0.04</td>
</tr>
<tr>
<td>EVAL E</td>
<td>0.21</td>
<td>&lt;0.06</td>
<td>0.13</td>
<td>&lt;0.06</td>
</tr>
<tr>
<td>OPA</td>
<td>16.9</td>
<td>1.19</td>
<td>3.38</td>
<td>0.48</td>
</tr>
<tr>
<td>OPP</td>
<td>3740</td>
<td>350</td>
<td>12</td>
<td>53</td>
</tr>
<tr>
<td>LDPE</td>
<td>6900</td>
<td>813</td>
<td>185</td>
<td>190</td>
</tr>
</tbody>
</table>

Unit: g • 20µm/m² • day • atm

**EVAL™ resists flavor absorption**

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Flavours</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flavor absorption (liquid)</td>
<td>ppm</td>
<td>d-Limonene</td>
<td>EF-E</td>
</tr>
<tr>
<td></td>
<td></td>
<td>n-Butyl acetate</td>
<td>LDPE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ethyl acetate</td>
<td>CPP</td>
</tr>
<tr>
<td>Flavor absorption (gas)</td>
<td>mg/g</td>
<td>1-Methol</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Salicylic acid methyl</td>
<td>1.7</td>
</tr>
</tbody>
</table>

Based on the application and typical conditions of use, it is possible to optimize barrier performance. The equilibrium relative humidity of the EVAL™ layer can be lowered by shifting its location or by carefully choosing the other materials in the structure.

**Adjusting structure design for optimal performance**
Applications in Food Packaging

Flexible (blown, cast, lamination)

**Extended freshness and protected value**

- Fresh meat shrink wrap
  PA/EVAL™/PA/tie/PE

- Sliced ham
  PET/tie/EVAL™/PA/tie/EVA

- MAP with long-lasting gas mix
  PET/PE/tie/EVAL™/tie/EVA

**Al foil-free for safety and reduced environmental impact**

- Ultra efficient bag-in-box liner
  PE/tie/EVAL™/tie/EVA

- Al foil-free aroma barrier
  PET/PE/tie/EVAL™/tie/PE

- Transparent barrier lid film
  PA/EVAL™ film/PP

- Affordable UHT milk pouch
  PE/tie/EVAL™/tie/PE

- Affordable soup powder sachet
  Paper/PE/tie/EVAL™/tie/PE

- Transparent packs for sensitive foods
  OPP/EVAL™ film/PE
Rigid (tray, cup, bottle, tube)

Thermoforming to replace metal cans and trays

Baby food
PP/tie/EVAL™/tie/PP
outside inside

Pet food tray
PP/tie/EVAL™/tie/PP
outside inside

Deep draw beverage “can”
PS/tie/EVAL™/tie/PS
outside inside

Improving safety, shelf life without conservatives

Metal replacement, no sharp edges
PE/tie/EVAL™/tie/regrind/PE
outside inside

Shelf-stable dairy
PE/tie/EVAL™/tie/PE
outside inside

Freshness without conservatives
PE or PP/tie/EVAL™/tie/PE or PP
outside inside

High quality packaging, protecting valuable ingredients

Seamless coextruded tube
PE/tie/EVAL™/tie/PE
outside inside

Glossy, printable exterior layer
EVAL™/tie/PP
outside inside

Barrier guaranteed vitamin content
PE/tie/EVAL™/tie/PE
outside inside
Coating (paperboard, paper)

Adding barrier function to renewable materials

Aroma barrier paper sachet
Paper/PE/tie/EVAL™/tie/PE
outside inside

Migration barrier paper liner
Paper/PE/tie/EVAL™/tie/PE
outside inside

Al-free carton for liquids
PE/paper/PE/tie/EVAL™/tie/PE
outside inside

New technologies that boost packaging shelf appeal

Coinjected barrier can
PP/EVAL™/PP/EVAL™/PP
outside inside

Barrier in-mold label cup
PE/tie/EVAL™/tie/PE/PE
outside inside

Ultralight tomato sauce pouch
PET//PE/tie/EVAL™/tie/PE
outside inside

Applications in Medical and Pharmaceutical

Ensuring product integrity and protection from contamination

Sealable medicine sachet
PET//AL//EVAL™ film
outside inside

Nutrition provided intact
PE/tie/EVAL™/tie/PE
outside inside

Visibility and protection
PET//PE/tie/EVAL™/tie/PE
outside inside
Applications in Building and Construction and Fuel containment

Extended energy efficiency and service life

- Underfloor heating pipe
  EVAL™/tie/PEX
  outside inside

- VOC barrier construction membranes
  PE/PE/tie/EVAL™/tie/PE/PE
  outside inside

- Preinsulated pipe
  PE/tie/EVAL™/PUR foam/EVAL™/tie/PEX
  outside inside

- Vacuum insulation panels
  Film/Film/EVAL™ film/sealant
  outside inside

- Durable and stain-resistant wallpaper
  EVAL™ film/PVC/paper
  outside inside

- Fuel tanks, lines and filler pipes
  PE/tie/EVAL™/tie/PE
  outside inside

Applications in Agriculture

Fewer chemical emissions, less waste of farm produce

- TIF much films
  PE/PE/tie/EVAL™/tie/PE/PE
  outside inside

- Chemical and solvent resistant bottles
  PE/tie/EVAL™
  outside inside

- Barrier IBC
  PE/tie/EVAL™/tie/PE
  outside inside
Open innovation

Application development with the world’s barrier experts

Kuraray is a world leader in specialty chemicals and functional materials. We are committed to developing products that ensure quality and value while helping our business partners differentiate themselves from their competition.

Kuraray Co. Ltd. was the first company in the world to produce and commercialize EVOH, starting in Okayama, Japan in 1972. Today Kuraray is the world’s largest producer of Vinyl Acetate Monomer derivatives, and is still the leader in EVOH technology, production, structure analysis and technical development.

EVAL™ production began in Houston, USA in 1986, and in Antwerp, Belgium in 1999. Technical centers were established in Kurashiki, Japan, at the Houston and Antwerp production sites, and in Singapore. At each site we work together with converters and end users, bringing our expertise in barrier technology and structure optimization.

To learn more about our open innovation development, visit our global website www.evalevoh.com
Antwerp 24,000T*

Nizhny Novgorod

Houston 47,000T**

New Delhi

Shanghai

Bangkok

Tokyo

Kurashiki

Okayama 10,000T

SINGAPORE

KURASHIKI, JAPAN

* Production capacity increased to 35,000T in early 2017
** Production capacity increased to 58,000T in mid 2018
NOTICE

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