GROUND IMPROVEMENT EQUIPMENT
For stone columns and vibro compaction
PTC masters vibration technology since more than 90 years. This know-how has been applied to the field of ground improvement, to develop a complete range of Vibrolance solutions for Vibro compaction and stone columns.
WORLD LEADING COMPANY

PTC is a company specialised in the design and manufacturing of piling and ground improvement equipment.

Our agent network, which is present in more than 40 countries, is supported from our head office in France, and our two subsidiaries in Singapore, Middle East.

This large international presence allows us to guarantee sales and technical support worldwide.

SUPPORT FROM THE PROJECT TO THE JOBSITE

Our sales, engineering and service teams, work in cooperation with our clients throughout all the project phases:

- Geo-technical and engineering advise
- Equipment selection
- Customisation requirements
- Equipment commissioning
- On-site training
- Maintenance and after sales service
- Spare parts availability
OVERVIEW

Ground improvement techniques with Vibrolance.

When land is reclaimed from the seabed or the in-situ soil does not fulfil the requirements of bearing capacity, lateral stability and liquefaction potential, ground improvement techniques with Vibrolance offer a qualitative and economical solution.

Soil treatment with Vibrolance is adapted for a wide variety of ground conditions and can be carried out to almost any depth. The execution is fast and enables large volumes of soil to be improved, allowing subsequent structural works to follow quickly.

Another advantage is the environmental friendliness, the soil is treated with natural materials, such as in-situ soil, stones or gravel, rather than with cement, bentonite or steel, used in other deep foundations.

The choice of the best-adapted technique will be determined mainly by the type of soil and the soil’s water saturation and bearing capacity requirements.

The following graph illustrates the limits of application of the two main Vibrolance techniques: Vibro compaction and stone columns.
VIBRO COMPACTION

This technique is used in granular soils. The Vibrolance® produces vibrations to rearrange the soil particles of non-cohesive soils into a denser state.

The action of the Vibrolance, usually accompanied by water jetting, reduces the inter-granular forces between the soil particles allowing them to move into a more compact configuration.

STONE COLUMNS

This technique is mostly used for cohesive saturated soils. In some cases this technique can also be used for non cohesive soils. It consists in installing and compacting in the ground load bearing columns made of gravel or crushed stone, following a grid pattern previously determined by a test trial.

TOP FEED METHOD

The column is build with stones that are added from the ground surface into the hole created by the Vibrolance. To do this, the Vibrolance must be withdrawn from the ground several times to allow the addition of the stones and re-inserted to assure the compaction.

BOTTOM FEED METHOD

The column is done with compacted stones that are fed from the bottom of the column (at desired depth), thanks to a stone feeding tube at the tip of the Vibrolance.
The Vibrolance® is a cylindrical hydraulic vibratory system, composed of a vibrator, an isolator and various extension tubes. The vibrator contains an eccentric that continuously oscillates, generating radial vibrations. These vibrations are used to penetrate the ground and then to treat the soil, according to the chosen ground improvement technique (vibro compaction or stone columns). 5 meter extension tubes allow the Vibrolance® to adjust to almost any treatment depth. Vibrolances can be equipped with a Bottom Feed System (BFS), for stone column applications. In this case, a stone tube and a stone tank with a stone gate, will be added to the Vibrolance®.

**EASY ON-SITE MAINTENANCE DESIGN**

PTC Vibrolances have a patented design that allows easy access for fast on-site maintenance. It consists in dismountable modules which are easy to take apart and reassemble, thus providing quick access to all internal parts of the vibrator (bearings, hydraulic motor, eccentrics and more)
THE WORKING PRINCIPLE

The eccentric in the vibrator generates radial vibrations. This vibrations, the pull down force (if it is mounted on a carrier) and the Vibrolance weight are used to penetrate the ground to the required treatment depth. The penetration can be assisted by water or air jetting at the tip of the Vibrolance.

During the extraction phase, the Vibrations of the Vibrolance are used to carry out the soil treatment, by agitating the soil particles and forcing then to rearrange in a denser state of compaction (vibro compaction), and/or by compacting a pile of stones installed in the ground (stone column).

Then to rearrange in a denser state of compaction (vibro compaction).
And/or by compacting a pile of stones installed in the ground (stone column).

Power source
When Vibrolances are used free hanging on a crane they are powered by a PTC Power Pack. When Vibrolances are mounted on rigs or excavators they can use the power source of the machine they are mounted on.
VIBRO COMPACTION
For land reclamation and sand compaction

The Vibro compaction technique is used in granular soils with limited fines content. This technique uses the Vibrolance® sustained vibrations to rearrange the soil particles of non-cohesive soils into a denser state. The action of the vibrator reduces the inter-granular forces between the soil particles, allowing them to move into a more compact configuration.

1. Penetration

The PTC Vibrolance penetrates the ground thanks to the combined effect of the vibrations emitted by the vibrator and the Vibrolance own weight.

The penetration is usually assisted by a water jetting system at the tip of the Vibrolance. The water reduces the interstitial pressure between the soil particles, thus reducing the friction with the soil.

2. Compaction

Once at depth the Vibrolance performs a series of compaction intervals, starting from maximum depth of penetration upwards. During compaction, the vibrolance sustained vibrations agitate the particles and force the soil to rearrange to a denser state of compaction. The compacted soil forms a cylinder around the vibrolance.

Side water jetting may be used to facilitate the extraction of the Vibrolance when the penetration depth surpasses 20m.

3. Backfilling

The densification of the soil lowers the surface level and forms a crater at the top of the Vibrolance insertion point. This gap is backfilled during the compaction process, either with imported or in-situ material, which is added to the Vibrolance insertion point.

The compaction and backfilling process are repeated until the Vibrolance reaches the surface and is completely extracted from the ground.
4. Finishing

When the Vibrolance reaches the surface, the compacted ground has a cylindrical shape from the bottom to the top of the Vibrolance insertion point.

The Vibrolance will be re-inserted in the ground at the next spot of the compaction grid, until the treated soil reaches the degree of compaction required.

The compaction of the soil causes a decrease of the volume of up to 10%.

OFFSHORE

The Vibro compaction can be used to compact the seabed, thanks to the extension tubes that can be adapted to the PTC Vibrolances to work under water for almost any treatment depth. Particularly interesting for reclaimed lands.
PTC Vibrolance models can be adapted to the required treatment depth through the addition of 5 m extension tubes. Different mounting attachments are proposed for better adaption to the contractor’s job site equipment.

### AVAILABLE VERSION

<table>
<thead>
<tr>
<th>MODEL</th>
<th>CRANE SUSPENDED VL-F</th>
<th>EXCAVATOR MOUNTED VL-E</th>
<th>RIG MOUNTED VL-R</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIBROLANCE VL18</td>
<td>VL40</td>
<td>VL110</td>
<td></td>
</tr>
<tr>
<td>ECCENTRIC MOMENT</td>
<td>1.8</td>
<td>4.0</td>
<td>11.2</td>
</tr>
<tr>
<td>VIBROLANCE POWER</td>
<td>113 / 154</td>
<td>135 / 183</td>
<td>202 / 274</td>
</tr>
<tr>
<td>FREQUENCY Hz/rpm</td>
<td>50 / 3000</td>
<td>30 / 1800</td>
<td>28 / 1680</td>
</tr>
<tr>
<td>CENTRIFUGAL FORCE</td>
<td>181</td>
<td>145</td>
<td>353</td>
</tr>
<tr>
<td>WATER JETTING SYSTEM</td>
<td>Option</td>
<td>Option</td>
<td>Option</td>
</tr>
<tr>
<td>AIR JETTING SYSTEM</td>
<td>Option</td>
<td>Option</td>
<td>Option</td>
</tr>
<tr>
<td>RECOMMENDED POWER PACK</td>
<td>240</td>
<td>240</td>
<td>400</td>
</tr>
</tbody>
</table>

PTC reserves the right to modify the technical data without notice.
APPLICATIONS

- Land reclamation: Treatment of soil reclaimed from the sea or lake, by dredging.
- Reduction of the liquefaction risk in seismic zones.
- Sand compaction: In-situ densification of loose sands.
- Offshore Vibro-compaction.

Two Vibrolances working in the compaction of 17 million m³ reclamation sand at an underwater depth of 15 to 20 m. The soil improvement treatment is required for building a new 6 km long quay, Singapore.

Vibrolance VL110 working at 31 m depth to compact 2,000,000 m³ of land reclamation for the extension of the LAMME power station, Hong Kong.

VL18 Vibrolance in a deep compaction works of a 7 m depth for a river bank stabilization in Canada.

7 sets of Vibrolances VL110 working at 12 m to 15 m compaction depth for a 500 acres sea bed land reclamation project, needed for the Pengerang Independent Deepwater Petroleum Terminal, Malaysia.
STONE COLUMNS

Top feed method.

The top feed stone columns are a vibro replacement technique recommended for cohesive saturated soils. This technique consists in building and compacting in the ground columns made from coarse gravel, crushed stone or crushed aggregate, following a grid pattern previously determined by a test trial. In the top feed method, the column is made with stones that are added from the ground surface into the hole created by the Vibrolance®.

1. Penetration
The PTC Vibrolance penetrates the ground to form the hole that will contain the stone column. The Vibrolance penetration force is the result of the combined effect of the vibrations emitted by the Vibrator and the Vibrolance own weight.

The penetration can be assisted by air or water jetting at the tip of the Vibrolance.

2. Stone feeding
When the required depth is reached, the Vibrolance is withdrawn to surface level. Stones (coarse gravel, crushed stone or crushed aggregate) are placed into the hole from the ground surface with an excavator.

3. Compaction
The Vibrolance is reinserted in the hole to perform the compaction of the stores.

The vibrations of the Vibrolance compact the stones, by forcing out the stones and interlocking them with the in-situ soil. When the required degree of compaction has been reached, the Vibrolance is withdrawn again to the surface level.
Top Feed stone columns can be installed under water. For this application the most commonly used method is to install a blanket of gravel on the seabed. Afterwards, the Vibrolance® penetrates the water, the gravel blanket and finally the seabed at desired depth. The gravel on the seabed is pushed down to the hole created by the Vibrolance, and forms a stone column.
STONE COLUMNS
Top feed method.

EQUIPMENT: VIBROLANCE VL18 - VL40 - VL40S

PTC Vibrolance models can be used on vibro compaction as much as stones columns. The system 2 in 1 offers to its customer the most economical and adapted products on both solutions.

<table>
<thead>
<tr>
<th>VIBROLANCE®</th>
<th>VL18</th>
<th>VL40</th>
<th>VL40S</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECCENTRIC MOMENT</td>
<td>m.kg</td>
<td>1.8</td>
<td>4.0</td>
</tr>
<tr>
<td>VIBROLANCE POWER</td>
<td>kW/HP</td>
<td>113 / 154</td>
<td>135 / 183</td>
</tr>
<tr>
<td>FREQUENCY</td>
<td>Hz/rpm</td>
<td>50 / 3000</td>
<td>30 / 1800</td>
</tr>
<tr>
<td>CENTRIFUGAL FORCE</td>
<td>kN</td>
<td>181</td>
<td>145</td>
</tr>
<tr>
<td>WATER JETTING SYSTEM</td>
<td>Option</td>
<td>Option</td>
<td>Option</td>
</tr>
<tr>
<td>AIR JETTING SYSTEM</td>
<td>Option</td>
<td>Option</td>
<td>Option</td>
</tr>
<tr>
<td>RECOMMENDED POWER PACK</td>
<td>MODEL</td>
<td>240</td>
<td>240</td>
</tr>
</tbody>
</table>

PTC reserves the right to modify the technical data without notice.
APPLICATIONS

- Increase of soil bearing capacity.
- Improve the settlement characteristics of the ground.
- Speed up of vertical drainage.
- Stability of embankments.
- Reduction of the soil liquefaction risk in seismic areas.
- Offshore top-feed stone columns.

Two Vibrolances doing top feed stone columns under water at 17 m depth for the Malabo Harbor, Equatorial Guinea.

900 stone columns realized with a VL18 Vibrolance for the foundation of a new school in Sharjah, UAE. Those column was installed with a triangular grid of 2.5m, 4m deep within 3 weeks.

Two Vibrolances VL40S sets for the construction of a new hospital in Quebec, Canada. The project consists of working on the soil treatment by installing 12,000 linear meters of stone columns. Each Vibrolance had a productivity of 150 linear meters a day.

2030 stone columns of 8 m depth have been built by two Vibrolances VL18 for the ground treatment of an industrial area, India.
STONE COLUMNS

Bottom feed method.

The stone columns are a vibro replacement technique recommended for granular soils with high fines content, soft cohesive saturated soils and mixed fills. This technique consists in building and compacting in the ground load bearing columns made from gravel or crushed stone.

The Bottom feed method, is used to produce high quality stone columns due to the fact that the stones are fed directly at the bottom of the hole created by the Vibrolance®, up to the surface. This is possible thanks to a stone feeding tube at the tip of the Vibrolance. The pull-down force of the carrier, the mast verticality and the monitoring system, offer additional advantages to make this method the most reliable and productive for stone columns in small and large projects.

1. Preparation

The hopper at the top of the Vibrolance is filled with stones. The Vibrolance penetrates into the soil.

2. Penetration

When the required depth of treatment is attained, the stones are poured into the space created by the Vibrolance.

3. Stone feeding

The Vibrolance rises up a few centimeters, adds stones and then drops down to compact them.
4. Compaction

The Vibrolance performs several compaction cycles until it reaches ground level.

**OFFSHORE**

Stone columns using the bottom feed method can also be built in the seabed. A free hanging Vibrolance® (BFS) equipped with a stone tube and a stone tank is required.
STONE COLUMNS
Bottom feed method.

EQUIPMENT: VIBROLANCE BFS18 - F/E/R - BFS40 - F/E/R

PTC Vibrolance models with Bottom Feed system offer a variety of working possibilities (Rig, Crane, Excavator) for the production of stone columns.

F : Free Hanging
E : Excavator Mounted
R : Rig Mounted

<table>
<thead>
<tr>
<th>VIBROLANCE*</th>
<th>BFS18 (E/R)</th>
<th>BFS40 (E/R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOIL TREATMENT DEPTH (in standard configuration)</td>
<td>m</td>
<td>6</td>
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<tr>
<td>MAX. SOIL TREATMENT DEPTH (with extensions)</td>
<td>m</td>
<td>17.5</td>
</tr>
<tr>
<td>STONE COLUMN DIAMETER</td>
<td>mm</td>
<td>450 - 800</td>
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<tr>
<td>HYDRAULIC POWER</td>
<td>kW/HP</td>
<td>113 / 154</td>
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<tr>
<td>HYDRAULIC FLOW</td>
<td>l/min</td>
<td>190</td>
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<tr>
<td>OPERATIONAL FREQUENCY</td>
<td>Hz/rpm</td>
<td>50 / 3000</td>
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<tr>
<td>CENTRIFUGAL FORCE</td>
<td>kN</td>
<td>181</td>
</tr>
<tr>
<td>ECCENTRIC MOMENT</td>
<td>m.kg</td>
<td>1.8</td>
</tr>
</tbody>
</table>

RECOMMENDED POWER PACK
| MODEL | 240 | 400 |

*Adaptation required, depending on the type of rig. Please consult PTC.
APPLICATIONS

• Increase of soil bearing capacity.
• Decrease in soil settlement under load.
• Speed up of vertical drainage.
• Stability of embankments.
• Reduction of the soil liquefaction risk in seismic areas.
• Offshore Bottom-feed stone columns.

CONTINUOUS PRODUCTION: HIGH PRODUCTIVITY

Easy loading of the skip:
The very low height of the skip permits to easily charge the stones with broadly available loaders.
No interruptions for stone feeding, thanks to the high capacity of the skip and the stone tank.

QUALITY OF THE STONE COLUMN

The use of the Vibcorder® monitoring and recording system, allows to monitor in real time: the length, diameter, and verticality of the stone column. These parameters can be registered for analysis and to guarantee to the client the quality of the ground improvement job.
**COMPLEMENTARY EQUIPMENT**

**POWER PACKS**

Power pack models complying to the most recent environmental regulations and emission standards. These power packs are equipped with Ecomode, which is an electronic module that reduces fuel consumption, polluting emissions and noise. This module automatically adapts the speed of the diesel engine to only supply the power that is needed according to the soil conditions.

<table>
<thead>
<tr>
<th>POWER PACKS</th>
<th>240VO</th>
<th>400CO</th>
<th>400VO</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPEN LOOP CIRCUIT</td>
<td>OPEN LOOP</td>
<td>OPEN LOOP</td>
<td>OPEN LOOP</td>
</tr>
<tr>
<td>ENGINE MODEL (STAGE V)</td>
<td>VOLVO TAD 562 VE</td>
<td>-</td>
<td>VOLVO TAD 862 VE</td>
</tr>
<tr>
<td>ENGINE MODEL (STAGE IV)</td>
<td>VOLVO TAD 572 VE</td>
<td>-</td>
<td>VOLVO TAD 873 VE</td>
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<tr>
<td>ENGINE MODEL (STAGE IIIA)</td>
<td>VOLVO TAD 552 VE</td>
<td>CAT C9</td>
<td>VOLVO TAD 853 VE</td>
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<tr>
<td>ENGINE MODEL (STAGE II)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>ENGINE POWER kW/HP</td>
<td>160 / 217</td>
<td>242 / 329</td>
<td>235 / 319</td>
</tr>
<tr>
<td>ROTATION SPEED rpm</td>
<td>2200</td>
<td>2200</td>
<td>2200</td>
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<tr>
<td>MAX. OIL FLOW L/min</td>
<td>280</td>
<td>500</td>
<td>500</td>
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<tr>
<td>NOMINAL OIL FLOW L/min</td>
<td>240</td>
<td>380</td>
<td>380</td>
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<tr>
<td>MAX. PRESSURE bar</td>
<td>350</td>
<td>350</td>
<td>350</td>
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<tr>
<td>HYDRAULIC OIL CAPACITY L</td>
<td>710</td>
<td>700</td>
<td>710</td>
</tr>
<tr>
<td>FUEL CAPACITY L</td>
<td>595</td>
<td>650</td>
<td>595</td>
</tr>
<tr>
<td>LENGTH m</td>
<td>3.50</td>
<td>3.85</td>
<td>3.50</td>
</tr>
<tr>
<td>WIDTH m</td>
<td>1.60</td>
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<td>1.60</td>
</tr>
<tr>
<td>HEIGHT m</td>
<td>2.15</td>
<td>2.02</td>
<td>2.15</td>
</tr>
<tr>
<td>WEIGHT (with fuel) kg</td>
<td>3975</td>
<td>5585</td>
<td>5100</td>
</tr>
<tr>
<td>ECOMODE®</td>
<td>ECOMODE</td>
<td>ECOMODE</td>
<td>ECOMODE</td>
</tr>
<tr>
<td>QUICK COUPLINGS</td>
<td>STANDARD</td>
<td>STANDARD</td>
<td>STANDARD</td>
</tr>
<tr>
<td>CONNECTING HOSES m</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>CONNECTING HOSES kg</td>
<td>220</td>
<td>350</td>
<td>350</td>
</tr>
</tbody>
</table>

PTC reserves the right to modify the technical data without notice.
OPTIONAL EQUIPMENT: AIR & WATER JETTING

Air or water jetting are frequently used to assist the Vibrolance penetration in the ground. Their use will depend on the treatment depth and the type of ground improvement technique being applied. When the soil treatment is done at important depths (generally more than 20 m), side water jetting is recommended to assist the extraction of the Vibrolance. Please consult PTC for advise on the type of jetting system that is best adapted to your application.

<table>
<thead>
<tr>
<th>Air compressor</th>
<th>Water jetting pumps</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Air compressor" /></td>
<td><img src="image" alt="Water jetting pumps" /></td>
</tr>
</tbody>
</table>

### Air Compressor

<table>
<thead>
<tr>
<th>Model</th>
<th>Kaeser M114</th>
<th>Kaeser M122</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine Model</td>
<td>Deutz</td>
<td>Deutz</td>
</tr>
<tr>
<td>Max. Working Pressure</td>
<td>Bar 10</td>
<td>Bar 10</td>
</tr>
<tr>
<td>Air Flow</td>
<td>m³/min 9.7</td>
<td>m³/min 9.5</td>
</tr>
</tbody>
</table>

### Water Jetting Pumps

<table>
<thead>
<tr>
<th>Pump Model</th>
<th>WJ70</th>
<th>WJ150</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational Water Flow/Pressure</td>
<td>m³/h</td>
<td>70 (at 15.5 bar)</td>
</tr>
<tr>
<td>Maximum Water Pressure</td>
<td>Bar</td>
<td>16</td>
</tr>
</tbody>
</table>

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VIBCORDER®
Monitoring system.

The Vibcorder® is the monitoring system recommended for all PTC Vibrolances and stone column rigs. It monitors in real time a variety of working parameters allowing to be sure to comply with the job site requirements.

The Vibcorder® displays in real time the following measurements:

• Soil compaction, through the reading of the Vibrolance pressure.
• Depth of the Vibrolance (in meters).

Optional Vibcorder® parameters:

• Stone consumption (cubic meters) and stone column profile (diameter of the stone column depending of the depth).
• Verticality of the Vibrolance (through the use of the inclinometer).
• Position of the Vibrolance (with the use of a GPS system). This parameter is especially useful for offshore projects where following a precise grid is needed.

In addition, you can get a copy of the data on a USB key or store the data on your computer, to analyse the work data and prepare better for the next jobsite or to show it to a certification body.

Data can be also transmitted directly by mobile network (additional subscription required with your mobile operator) and be analysed instantly at your headquarter.

DEPTH
It can be obtained through the use of one of the following sensors:

VERTICALITY
Measured with an inclinometer.

GPS POSITIONING
Position of the Vibrolance.

STONE COLUMN DIAMETER
Stone consumption sensor measures gravel consumption and gives the stone column profile.
YOU ARE THE CONTRACTOR

PTC ground improvement equipment opens a window of new market opportunities for contractors.

MORE AUTONOMY AND CONTROL

• You do the job, it is your equipment.
• You control every aspect of the jobsite.
• No hidden costs.
• No more outsourcing.

SIMPLE AND COST-EFFECTIVE

• The simplicity of the vibrolance modular design and assembly, results in great reliability and ease of on-site maintenance.
• Easy to operate: With a short training your personnel can operate it.
• Low equipment investment: You can use the Vibrolances with your regular crane or rig.

Our technical support and wide variety of ground improvement equipment gives you the opportunity to carry out high quality vibro compaction and stone column jobs. We provide the solution... you are in charge of the job.
WORLDWIDE NETWORK IN OVER 40 COUNTRIES

www.ptc.fayat.com

PTC Headquarter
56 rue de Neuilly
93136 Noisy-le-Sec Cedex France
Tel: +33 1 49 42 72 95
Mail: contact@ptc.fayat.com

PTC MIDDLE EAST
JAFZA south FZS1 AH03
P.O. Box 262637, Jebel Ali-Dubai - UA
Tel: +971 4-8863233
Mob: +971 50 340 2451
Mail: s.espin@ptc.fayat.com

PTC FAR EAST
3 Tuas Avenue 16
638926 - Singapore
Tel: +65 6861 7977
Tel: +65 6861 6338
Mail: ptcfe@ptcfareast.com

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