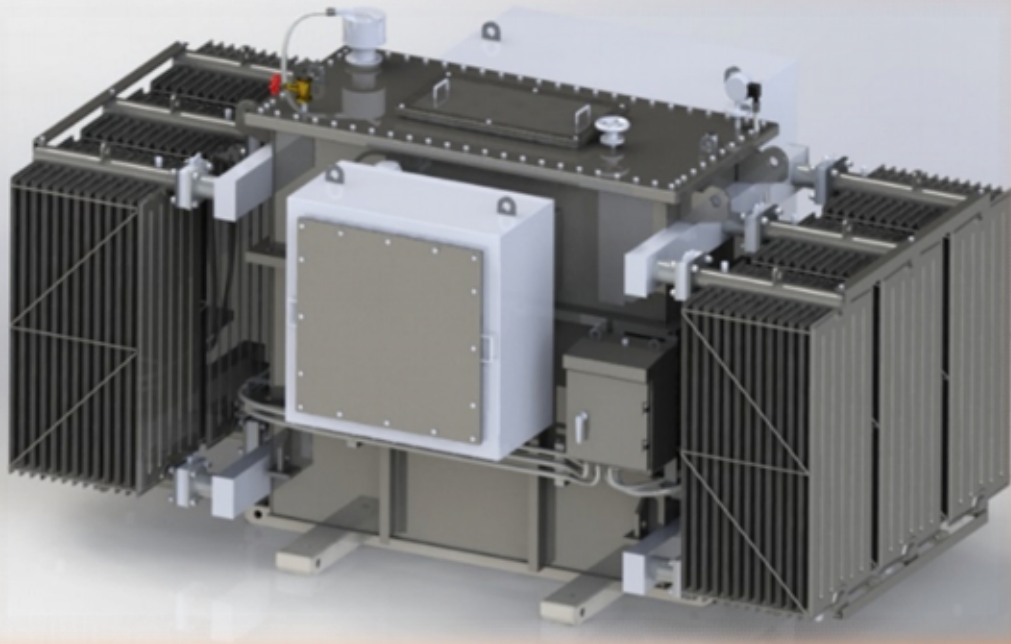




# **EKARAT ENGINEERING PUBLIC COMPANY LIMITED**

**Operating & Maintenance Manual**

**for Oil-immersed Transformer (FR3 fluid)**





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# 1. Introduction

## **General**

“Ekarat” is the name in Thailand industry that everyone knows its reliability. We hold strong the policy of making the best quality Transformers. “Ekarat Transformers” did not produce just to transform electricity for your business, but they must withstand all conditions. We had passed the “Short Circuit” test form International Laboratories.

## **Scope of Manual**

The objective of this Manual is made for Oil-immersed Transformer



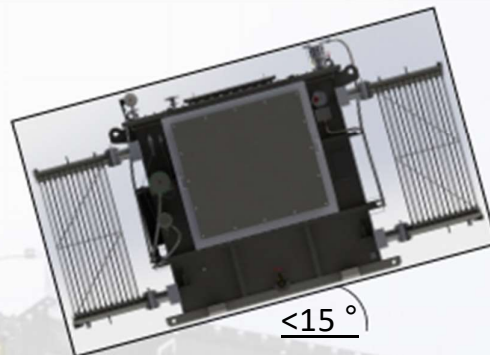
### **Caution!**

- Please read this instruction manual carefully before attempting to handle , install , use or make services to the transformers
- Please lifting, handling, jacking followed this instruction manual

## 2. Handling and Installation

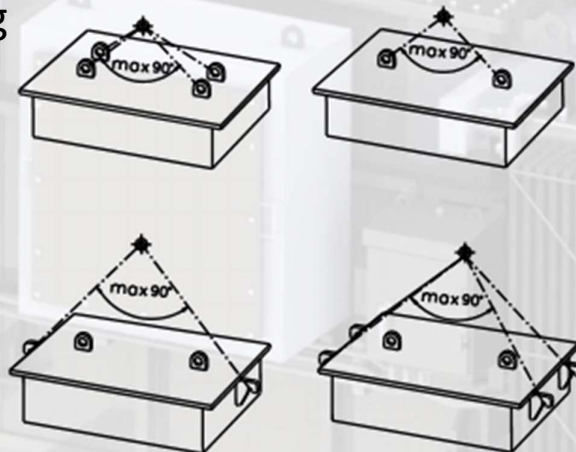
### 2.1 Handling

#### 2.1.1 Tilting



The transformer must not be tilted for more than 15 degree.

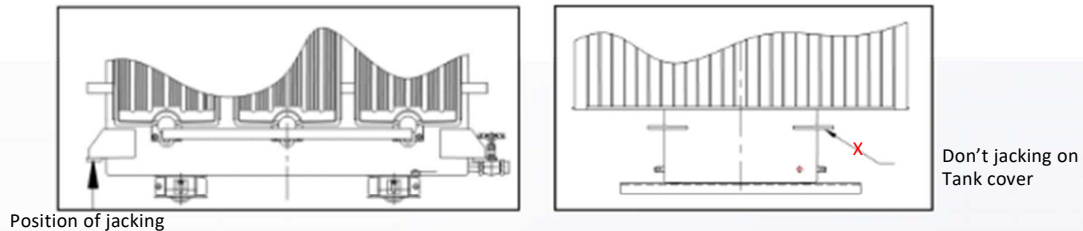
#### 2.1.2 Lifting



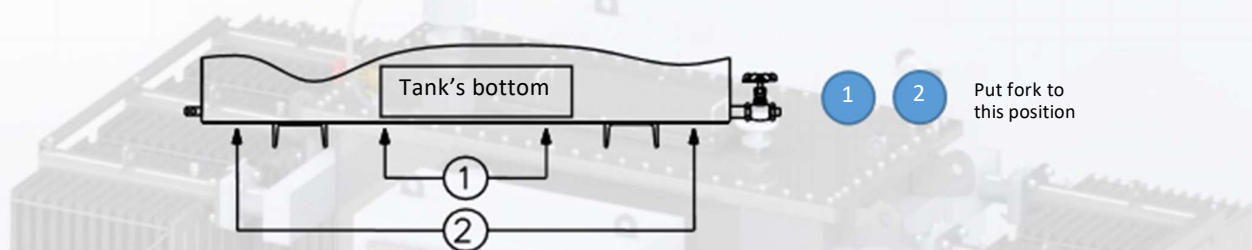
#### Sling Load Angle Efficiency

Horizontal Lift Angle	Efficiency Rating	Loss of Rating
90°	100%	0%
80°	98%	2%
70°	94%	6%
60°	86%	14%
50°	76%	24%
45°	70%	30%
40°	64%	36%
35°	50%	50%

### 2.1.3 Jacking



### 2.1.4 Forklift



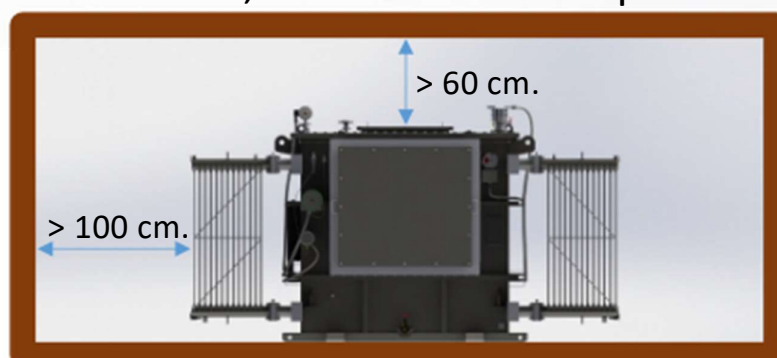
## 2.2 Installation location

2.2.1 Transformers should be located at the appropriate location, comfortably move, inspect and maintain on outdoor yard/pole mounted and indoor room.

2.2.2 Provide a good ventilation area to ensure that is sufficient when operating.

2.2.3 Installation on the floor or platform must be even and strong enough for each transformers.

2.2.4 Indoor installation, these should be space at least 100 cm with wall, 60 cm with ceiling. Also at least 30 cm with inflammable material, clearance shall be provided.





## 2.3 Installation

2.3.1 Check the Tap changer position and change to the required position.

2.3.2 Check the ground connection

2.3.3 Check all external bolt and devices. If loosen, retighten(see table 1.)

2.3.4 Check all accessories install in the right position then connect alarm/trip to terminal. All protective devices are usually set by manufacturer or according to requirement (if you needed a suggestions please contact Ekarat Sale and Service)

2.3.5 Make sure that phasing is correct according to nameplate attached.

2.3.6 Check leaking of Transformer tank, all valves and gaskets.

2.3.7 Check insulation Resistance. (see table 2.)

\*If the transformer is not energize more than six months, Please contact Ekarat's Service Center for sampling oil to take a dielectric oil test. (see table 3.)

2.3.8 Measuring the output voltage according to selected tap position

**(\*The off-load tap changer can not be changed while the transformer is energized.)**

**Caution !**

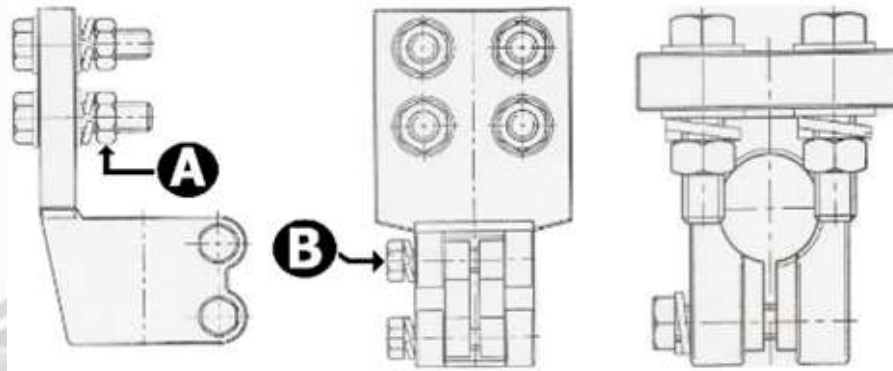
**According to IEC60076-7 or equivalent standards unless deviating customer specifications have been approved upon**

- Ambient temperature should not exceed 40° c
- Operating voltage should not exceed  $\pm 5\%$  at on load and  $\pm 10\%$  at no load.
- Maximum height designed at 3300 feet above sea level , any installation above 3300 feet will affect to the capability of transformer and oil temperature.

**Table 1. Bolt Tightening Torque**

Bolt Size	Material	Torque N-m.
M10	Steel	40
	Stainless	40
M12	Steel	45
	Stainless	45
M16	Steel	70
	Stainless	70

**LV Terminal Plate**



Bolt Size	Material	Torque (N-m.)	
		Position A	Position B
M8	Steel	35	40
	Stainless	35	40
M10	Steel	40	70
	Stainless	40	70
M12	Steel	70	140
	Stainless	70	140
M16	Steel	140	-
	Stainless	140	-

**Position A : Cable and LV terminal**  
**Position B : LV terminal and LV bushing**

**Table 2. Insulation Resistance**

MEGGER SIZE (Test Voltage)	MegaOhm @ 20 °C		
	HV - GND	LV - GND	HV - LV
2500 VDC	≥ 1000	≥ 500	≥ 1000

Temperature correction Factor (Base 20°C)		
Temperature correction Factor		
oC	oF	Correction Factor
0	32	0.25
5	41	0.36
10	50	0.50
15	59	0.72
20	68	1.00
30	86	1.98
40	104	3.95
50	122	7.85

**Table 3. Dielectric oil test ( FR3 fluid)**

Oil Dielectric Strength	Limit(kV)	Method
<div style="border: 1px solid black; width: 100px; height: 20px; margin-bottom: 5px;"></div> (IEC60422:2013) ( 2.5mm gap)	Unused oil > 30/55*	IEC60156:2018
	Used oil > 40    Good 30-40            Fair < 30              Poor	

\*After Treatment

## **3. Inspection and maintenance**

Oil-immersed type transformers are recommended for periodic inspection and maintenance to verify that the transformers are in normal operation, and extends the life time of transformers

3.1 Inspect indicating accessories such as thermometer, oil level, and pressure gauge to ensure their proper functioning. If any signs of malfunction is noticed, please contact Ekarat's representative.

3.2 Inspect tank and all joints of gaskets to ensure that there is no leakage.

3.3 Inspect conditions of external compartments such as bushings, color of silica gel, contacts or termination of cable lugs or cable, bolts and nuts whether they are still tight, paint etc. The above general inspections are recommended to be carried out as your periodic routine inspection.

## 4. Information on nameplate

Nameplate which gives the basic information for reference is supplied and attached on one side of every transformer.

### **Information shown on Nameplate :**

4.1 kVA : Power output in kilovolt – ampere of transformers under the specified condition of operating.

4.2 Phase: The number of phase

4.3 Frequency : Frequency of the system on which transformer is connected

4.4 Type : Type of cooling system.

4.5 Class : Class of insulation, which used for production.

4.6 Pri. Volt and Amp./Sec. Volt and Amp.

: Rated line voltage and rated line current of primary and secondary of transformers.

4.7 Percent Imp : Impedance voltage in percentage.

4.8 Oil Temp. Rise : An Top oil temperature rise above ambient temperature at rated kVA

4.9 Oil Qty (L) : The estimated oil volume in liter.

4.10 Drain Oil Qty (L) : This information is for “hermetically sealed” (completely oil filled) transformer and used by manufacturer only.

4.11 Total Wt. (Kg) : Total weight of whole transformer.

4.12 Lifting Wt. (Kg) : The weight of total active parts.

4.13 Voltage and Tap position

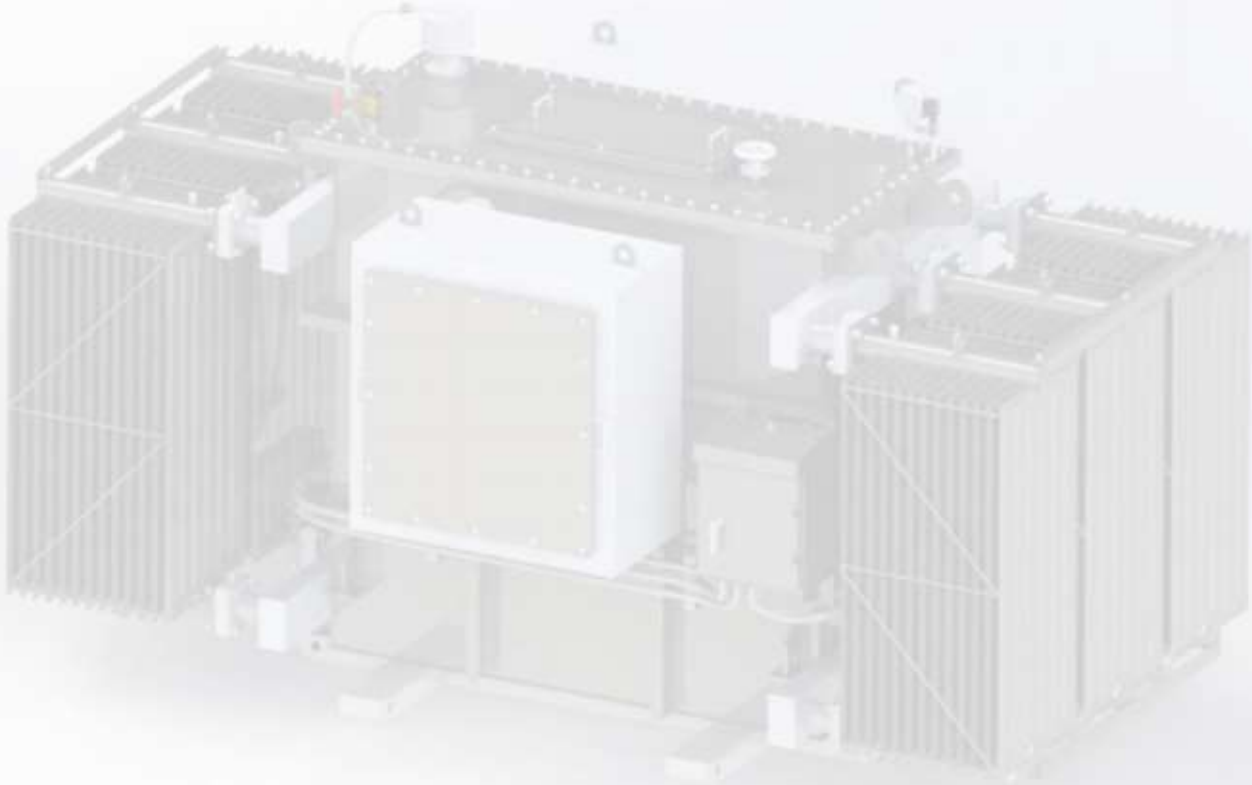
: The relevant primary voltage at any Tap position with the condition of constant secondary voltage.

4.14 Connection Diagrams : Position of terminal of primary and secondary side.

4.15 Vector Diagram : The phase rotation and phase angle shift between the high voltage and low voltage.

4.16 Item Code : Manufacturer's particular design reference.

4.17 Serial Number : Identification number of each specific transformer. Please refer to this serial number.





## 5. Inspection and maintenance in 10 years

Table 4. Inspection and maintenance for oil immersed transformer in 10 years

Year	Type of check	Inspection item	Frequency (per year)	TYPE OF TRANSFORMER		
				Conservator	Nitrogen Gas sealed	Hermetically Sealed
1	No Shut Down	1.Outside appearance inspection	Once	ü	ü	ü
2	No Shut Down	1.Outside appearance inspection	Once	ü	ü	ü
3	Shut Down	1.Outside appearance inspection	Twice	ü	ü	ü
		2.Oil sampling for breakdown voltage test (see Table3.)	Once	ü	-	-
4	Shut Down	1.Outside appearance inspection	Twice	ü	ü	ü
		2.Oil sampling for breakdown voltage test (see Table3.)	Once	ü	-	-
5	Shut Down	1.Outside appearance inspection	Twice	ü	ü	ü
		2.Oil sampling for breakdown voltage (see Table3.) Test power factor, moisture content, acid number, DGA (for transformer more than 1000 kVA)	Once	ü	ü	ü
6	Shut Down	1.Outside appearance inspection	Twice	ü	ü	ü
		2.Oil sampling for breakdown voltage test (see Table3.)	Once	ü	-	-
7	Shut Down	1.Outside appearance inspection & maintenance	Twice	ü	ü	ü
		2.Oil sampling for breakdown voltage test (see Table3.)	Once	ü	ü	ü

Year	Type of check	Inspection item	Frequency (per year)	Type of transformer		
				Conservator	Nitrogen Gas sealed	Hermetically Sealed
8	Shut Down	1. Outside appearance inspection	Twice	ü	ü	ü
		2. Oil sampling for breakdown voltage (see Table3.) Test power factor, moisture content, acid number, DGA (for transformer more than 1000 kVA)	Once	ü	ü	ü
9	Shut Down	1. Outside appearance inspection	Twice	ü	ü	ü
		2. Oil sampling for breakdown voltage test (see Table3.)	Once	ü	-	-
10	Shut Down	1. Outside appearance inspection	Twice	ü	ü	ü
		2. Oil sampling for breakdown voltage test (see Table3.)	Once	ü	ü	ü

**Additional inspection item to analyze transformer for transformer put in service 3 years and more**

Inspection item	Type of transformer		
	Conservator	Nitrogen Gas sealed	Hermetically Sealed
1. Test of Moisture Content, Acid Number, Power Factor	ü	ü	ü
2. DGA Test	ü	ü	ü
3. Insulation test by Polarize index	ü	ü	ü

## 6. Safety and environment

6.1 Transformers must be switched off, isolated and grounded if maintenance, internal inspection, connection or changing tap position are necessary as to ensure that no residual or feedback voltage remains in transformers.

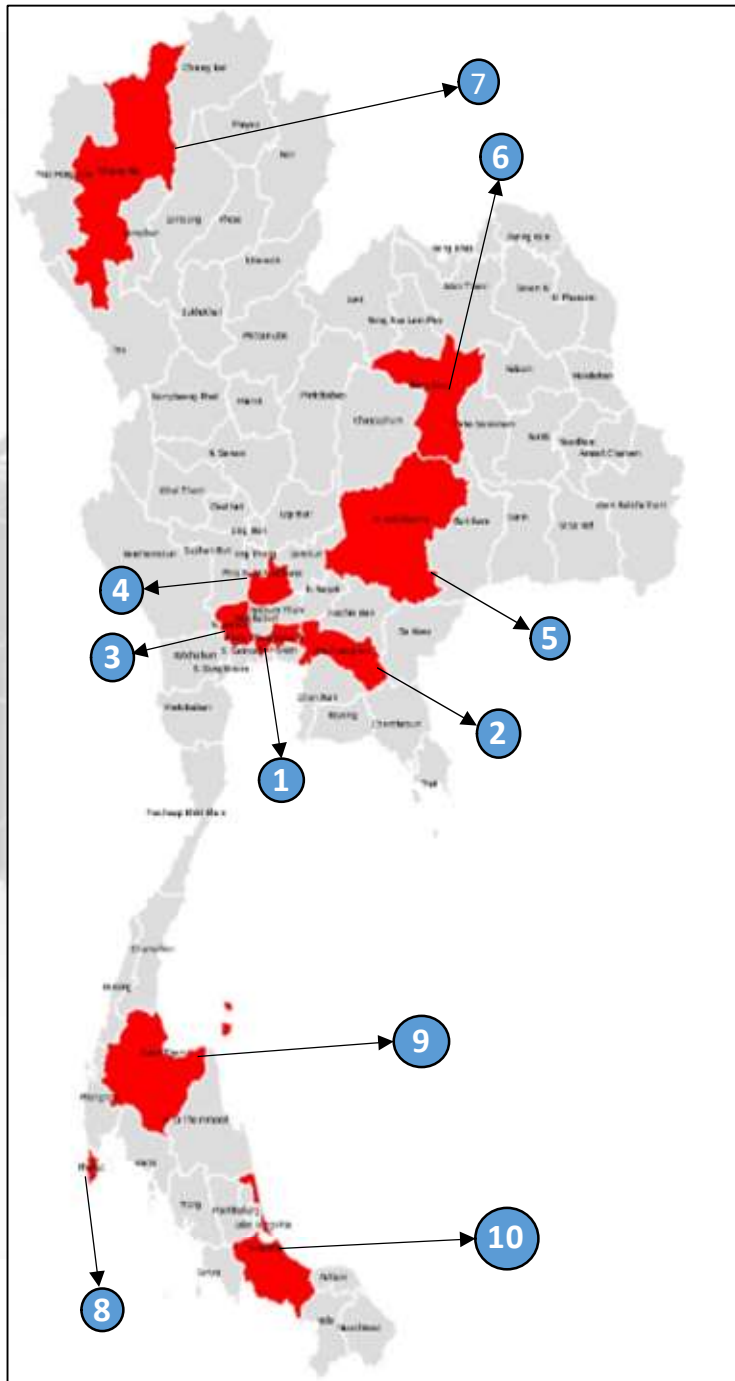
6.2 The transformer oil is mineral oil (FR3 fluid) produced from crude oil, and does not contain any PCBs (Polychlorinated Biphenyl's) which is banned in many countries. However it is necessary to handle and dispose of with care and in proper manner, please contact Ekarat's representative.

6.3 Transformers should be operated strictly under the conditions or specified environment.

6.4 In case of fire, the appropriate extinguisher is CO<sub>2</sub> or other which is suitable for each purpose.

6.5 Signboard should be put at the position which can be seen clearly during operation or for alert. To avoid unexpected incident, please read and follow the instruction and suggestion for safety and correct operation. More information and services can be obtained through Ekarat's Service Center

## 7. Service Center



### 1. Bangkok

#### 1.1 Head office

Tel : +669 5371 5551,

+662 719 8777

#### 1.2 Bangkok Center

Tel : +66 2393 0437

### 2. Chachoengsao Center

Tel : +6638 530 213

### 3. Nakhon Pathom Center

Tel : +6634 244 045-6

### 4. Ayutthaya Center

Tel : +6635 345 078

### 5. Nakhon Ratchasima Center

Tel : +6644 277 279

### 6. Khon Kaen Center

Tel : +6643 465 276

### 7. Chiang Mai Center

Tel : +6653 128 039

### 8. Phuket Center

Tel : +6676 307 570

### 9. Surat Thani Center

Tel : +6677 295 488

### 10. Songkhla Center

Tel : +6674 250 648

## 8. Annex

### Service Center Area

#### **1. Bangkok Center**

Service Area : Bangkok, Samutprakan, Nonthaburi

#### **2. Chachoengsao Center**

Service Area : Chachoengsao, Chonburi, Rayong, Chanthaburi, Prachinburi, Srakaew, Trad

#### **3. Nakhon Pathom Center**

Service Area : Nakhon Pathom, Kanchanaburi, Phetchaburi, Prachuapkhirikhan, Samutsakhon, Samutsongkram, Ratchaburi, Suphanburi

#### **4. Ayutthaya Center**

Service Area : Ayutthaya, Pathumthani, Angthong, Nakarnnayok, Saraburi, Lopburi, Singburi, Chainat, Uthai Thani, Nakhon Sawan, Phetchabun, Phichit

#### **5. Nakhon Ratchasima Center**

Service Area : Nakhon Ratchasima, Chaiyaphum, Buriram, Roi Et, Surin, Ubon Ratchathani, Sisaket, Amnatcharoen, Mahasarakham, Yasothon

#### **6. Khon Kaen Center**

Service Area : Khon Kaen, Udonthani, Kalasin, Loei, Nakornphanom, Mukdahan, Nongbuaiamphu, Sakonnakhon

#### **7. Chiang Mai Center**

Service Area : Chiangmai, Chiangrai, Mea Hong Sorn, Phayao, Lamphun, Lampang, Nan, Pheae, Uttaradit, Tak Sukhothai, Kamphaengphet, Phitsanulok

#### **8. Phuket Center**

Service Area : Phuket, Krabi, Phang-nga

#### **9. Surat Thani Center**

Service Area : Surat Thani, Chumphon, Ranong, Nakornsithammarat

#### **10. Songkhla Center**

Service Area : Songkhla, Trang, Pattani, Narathiwat, Yala, Satun, Phatthalung

\*Other provinces are not mentioned above, Please contact nearby our Service Center.