

W-VACi 12 / 17.5 / 24 kV IEC Vacuum Circuit Breakers



**EATON**

*Powering Business Worldwide*



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# 1 Safety

W-VACi vacuum circuit breakers are equipped with high speed, high energy operating mechanisms. They are designed with several built-in interlocks and safety features to provide safe and proper operating sequences.

## 1.1 Safety precautions

All safety codes, safety standards and/or regulations must be strictly observed in the installation, operation and inspection of this device.



### WARNING

**WARNING indicates a hazard with a medium level of risk which, if not avoided, may result in death or serious bodily injury**



### CAUTION

CAUTION indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury or property damage only.

## 1.2 Safety practices



### WARNING

**To protect the personnel associated with installation, operation, and inspection of these breakers, the following practices must be followed:**

- As defined in the local electrical code, only qualified persons who are familiar with the installation and Inspection of medium voltage circuits and equipment should be permitted to work on these breakers.
- Read these instructions carefully before attempting any installation, operation or inspection of these breakers.
- Always remove the withdrawable breakers from their enclosures before performing any inspection. Failure to do so could result in electrical shock leading to death, severe personal injury or property damage.
- Do not work on a breaker with the secondary test coupler engaged or fixed secondary connections made. Failure to disconnect the test coupler could result in an electrical shock leading to death, personal injury or property damage.
- Do not work on a closed breaker or a breaker with closing springs charged. The closing spring should be discharged and the main contacts open before working on the breaker. Failure to do so could result in cutting or crushing injuries.
- Do not use a withdrawable circuit breaker by itself as the only mean of isolating a high voltage circuit, remove the circuit breaker to the DISCONNECT POSITION and follow correct lock-out and tagging

rules, as well as all applicable codes, regulations and work rules.

- Do not leave a withdrawable circuit breaker in an intermediate position in the cell. Always have the circuit breaker either in the “Test” or “Service” position. Failure to do so could result in a flash over, death, personal injury or property damage.
- Always re-insert the handle into the front panel of the breaker after charging the closing springs. Otherwise the circuit breaker will not operate.
- Circuit breaker elements are equipped with safety interlocks. DO NOT remove, interfere with or in any manner defeat the safety interlocks. This may result in death, bodily injury or equipment damage.
- All personnel involved in operations carried out on, with or near electrical installations, require to have been instructed on the safety requirements, safety rules and instructions applicable to the operation of the installation.
- Ensure that access and escape routes are free at all times. Do not leave flammable materials in or near access and escape routes.
- Flammable materials must not be stored in areas which could be affected by arcs, such as: ethers, alcohols and alcohol based cleaners. In the event of a fire, never attempt to extinguish a fire on the switchgear unit before it is completely dead; this applies to both primary and secondary switchgear. Even if non-conducting extinguishing materials are used, electricity may pass through the extinguishing equipment. Never extinguish a fire on the unit with water.



### WARNING

**The circuit breaker elements described in this book are designed and tested to operate within their nameplate ratings.**

**Operation outside of these ratings may cause the equipment to fail, resulting in death, bodily injury and property damage.**

**These circuit breaker elements are designed to be installed pursuant to the IEC standards. Serious injury, including death, can result from failure to follow the procedures outlined in this manual. These circuit breaker elements are sold pursuant to a non-standard purchasing agreement which limits the liability of the manufactory.**

## 2 Product Summary

The purpose of this book is to provide instructions for the unpacking, storage, installation, operation and inspection of W-VACi IEC vacuum circuit breakers for qualified personnel. Reliable control and protection of short circuit current can be achieved through the application of W-VACi vacuum circuit breakers in 12 / 17.5 / 24kV air insulated switchgear. Legal and other regulations and documents pertaining to accident prevention, personal safety and environmental protection must be observed. Operations involving the repair of the breaker are to be carried out by or under the approval of Eaton. Information with respect to these operations is, therefore, not included in this manual. If further information is required by the purchaser regarding a particular installation, application or inspection activity, an Eaton representative should be contacted.

### 2.1 Standards and Specifications

W-VACi IEC circuit breakers are designed and third party tested to the latest IEC 62271-100 and IEC 62271-1 standards. All W-VACi circuit breakers meet or exceed the electrical and mechanical endurance requirements of E2 and M2, in accordance with IEC 62271-100.

### 2.2 Altitude Correction Factor

The main external insulation of the 12 / 17.5 / 24 kV W-VACi vacuum circuit breakers is air. The insulation capabilities of air change relative to altitude above sea level. Customers should always consider this phenomenon when designing / specifying new switchgear installations. Eaton uses and specifies a correction factor ( $K_a$ ) to address this phenomenon. This correction factor is shown in Figure 2.2A. The source is the IEC 62271-1 standard. One factor that is not hindered by this property is the internal insulation of the vacuum interrupters.

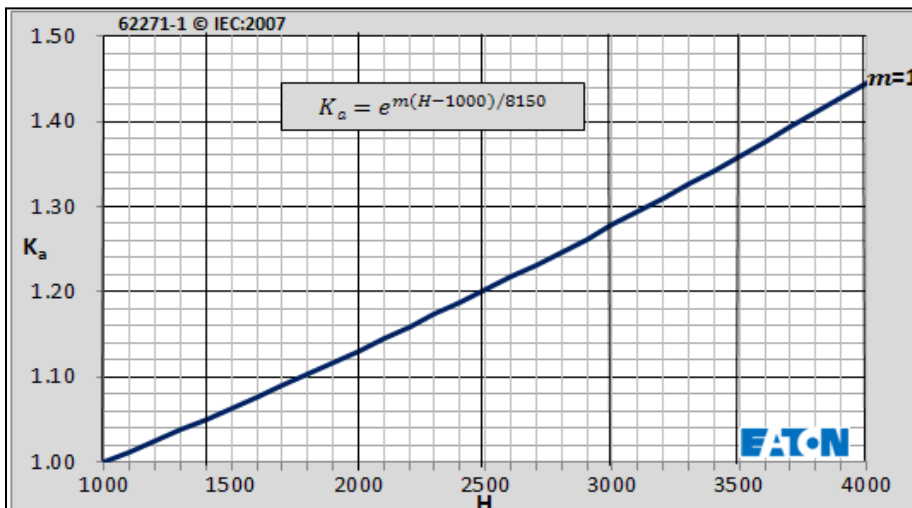


Figure 2.2A: Altitude Correction Factor

$K_a$  = Correlates to the correction factor in regards to the altitude.

H = The value of Altitude (in meters).

M = A fixed value, in terms of power frequency, lighting impulse, and phase to phase switching impulse voltages;  $m=1$ .

### ALTITUDE CORRECTION FACTOR- EXAMPLE

Installation altitude	3000 m
Operation at the rated voltage	17.5 kV
Power frequency withstand voltage	38 kV
Lightning impulse withstand voltage	95 kV
Correction Factor ( $K_a$ ) obtained from graph	1.28

In this example, the above information would compute the withstanding capabilities of the unit to be:

- Power frequency withstand voltage equal to:  
**38 kV x 1.28 = 48.64 kV**
- Lightning impulse withstand voltage equal to:  
**95 kV x 1.28 = 121.60 kV**

Focusing on the values determined above, it can be concluded that this unit at 3000 m above sea level, with 17.5 kV of available service voltage must use a 24 kV rated voltage breaker. The resulting breaker selection is due to the 125 kV modified Lightning impulse requirement. The minimum circuit breaker with the required capabilities for this application is the 24kV circuit breaker, which also provides the 50kA Power Frequency Withstand Voltage (see section 2.6, *Technical Parameters 24 kV W-VACi IEC Circuit Breaker*). Referencing the above calculations, these values are influenced by the Correction factor ( $K_a$ ). The correction factor ( $K_a$ ) is obtained from the graph, by using the known height above sea level (3000 m). The insulation levels must also conform to a power frequency rating of 50 kV with a 125 kV lightning impulse withstand voltage.

### 2.3 Technology Parameters

Charts on the following pages include all technical parameters for the IEC standard 12 / 17.5 / 24kV W-VACi vacuum circuit breakers.

## 2.4 Technical Parameters 12 kV W-VACi IEC Circuit Breaker

Item		Unit	12kV W-VACi													
Voltage (Ur)		kV	12													
Normal Current(I <sub>n</sub> )		A	630	800	1250	1600	2000	2500	3150	630	800	1250	1600	2000	2500	3150
Short-Time Withstand Current(I <sub>k</sub> )		kA	25	25	25	25	25	25	25	26.3	26.3	26.3	26.3	26.3	26.3	26.3
Short Circuit Breaking Current(I <sub>sc</sub> )		kA	25	25	25	25	25	25	25	26.3	26.3	26.3	26.3	26.3	26.3	26.3
Duration of Short Circuit(t <sub>k</sub> )		sec	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Frequency(f <sub>r</sub> )		Hz	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60
Short circuit Making Current(I <sub>ma</sub> )		kA	63/65	63/65	63/65	63/65	63/65	63/65	63/65	66/65	66/65	66/65	66/65	66/65	66/65	66/65
Contact Closing Bounce Time		ms	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2
Time Difference of Three Pole Opening and Closing		ms	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2
Fixed Resistance <sup>1</sup>		μΩ	≤35	≤35	≤20	≤15	≤15	≤12	≤12	≤35	≤35	≤20	≤15	≤15	≤12	≤12
DO Resistance <sup>1</sup>		μΩ	≤45	≤45	≤35	≤30	≤30	≤25	≤25	≤45	≤45	≤35	≤30	≤30	≤25	≤25
Closing Time		ms	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50
Opening Time		ms	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60
Closing Speed <sup>1</sup>		m/s	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3
Opening Speed <sup>1</sup>		m/s	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7
D.C. Component of Breaking Current(I <sub>dc</sub> )		%	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35
Cable-Charging Breaking Current (C2)		A	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Single Capacitor Bank Breaking Current (C2)		A	400	400	-	-	-	-	-	400	400	-	-	-	-	-
Back to Back Capacitor Bank Breaking Current (C1)		A	400	400	-	-	-	-	-	400	400	-	-	-	-	-
Pole to Pole Spacing (Center to Center)		mm	150	150	150	210	210	275	275	150	150	150	210	210	275	275
Upper to Lower Terminal Spacing		mm	205	205	275	310	310	310	310	205	205	275	310	310	310	310
Mechanical Endurance <sup>2</sup>		Cycle	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k
Electrical Endurance		Cycle	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k
Rated Insulation Level	Rated Power Frequency Withstand Voltage(U <sub>d</sub> )	kV	28													
	Rated Lightning Impulse Withstand Voltage(U <sub>p</sub> )	kV	75													
Operating Sequence			O-0.3s-CO-15s-CO													
Classification			E2-M2-S1													

<sup>1</sup>: Testing configurations available upon request

<sup>2</sup>: 20K operations can be achieved on the 12kV, 25 kA Breaker

Item	Unit	12kV W-VACi																	
Voltage (Ur)	kV	12																	
		630	800	1250	1600	2000	2500	3150	1250	1600	2000	2500	3150	1250	1600	2000	2500	3150	
Normal Current(I <sub>r</sub> )	A	630	800	1250	1600	2000	2500	3150	1250	1600	2000	2500	3150	1250	1600	2000	2500	3150	
Short-Time Withstand Current(I <sub>k</sub> )	kA	31.5	31.5	31.5	31.5	31.5	31.5	31.5	40	40	40	40	40	50	50	50	50	50	
Short Circuit Breaking Current(I <sub>sc</sub> )	kA	31.5	31.5	31.5	31.5	31.5	31.5	31.5	40	40	40	40	40	50	50	50	50	50	
Duration of Short Circuit(t <sub>k</sub> )	sec	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
Frequency(f <sub>r</sub> )	Hz	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	
Short circuit Making Current(I <sub>ma</sub> )	kA	80/83	80/83	80/83	80/83	80/83	80/83	80/83	100/104	100/104	100/104	100/104	100/104	125/130	125/130	125/130	125/130	125/130	
Contact Closing Bounce Time	ms	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	
Time Difference of Three Pole Opening and Closing	ms	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	
Fixed Resistance <sup>1</sup>	μΩ	≤35	≤35	≤20	≤15	≤15	≤12	≤12	≤20	≤15	≤15	≤12	≤12	≤20	≤15	≤15	≤12	≤12	
DO Resistance <sup>1</sup>	μΩ	≤45	≤45	≤35	≤30	≤30	≤25	≤25	≤35	≤30	≤30	≤25	≤25	≤35	≤30	≤30	≤25	≤25	
Closing Time	ms	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	
Opening Time	ms	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	
Closing Speed <sup>1</sup>	m/s	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	
Opening Speed <sup>1</sup>	m/s	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	
D.C. Component of Breaking Current(I <sub>dc</sub> )	%	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	
Cable-Charging Breaking Current (C2)	A	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	
Single Capacitor Bank Breaking Current (C2)	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Back to Back Capacitor Bank Breaking Current (C1)	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Out-of-Phase Breaking Current	kA	-	-	-	-	-	-	-	10	10	10	10	10	12.5	12.5	12.5	12.5	12.5	
Pole to Pole Spacing (Center to Center)	mm	150	150	150	210	210	275	275	210	210	210	275	275	210	210	210	275	275	
Upper to Lower Terminal Spacing	mm	275	275	275	310	310	310	310	275	310	310	310	310	310	310	310	310	310	
Mechanical Endurance <sup>2</sup>	Cycle	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	
Electrical Endurance	Cycle	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	
Rated Insulation Level	Rated Power Frequency Withstand Voltage(U <sub>d</sub> )	kV	28																
	Rated Lighting Impulse Withstand Voltage(U <sub>p</sub> )	kV	75																
Operating Sequence		O-0.3s-CO-15s-CO																	
Classification		E2-M2-S1																	

<sup>1</sup>: Testing configurations available upon request

<sup>2</sup>: 20K operations can be achieved on the 12kV, 25 kA Breaker



## 2.5 Technical Parameters 17.5 kV W-VACi IEC Circuit Breaker

Item	Unit	17.5kV W-VACi														
Voltage (Ur)	kV	17.5														
Normal Current(I <sub>r</sub> )	A	630	800	1250	1600	2000	2500	3150	630	800	1250	1600	2000	2500	3150	
Short-Time Withstand Current(I <sub>k</sub> )	kA	25	25	25	25	25	25	25	31.5	31.5	31.5	31.5	31.5	31.5	31.5	
Short Circuit Breaking Current(I <sub>sc</sub> )	kA	25	25	25	25	25	25	25	31.5	31.5	31.5	31.5	31.5	31.5	31.5	
Duration of Short Circuit(t <sub>k</sub> )	sec	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
Frequency(f <sub>r</sub> )	Hz	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	
Short circuit Making Current(I <sub>ma</sub> )	kA	63/65	63/65	63/65	63/65	63/65	63/65	63/65	80/82	80/82	80/82	80/82	80/82	80/82	80/82	
Contact Closing Bounce Time	ms	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	
Time Difference of Three Pole Opening and Closing	ms	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	
Fixed Resistance <sup>1</sup>	μΩ	≤35	≤35	≤20	≤15	≤15	≤12	≤12	≤35	≤35	≤20	≤15	≤15	≤12	≤12	
DO Resistance <sup>1</sup>	μΩ	≤45	≤45	≤35	≤30	≤30	≤25	≤25	≤45	≤45	≤35	≤30	≤30	≤25	≤25	
Closing Time	ms	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	
Opening Time	ms	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	
Closing Speed <sup>1</sup>	m/s	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	
Opening Speed <sup>1</sup>	m/s	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	
D.C. Component of Breaking Current(I <sub>dc</sub> )	%	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	
Cable-Charging Breaking Current (C2)	A	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	
Single Capacitor Bank Breaking Current (C2)	A	400	400	-	-	-	-	-	-	-	-	-	-	-	-	
Back to Back Capacitor Bank Breaking Current (C1)	A	400	400	-	-	-	-	-	-	-	-	-	-	-	-	
Pole to Pole Spacing (Center to Center)	mm	150	150	150	210	210	275	275	150	150	150	210	210	275	275	
Upper to Lower Terminal Spacing	mm	205	205	275	310	310	310	310	275	275	275	310	310	310	310	
Mechanical Endurance <sup>2</sup>	Cycle	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	
Electrical Endurance	Cycle	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k	
Rated Insulation Level	Rated Power Frequency Withstand Voltage(U <sub>d</sub> )	kV	38													
	Rated Lighting Impulse Withstand Voltage(U <sub>p</sub> )	kV	95													
Operating Sequence		O-0.3s-CO-15s-CO														
Classification		E2-M2-S1														

<sup>1</sup>: Testing configurations available upon request

<sup>2</sup>: 20K operations can be achieved on the 12kV, 25kA Breaker

Item		Unit	17.5kV W-VACi									
Voltage (Ur)		kV	17.5									
Normal Current(I <sub>r</sub> )		A	1250	1600	2000	2500	3150	1250	1600	2000	2500	3150
Short-Time Withstand Current(I <sub>k</sub> )		kA	40	40	40	40	40	50	50	50	50	50
Short Circuit Breaking Current(I <sub>sc</sub> )		kA	40	40	40	40	40	50	50	50	50	50
Duration of Short Circuit(t <sub>k</sub> )		sec	3	3	3	3	3	3	3	3	3	3
Frequency(f <sub>i</sub> )		Hz	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60
Short circuit Making Current(I <sub>ma</sub> )		kA	100/104	100/104	100/104	100/104	100/104	125/130	125/130	125/130	125/30	125/130
Contact Closing Bounce Time		ms	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2
Time Difference of Three Pole Opening and Closing		ms	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2
Fixed Resistance <sup>1</sup>		μΩ	≤20	≤15	≤15	≤15	≤12	≤20	≤15	≤15	≤12	≤12
DO Resistance <sup>1</sup>		μΩ	≤35	≤30	≤30	≤30	≤25	≤35	≤30	≤30	≤25	≤25
Closing Time		ms	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50
Opening Time		ms	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60
Closing Speed <sup>1</sup>		m/s	0.7~ 1.3	0.7~ 1.3	0.7~ 1.3	0.7~ 1.3	0.7~ 1.3	0.7~ 1.3	0.7~ 1.3	0.7~ 1.3	0.7~ 1.3	0.7~ 1.3
Opening Speed <sup>1</sup>		m/s	1.0~ 1.7	1.0~ 1.7	1.0~ 1.7	1.0~ 1.7	1.0~ 1.7	1.0~ 1.7	1.0~ 1.7	1.0~ 1.7	1.0~ 1.7	1.0~ 1.7
D.C. Component of Breaking Current(I <sub>dc</sub> )		%	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35	29-35
Cable-Charging Breaking Current (C2)		A	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5
Single Capacitor Bank Breaking Current (C2)		A	-	-	-	-	-	-	-	-	-	-
Back to Back Capacitor Bank Breaking Current (C1)		A	-	-	-	-	-	-	-	-	-	-
Out-of-Phase Breaking Current		kA	10	10	10	10	10	12.5	12.5	12.5	12.5	12.5
Pole to Pole Spacing (Center to Center)		mm	210	210	210	275	275	210	210	210	275	275
Upper to Lower Terminal Spacing		mm	310	310	310	310	310	310	310	310	310	310
Mechanical Endurance <sup>2</sup>		Cycle	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k
Electrical Endurance		Cycle	10k	10k	10k	10k	10k	10k	10k	10k	10k	10k
Rated Insulation Level	Rated Power Frequency Withstand Voltage(U <sub>d</sub> )	kV	38									
	Rated Lightning Impulse Withstand Voltage(U <sub>p</sub> )	kV	95									
Operating Sequence			O-0.3s-CO-15s-CO									
Classification			E2-M2-S1									

<sup>1</sup>: Testing configurations available upon request

<sup>2</sup>: 20K operations can be achieved on the 12kV, 25kA Breaker

## 2.6 Technical Parameters 24 kV W-VACi IEC Circuit Breaker

Item	Unit	24kV W-VACi							
		24		24			24		
Voltage (U <sub>r</sub> )	kV	630	800	630	800	1250	1600	2000	2500
Normal Current(I <sub>r</sub> )	A	630	800	630	800	1250	1600	2000	2500
Short-Time Withstand Current(I <sub>k</sub> )	kA	20	20	25	25	25	25	25	25
Short Circuit Breaking Current(I <sub>sc</sub> )	kA	20	20	25	25	25	25	25	25
Duration of Short Circuit(t <sub>k</sub> )	sec	3	3	3	3	3	3	3	3
Frequency(f <sub>r</sub> )	Hz	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60
Short circuit Making Current(I <sub>ma</sub> )	kA	50/52	50/52	63/65	63/65	63/65	63/65	63/65	63/65
Contact Closing Bounce Time	ms	≤2	≤2	≤2	≤2	≤2	≤2	≤2	≤2
Time Difference of Three Pole Opening and Closing	ms	≤2	≤2	≤2	≤2	≤2	≤2	≤2	≤2
Fixed Resistance <sup>1</sup>	μΩ	≤35	≤35	≤20	≤20	≤20	≤15	≤15	≤12
DO Resistance <sup>1</sup>	μΩ	≤45	≤45	≤35	≤35	≤35	≤30	≤30	≤25
Closing Time	ms	25~50	25~50	25~50	25~50	25~50	25~50	25~50	25~50
Opening Time	ms	40~60	40~60	40~60	40~60	40~60	40~60	40~60	40~60
Closing Speed <sup>1</sup>	m/s	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3	0.7~1.3
Opening Speed <sup>1</sup>	m/s	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7	1.0~1.7
D.C. Component of Breaking Current(I <sub>dc</sub> )	%	30	30	30	30	30	30	30	30
Cable-Charging Breaking Current (C2)	A	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5
Single Capacitor Bank Breaking Current (C2)	A	-	-	-	-	-	-	-	-
Back to Back Capacitor Bank Breaking Current (C1)	A	-	-	-	-	-	-	-	-
Out-of-Phase Breaking Current	kA	-	-	-	-	-	6.25	6.25	6.25
Pole to Pole Spacing (Center to Center)	mm	210	210	275	275	275	275	275	275
Upper to Lower Terminal Spacing	mm	310	310	310	310	310	310	310	310
Mechanical Endurance	Cycle	10k	10k	10k	10k	10k	10k	10k	10k
Electrical Endurance	Cycle	10k	10k	10k	10k	10k	10k	10k	10k
Rated Insulation Level	Rated Power Frequency Withstand Voltage(U <sub>d</sub> )	kV	50	50	50	50	50	50	50
	Rated Lighting Impulse Withstand Voltage(U <sub>p</sub> )	kV	125	125	125	125	125	125	125
Operating Sequence	O-0.3s-CO-15s-CO								
Classification	E2-M2-S1								

<sup>1</sup>: Testing configurations available upon request

## 2.7 Operating Conditions

W-VAC*i* breakers are designed for switchgear mounted in indoor areas under normal service conditions (ambient air temperature, altitude, humidity, etc.) as laid out in IEC60694 clause 2.1.1.

**Table 2-1: Operating Conditions**

<p><b>Ambient Temperature:</b></p> <p>Maximum = +40°C Minimum = -5°C</p>
<p><b>Altitude:</b></p> <p>Do not exceed 1000m For applications above 1000 m de-rating is required</p>
<p><b>Service Site:</b></p> <p>The environment shall be free of water, flame, and/or explosive hazard. No chemical corrosive gases, and/or intensive vibration.</p>

## 2.8 Breaker Description

<b><u>12kV/17.5kV/24 kV</u></b>	→	RATED VOLTAGE (kV) IDENTIFICATION
<b><u>W-VAC<i>i</i> or W-VAC<i>r</i></u></b>	→	WITHDRAWABLE (W-VAC <i>i</i> ) OR FIXED(W-VAC <i>r</i> ) VACUUM CIRCUIT BREAKER
<b><u>20/25/26.3/31.5/40/50</u></b>	→	RATED SHORT CIRCUIT BREAKING CURRENT (kA)
<b><u>630/800/1250/1600/2000</u></b>	→	NORMAL CURRENT (A)
<b><u>150/210/275</u></b>	→	POLE SPACING (mm)

**Fig. 2-1: Breaker Description**

## 2.9 Outline and Dimensions

### Frame Description:

Example: **12 W – 1**

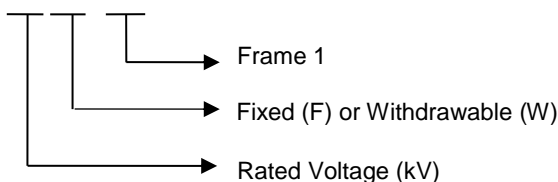


Table 2-2: List of Available Breaker Frames

Voltage (kV)	Continuous current (A)	Interrupting current (kA)	Pole Spacing (mm)	Upper to Lower terminal spacing (mm)	Withdrawable Breaker Frame	Withdrawable Breaker Frame Page Number	Fixed Breaker Frame	Fixed Breaker Frame Page Number
12	630	25	150	205	12W-1	14	12F-1	28
	800	25	150	205	12W-1	14	12F-1	28
	1250	25	150	275	12W-2	15	12F-2	29
	1600	25	210	310	12W-3	16	12F-3	30
	2000	25	210	310	12W-3	16	12F-3	30
	2500	25	275	310	12W-5	18	12F-5	32
	3150	25	275	310	12W-5	18	12F-5	32
	630	26.3	150	205	12W-1	14	12F-1	28
	800	26.3	150	205	12W-1	14	12F-1	28
	1250	26.3	150	275	12W-2	15	12F-2	29
	1600	26.3	210	310	12W-3	16	12F-3	30
	2000	26.3	210	310	12W-3	16	12F-3	30
	2500	26.3	275	310	12W-5	18	12F-5	32
	3150	26.3	275	310	12W-5	18	12F-5	32
	630	31.5	150	275	12W-2	15	12F-2	29
	800	31.5	150	275	12W-2	15	12F-2	29
	1250	31.5	150	275	12W-2	15	12F-2	29
	1600	31.5	210	310	12W-3	16	12F-3	30
	2000	31.5	210	310	12W-3	16	12F-3	30
	2500	31.5	275	310	12W-5	18	12F-5	32
3150	31.5	275	310	12W-5	18	12F-5	32	
1250	40	210	310	12W-3	16	12F-3	30	
1600	40	210	310	12W-3	16	12F-3	30	
2000	40	210	310	12W-3	16	12F-3	30	
2500	40	275	310	12W-5	18	12F-5	32	
3150	40	275	310	12W-5	18	12F-5	32	
1250	50	210	310	12W-4	17	12F-4	31	
1600	50	210	310	12W-4	17	12F-4	31	
2000	50	210	310	12W-4	17	12F-4	31	
2500	50	275	310	12W-5	18	12F-5	32	
3150	50	275	310	12W-5	18	12F-5	32	
17.5	630	25	150	205	17.5W-1	19	17.5F-1	33
	800	25	150	205	17.5W-1	19	17.5F-1	33
	1250	25	150	275	17.5W-2	20	17.5F-2	34
	1600	25	210	310	17.5W-3	21	17.5F-3	35
	2000	25	210	310	17.5W-3	21	17.5F-3	35
	2500	25	275	310	17.5W-5	23	17.5F-5	37
	3150	25	275	310	17.5W-5	23	17.5F-5	37
	630	31.5	150	275	17.5W-2	20	17.5F-2	34
	800	31.5	150	275	17.5W-2	20	17.5F-2	34
	1250	31.5	150	275	17.5W-2	20	17.5F-2	34
	1600	31.5	210	310	17.5W-3	21	17.5F-3	35
	2000	31.5	210	310	17.5W-3	21	17.5F-3	35
	2500	31.5	275	310	17.5W-5	23	17.5F-5	37
	3150	31.5	275	310	17.5W-5	23	17.5F-5	37
	1250	40	210	310	17.5W-3	21	17.5F-3	35
	1600	40	210	310	17.5W-3	21	17.5F-3	35
	2000	40	210	310	17.5W-3	21	17.5F-3	35
	2500	40	275	310	17.5W-5	23	17.5F-5	37
	3150	40	275	310	17.5W-5	23	17.5F-5	37
	1250	50	210	310	17.5W-4	22	17.5F-4	36
1600	50	210	310	17.5W-4	22	17.5F-4	36	
2000	50	210	310	17.5W-4	22	17.5F-4	36	
2500	50	275	310	17.5W-5	23	17.5F-5	37	
3150	50	275	310	17.5W-5	23	17.5F-5	37	
24	630	20	210	310	24W-1	24	24F-1	38
	800	20	210	310	24W-1	24	24F-1	38
	630	25	210	310	24W-2	25	24F-2	39
	800	25	210	310	24W-2	25	24F-2	39
	1250	25	210	310	24W-2	25	24F-2	39
	1600	25	275	310	24W-3	26	24F-3	40
	2000	25	275	310	24W-3	26	24F-3	40
2500	25	275	310	24W-4	27	24F-4	41	

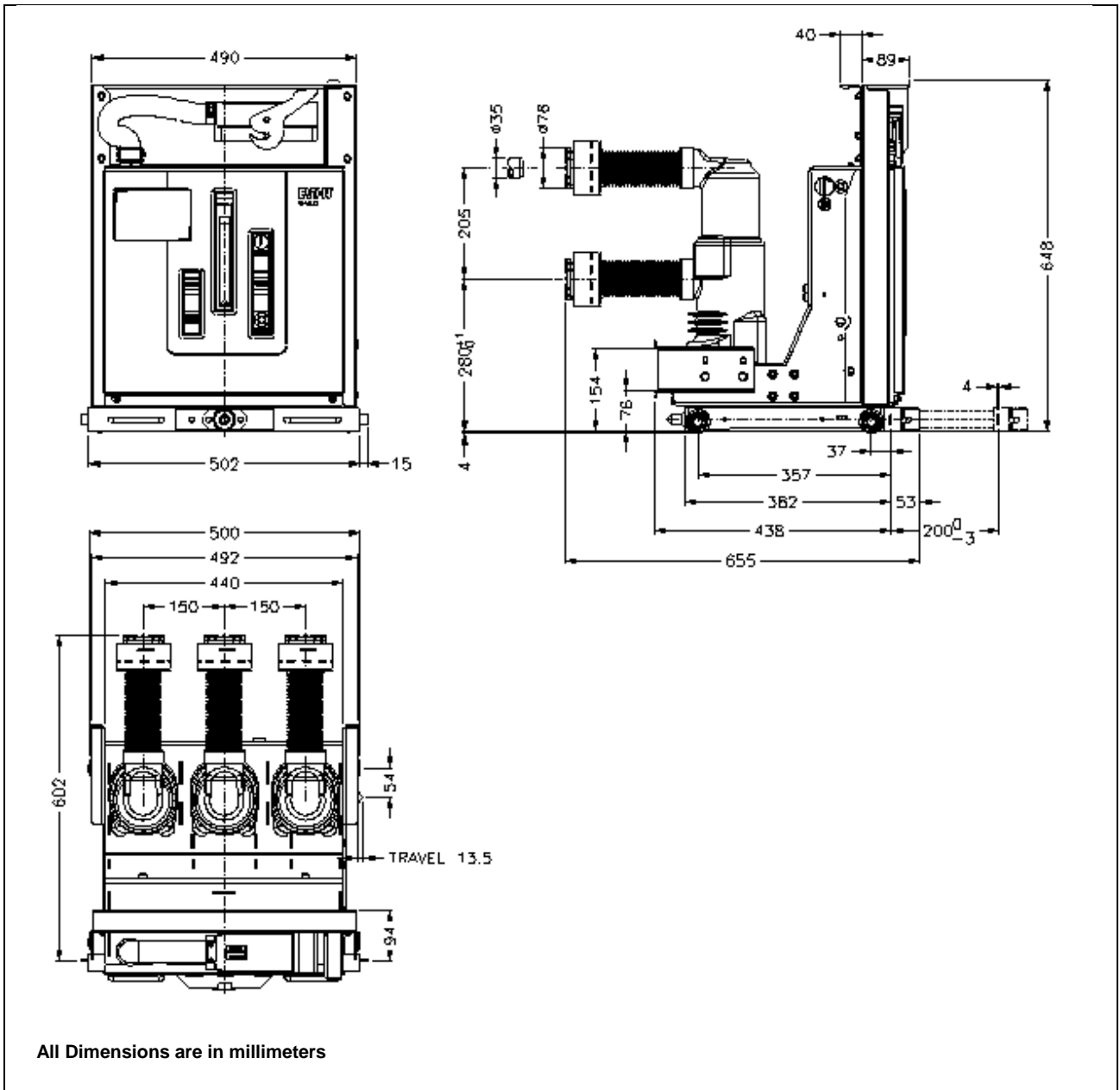


Fig. 2-2: 12kV Withdrawable W-VACi Circuit Breaker Frame 12W-1

Applicable Ratings			
Voltage	Breaking Current	Normal Current	
12kV	25kA	630A	800A
12kV	26.3kA	630A	800A

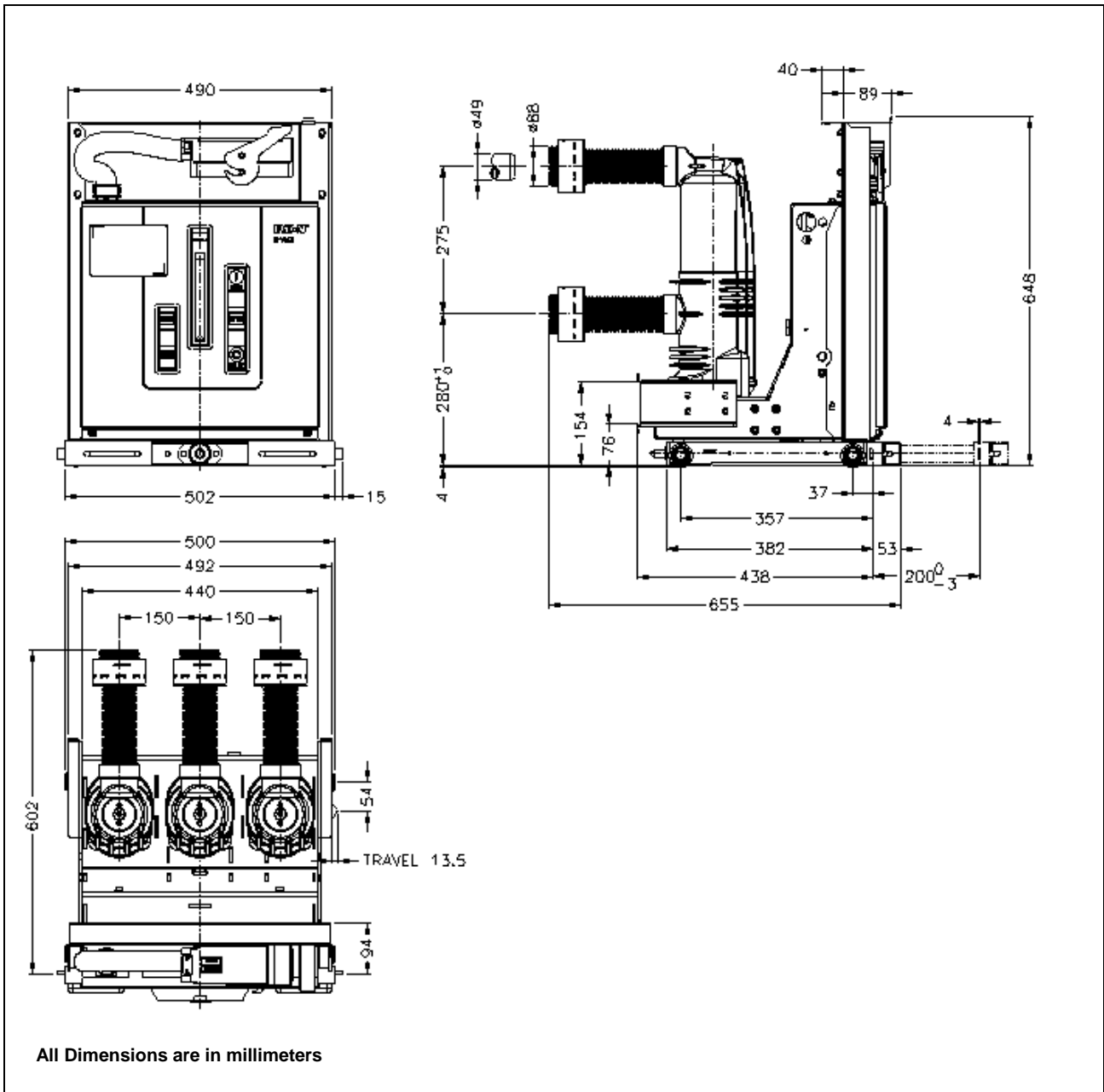


Fig. 2-3: 12kV Withdrawable W-VACi Circuit Breaker Frame 12W-2

Applicable Ratings				
Voltage	Breaking Current	Normal Current		
12kV	25kA	NA	NA	1250A
	26.3kA	NA	NA	1250A
	31.5kA	630A	800A	1250A

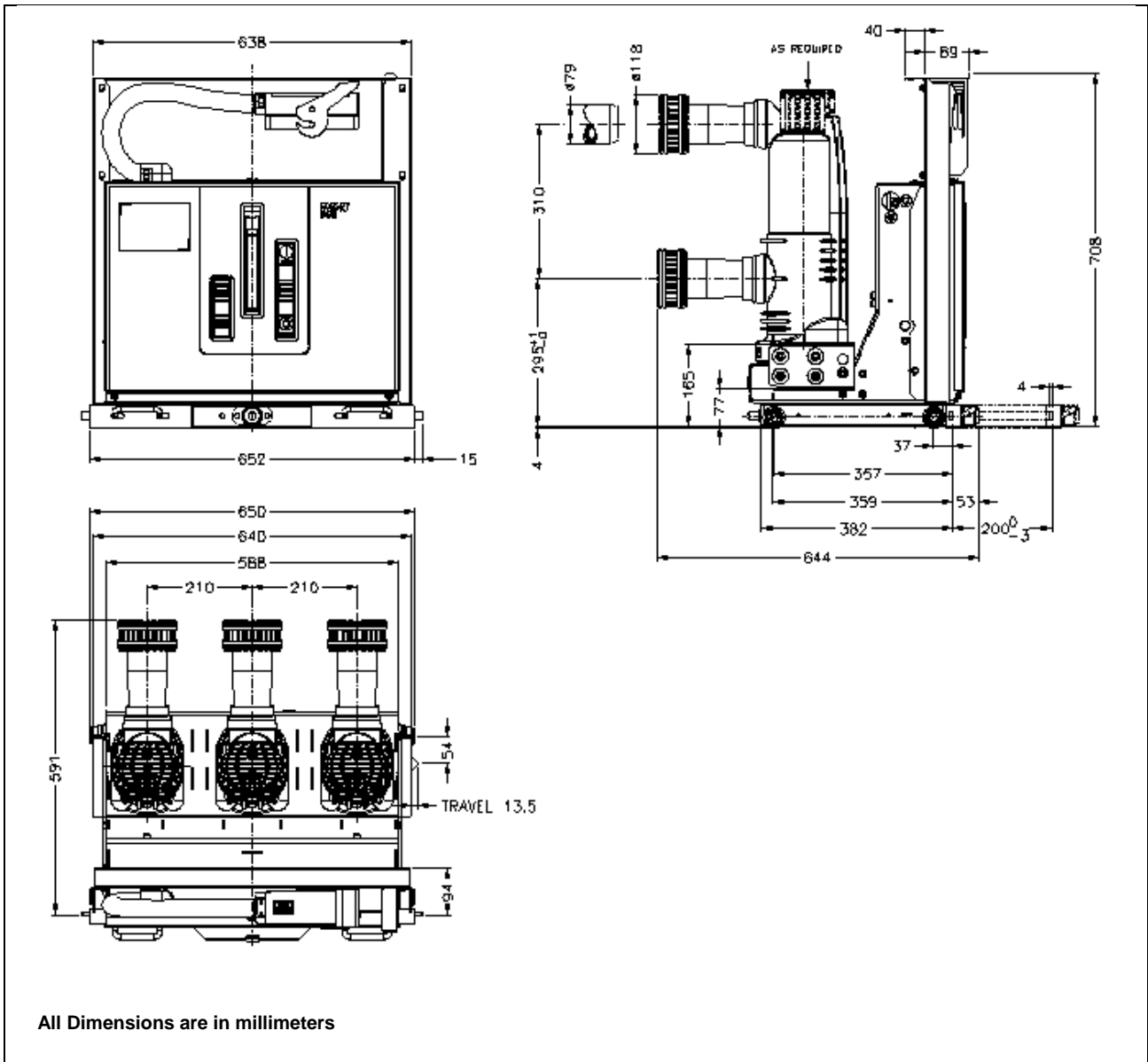


Fig. 2-4: 12kV Withdrawable W-VACi Circuit Breaker Frame 12W-3

Applicable Ratings				
Voltage	Breaking Current	Normal Current		
		12kV	25kA	NA
	26.3kA	NA	1600A <sup>1</sup>	2000A <sup>2</sup>
	31.5kA	NA	1600A <sup>1</sup>	2000A <sup>2</sup>
	40kA	1250A <sup>1</sup>	1600A <sup>1</sup>	2000A <sup>2</sup>

<sup>1</sup> These ratings do not use a heat sink

<sup>2</sup> These ratings do use a heat sink



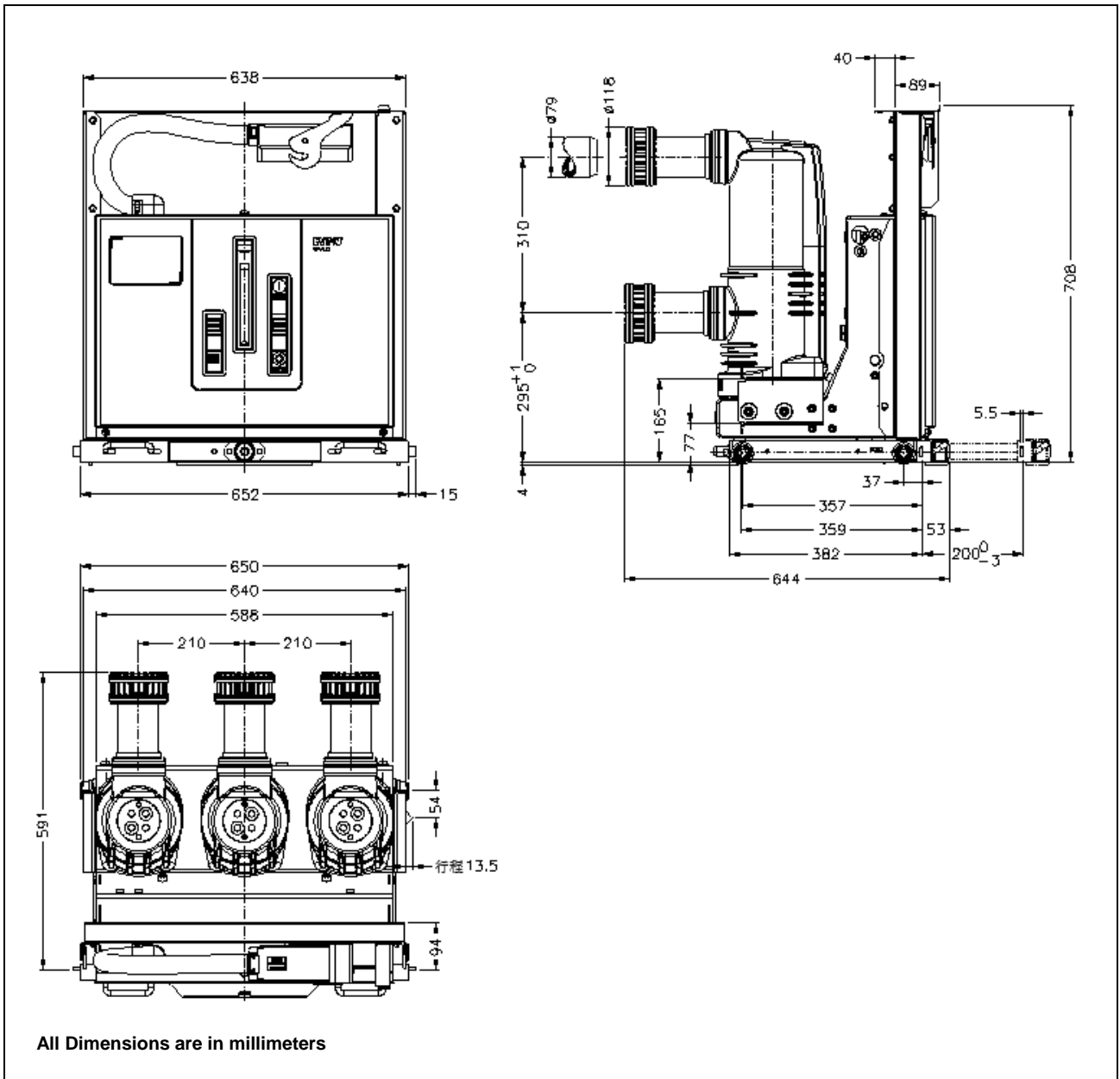


Fig. 2-6: 12kV Withdrawable W-VACi Circuit Breaker Frame 12W-4

Applicable Ratings				
Voltage	Breaking Current	Normal Current		
12kV	50kA	1250A <sup>1</sup>	1600A <sup>1</sup>	2000A <sup>1</sup>

<sup>1</sup> These ratings do not use a heat sink

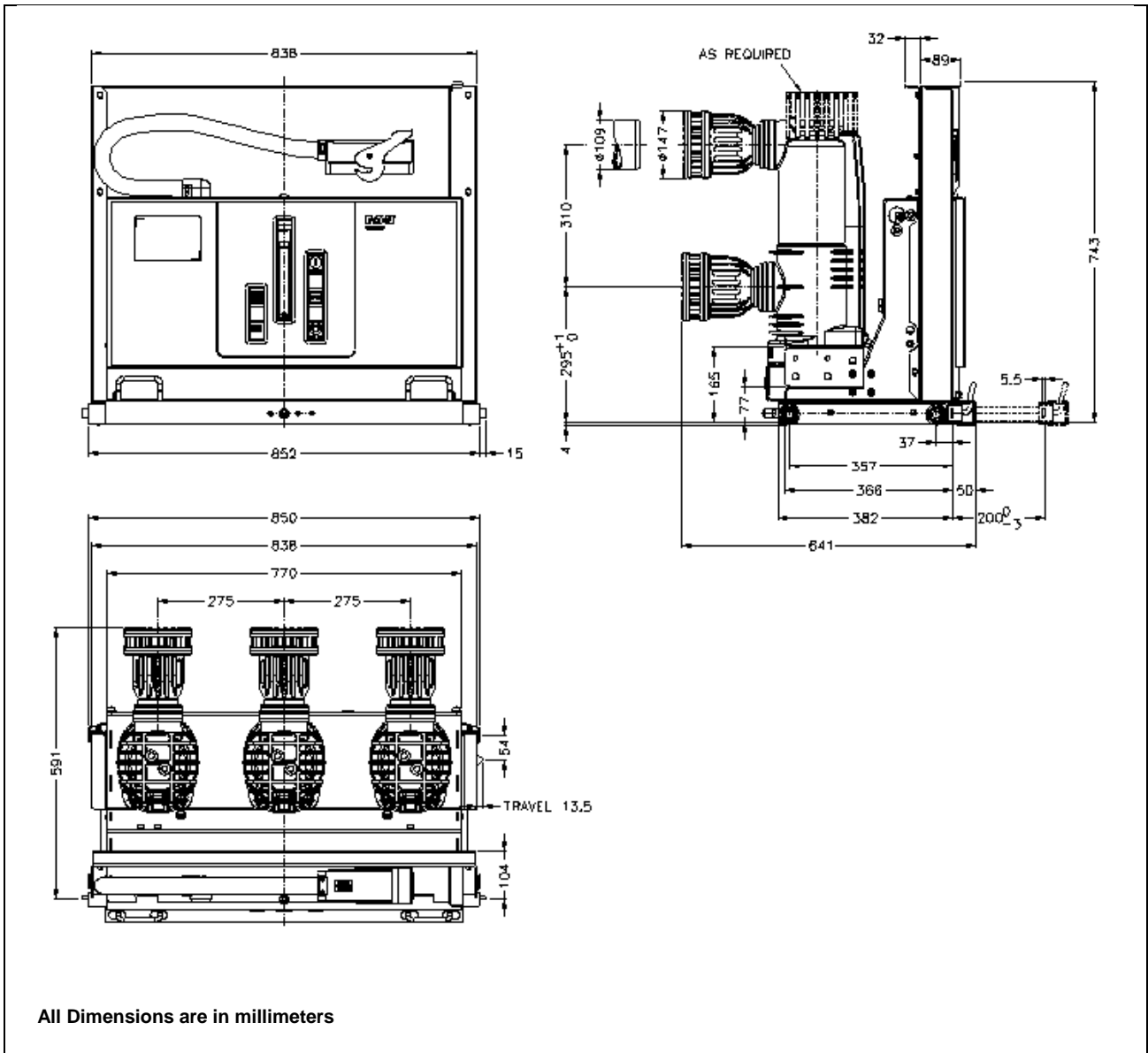


Fig. 2-5: 12kV Withdrawable W-VACi Circuit Breaker Frame 12W-5

Applicable Ratings			
Voltage	Breaking Current	Normal Current	
		12kV	25kA
	26.3kA	2500A <sup>1</sup>	3150A <sup>2</sup>
	31.5kA	2500A <sup>1</sup>	3150A <sup>2</sup>
	40kA	2500A <sup>1</sup>	3150A <sup>2</sup>
	50kA	2500A <sup>1</sup>	3150A <sup>2</sup>

<sup>1</sup> These ratings do not use a heat sink

<sup>2</sup> These ratings do use a heat sink

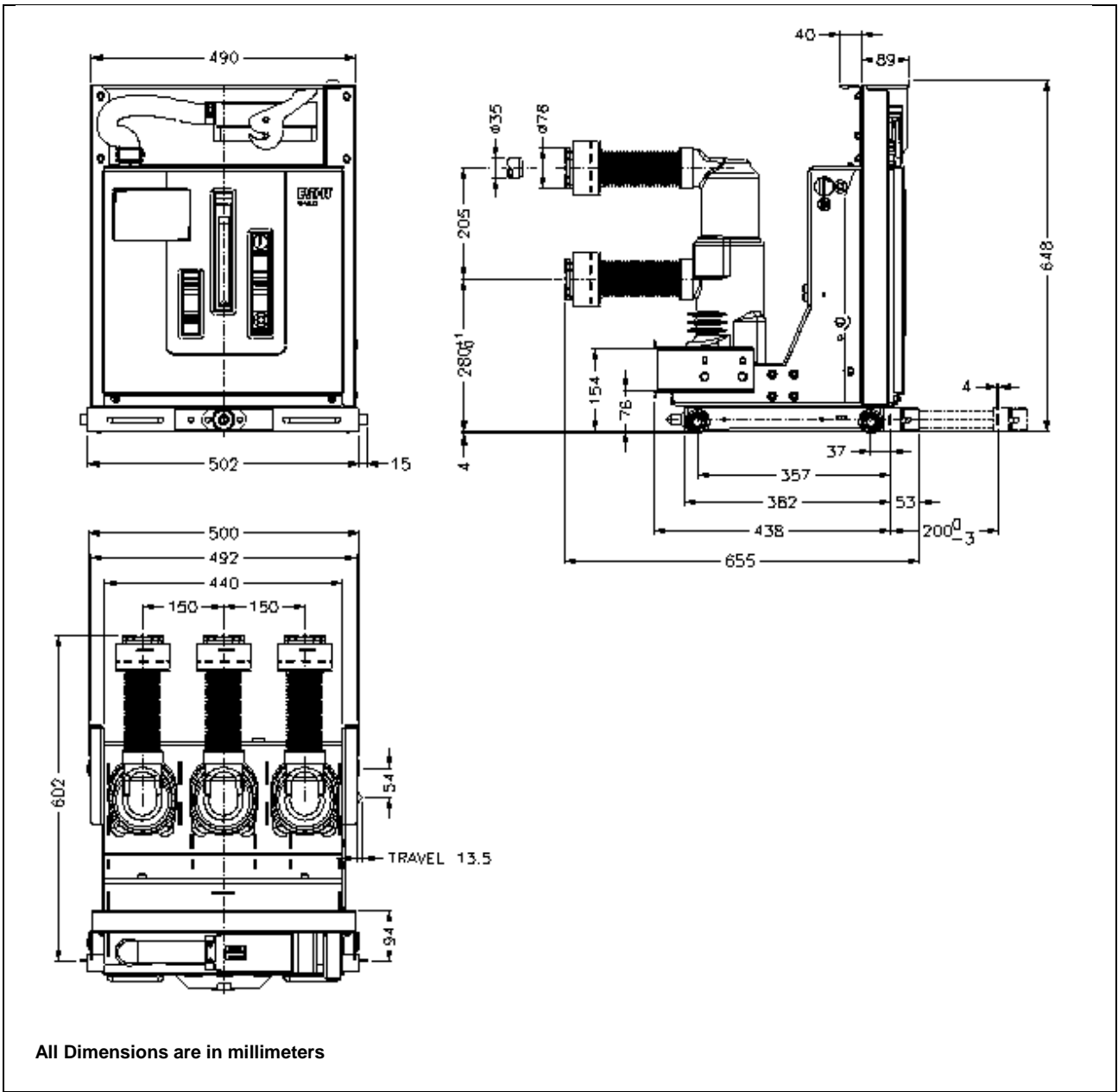


Fig. 2-7: 17.5kV Withdrawable W-VACi Circuit Breaker Frame 17.5W-1

Applicable Ratings			
Voltage	Breaking Current	Normal Current	
17.5kV	25kA	630A <sup>1</sup>	800A <sup>1</sup>

<sup>1</sup> These ratings do not use a heat sink

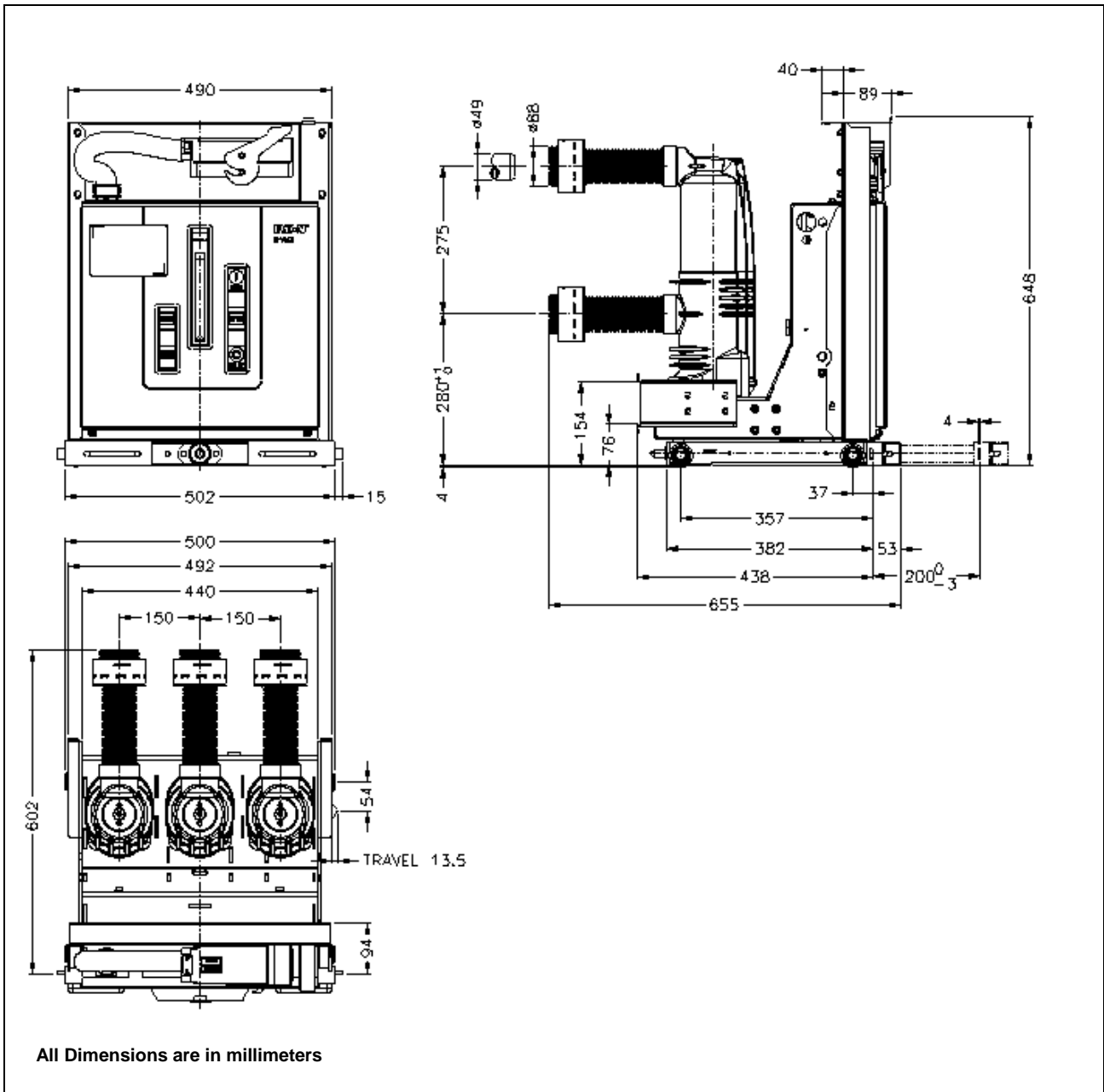


Fig. 2-8: 17.5kV Withdrawable W-VACi Circuit Breaker Frame 17.5W-2

Applicable Ratings				
Voltage	Breaking Current	Normal Current		
17.5kV	25kA	NA	NA	1250A
	31.5kA	630A	800A	1250A

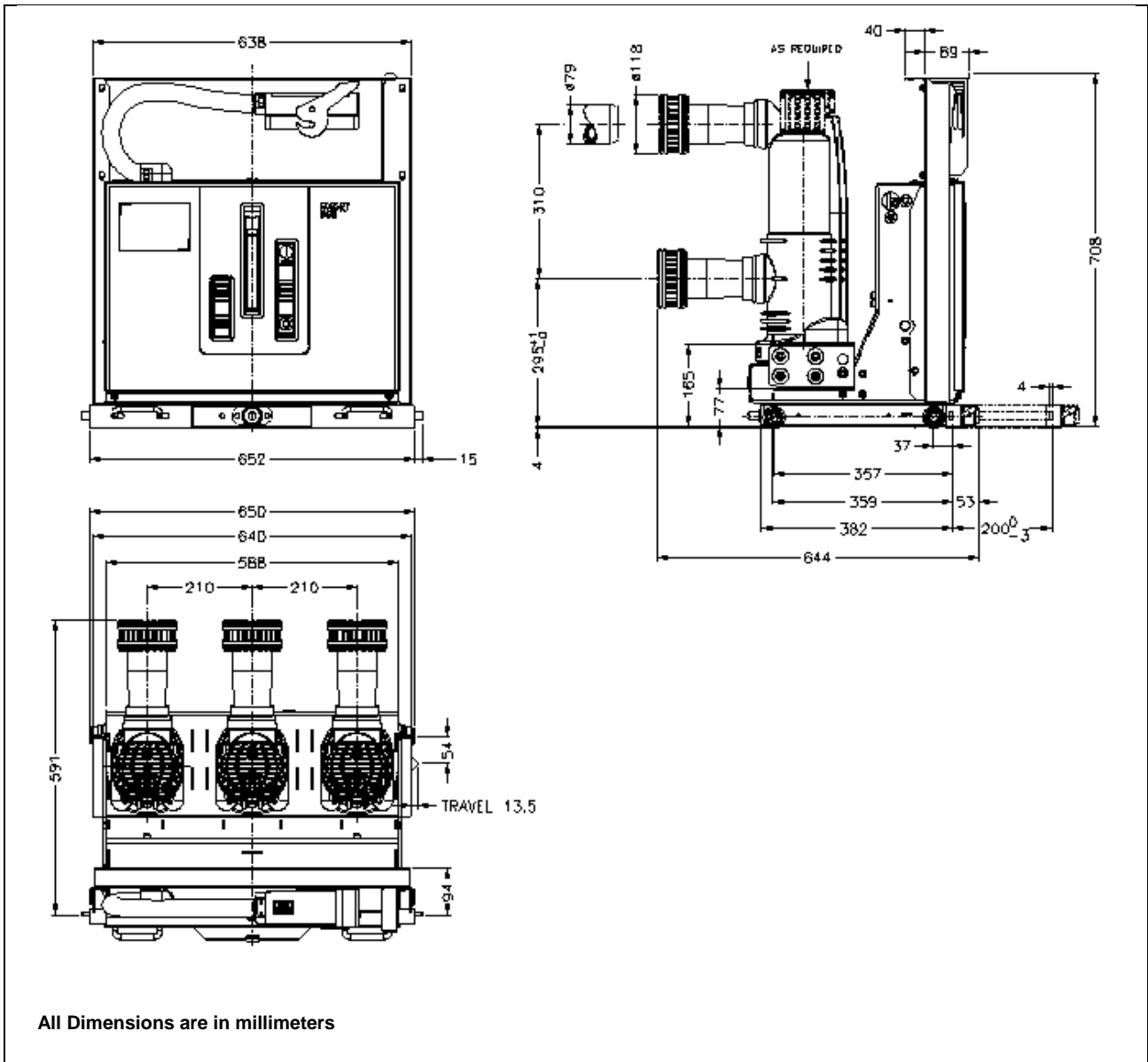
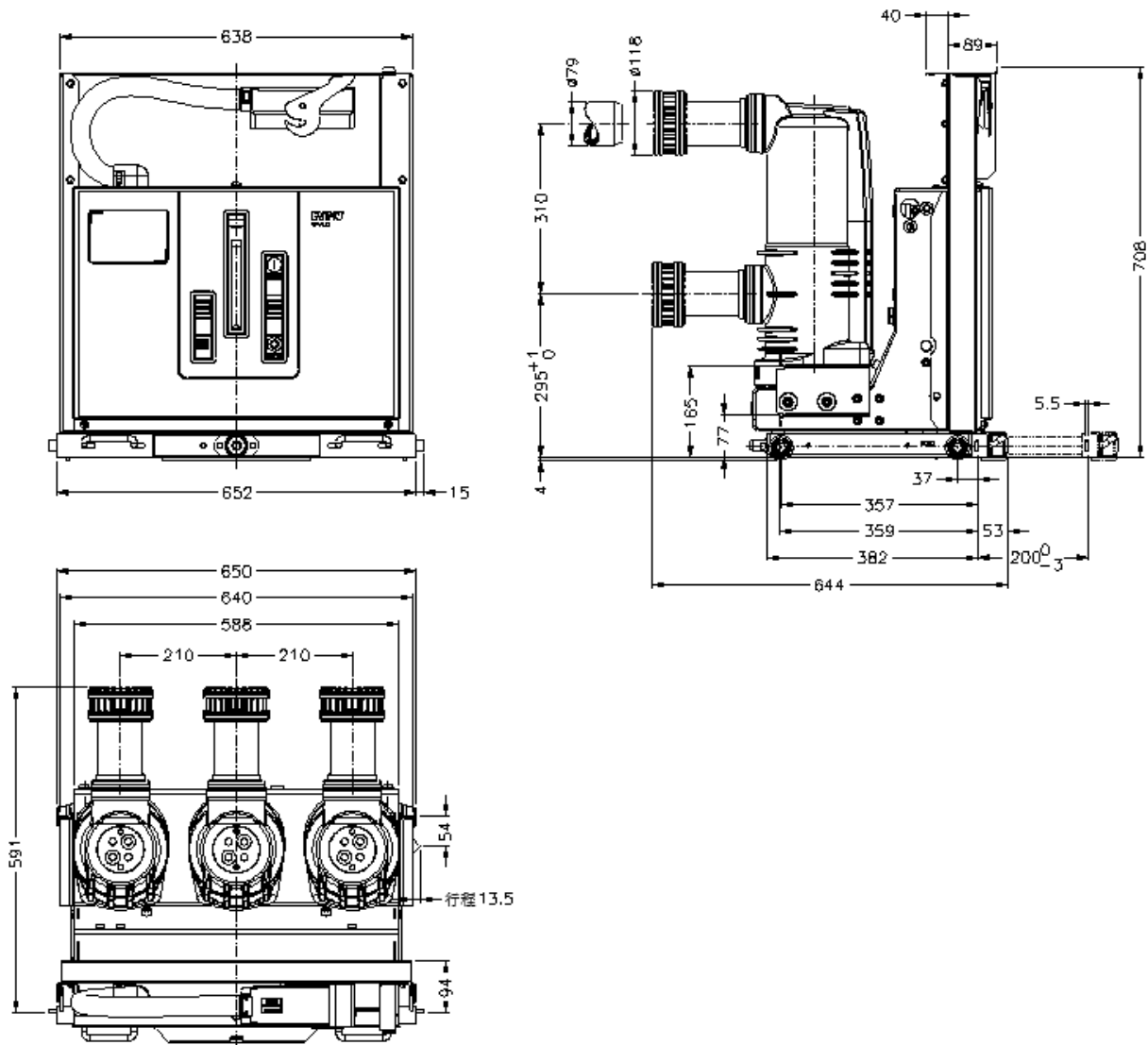


Fig. 2-9: 17.5kV Withdrawable W-VACi Circuit Breaker Frame 17.5W-3

Applicable Ratings				
Voltage	Breaking Current	Normal Current		
17.5kV	25kA	NA	1600A <sup>1</sup>	2000A <sup>2</sup>
	31.5kA	NA	1600A <sup>1</sup>	2000A <sup>2</sup>
	40kA	1250A <sup>1</sup>	1600A <sup>1</sup>	2000A <sup>2</sup>

<sup>1</sup> These ratings do not use a heat sink

<sup>2</sup> These ratings do use a heat sink



All Dimensions are in millimeters

Fig. 2-10: 17.5kV Withdrawable W-VACi Circuit Breaker Frame 17.5W-4

Applicable Ratings				
Voltage	Breaking Current	Normal Current		
17.5kV	50kA	1250A <sup>1</sup>	1600A <sup>1</sup>	2000A <sup>1</sup>

<sup>1</sup> These ratings do not use a heat sink

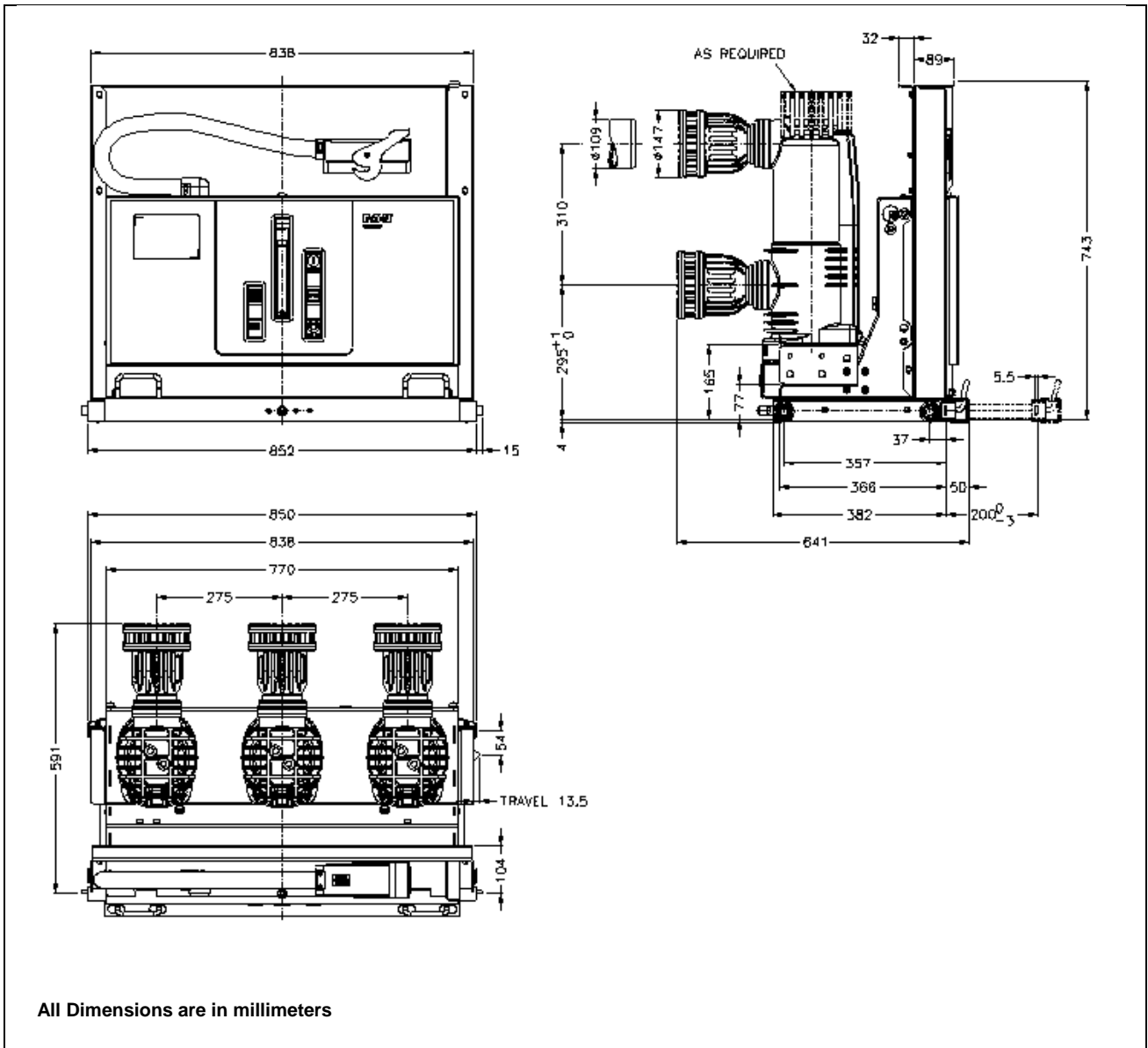


Fig. 2-11: 17.5kV Withdrawable W-VACi Circuit Breaker Frame 17.5W-5

Applicable Ratings			
Voltage	Breaking Current	Normal Current	
17.5kV	25kA	2500A <sup>1</sup>	3150A <sup>2</sup>
	31.5kA	2500A <sup>1</sup>	3150A <sup>2</sup>
	40kA	2500A <sup>1</sup>	3150A <sup>2</sup>
	50kA	2500A <sup>1</sup>	3150A <sup>2</sup>

<sup>1</sup> These ratings do not use a heat sink

<sup>2</sup> These ratings do use a heat sink

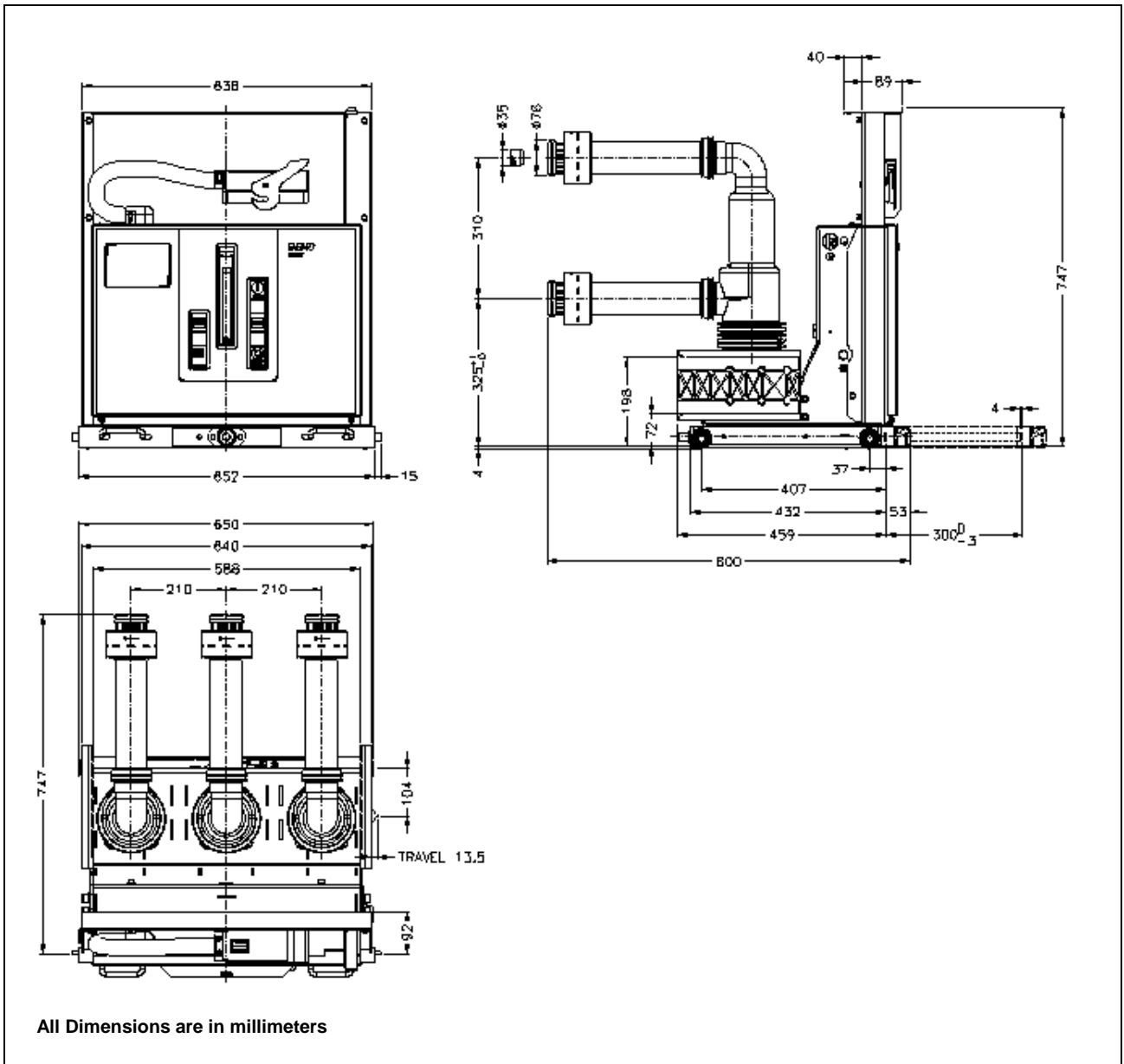


Fig. 2-12: 24 kV Withdrawable W-VACi Circuit Breaker Frame 24W-1

Applicable Ratings		
Voltage	Breaking Current	Normal Current
24kV	20kA	630A
	20kA	800A



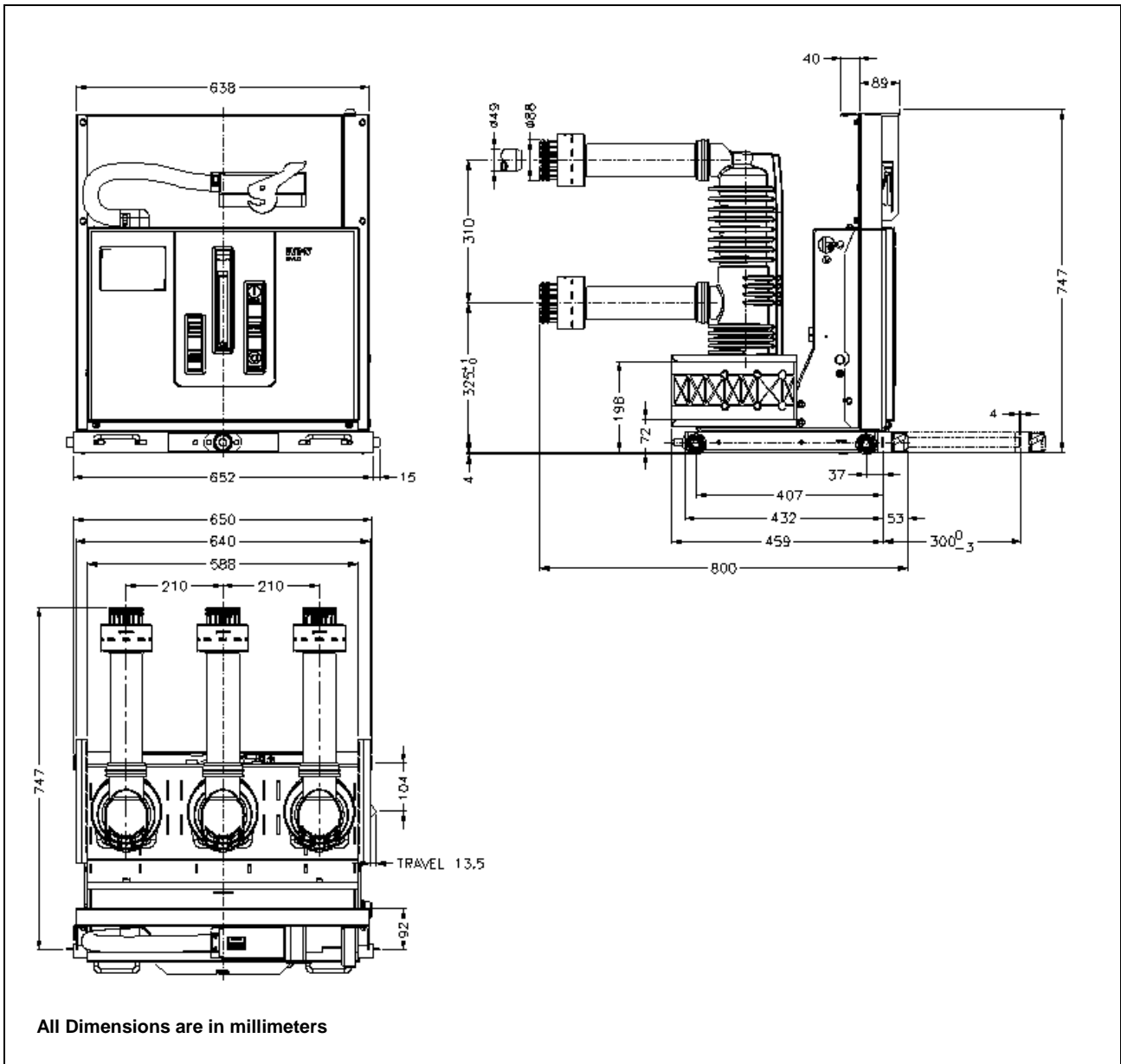


Fig. 2-13: 24 kV Withdrawable W-VACi Circuit Breaker Frame 24W-2

Applicable Ratings				
Voltage	Breaking Current	Normal Current		
24kV	25kA	630A <sup>1</sup>	800A <sup>1</sup>	1250A <sup>1</sup>

<sup>1</sup> These ratings do not use a heat sink

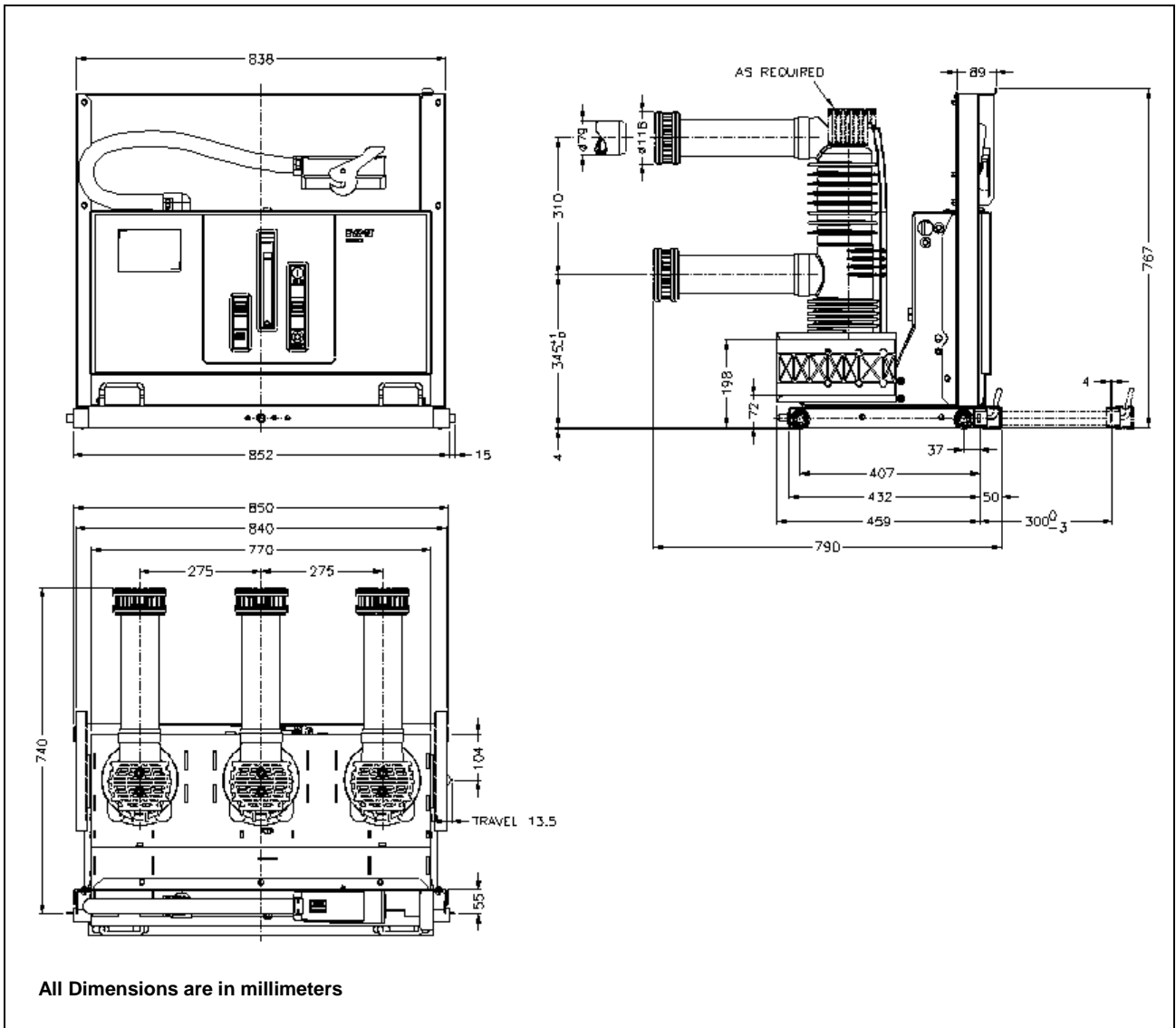


Fig. 2-14: 24 kV Withdrawable W-VACi Circuit Breaker Frame 24W-3

Applicable Ratings			
Voltage	Breaking Current	Normal Current	
24kV	25kA	1600A <sup>1</sup>	2000A <sup>2</sup>

<sup>1</sup> These ratings do not use a heat sink

<sup>2</sup> These ratings do use a heat sink

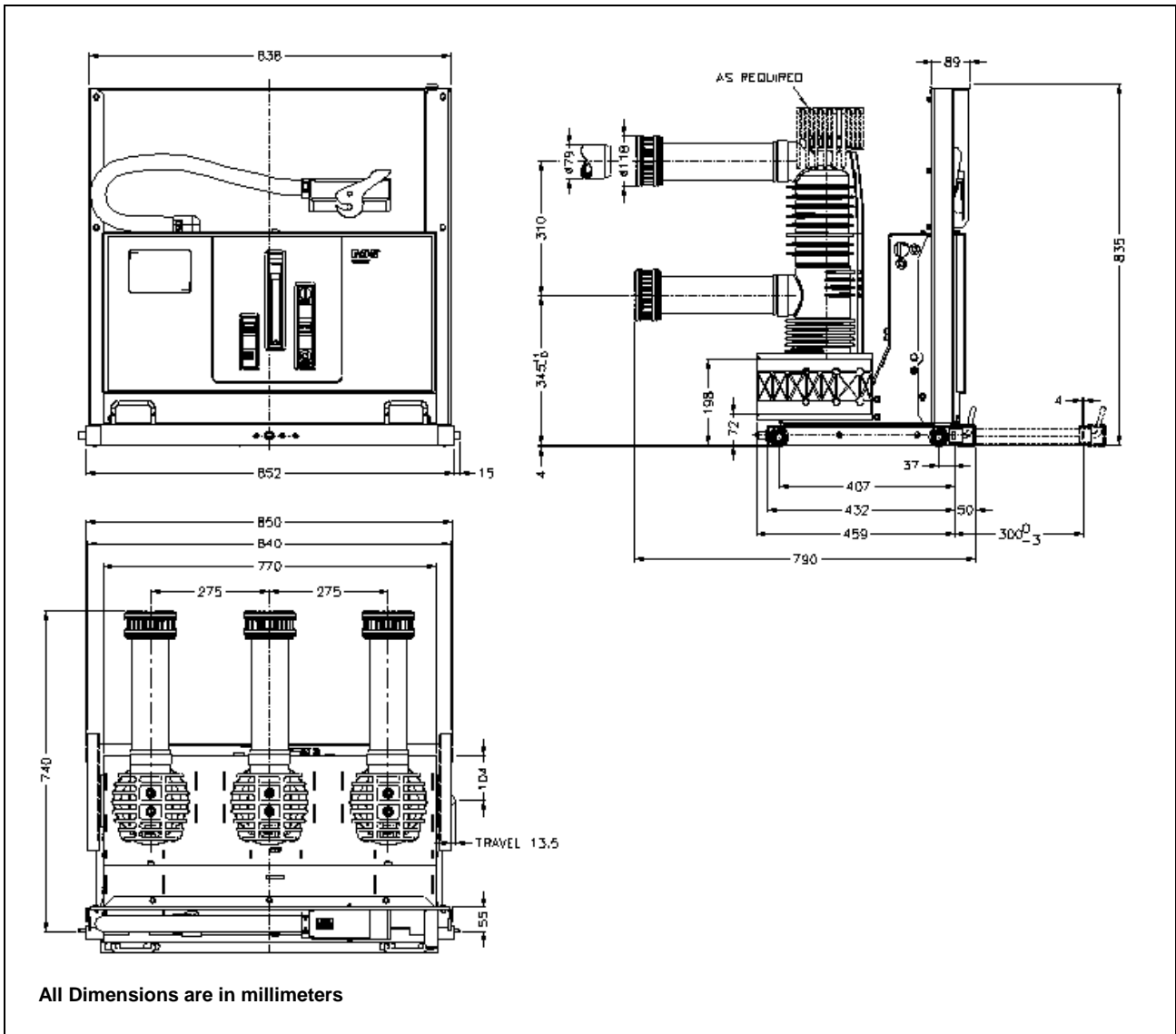


Fig. 2-15: 24 kV Withdrawable W-VACi Circuit Breaker Frame 24W-4

Applicable Ratings		
Voltage	Breaking Current	Normal Current
24kV	25kA	2500A <sup>2</sup>

<sup>2</sup> These ratings do use a heat sink

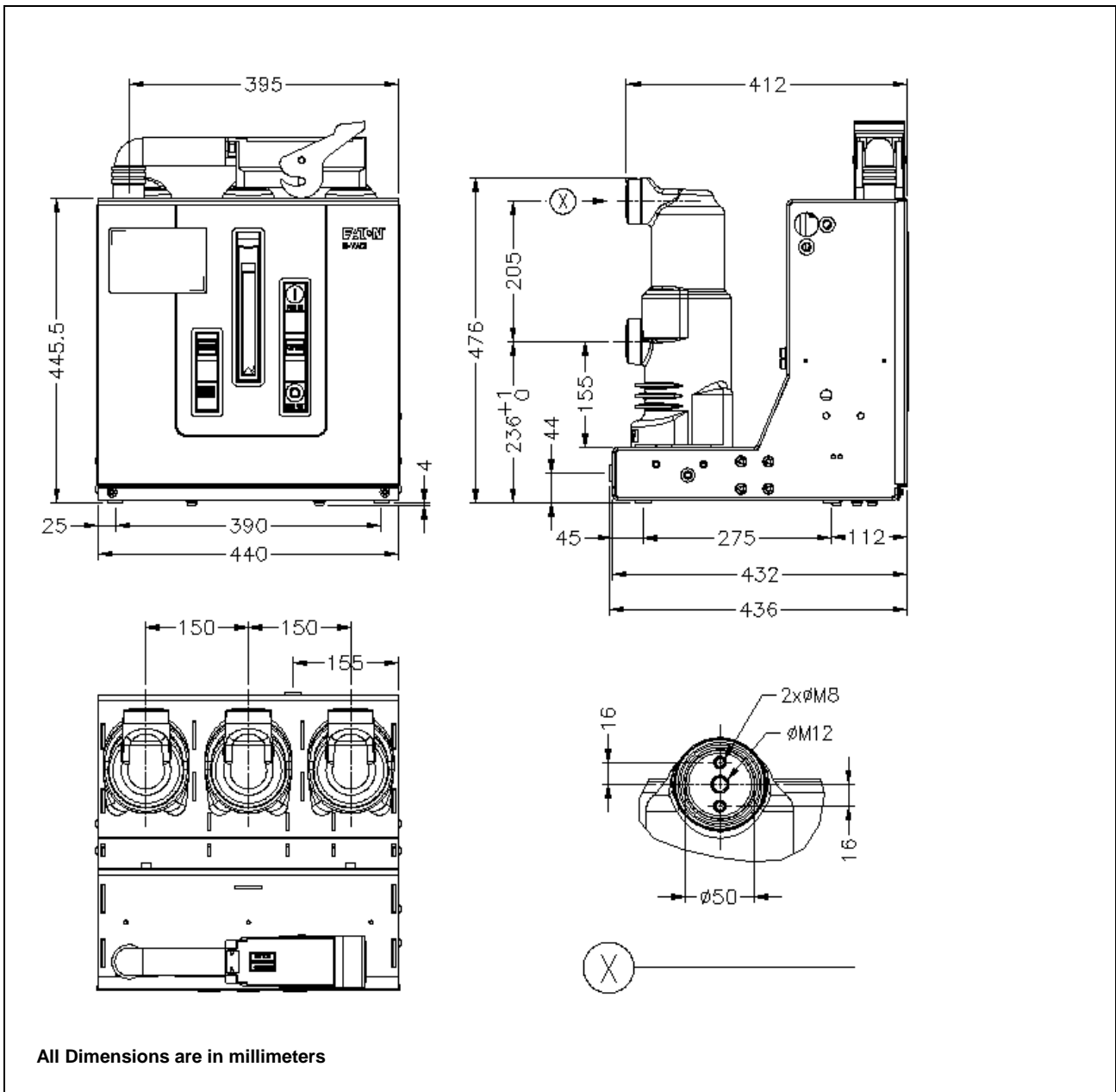


Fig. 2-16: 12kV Fixed W-VACi Circuit Breaker Frame 12F-1

Applicable Ratings			
Voltage	Breaking Current	Normal Current	
		12kV	25kA
	26.3kA	630A	800A

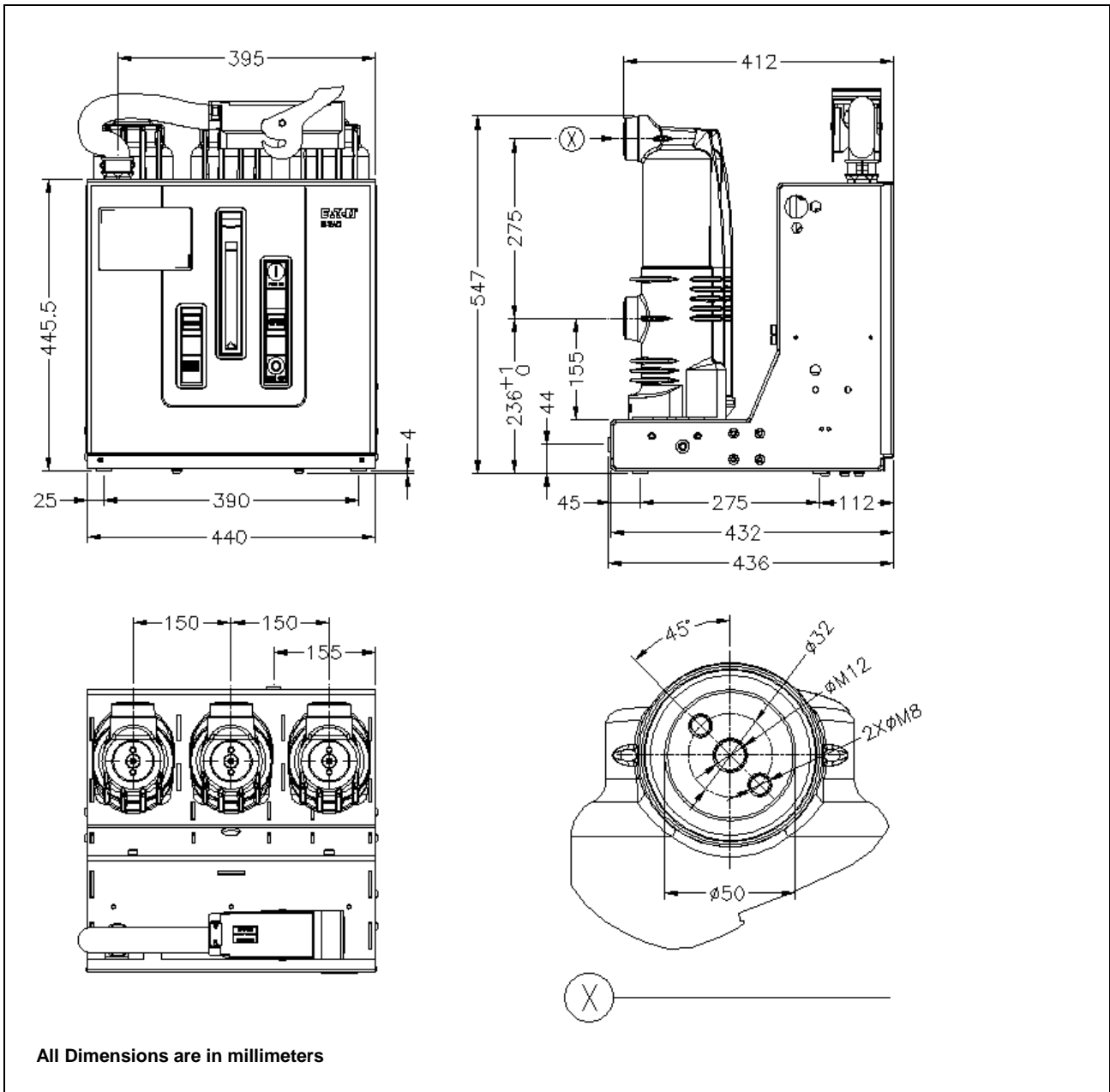


Fig. 2-17: 12kV Fixed W-VACi Circuit Breaker Frame 12F-2

Applicable Ratings				
Voltage	Breaking Current	Normal Current		
12kV	25kA	NA	NA	1250A
	26.3kA	NA	NA	1250A
	31.5kA	630A	800A	1250A

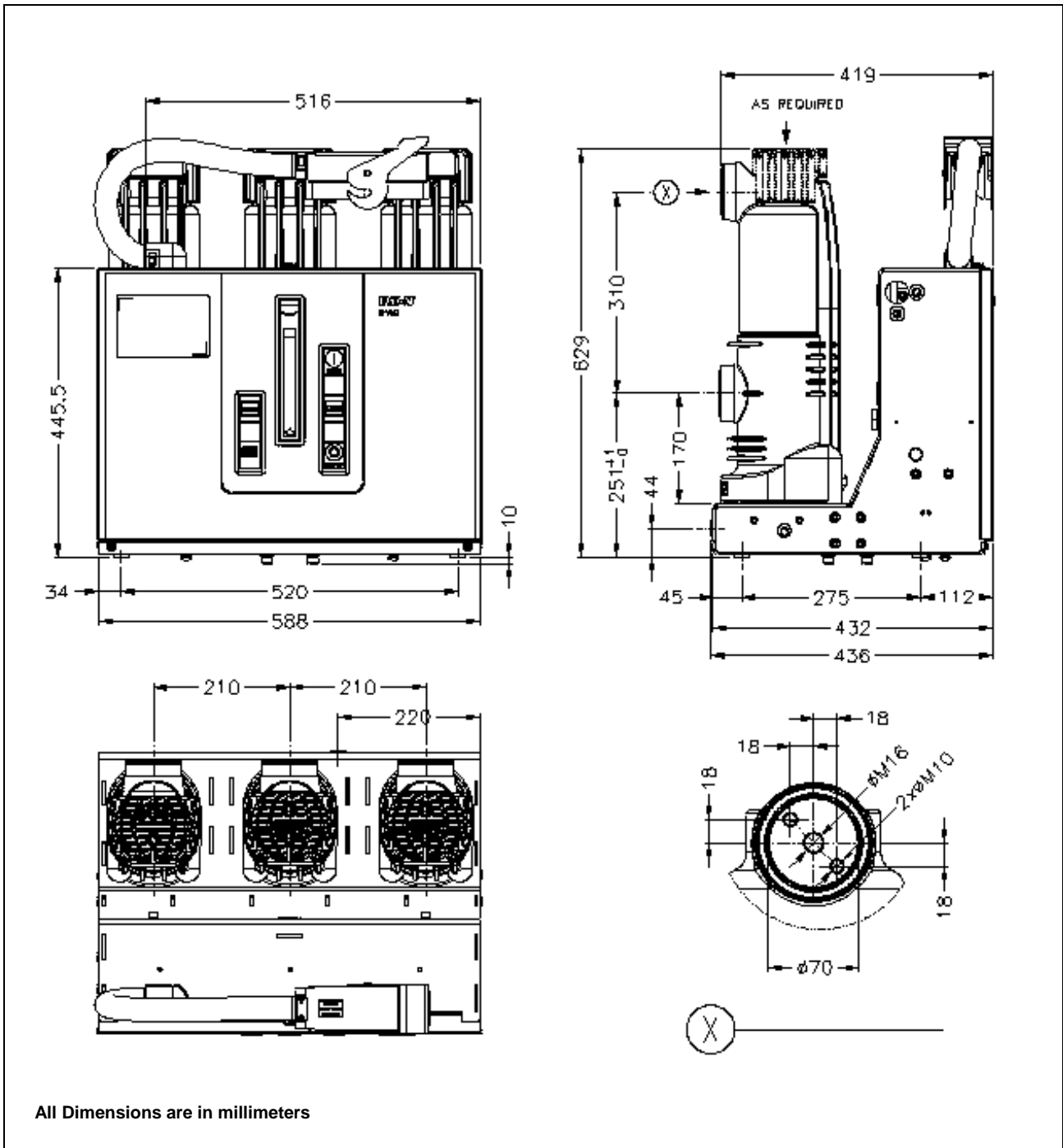


Fig. 2-18: 12kV Fixed W-VACi Circuit Breaker Frame 12F-3

Applicable Ratings				
Voltage	Breaking Current	Normal Current		
12kV	25kA	NA	1600A <sup>1</sup>	2000A <sup>2</sup>
	26.3kA	NA	1600A <sup>1</sup>	2000A <sup>2</sup>
	31.5kA	NA	1600A <sup>1</sup>	2000A <sup>2</sup>
	40kA	1250A <sup>1</sup>	1600A <sup>1</sup>	2000A <sup>2</sup>

<sup>1</sup> These ratings do not use a heat sink

<sup>2</sup> These ratings do use a heat sink

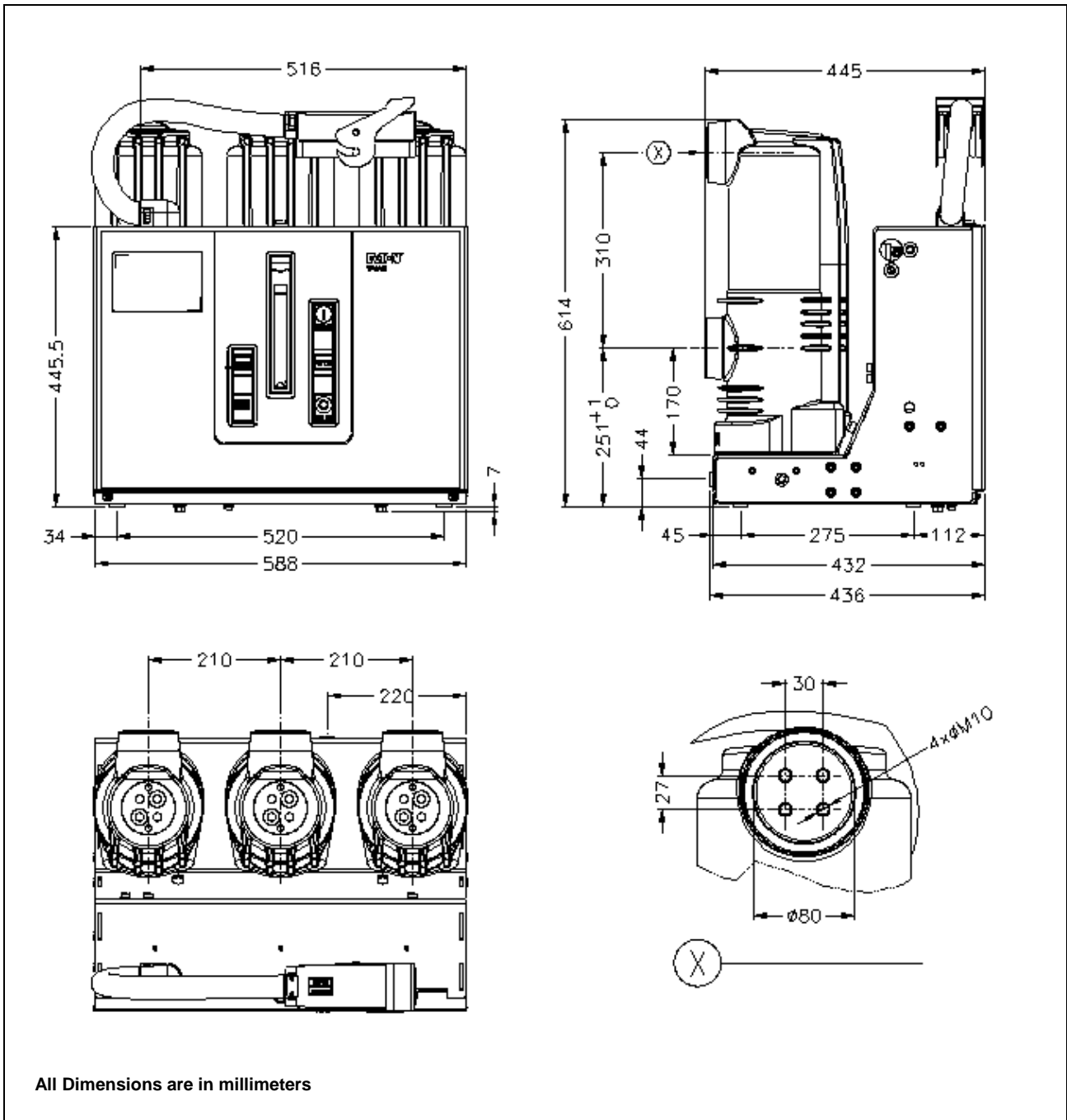


Fig. 2-19: 12kV Fixed W-VACi Circuit Breaker Frame 12F-4

Applicable Ratings				
Voltage	Breaking Current	Normal Current		
12kV	50kA	1250A <sup>1</sup>	1600A <sup>1</sup>	2000A <sup>1</sup>

<sup>1</sup>These ratings do not use a heat sink

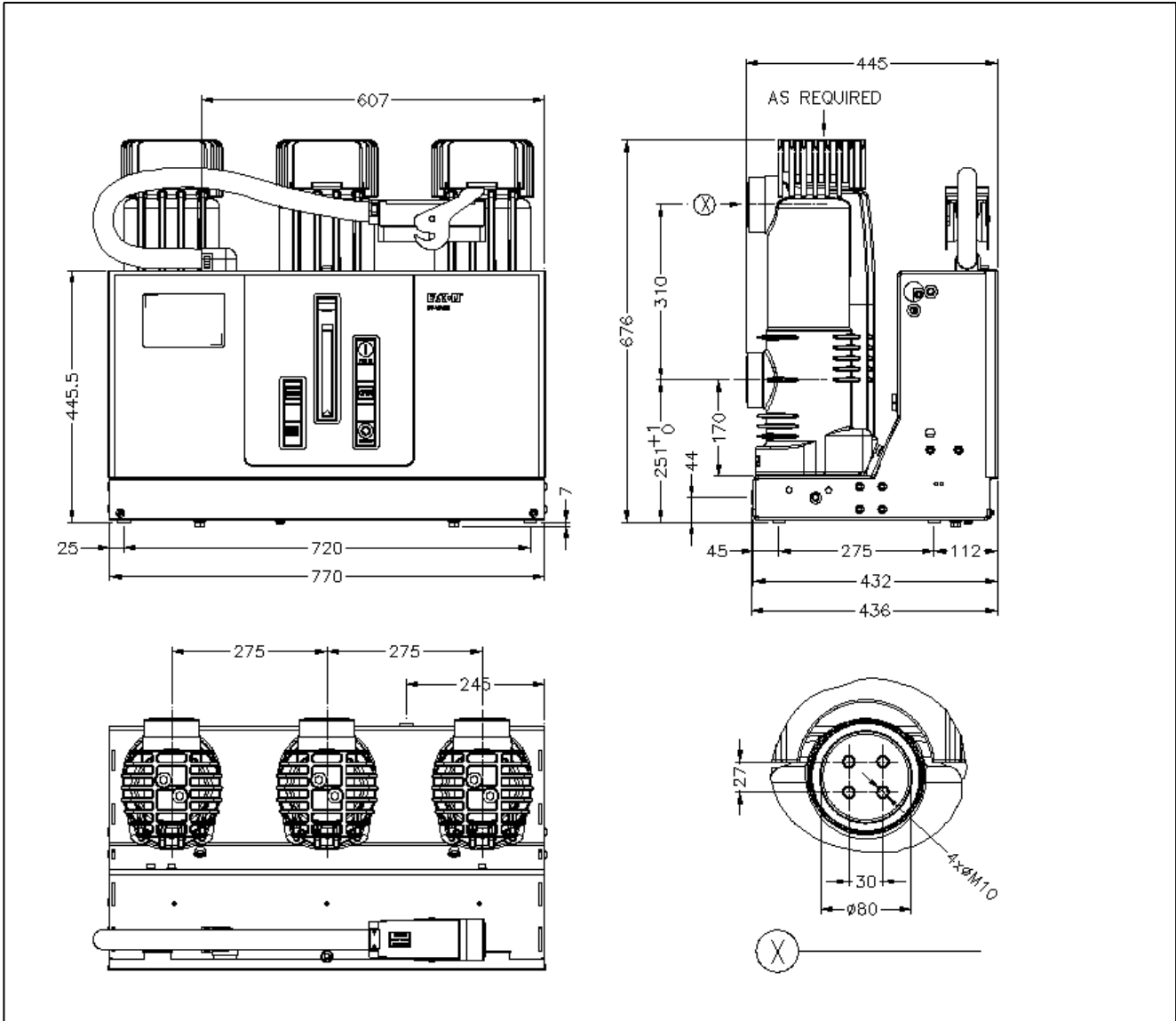


Fig. 2-20: 12kV Fixed W-VACi Circuit Breaker Frame 12F-5

Applicable Ratings			
Voltage	Breaking Current	Normal Current	
12kV	25kA	2500A <sup>1</sup>	3150A <sup>2</sup>
	26.3kA	2500A <sup>1</sup>	3150A <sup>2</sup>
	31.5kA	2500A <sup>1</sup>	3150A <sup>2</sup>
	40kA	2500A <sup>1</sup>	3150A <sup>2</sup>
	50kA	2500A <sup>1</sup>	3150A <sup>2</sup>

<sup>1</sup> These ratings do not use a heat sink

<sup>2</sup> These ratings do use a heat sink



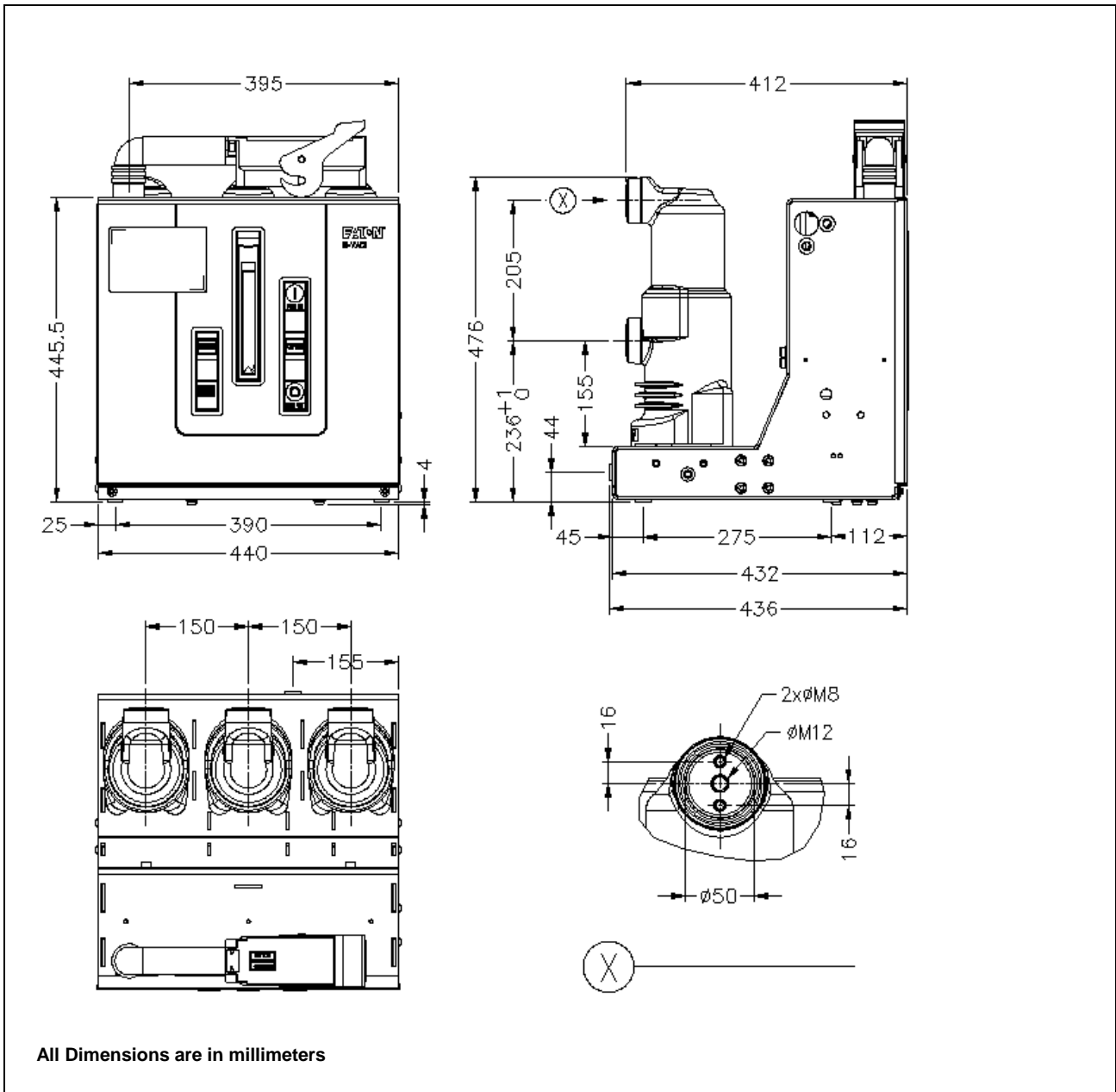


Fig. 2-21: 17.5kV Fixed W-VACi Circuit Breaker Frame 17.5F-1

Applicable Ratings			
Voltage	Breaking Current	Normal Current	
		17.5kV	25kA

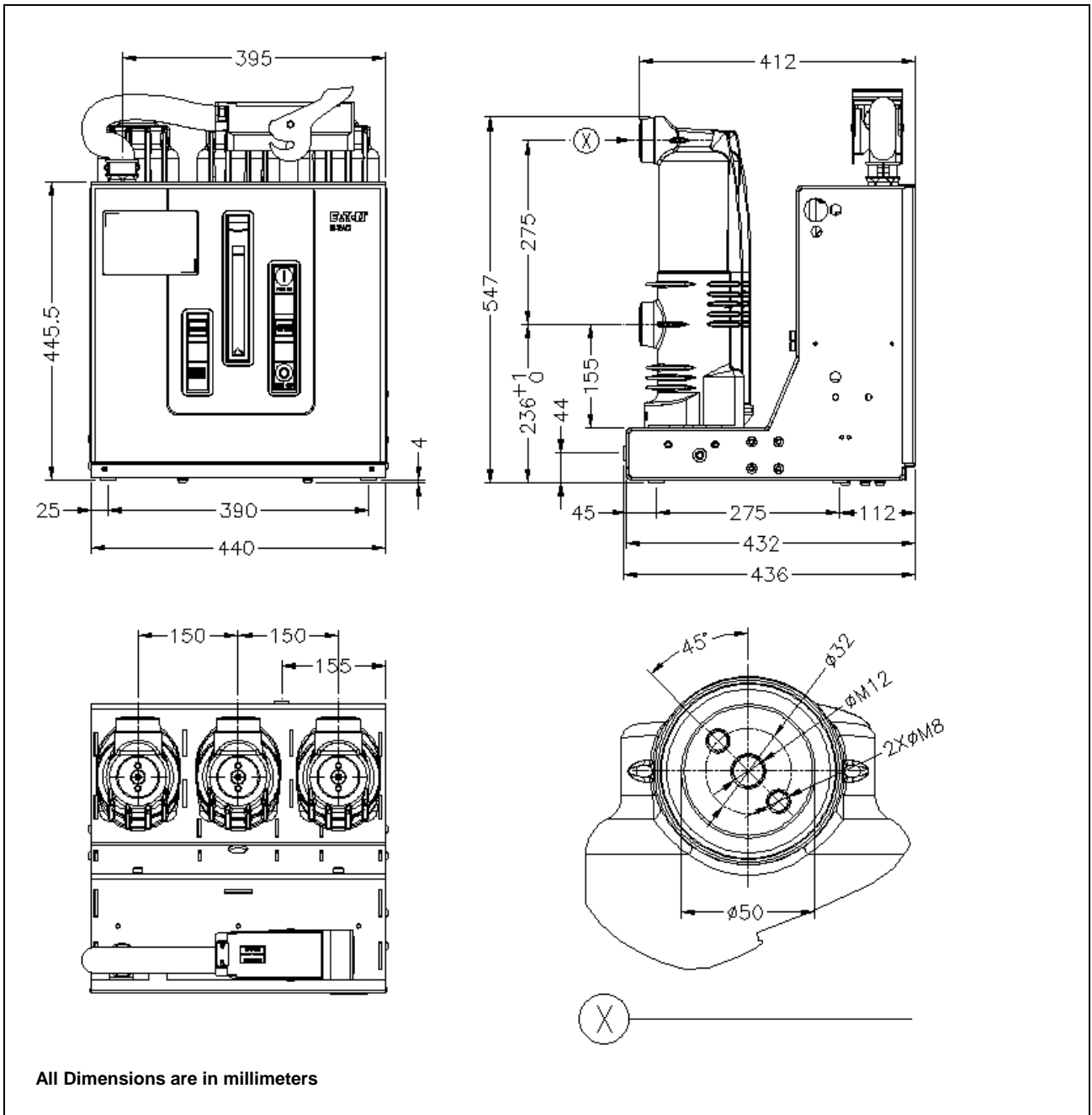


Fig. 2-22: 17.5kV Fixed W-VACi Circuit Breaker Frame 17.5F-2

Applicable Ratings				
Voltage	Breaking Current	Normal Current		
		17.5kV	25kA	NA
	31.5kA	630A	800A	1250A

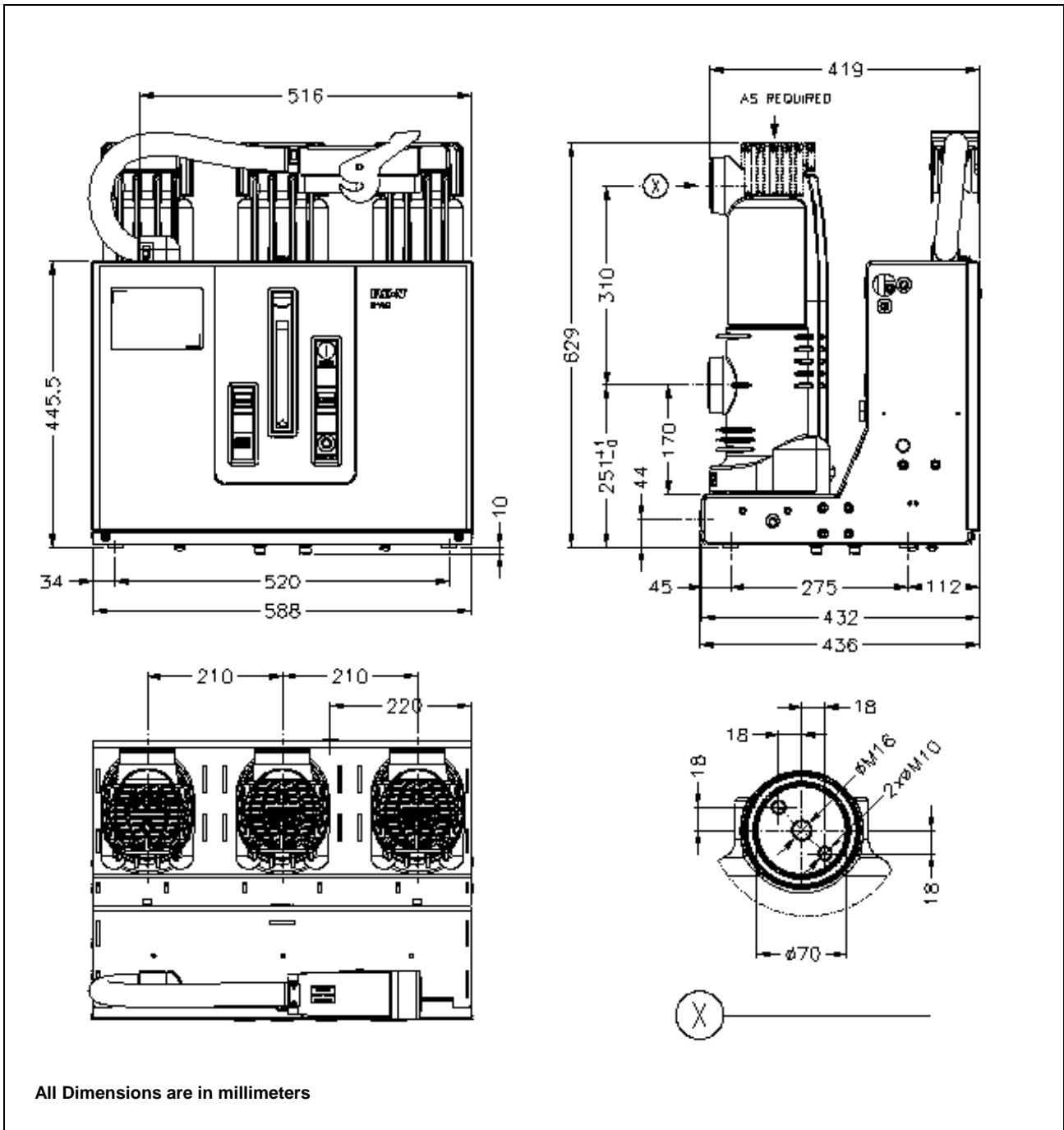


Fig. 2-23: 17.5kV Fixed W-VACi Circuit Breaker Frame 17.5F-3

Applicable Ratings				
Voltage	Breaking Current	Normal Current		
17.5kV	25kA	NA	1600A <sup>1</sup>	2000A <sup>2</sup>
	31.5kA	NA	1600A <sup>1</sup>	2000A <sup>2</sup>
	40kA	1250A <sup>1</sup>	1600A <sup>1</sup>	2000A <sup>2</sup>

<sup>1</sup> These ratings do not use a heat sink

<sup>2</sup> These ratings do use a heat sink

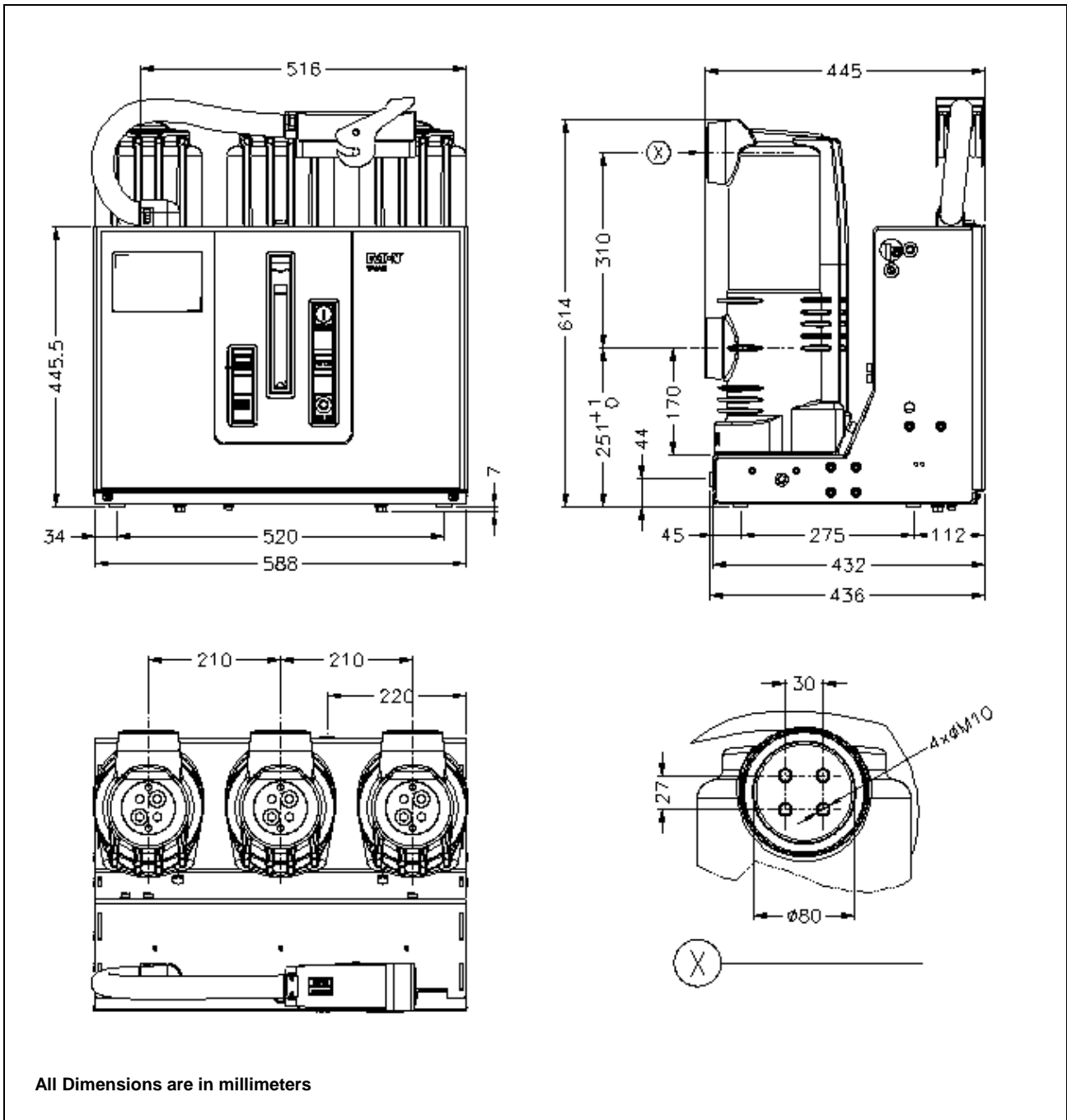


Fig. 2-24: 17.5kV Fixed W-VACi Circuit Breaker Frame 17.5F-4

Applicable Ratings				
Voltage	Breaking Current	Normal Current		
17.5kV	50kA	1250A <sup>1</sup>	1600A <sup>1</sup>	2000A <sup>1</sup>

<sup>1</sup> These ratings do not use a heat sink

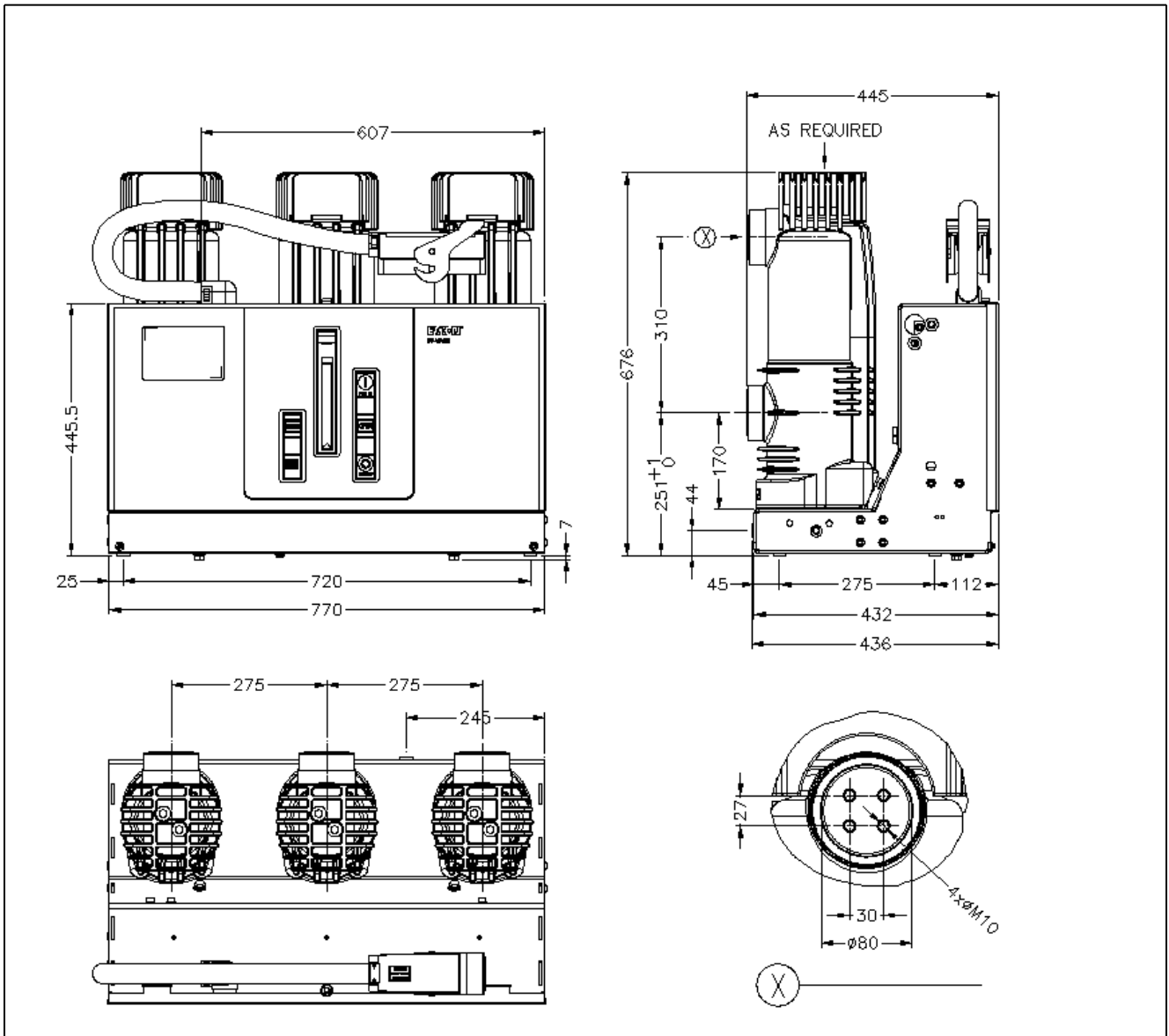


Fig. 2-25: 17.5kV Fixed W-VACi Circuit Breaker Frame 17.5F-5

Applicable Ratings			
Voltage	Breaking Current	Normal Current	
		17.5kV	25kA
	31.5kA	2500A <sup>1</sup>	3150A <sup>2</sup>
	40kA	2500A <sup>1</sup>	3150A <sup>2</sup>
	50kA	2500A <sup>1</sup>	3150A <sup>2</sup>

<sup>1</sup> These ratings do not use a heat sink

<sup>2</sup> These ratings do use a heat sink

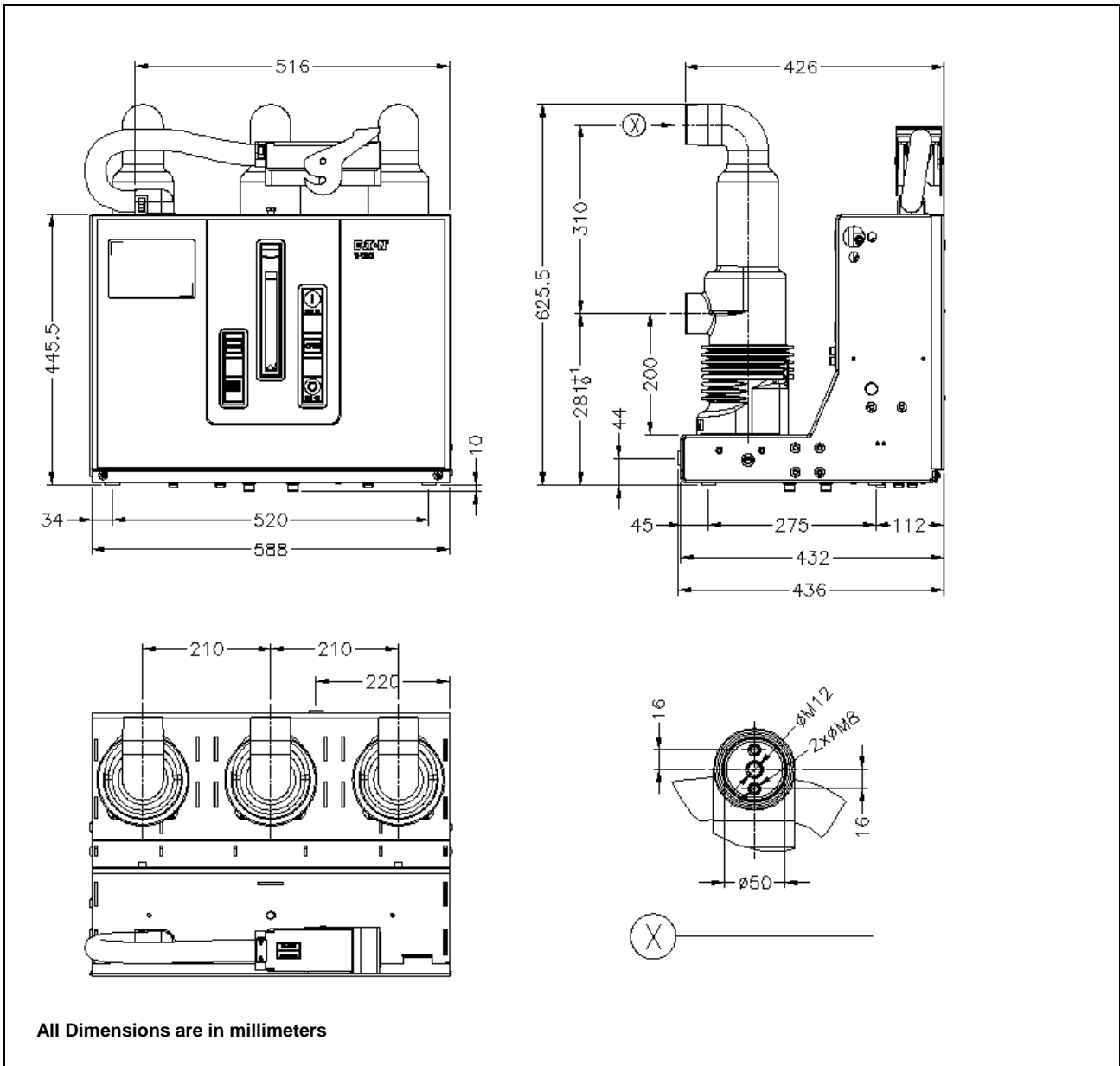


Fig. 2-26: 24kV Fixed W-VACi Circuit Breaker Frame 24F-1

Applicable Ratings		
Voltage	Breaking Current	Normal Current
24kV	20kA	630A
	20kA	800A

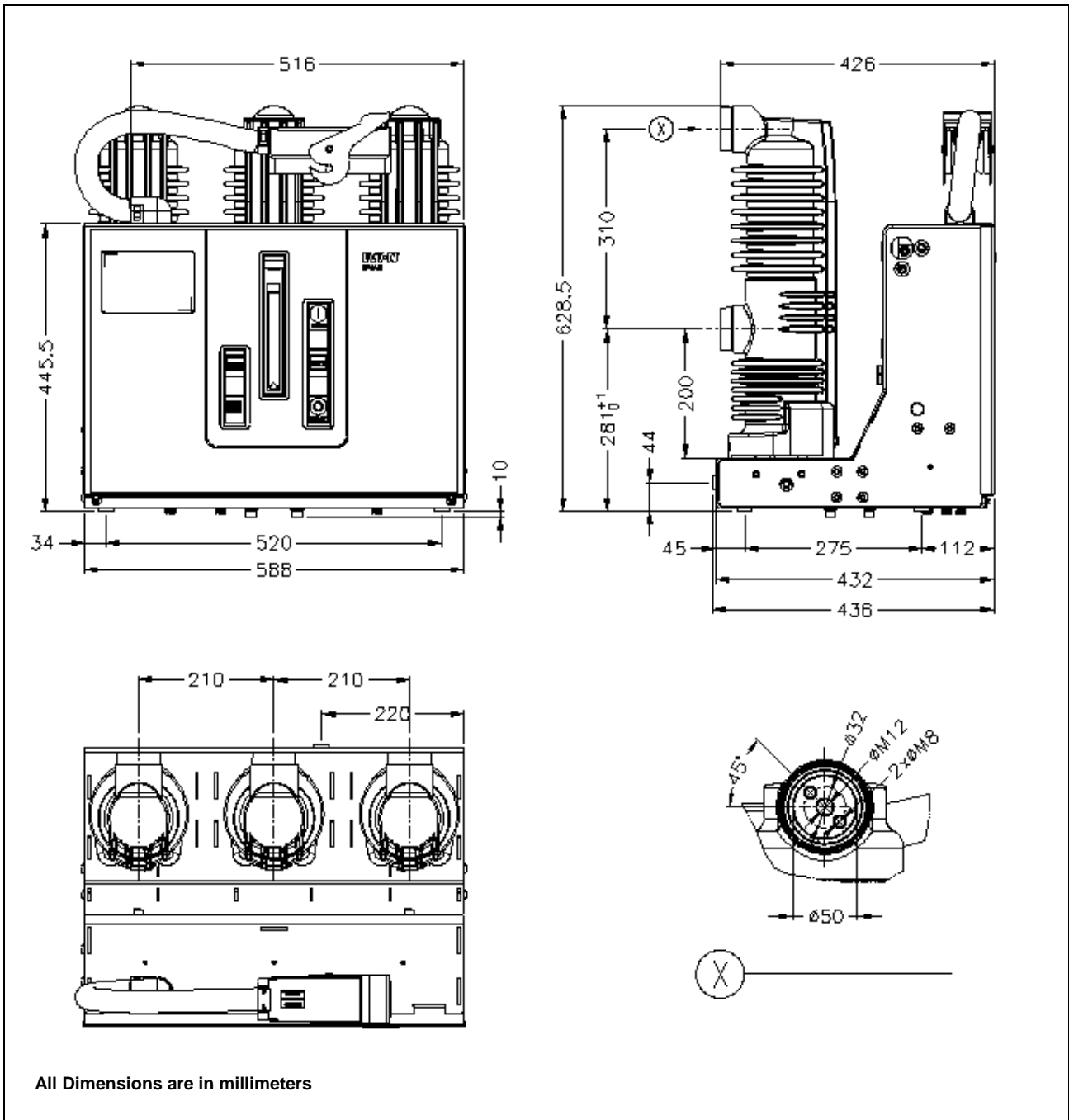


Fig. 2-27: 24kV Fixed W-VACi Circuit Breaker Frame 24F-2

Applicable Ratings				
Voltage	Breaking Current	Normal Current		
24kV	25kA	630A <sup>1</sup>	800A <sup>1</sup>	1250A <sup>1</sup>

<sup>1</sup> These ratings do not use a heat sink

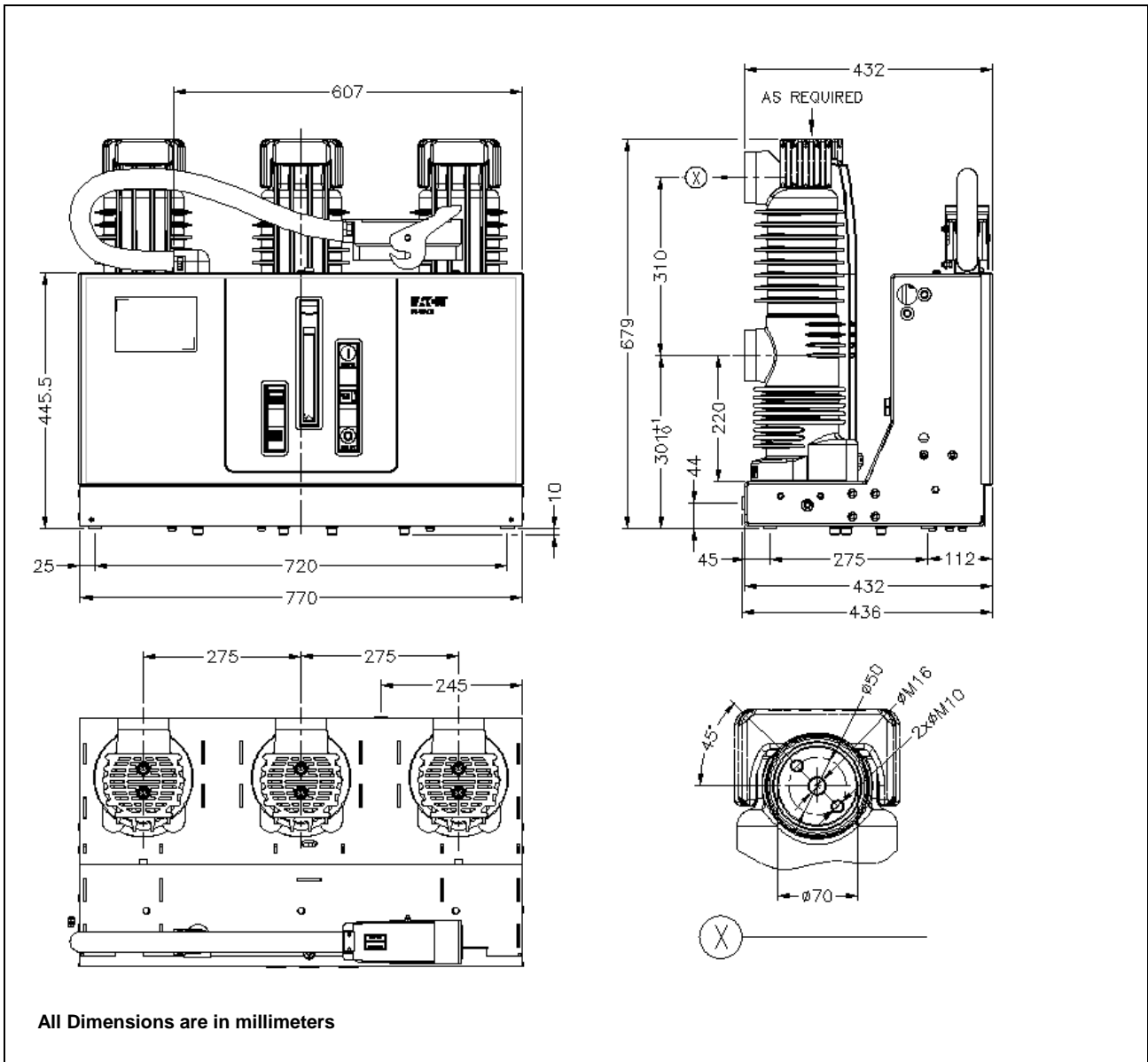


Fig. 2-28: 24kV Fixed W-VACi Circuit Breaker Frame 24F-3

Applicable Ratings			
Voltage	Breaking Current	Normal Current	
24kV	25kA	1600A <sup>1</sup>	2000A <sup>2</sup>

<sup>1</sup> These ratings do not use a heat sink

<sup>2</sup> These ratings do use a heat sink



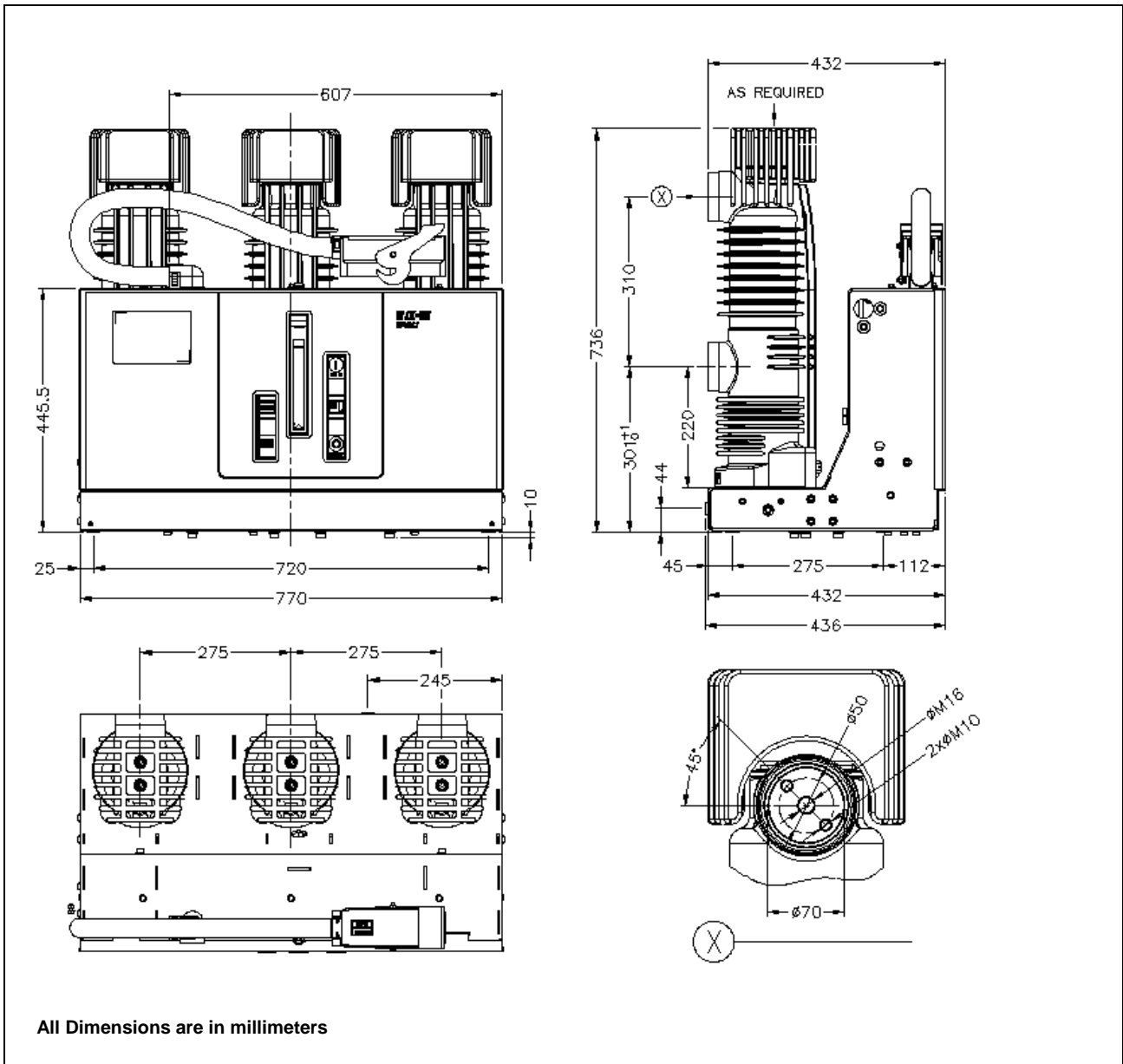


Fig. 2-29: 24kV Fixed W-VACi Circuit Breaker Frame 24F-4

Applicable Ratings		
Voltage	Breaking Current	Normal Current
24kV	25kA	2500A <sup>2</sup>

<sup>2</sup> These ratings do use a heat sink

## 3 Receiving, handling and storage

### 3.1 Receiving

Until the circuit breaker is ready to be delivered to the installation site, **DO NOT** remove container. When the circuit breaker is placed in storage, maximum protection can be obtained only when the circuit breaker is placed in storage and is in its original packaging.

Inspect the container for any signs of damage or rough handling upon receipt. Open the container carefully to avoid any damage to the contents.

Be careful that any loose items or hardware are not discarded with the packing material. When opening the container, check the content of each package against the packing list.

Examine the circuit breaker for any sign of shipping damage such as broken, missing or loose hardware, and damaged or deformed insulation. File claims immediately with the carrier if damage or loss is detected and notify the appropriate Eaton representative.

### 3.2 Handling



#### WARNING

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**Do not use a lifting device as a platform for performing inspection or repair on the circuit breaker, nor for operating the contacts or charging the springs. The breaker may fall, causing severe personal injury. Always use a suitable workbench capable of supporting the breaker.**

The circuit breaker shipping containers are designed to be handled either by use of a rope sling and overhead lifting device or by a fork truck. If containers must be moved, it is preferable to use one of the above methods, roller conveyors, or individual pipe rollers.

After inspecting for potential shipping damage, the breaker should be returned to its original shipping container until it is ready to be installed.

When a circuit breaker is ready for installation, a removable lifting bar in conjunction with an overhead lifter or portable floor lifter can be used to move the breaker. If the circuit breaker is to be lifted, the lifting bar must be positioned over the circuit breaker and the bar must be inserted into the circuit breaker side openings with the lifting hole toward the interrupters. Once the lifting bar is securely seated in the lifting holes, the circuit breaker can be carefully lifted and moved.

### 3.3 Storage

If the circuit breaker is placed in storage, it must be kept in the original packaging for maximum protection. The circuit breaker is shipped with its contacts open and closing springs discharged. The indicator on the front panel should confirm this. Refer to Section 4 for detailed information on both manual and electrical operation of the circuit breaker.

Outdoor storage is NOT recommended. However, if unavoidable, the outdoor location must be well drained and a temporary shelter from sun, rain, snow, corrosive fumes, dust, dirt, falling objects and excessive moisture must be provided. Containers should be arranged to permit free circulation of air on all sides and temporary heaters should be used to minimize condensation. Moisture can cause rusting of metal parts and deterioration of high voltage insulation. A heat level of approximately 400 watts for each 3 cubic meters of volume is recommended with the heaters distributed uniformly throughout the structure near the floor.

Indoor storage should be in a building with sufficient heat and circulation to prevent condensation. If the building is not heated, the same rules for outdoor storage should be applied.

### 3.4 Lifting of Circuit Breakers

Always consider the center of gravity of the breaker may induce the breaker to tip over.

If a breaker has a single hole on each side and a picture of a lifting hook, as shown in Fig. 3-1, use lifting straps and hooks to attach to the circuit breaker at those points to lift the circuit breaker. When the circuit breaker has a single lifting hole with two additional bolt holes, use the lifting attachments shown in Fig. 3-2 to attach to the breaker. Then attach the lifting straps and hooks to the attachments. When using any lifting equipment, remove the lifting equipment before installing the circuit breaker into the switchgear.



Fig. 3-1: Lifting Point

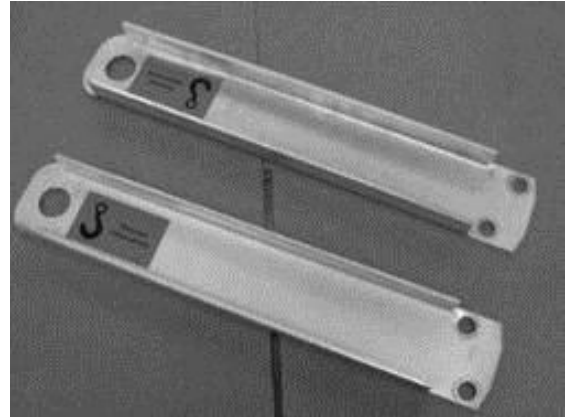


Fig. 3-2: Lifting Attachments

### 3.5 W-VACi Circuit Breaker Weights

Table 3- 1: 12kV Circuit Breaker weights

12 kV Circuit Breaker Weights(kg)*							
		630 A	800 A	1250 A	1600 A	2000 A	3150 A
Fixed	25kA	83	83	92	130	130	210
	26.3kA	83	83	92	130	130	210
	31.5kA	92	92	92	130	130	210
	40kA	N/A	N/A	130	130	130	210
	50kA	N/A	N/A	155	155	155	210
Withdrawable	25kA	110	110	123	174	174	287
	26.3kA	110	110	123	174	174	287
	31.5kA	123	123	123	174	174	287
	40kA	N/A	N/A	174	174	174	287
	50kA	N/A	N/A	203	203	203	287

\*±3kg.

Table 3- 2: 17.5 kV Circuit Breaker Weights

17.5 kV Circuit Breaker Weights(kg)							
		630 A	800 A	1250 A	1600 A	2000 A	3150 A
Fixed	25kA	83	83	92	130	130	210
	31.5kA	92	92	92	130	130	210
	40kA	N/A	N/A	130	130	130	210
	50kA	N/A	N/A	130	130	155	210
Withdrawable	25kA	110	110	123	174	174	287
	31.5kA	123	123	123	174	174	287
	40kA	N/A	N/A	174	174	174	287
	50kA	N/A	N/A	203	203	203	287

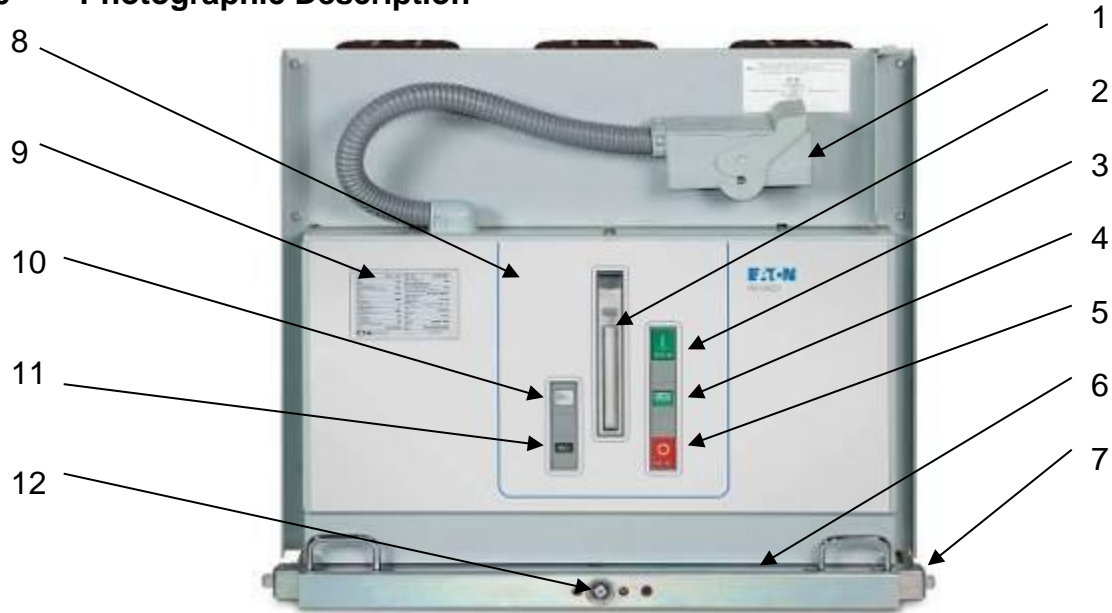
\*±3kg.

Table 3- 3: 24 kV Circuit breaker Weights

24 kV Circuit Breaker Weights(kg)							
		630 A	800 A	1250 A	1600 A	2000 A	2500 A
Fixed	20 kA	104	104	N/A	N/A	N/A	N/A
	25 kA	112	112	113	158	158	159
Withdrawable	20 kA	144	144	N/A	N/A	N/A	N/A
	25 kA	162	162	163	234	234	242

\*±3kg.

### 3.6 Photographic Description



**Fig. 3-3: Front view of W-VACi Withdrawable Circuit Breaker Element**

- |                           |   |
|---------------------------|---|
| 1. Secondary Disconnect   | 7. Operation Handle for Shout-bolts       |
| 2. Manual Charging Handle | 8. Front Panel                            |
| 3. Manual Close Button    | 9. Nameplate                              |
| 4. Closed/Open Indicator  | 10. Spring Charged/Discharged Indicator   |
| 5. Manual Open Button     | 11. Operation Counter                     |
| 6. Racking in Assembly    | 12. Coupling Lever for Racking in and out |



**Fig. 3-4: Internal view of W-VACi Circuit Breaker Element**

- |  |                             |
|--|-----------------------------|
| 1. Universal Mechanism Assembly (UMA)    | 7. Charging Motor           |
| 2. Closing Spring                        | 8. Integral Charging Handle |
| 3. Spring Charged / Discharged Indicator | 9. Manual Close Button      |
| 4. Operation Counter                     | 10. Closed / Open Indicator |
| 5. Hydraulic Damper                      | 11. Manual Open Button      |
| 6. Auxiliary switch                      |                             |



W-VACi with 150 mm Pole Spacing Breaker

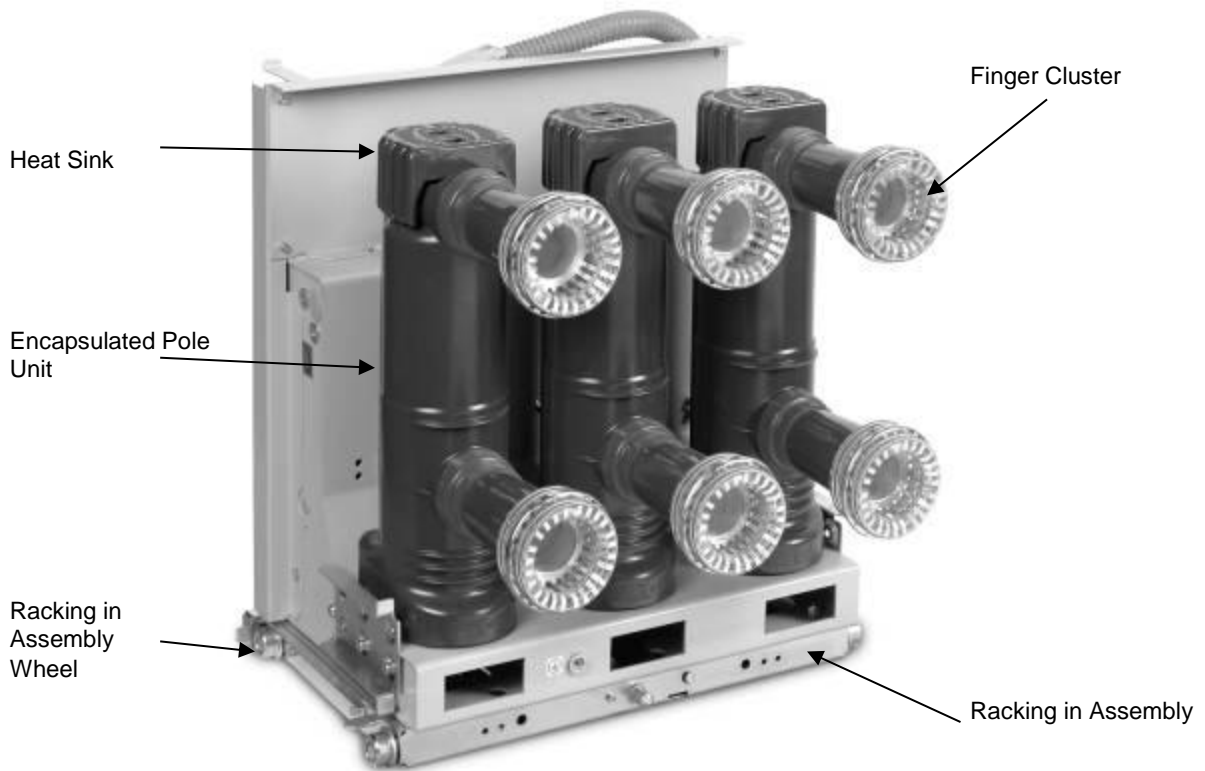


W-VACi with 210 mm Pole Spacing Breaker



W-VACi with 275 mm Pole Spacing Breaker

**Fig. 3-5: W-VACi Circuit Breaker Withdrawable Frames**



**Fig. 3-6: Typical Rear View of a Withdrawable W-VACi**

## 4 Inspection

### 4.1 Inspection

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 **WARNING**

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- Do not work on a breaker in the "service" position.
- Do not work on a breaker with secondary disconnects engaged.
- Do not work on a breaker with springs charged or contacts closed.
- Do not override any safety interlocks.
- Do not leave the manual charging handle in working location after charging the closing springs.
- Do not stand less than one meter away from the breaker when testing for vacuum integrity.

### 4.2 Frequency of Inspection

It is recommended to inspect the breaker when it is received. In cases where the breaker operates in a clean and non-corrosive environment, the circuit breaker should be inspected after 10 years or 10,000 operations, whichever comes first. In dusty and/or corrosive environment, inspection should be performed at least once a year. Additionally, it is recommended to inspect the breaker every time it interrupts a fault current.

### 4.3 Inspection Process

See Table 4-4 and follow the steps to inspect the breaker.

### 4.4 Vacuum Interrupter Integrity Test

Vacuum interrupters used in all W-VACi circuit breakers are highly reliable interrupting elements. Satisfactory performance of these devices is dependent upon the integrity of the vacuum in the interrupter and the internal dielectric strength. Both of these parameters can be readily checked by a one minute AC high potential test. During this test, the following warning must be observed:

Table 4-1: Testing Ratings

Breaker	Testing Voltage
12kV	28kV ac
17.5kV	38kV ac
24kV	50kV ac

This test should be done with the breaker in "OPEN" position.

---

 **WARNING**

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Applying abnormally high voltage across a pair of contacts in vacuum may produce x-radiation. The radiation may increase with the increase in voltage and/or decrease in contact spacing. X-radiation produced during this test with recommended voltage and normal contact spacing is extremely low and is well below maximum levels.

---

 **WARNING**

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After the high potential test is conducted, an electrical charge may be retained by the vacuum interrupters. Failure to discharge this residual electrostatic charge could result in an electrical shock. Follow safety procedures for this type of test.

### 4.5 Insulation Inspection

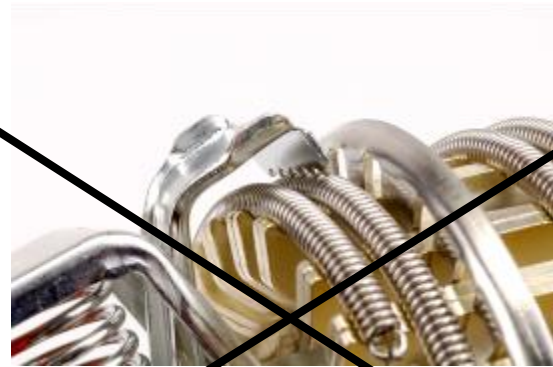
Insulation inspection is performed to keep all insulating surfaces clean. This can be done by wiping all insulating surfaces with a dry lint free cloth and denatured alcohol. In case there is any tightly adhering dirt that will not come off by wiping, it can be removed with a mild solvent or distilled water. Confirm that the surfaces are dry before placing the breaker in service. If a solvent is required to remove the dirt, once the switchgear has been isolated, use benzene or white spirit. Secondary control wiring requires inspection for tightness of all connections and damage to insulation.

## 4.6 Main Circuit Resistance Check

The resistance of the main circuit can be measured as follows: Ensure the breaker is in closed status, deliver 100A DC current to the main circuit, and measure the DC resistance with the help of a test machine. The results cannot exceed the value in the Table 4-2. When conducting this test with a withdrawable breaker, **DO NOT** attach the test clamp to the springs. Use Fig. 4-1 as reference.

Table 4-2: Resistance chart of Main Circuit

Normal Current	Fixed	D.O.
	DC Resistance ( $\mu\Omega$ )	
630A	$\leq 35$	$\leq 45$
800A	$\leq 35$	$\leq 45$
1250A	$\leq 20$	$\leq 35$
1600A	$\leq 15$	$\leq 30$
2000A	$\leq 15$	$\leq 30$
2500A	$\leq 12$	$\leq 25$
3150A	$\leq 12$	$\leq 25$



When testing circuit resistance: **DO NOT** directly clamp onto the springs when injecting current.



When testing circuit resistance: clamp directly onto the finger cluster between the springs as shown.

Fig. 4-1: Finger Cluster Warning

## Mechanism Inspection Check

Carefully inspect the mechanism for any possible loose parts such as bolts, nuts, pins and rings. Check for excessive wear or damage to the breaker components. Operate the breaker several times manually and electrically. Check the closing and opening times to verify that they are in accordance with acceptable limits. Refer to the technical parameters sections 2.4, 2.5 and 2.6 for closing and opening time limits.

## 4.7 Torque specifications

Table 4-3: Torque Specifications

Nominal size and pitch	Newton Meters (Nm)
M5 x 0.80	6
M6 x 1.00	10
M7 x 1.00	18
M8 x 1.25	25
M10 x 1.50	50
M12 x 1.75	88
M14 x 2.00	141

**Table 4-4: Inspection Process Chart**

<b>Section</b>	<b>Inspection Item</b>	<b>Criteria</b>	<b>Inspection Method</b>	<b>Corrective Action</b>
Insulation	Drive insulator, barriers, and stand-off insulators	No dirt and no cracking	Visual inspection	Clean with lint-free cloth or replace cracked piece
Insulation Integrity	Main circuit to ground	Withstand	AC High Potential Test	Clean and retest or replace
	Between main circuit terminals	Withstand	AC High Potential Test	Clean and retest or replace
	Control circuit to ground	Withstand	AC High Potential Test	Clean and retest or replace
Power Elements	Vacuum Interrupters	Adequate vacuum	Proceed with integrity check	If integrity check is not satisfactory, replace encapsulated pole unit assembly
	Main Circuit Resistance	Resistance less than Table 4-2 values	Per Section 4-6	Contact Eaton rep. for recommendations
	Primary disconnects	No burning or damage or spring discoloration	Visual inspection	Replace if burned, damaged, eroded or discolored
Control Circuit Parts	Shunt (Closing and Opening) release, including disconnects	Smooth and correct operation by control power	Test closing and tripping of the circuit breaker twice	Replace any defective parts
	Wiring	Securely tied in proper place	Visual inspection	Repair or tie as necessary
	Terminals	Tight	Visual inspection	Tighten or replace if necessary
	Motor	Smooth, normal operation	Functional Test	Replace brushes or motor
Operating Mechanism	Tightness of hardware	No loose or missing parts	Visual and tactile	Tighten or replace parts
	Dust or foreign object	No dust or foreign object	Visual check	Clean as necessary
	Lubrication	Smooth operation and no excessive wear	Visual and tactile	Contact Eaton rep. for recommendations
	Deformation or Excessive Wear	No excessive deformation or wear	Visual and operational	Remove cause and/or replace parts
	Manual Operation	Smooth operation	Manual charging, closing, and tripping	Correct per troubleshooting chart 6.9



## 4.8 Troubleshooting Chart

Symptom	Inspection area	Probable cause
<b>Fail to Close</b>		
Closing-spring not charged	Motor Circuit	<ul style="list-style-type: none"> <li>• No control power (fuse blown or switch off)</li> <li>• Secondary disconnect is not connected</li> <li>• Motor cut-off switch or its push lever is damaged</li> <li>• Loose wire terminal connections</li> <li>• Motor failure</li> </ul>
Closing-spring charged but breaker does not close	Shunt Closing Release circuit, when the plunger of the shunt does not pick up	<ul style="list-style-type: none"> <li>• No control power, or its out of voltage range (fuse blown or switch off, or wrong voltage applied)</li> <li>• Secondary disconnects is not in service</li> <li>• Anti-pumping device is in service</li> <li>• Shunt closing release failure</li> <li>• The breaker is between service and test position when it is in the switchgear</li> </ul>
	Mechanical Interlock, may override the plunger of the shunt close release may pick up	<ul style="list-style-type: none"> <li>• The breaker is between service and test position when it is in the switchgear</li> </ul>
	Closing spring is released, but the breaker fails to close.	<ul style="list-style-type: none"> <li>• Trip circuit is energized (trip free)</li> <li>• Trip latch does not reset</li> </ul>
Breaker does not close when manually pushing the close button	Electromechanical Interlock	<ul style="list-style-type: none"> <li>• Secondary Disconnect is not plugged in or has no control power to it</li> </ul>
Breaker does not rack in	Electromechanical Interlock	<ul style="list-style-type: none"> <li>• Check to see if proper secondary control voltage is applied to the interlock</li> </ul>

Symptom	Inspection area	Probable cause
<b>Undesirable Close</b>		
Undesirable Close	Control Circuit	<ul style="list-style-type: none"> <li>• Shunt closing release circuit is energized</li> <li>• Auxiliary switch does not switch properly</li> </ul>
	Mechanism	<ul style="list-style-type: none"> <li>• Close release latch(does not reset)</li> <li>• Close button does not reset in time</li> </ul>
<b>Fail to Trip</b>		
Breaker does not trip	Shunt trip release circuit	<ul style="list-style-type: none"> <li>• No control power, or its voltage is out of range (fuse blown or switch off, or wrong voltage applied)</li> <li>• Secondary disconnect is not connected</li> </ul>
	Mechanism	<ul style="list-style-type: none"> <li>• Entire mechanism non functional</li> </ul>
	Vacuum Interrupter	<ul style="list-style-type: none"> <li>• One or more welded</li> </ul>
<b>Undesirable Trip</b>		
Undesirable Trip	Control Circuit	<ul style="list-style-type: none"> <li>• Shunt trip circuit is energized</li> <li>• Auxiliary switch does not switch properly</li> </ul>
	Mechanism	<ul style="list-style-type: none"> <li>• Trip latch is damaged</li> <li>• Trip latch does not reset</li> <li>• Manual trip push button "O" does not reset</li> </ul>

## 5 Circuit Breaker Description and Operations

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### WARNING

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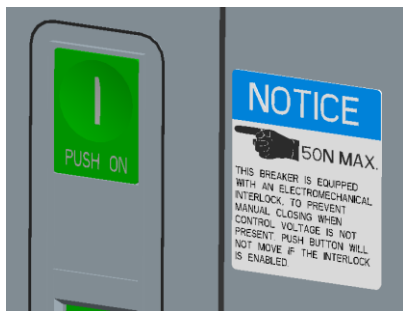
Before placing the circuit breaker in service, follow the installation procedure given below carefully. Not following the procedure can lead to a failure to uncover damage that may have resulted in faulty breaker operation.

### 5.1 Initial Inspection and Operation

Before attempting to put the circuit breaker in service, it should be examined carefully and operated manually and electrically three times. It is highly recommended that Section 3 (Receiving, handling & storage) and Section 5 (circuit breaker description & operations) are closely reviewed before proceeding with installation into switchgear.

#### Manual Operation Notice:

During operation, excessive force on the close button can cause damage. Maximum forces on the “CLOSE” and “OPEN” buttons must not exceed 50 N. Not following these warnings when pushing the close button could cause the electromagnetic interlock to become damaged and jam the mechanism.



### 5.2 Manual Operation Check

Withdraw the charging handle as shown in Fig. 5-1 & Fig. 5-2. Charge the closing spring by turning the handle clockwise, as shown in Fig. 5-3. When the closing spring is charged, the indicator of the spring charged state (Fig. 3-4) turns to “charged”.

Return the handle to its original resting place and press the “close button” (Fig. 5-4). The closing spring becomes discharged and the breaker closes. Note the indicator now reads “CLOSE”. Now press the “open” button (Fig. 5-5). The breaker is now open and the indicator reads “OPEN”.

After completing this check, leave the closing springs “discharged” and the breaker contacts “open” until another check is ready to be performed. Check the breaker operation three times using this procedure.



Fig. 5-1: Pull the round handle down



Fig. 5-2: Pull out the handle with two hands



Fig. 5-3: Turn the handle clockwise



Fig. 5-4: Close manually



Fig. 5-5: Open manually

### 5.3 Nameplate

Compare the circuit breaker nameplate information with technical data in the technical parameters sections 2.4, 2.5 or 2.6. Also compare the breaker with the breaker outline drawings and switchgear drawings for conformance and compatibility. In case of potential discrepancy, contact your Eaton representative before installing the circuit breaker.

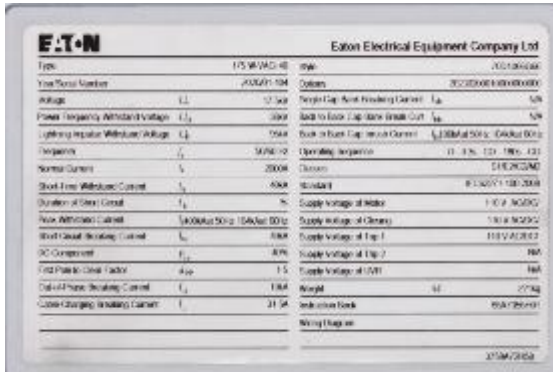


Fig. 5-6: Name Plate Label

### 5.4 Vacuum Interrupter Integrity Check

Clean all the insulating surfaces of the pole units with a dry, lint free cloth and denatured alcohol. Refer to section 4.4 after this action is completed.

### 5.5 Insulation

The primary insulation for the vacuum interrupters need to be checked. Refer to the procedure in Section 4.5 and Table 4.4. This can be done by closing the circuit breaker and performing a power frequency voltage test.

### 5.6 Main Circuit Resistance Check

Check the main circuit resistance. Refer to procedure in Section 4.6. The DC resistance should not exceed the permissible values. Record the obtained values for future reference. Refer to Table 4-2 for value limits and procedure.

**Note: Do not apply test current to the spring of main contact finger cluster. Refer to Fig. 4-1 for finger cluster location. Damage can occur if this process is not followed correctly.**

### 5.7 Electrical Operations Check

After going through the previous steps, the breaker is ready to be operated electrically. It is preferred that this check be made with a withdrawable breaker in a "Test" position or disconnected position. A fixed breaker can not be in the cell during this test.

---

#### CAUTION

---

Examine the inside of the cell before inserting or mounting the breaker for excessive dirt or anything that might interfere with the breaker travel or installation.

---

#### WARNING

---

**Extreme caution must be exercised to ensure that primary circuits are not energized while checks are performed in the breaker compartment. Failure to do so may result in personal injury or death.**

The energy required by a circuit breaker closing operation is normally provided by charging the closing spring with a charging motor. Make sure that the manual charging handle is inserted into the resting place in the front cover. The closing spring can also be charged manually as previously described. When performing charging, closing or opening operations electrically, observe that the indication of the charging state to confirm they are correct.

When testing a withdrawable breaker electrically, it should be done in the TEST position. To achieve the TEST position, the circuit breaker must first be placed in the cell structure with the shoot bolt engaged and the secondary contacts engaged. To complete this testing procedure, the operator should first be familiar with inserting and removing the circuit breaker into and out of the cell structure. When the circuit breaker needs to be racked into switchgear, insert the racking handle onto the racking coupling lever and rotate it clockwise for insertion and counterclockwise for withdrawal. When the circuit breaker has reached "CONNECTED" position during the racking process, a distinctive sound will be heard. Excessive force applied to the racking handle when the circuit breaker has reached "CONNECTED" position could cause mechanism damage.

After completing this check, leave the "closing springs" discharged, the breaker contacts "open", and the breaker in "TEST" position until another check is ready to be performed.

## 5.8 Racking handle

The racking handle is used to move withdrawable circuit breakers from the test position to the service position.



Fig. 5-7: Racking Handle



Fig. 5-8: Inserted racking Handle

### Cradle Interlock Notice:

When a cradle electromagnetic interlock is installed, the beginning torque can not be greater than 25 Nm. If a greater force is used, this will cause damage to the interlock. If the circuit breaker can not be racked in, check to see if the interlock is receiving the proper voltage.



Fig. 5-8 b: Levering In Force Notice

## 5.9 Circuit Breaker Interaction with Switchgear

W-VACi circuit breakers provide a number of safety interlocks. The following list can help confirm the breakers function properly.

---

### WARNING

---

**Never disable any interlocks. They are intended for proper and safe operation. Failure to comply could result in death, severe personal injury and/or property damage due to the hazardous voltage present.**

1. When the breaker is in the "CLOSED" state, the operation of close cannot be accomplished again until "OPEN" operation has been completed.
2. When the breaker is in the "CLOSED" state and the function of anti-pumping is on, the spring release cannot actuate.
3. When the breaker is in the "CLOSED" state, it cannot be racked into the switchgear from the TEST position to the SERVICE position.
4. Withdrawable type breakers cannot be racked out from the switchgear from the SERVICE position to the TEST position in the "CLOSED" state.
5. Withdrawable type breakers cannot perform "CLOSE" and "OPEN" operations between the TEST and SERVICE positions.
6. For withdrawable breakers with optional electrical magnetic interlock, the breaker cannot finish the "CLOSE" operation, unless the secondary disconnect is connected and the breaker is either at TEST or SERVICE position. See section 5.12.
7. As to other optional parts, such as, Under Voltage Release (UVR) trip device or an over current trip, you must confirm their function based on their system design needs. Please refer to your own specifications when you ordered the breaker.
8. When there is no power supplied to the mechanism electromagnetic interlock, the breaker will not be allowed to "CLOSE" manually.
9. When there is no power supplied to the cradle electromagnetic interlock, withdrawable type breakers cannot be racked out from the switchgear from the SERVICE position to the TEST position.

## 5.10 IEC Standard Interlocks

The IEC standards require that an interlock be provided either on the breaker and or in the gear to prevent the user from removing the breaker improperly. Eaton has three ways to solve this IEC interlock issue.

## 5.11 UX Switchgear Door Interlocks

The UX Switchgear has two interlocks included within the gear as a standard. Breakers that are ordered for use within the Eaton UX Switchgear will have a special levering in assembly that includes a door interlock mounted on the breaker. The door interlock is used to keep the W-Vac<sub>i</sub> from being moved from the Test/Withdrawn position to the Service position while the switchgear door is open. The interlock also prevents the UX Switchgear door from being opened when the W-VAC<sub>i</sub> breaker is in the Service position. The levering in cradle interlock functions in the following way:

When the UX Switchgear door closes, it pushes on the lever (4). This in turn moves the plate (3) and allows access to the spindle to engage the worm gear. As the cradle is racked-in, the hook (2) pivots around the pin (1) and catches on a corresponding pin mounded on the door, this locks the door closed when the breaker is in the service position.

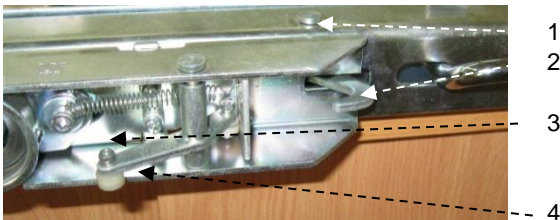


Fig. 5-9: Door / Cradle interlock assembly

The UX Switchgear second interlock works with the Eaton W-VAC<sub>i</sub> breaker secondary disconnect. It is a rod that hooks over the secondary disconnect. This prevents the secondary disconnect from coming out of its position, when it is installed in the switch gear. The bar (5) is moved down to lock the secondary contact block (6) in place by the movement of the W-VAC<sub>i</sub> breaker from the Test/Withdrawn position to the Service position.

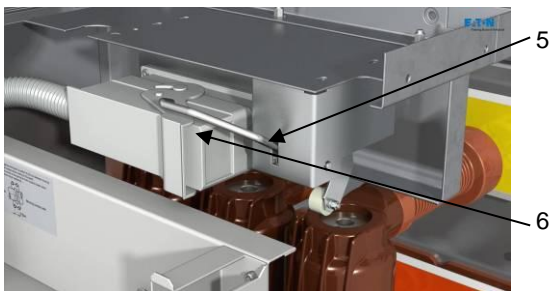


Fig. 5-10: Secondary Disconnect Interlock

## 5.12 Electromagnetic Interlocks

The cradle electromagnetic interlock shown in Fig. 5-11A is placed inside the breaker levering in cradle. It uses signals from the circuit breaker to determine if it should be electrically engaged or not. Unless the secondary disconnect is inserted and power is supplied, the interlock will prevent the circuit breaker from being racked in or out of its current position.



Fig. 5-11A: Cradle Electromagnetic Interlock

The mechanism's electromagnetic interlock shown in Fig. 5-11B prevents the breaker from being closed, unless the secondary disconnect is inserted and power is supplied. The voltage releases the locking coil, enabling the breaker to be closed. Please refer to section 5.9



Fig. 5-12B: Mechanism Electromagnetic Interlock

## 5.13 Unique OEM Interlocks

OEM's can create their own interlocks to work with the Eaton W-VAC<sub>i</sub> breaker. The interlocks created must make the complete solution to be in conformance to IEC standards. Please refer all questions in regards to unique OEM solutions directly with the OEM supplier.



## 6 Operation

W-VACi circuit breakers open and close primary circuits using Eaton vacuum interrupters (VI). The device used to open and close the VI is the Universal Mechanism Assembly (UMA). It is a modular assembly design. It is a self contained functional unit. All W-VACi circuit breakers are operated by a front mounted simple spring charged, stored energy mechanism (Figure 6-2). The stored energy mechanism is normally charged by an electric motor, but also can be charged manually with a charging handle.

### 6.1 Encapsulated Pole Units

The VI of the vacuum circuit breaker is incased in an epoxy resin which is cast by means of Automatic Pressure Gelation technology. This construction can effectively protect the vacuum interrupter from external influences, including external force impact, polluted environment and so on. The pole unit is mounted on the back of circuit breaker frame.

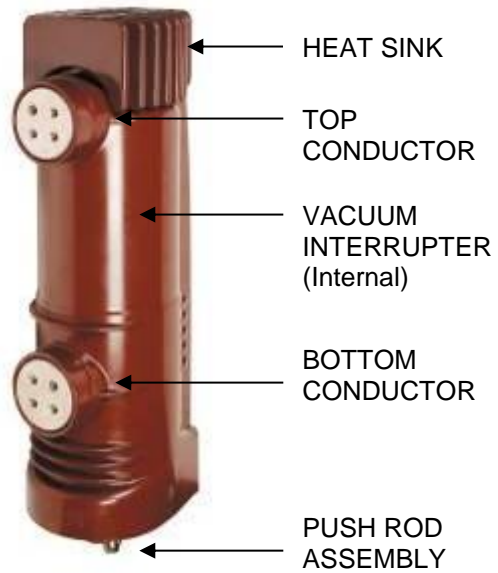


Fig. 6-1: Encapsulated Pole Unit (EPU) Structure

### 6.2 Electrical Circuit

Current flows into poles from one conductor, through the VI and through an electrical connection, and flows out the other conductor.

### 6.3 Operating Mechanism

**WARNING**

**Keep hands and fingers away from the breaker's internal parts while the breaker contacts are closed or the closing springs are charged. The breaker contacts may open or the closing springs may discharge causing a serious injury. Discharge the springs and open the breaker before performing any breaker inspection or repair.**

The operating mechanism uses stored energy from the closing spring (Fig. 6-2). The closing unit has one shunt closing release and the opening unit is composed of one or more shunt opening release coil(s). Both have auxiliary switches and indicating devices which are all installed in the circuit breaker frame. Closing and opening buttons, the manual charging handle, spring charging state indicator, and closed/open indicators are all front accessible.

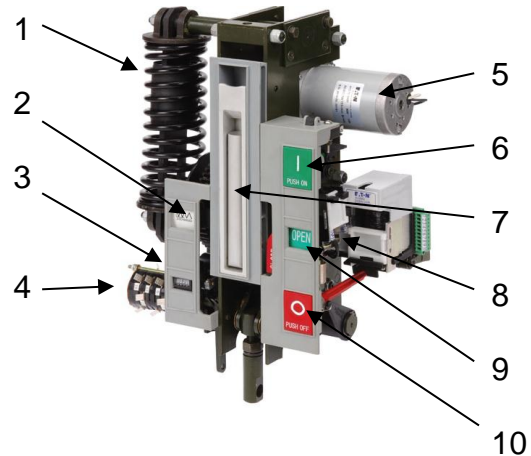
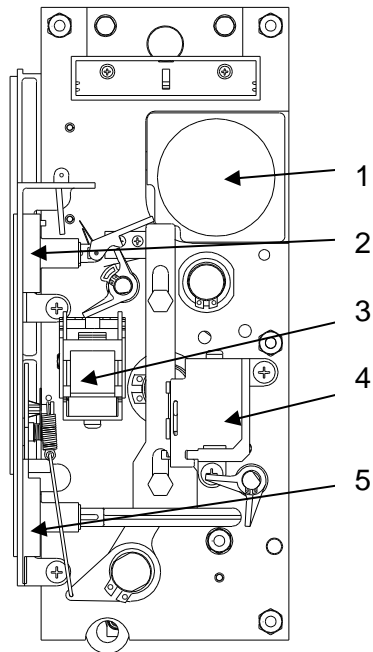


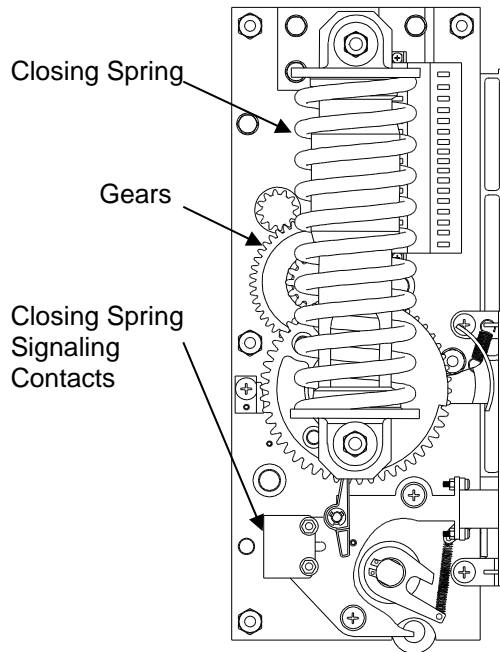
Fig. 6-2: Universal Mechanism Assembly (UMA)

- |                       |  |
|-----------------------|--|
| 1. Closing Spring     | 6. Close Button                            |
| 2. Charge Indicator   | 7. Charging Handle                         |
| 3. Operations Counter | 8. Optional Shunt Opening Release Location |
| 4. Auxiliary Switches | 9. Open/Close Indicator                    |
| 5. Motor              | 10. Open Button                            |



**Fig. 6-3: Universal Mechanism Assembly (UMA) Right Side View**

- |                          |                          |
|--------------------------|--------------------------|
| 1. Motor                 | 4. Shunt Opening Release |
| 2. Close Button          | 5. Open Button           |
| 3. Shunt Closing Release |                          |



**Fig. 6-4: Universal Mechanism Assembly (UMA) Left Side View**

## 6.4 Charging

The energy required for a circuit breaker closing is provided by charging a closing spring using a charging motor or manually charging with the charging handle. When electrically charging, the output shaft of the motor actuates a gear drive system. When manually charging, the gear driving system is actuated through a pinion gear that is attached to the charging handle. Once charged, the indicator will display "CHARGED" and the motor cutting switch will break the power supply of the charging motor. The circuit breaker is now ready for closing.

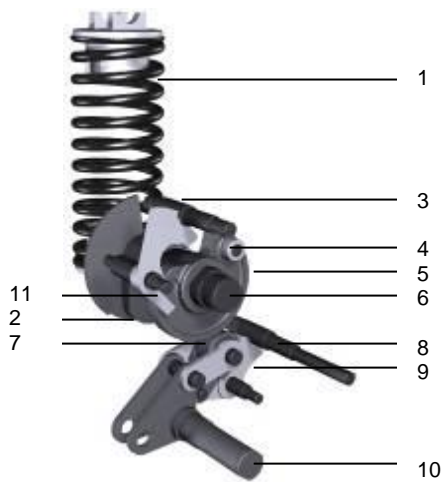
## 6.5 Closing

The closing operation is accomplished by either manually pressing the "CLOSE" button or by remote operation to actuate the shunt opening release coil. Once closed, the indicator will read "CLOSED" and the circuit for the power supply to the motor is returned. At the same time the counter is actuated to perform the counting function and the driving linkage actuates the main auxiliary switch to transfer states of the other switches and sensors between on and off. The 4 states of the mechanism can be seen in Figures 6-6 through Figure 6-9 on the following page.

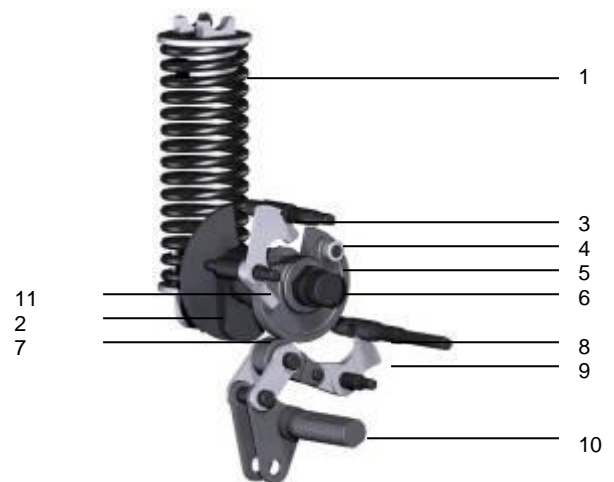


**Fig. 6-5: Manual Charging Process**

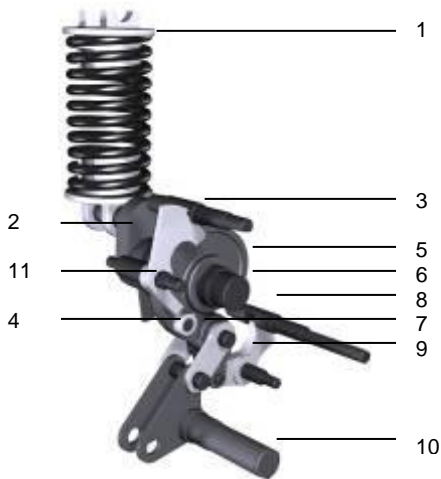




**Fig. 6-6: Breaker Open and Closing Spring Discharged**



**Fig. 6-7: Breaker Closed and Closing Spring Discharged**



**Fig. 6-8: Breaker Open and Closing Spring Charged**



**Fig. 6-9: Breaker Closed and Closing Spring Charged**

- 1-Closing Spring
- 2-Closing Spring Lever
- 3-Spring Release D Shaft
- 4-Close Roller
- 5-Cam

- 6-Cam Shaft
- 7-Main Roller
- 8-Trip bar D Shaft
- 9-Trip Latch
- 10-Drive Shaft
- 11-Spring Release Latch

## 6.6 Opening

The opening operation is accomplished by either manually pushing the “open” button or connecting the external power supply to actuate the shunt opening release coil. The breaker uses a hydraulic damper to help absorb some of the opening force. Once the breaker is open, the indicator will display “OPEN”.

## 6.7 Control Schemes

Refer to Fig. 6-10 for the W-VAC*i* circuit breaker diagram.

## 6.8 Selective Parts Configuration

The voltages for the secondary control circuit can be: 24-48-60-110-125-220-250 VDC and 120-220-230-240 VAC.

Configurations and electrical parameters for selective parts are presented in the next few sections.

Rated Parameters of UMA Motor <sup>1</sup>						
Item	Unit	Value				
Rated Voltage	VDC (Ua)	24	48	60	110/125	220/250
Rated Voltage	VAC (Ua)	-	-	-	120	220/230/240
Voltage Range	% (Ua)	85-110				
Time for Charging (S)	(s)	≤15				
Rated Parameters of Releases <sup>1</sup>						
Item	Unit	Value				
Rated Voltage	VDC (Ua)	24	48	60	110/125	220/250
Rated Voltage	VAC (Ua)	-	-	-	120	220/230/240
Rated Current	(A)	≤10	≤5	≤5	≤3	≤2
Shunt Closing Release Voltage Range*	% (Ua)	85-110				
Shunt Opening Release Voltage Range	% (Ua)	70-110				

Rated Parameters of Undervoltage Releases <sup>1</sup>						
Item	Unit	Value				
Rated Voltage	Ua (VDC)	24	48	60	110/125	220/250
Rated Voltage	Ua (VAC)	-	-	-	120	220/230/240
Rated Transient power	W (VDC)	213	219	219	281/363	281/363
	VA (VAC)	-	-	-	335	281/308/335
Rated Continuous Power	W (VDC)	9.5	9.6	9.7	5.5/7.1	5.5/7.1
	VA (VAC)	-	-	-	6.5	5.5/6/6.5
UVR Operates, & Circuit Breaker Opens Limits	% (Ua)	0-35				
UVR does not operate Limits	% (Ua)	70-110				
Rated Parameters of Electromagnetic Interlock <sup>1</sup>						
Item	Unit	Value				
Rated Voltage	Ua (VDC)	24	48	60	110/125	220/250
Rated Voltage	Ua (VAC)	-	-	-	120	220/230/240
Operating Limits	% (Ua)	85-110				
Continuous Power (Pc)	W (VDC)	5				
	VA (VAC)	5				

<sup>1</sup> Insulation voltage for all electronic parts is 2000 V 50/60 Hz (for 1 min.)

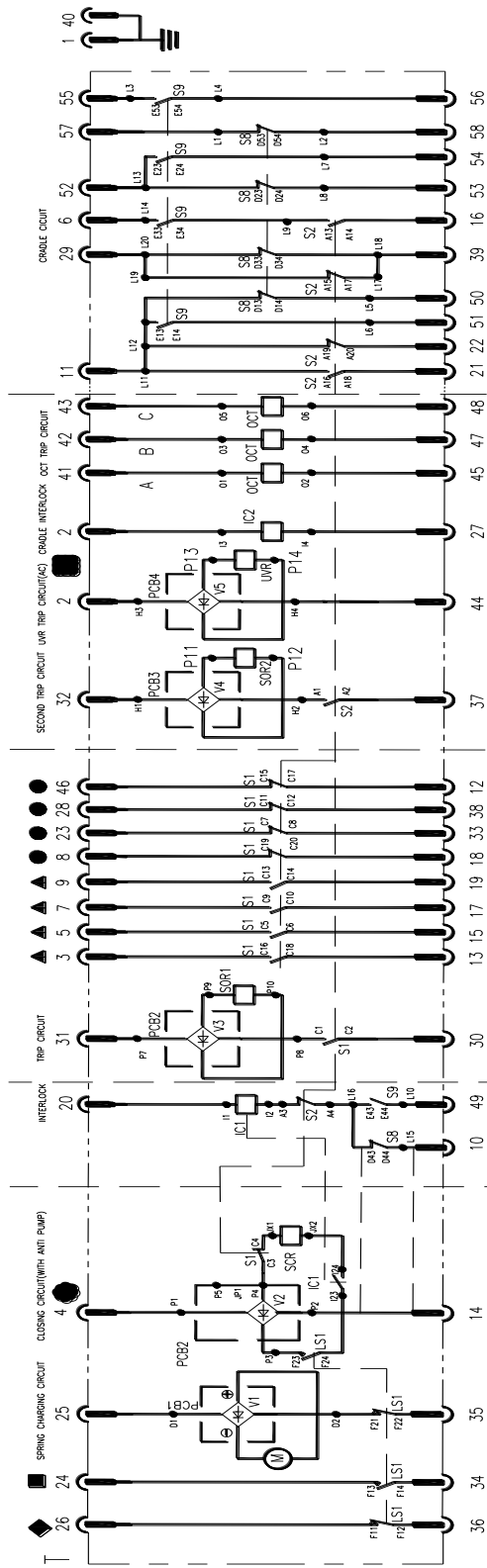


Fig. 6-10: Control Schematic

H02

OPTIONS

OPTIONS

- |                |  |        |  |
|----------------|--|--------|--|
| SCR            | SHUNT CLOSING RELEASE                          | JP1    | SHORT FOR CANCELING ANTI-PUMP FUNCTION                                     |
| M              | CHARGING MOTOR                                 | LS1    | CLOSING SPRING SIGNALING CONTACTS  |
| SCR1           | SHUNT OPENING RELEASE #1                       | OCT    | OVER CURRENT SHUNT RELEASE (OPTIONAL)                                      |
| SOR2           | SHUNT OPENING RELEASE #2(OPTIONAL)             | IC1    | MECHANISM ELECTROMAGNET INTERLOCK(OPTIONAL) NO INTERLOCK,CONNECT I23 & I24 |
| T              | 58 PIN SECONDARY DISCONNECT                    | S1, S2 | AUXILIARY CONTACTS (SWITCH WHEN 'OPEN' & 'CLOSE')                          |
| UVR            | UNDERVOLTAGE RELEASE(OPTIONAL)                 | S8, S9 | POSITION CONTACTS (SWITCH WHEN IN 'WORK' & 'TEST' POSITIONS)               |
| V1,V2,V3,V4,V5 | RECTIFIER                                      | PCB4   | UVR CIRCUIT PCB (AC/DC)  |
| PCB1           | CHARGING MOTOR CIRCUIT PCB (AC/DC)             | IC2    | CRADLE INTERLOCK COIL(OPTIONAL)(AC/DC)                                     |
| PCB2           | SHUNT OPENING&CLOSING CIRCUIT PCB (AC/DC)      |        |  |
|                | (INTEGRATE OPENING&CLOSING&ANTI-PUMP FUNCTION) |        |  |
| PCB3           | SECOND SHUNT OPENING CIRCUIT PCB (AC/DC)       |        |  |

- NOTE:
1. THIS DRAWING SHOWS THE BREAKER IS IN TEST, OPEN, DISCHARGED POSITION;
  2. SHOWS THE CIRCUIT CAN BE USED TO INDICATE DISCHARGED STATUS OF BREAKER;
  3. SHOWS THE CIRCUIT CAN BE USED TO INDICATE CHARGED STATUS OF BREAKER;
  4. SHOWS THE CIRCUIT CAN BE USED TO INDICATE CLOSED STATUS OF BREAKER;
  5. SHOWS THE CIRCUIT CAN BE USED TO INDICATE OPENED STATUS OF BREAKER;
  6. EATON DOES NOT RECOMMEN DISABLING OF ANTI-PUMP FUNCTION, IF CUSTOMER CHOOSE TO DISABLE, HE MUST ASSUME THAT ADDITIONAL PROTECTION SCHEME WILL PREVENT ANY MALFUNCTION. ANTI PUMP FUNCTION CAN BE DISABLE AT CUSTOMER RISK BY ADDING JUMPER JP1(P4-P5).
  7. WHEN CUSTOMER NEED BOTH FUNCTION,PLEASE CONTACT EATON.

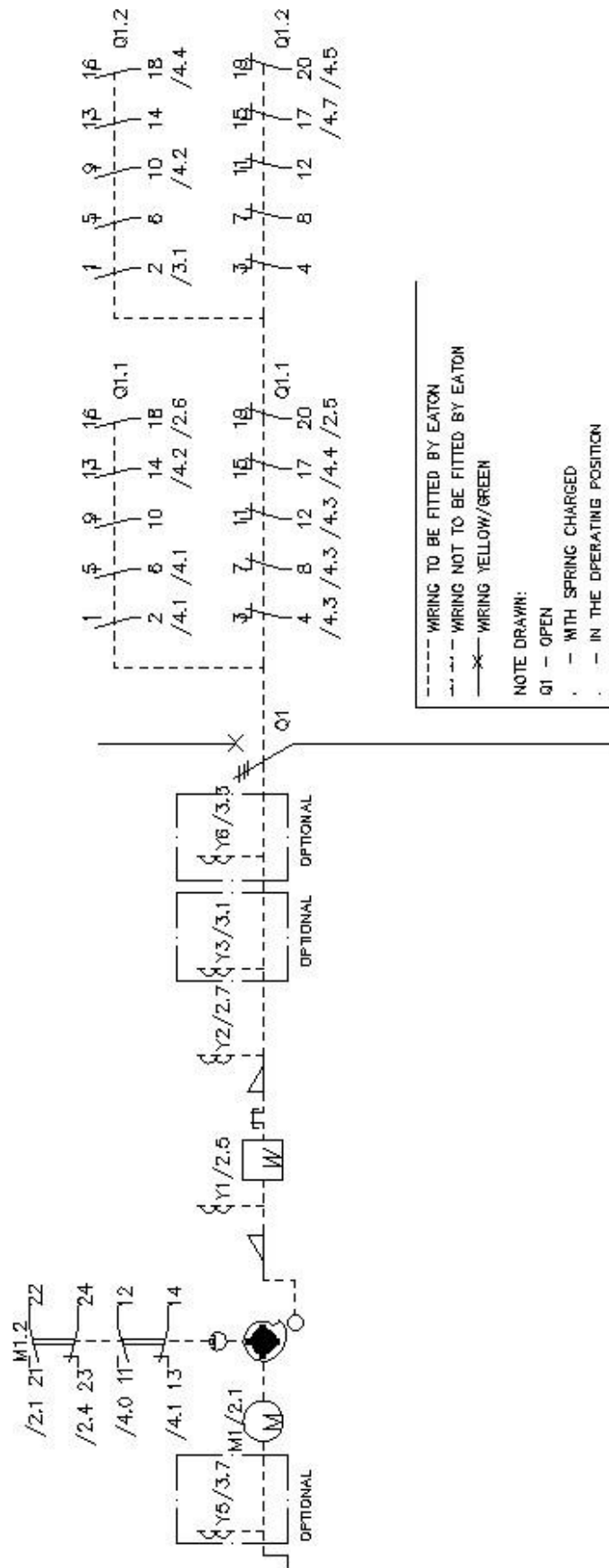
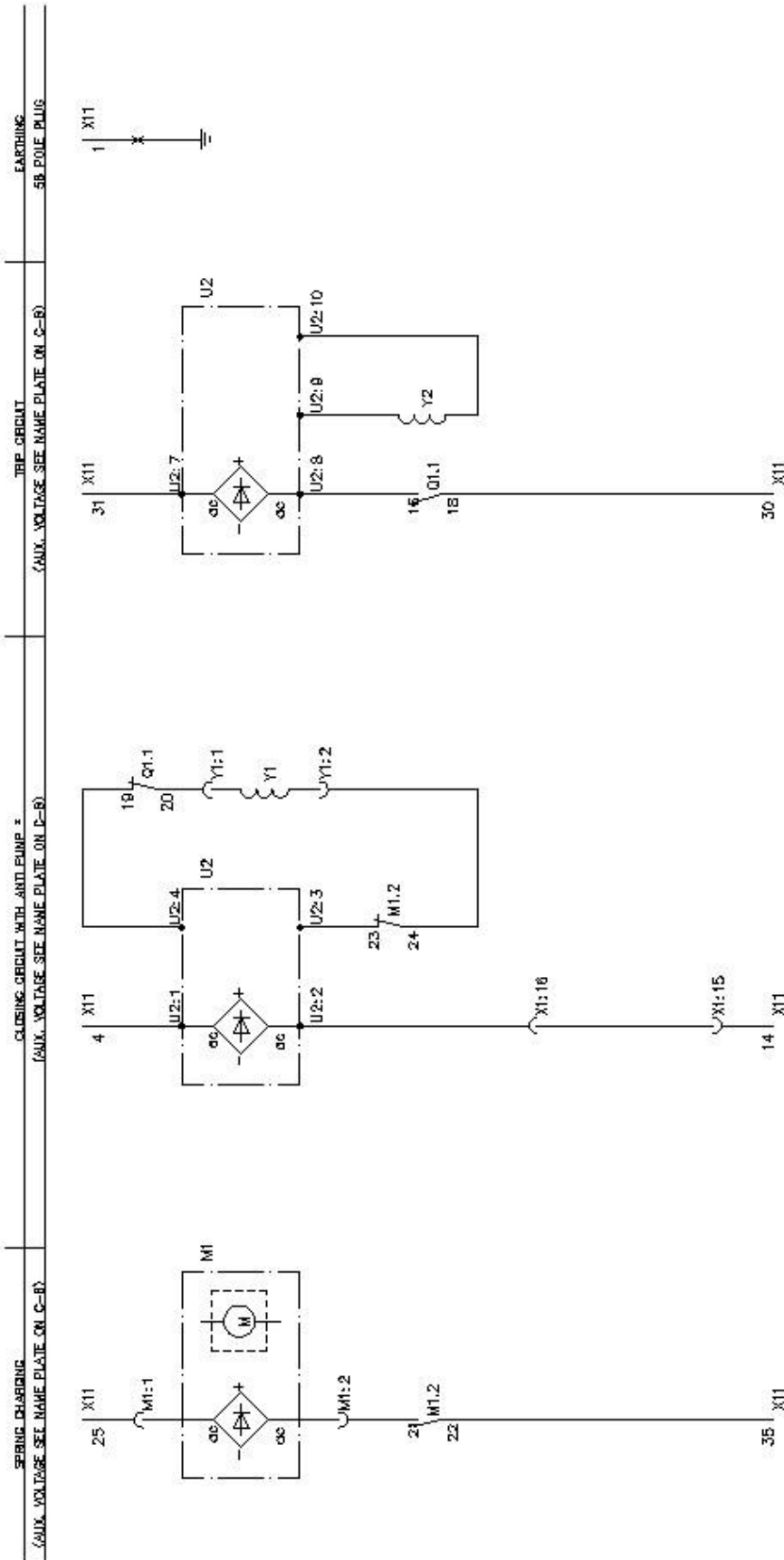


Fig. 6-11: Control Schematic



\* When mechanism electromagnetic interlock is used, this circuit has to be replaced with the closing circuit on page

Fig. 6-12: Control Schematic

2a TRIP CIRCUIT (OPTIONAL) (AUX. VOLTAGE SEE NAME PLATE ON C-B)	UNR TRIP CIRCUIT (OPTIONAL) (AUX. VOLTAGE SEE NAME PLATE ON C-B)	CLOSING CIRCUIT WITH ANTI PUMP AND MECHANISM ELECTROMAGNETIC INTERLOCKING COIL (OPTIONAL) (AUX. VOLTAGE SEE NAME PLATE ON C-B)
---	--	--

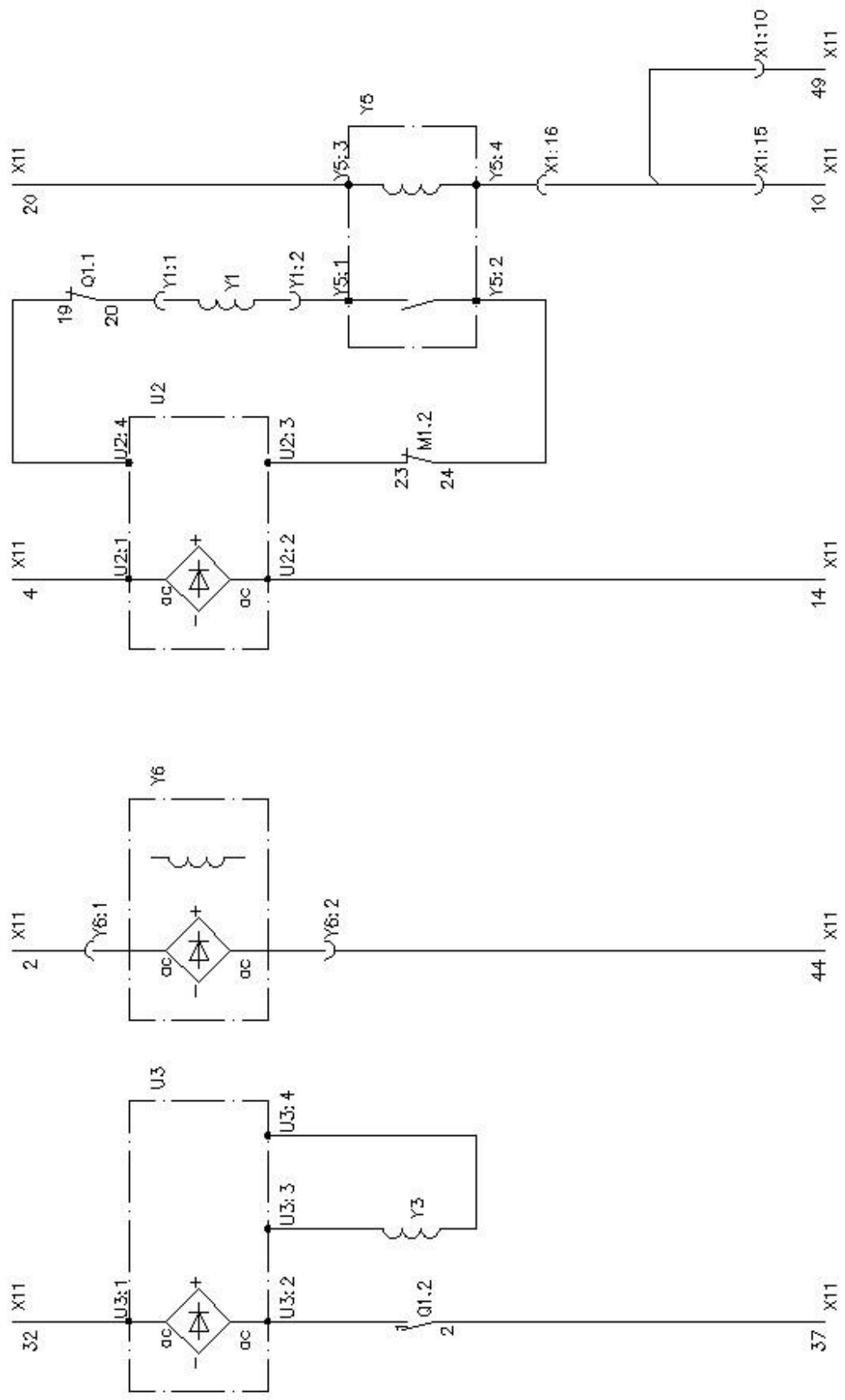
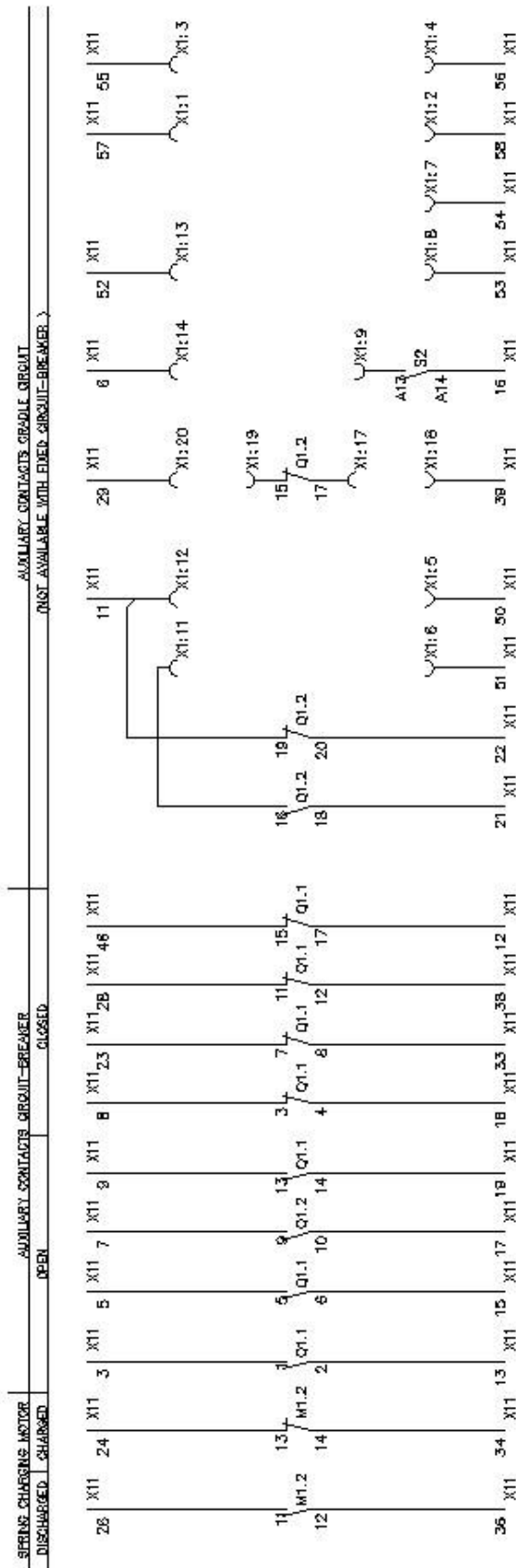


Fig. 6-13: Control Schematic



**Fig. 6-14: Control Schematic**

CODE	DESCRIPTION	MAKE	TYPE	ART. NR.	CIRCUIT NR.	REMARKS
M1	SPRING CHARGING MOTOR	EATON	...VAC/DC	65A7013G..	/1.1	
M1.2	CLOSING SPRING SIGNALING CONTACTS F11-F12; F21-F22 CLOSED ONLY WHEN THE SPRING IS CHARGED F13-F14; F23-F24 OPENED ONLY WHEN THE SPRING IS DISCHARGED	EATON	W-VAC1	65A7014G01	/1.1	
Q1	CIRCUIT-BREAKER	EATON	W-VAC1		/1.4	
Q1.1	AUXILIARY CONTACTS CIRCUIT-BREAKER C1-C2; C5-C8; ... CLOSED ONLY WHEN THE CIRCUIT-BREAKER IS CLOSED C3-C4; C7-C8; ... CLOSED ONLY WHEN THE CIRCUIT-BREAKER IS OPEN	EATON		65A7009G02	/1.4	
Q1.2	AUXILIARY CONTACTS CIRCUIT-BREAKER A1-A2; A5-A6; ... CLOSED ONLY WHEN THE CIRCUIT-BREAKER IS CLOSED A3-A4; A7-AB; ... CLOSED ONLY WHEN THE CIRCUIT-BREAKER IS OPEN	EATON		65A7009G02	/1.8	
U2	PRINT CIRCUIT BOARD CLOSING AND TRIPPING (ANTI PUMPING DEVICE INCLUDED)	EATON	...VAC/DC	65A7007E..	/2.3	
U3	PRINT CIRCUIT BOARD FOR SECOND TRIPPING (OPTIONAL)	EATON	...VAC/DC	65A7003G..	/3.1	
X1	PLUG AND SOCKET	WAGO			/5.3	
X11	58 PINS SECONDARY DISCONNECT PLUG	EATON			/5.3	
Y1	CLOSING COIL	EATON	...VAC/DC	65A7004G..	/1.2	
Y2	SHUNT TRIP COIL	EATON	...VAC/DC	65A7002G..	/1.2	
Y3	SECOND SHUNT TRIP COIL (OPTIONAL)	EATON	...VAC/DC	65A7003G..	/1.3	
Y5	MECHANISM ELECTROMAGNETIC INTERLOCK (OPTIONAL) PROTECTS THE OPERATING MECHANISM FROM BEING ACTIVATED WHEN CONTROL CIRCUIT IS NOT ENERGIZED	EATON	...VAC/DC	65A7003G..	/1.0	
Y6	UNDervOLTAGE RELEASE COIL CIRCUIT BOARD (OPTIONAL)	EATON	...VAC/DC	65A7006G..	/1.3	

Fig. 6-15: Control Schematic



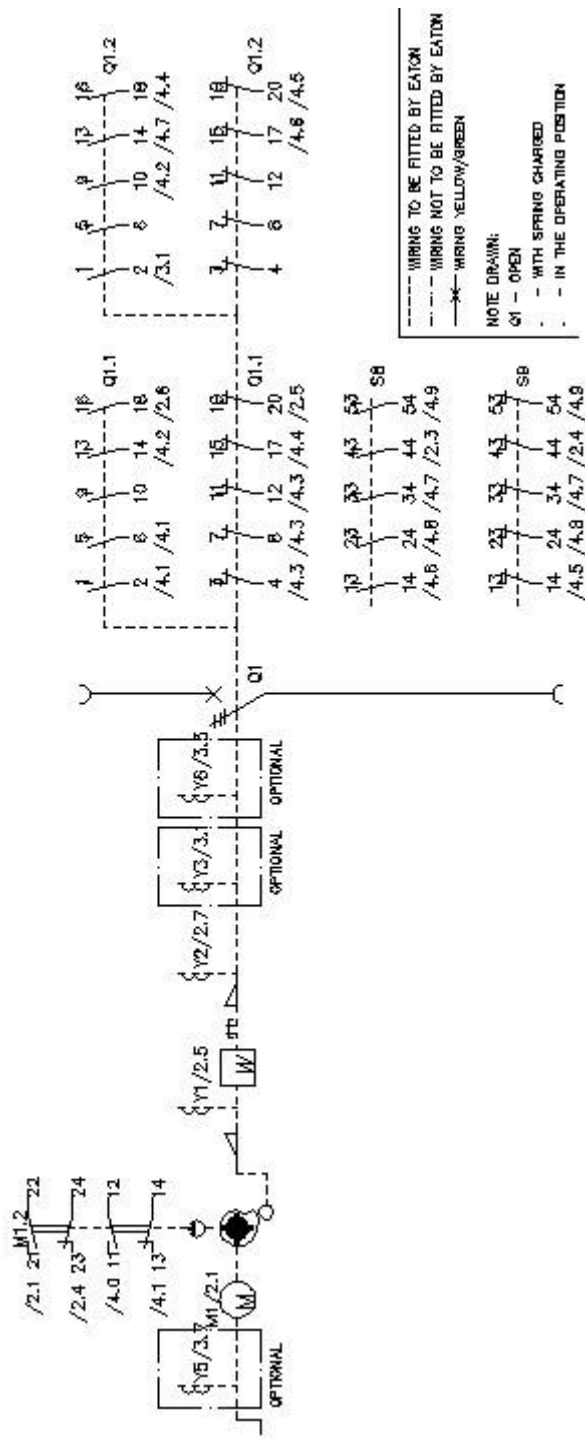


Fig. 6-16: Control Schematic

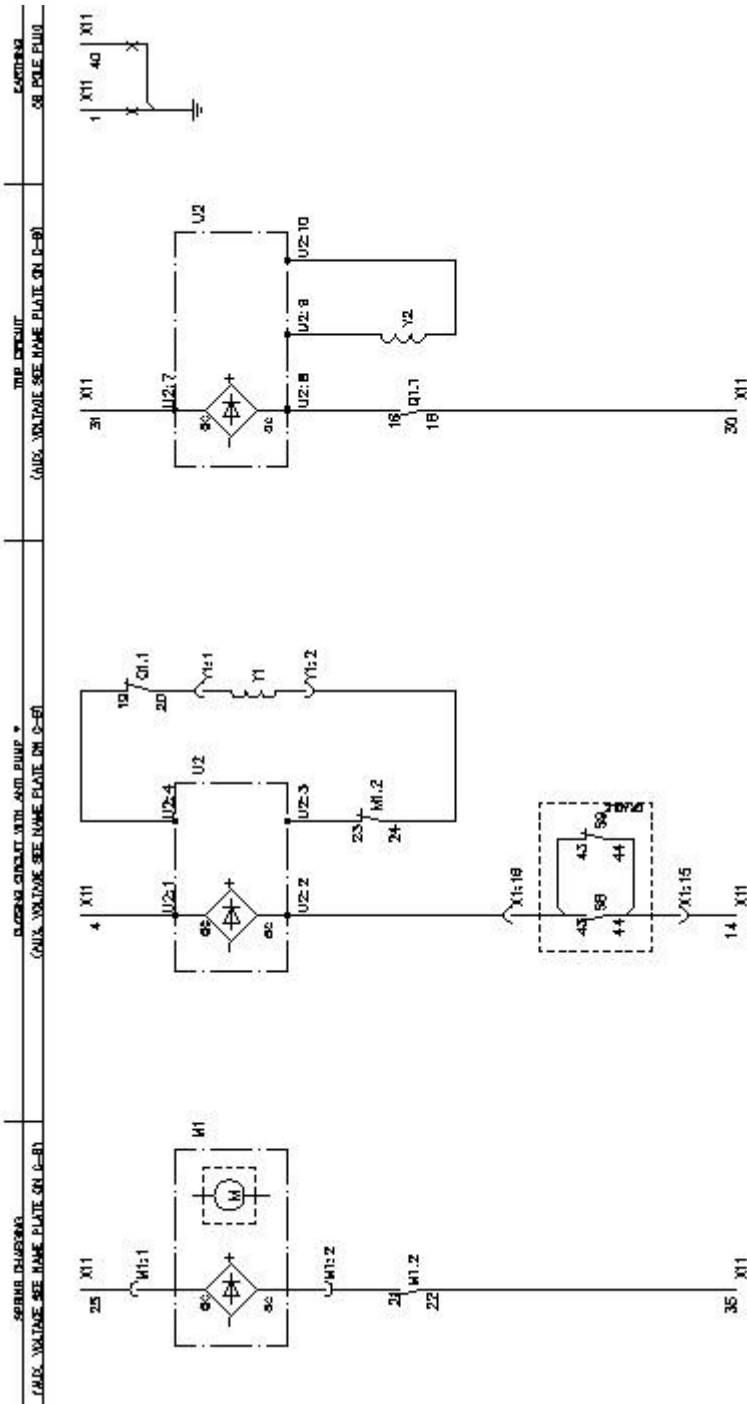


Fig. 6-17: Control Schematic

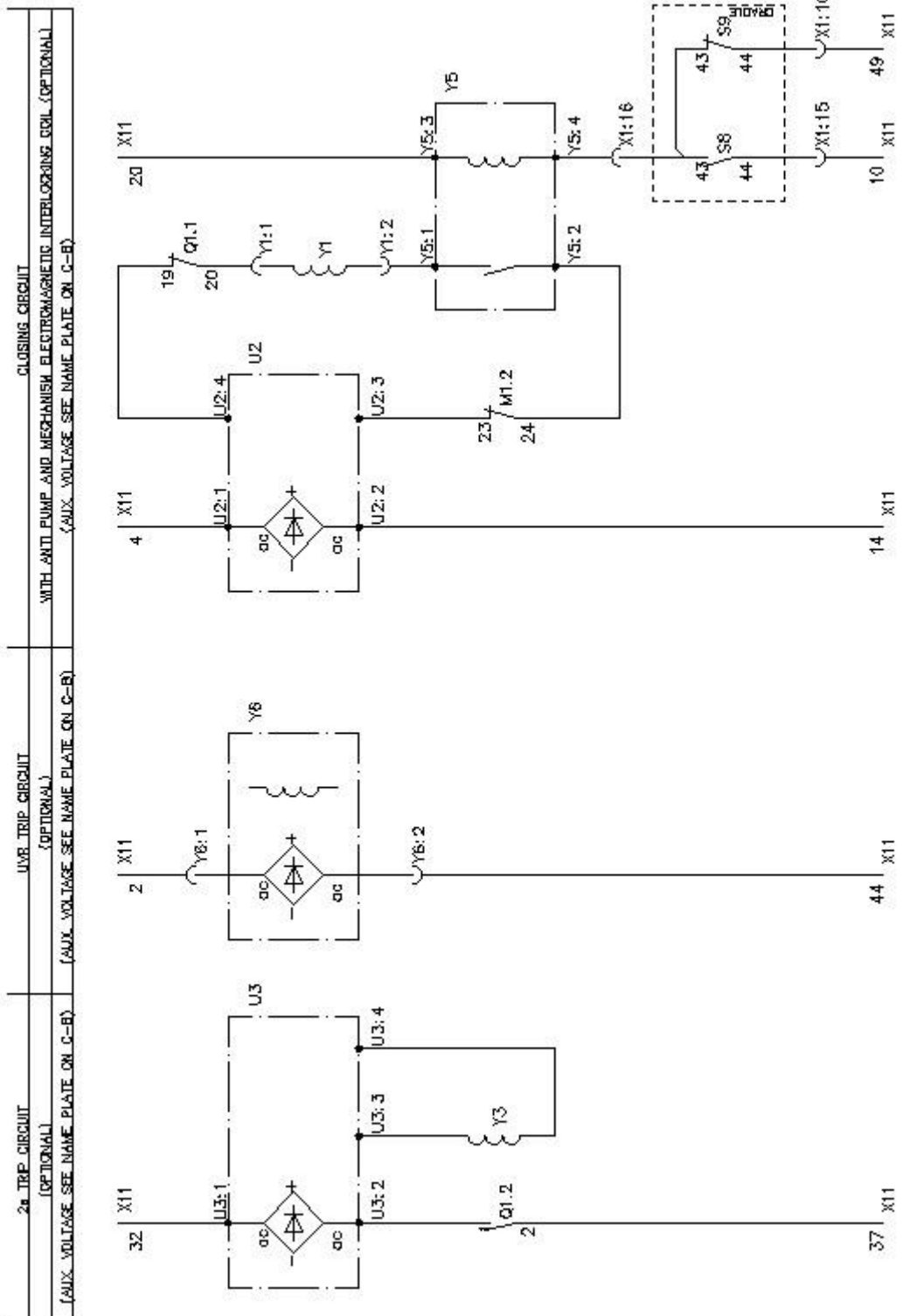


Fig. 6-18: Control Schematic

CODE	DESCRIPTION	MAKE	TYPE	ART. NR.	CIRCUIT NR.	REMARKS
M1	SPRING CHARGING MOTOR	EATON	...VAC/DC	65A70132...	/1.1	
M1.2	CLOSING SPRING SIGNALING CONTACTS 11-12; 21-22 CLOSED ONLY WHEN THE SPRING IS CHARGED 13-14; 23-24 OPENED ONLY WHEN THE SPRING IS DISCHARGED	EATON		65A7014601	/1.1	
Q1	CIRCUIT-BREAKER	EATON	W-VACI	65A7006602	/1.4	
Q1.1	AUXILIARY CONTACTS CIRCUIT-BREAKER 1-2; 5-6 ... CLOSED ONLY WHEN THE CIRCUIT-BREAKER IS CLOSED 3-4; 7-8 ... CLOSED ONLY WHEN THE CIRCUIT-BREAKER IS OPEN	EATON		65A7006602	/1.4	
Q1.2	AUXILIARY CONTACTS CIRCUIT-BREAKER 1-2; 5-6 ... CLOSED ONLY WHEN THE CIRCUIT-BREAKER IS CLOSED 3-4; 7-8 ... CLOSED ONLY WHEN THE CIRCUIT-BREAKER IS OPEN	EATON		65A7006602	/1.8	
SB	AUXILIARY CONTACTS OPERATING POSITION 13-14; 23-24 ... CLOSED ONLY WHEN THE CIRCUIT-BREAKER IS IN THE OPERATING POSITION	EATON		65A7012601	/1.0	
SP	AUXILIARY CONTACTS TEST POSITION 13-14; 23-24 ... CLOSED ONLY WHEN THE CIRCUIT-BREAKER IS IN THE TEST POSITION	EATON		65A7012601	/1.5	
U2	PRINT CIRCUIT BOARD CLOSING AND TRIPPING (ANTI PUMPING DEVICE INCLUDED)	EATON	...VAC/DC	65A70076...	/2.3	
U3	PRINT CIRCUIT BOARD FOR SECOND TRIPPING (OPTIONAL)	EATON	...VAC/DC	65A70036...	/3.1	
X1	PLUG AND SOCKET	WAGO			/4.3	
X11	SB PINS SECONDARY DISCONNECT PLUG	EATON			/4.3	
Y1	CLOSING COIL	EATON	...VAC/DC	65A70046...	/1.2	
Y2	SHUNT TRIP COIL	EATON	...VAC/DC	65A70026...	/1.2	
Y3	SECOND SHUNT TRIP COIL (OPTIONAL)	EATON	...VAC/DC	65A70036...	/1.3	
Y5	MECHANISM ELECTROMAGNETIC INTERLOCK (OPTIONAL) PROTECTS THE OPERATING MECHANISM FROM BEING ACTIVATED WHEN CONTROL CIRCUIT IS NOT ENERGIZED	EATON	...VAC/DC	65A70036...	/1.0	
Y6	UNDERVOLTAGE RELEASE COIL CIRCUIT BOARD (OPTIONAL)	EATON	...VAC/DC	65A70066...	/1.3	

Fig. 6-19: Control Schematic

## 7 Renewal parts

### 7.1 General

In order to minimize production downtime, it is recommended that an adequate quantity of spare parts be carried in stock. The quantity will vary from customer to customer, depending upon the service, severity and continuity requirements. Refer to Table 7-1 for guidance.

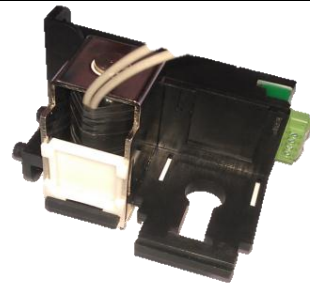
### 7.2 Ordering Instructions

- a.) Always specify the breaker rating information and style number.
- b.) Describe the item, provide the style number, and specify the quantity required.
- c.) Specify the control voltage for electrical components.
- d.) Specify the method of shipping desired.
- e.) Send all orders or correspondence to the appropriate Eaton representative.

### 7.3 Standard accessories

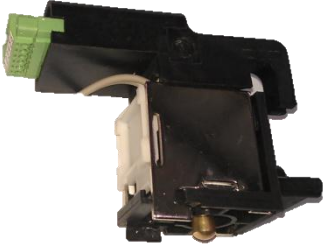
Table 7-1 Standard Accessories

<b>Shunt Opening Release (ST1)</b>		
This device allows for remote opening control of the circuit breaker and can operate with both direct and alternating current.		
	40kA and below	50kA
24 VDC	65A7002G21	65A7002G31
48 VDC	65A7002G22	65A7002G32
60 VDC	65A7002G23	65A7002G33
110/125 VDC	65A7002G24	65A7002G34
220/250 VDC	65A7002G25	65A7002G35
120 VAC	65A7002G26	65A7002G36
220/230/240 VAC	65A7002G27	65A7002G37
Attributes		
Ua (DC)	24-48-60-110-125-220-250 V	
Ua (AC)	120-220-230-240 V	
Operating Limits	70...110% Ua (DC) 85...110% Ua (AC)	
Insulating voltage	2000 V 50/60 Hz (for 1 min.)	




### Shunt Closing Release (SR)

This device allows for remote closing control of the circuit breaker and can operate with both direct and alternating current.

	40kA and below	50kA	
24 VDC	65A7004G21	65A7004G31	
48 VDC	65A7004G22	65A7004G32	
60 VDC	65A7004G23	65A7004G33	
110/125 VDC	65A7004G24	65A7004G34	
220/250 VDC	65A7004G25	65A7004G35	
120 VAC	65A7004G26	65A7004G36	
220/230/240 VAC	65A7004G27	65A7004G37	
Attributes			
Ua (DC)	24-48-60-110-125-220-250 V		
Ua (AC)	120-220-230-240 V		
Operating Limits	70...110% Ua (DC) 85...110% Ua (AC)		
Insulating voltage	2000 V 50/60 Hz (for 1 min.)		


### Charging Motor (M)

This device charges the mechanism closing springs electrically. In the event of a loss of power the mechanism closing springs can be charged manually.

	40kA and below	50kA	
24 VDC	65A7013G01	65A7013G21	
48 VDC	65A7013G02	65A7013G22	
60 VDC	65A7013G03	65A7013G23	
110/125 VDC	65A7013G04	65A7013G24	
220/250 VDC	65A7013G06	65A7013G26	
120 VAC	65A7013G10	65A7013G30	
220/230/240 VAC	65A7013G12	65A7013G32	
Attributes	90 W 0.8A	120 Watt 1.05A	
Ua (DC)	24-48-60-110-125-220-250 V		
Ua (AC)	120-220-230-240 V		
Operating Limits	85...110% Ua		
Insulating voltage	2000 V 50/60 Hz (for 1 min.)		


**Breaker Auxiliary Contacts (S1 & S2)**

Standard circuit breakers contain a 10A / 10B auxiliary switch. 6A / 6B contacts are used by the circuit breaker, therefore 4A / 4B contacts are available for the end user.

24 VDC	65A7009G02	
48 VDC		
60 VDC		
110/125 VDC		
220/250 VDC		
120 VAC		
220/230/240 VAC		
Attributes	IEC Contact Class 1, Rated Continuous Current 10A, Breaking Capacity 440W	
Insulating voltage	2000 V 50/60 Hz (for 1 min.)	


**Closing Spring Signaling Contact (LS1)**

This device is used to signal whether the operating mechanism's closing spring is charged or discharged. It uses a micro-switch that allows remote signaling of the state of the closing spring.

24 VDC	65A7014G01	
48 VDC		
60 VDC		
110/125 VDC		
220/250 VDC		
120 VAC		
220/230/240 VAC		
Attributes		
Insulating voltage	2000 V 50/60 Hz (for 1 min.)	


**Position Contacts (S8 & S9)**

Fitted in the levering-in assembly, these contacts are used to identify if the circuit breaker is in the service, test, or disconnected position.

24 VDC	65A7012G01	
48 VDC		
60 VDC		
110/125 VDC		
220/250 VDC		
120 VAC		
220/230/240 VAC		
Attributes	IEC Contact Class 1, Rated Continuous Current 10A, Breaking Capacity 440W	
Insulating voltage	2000 V 50/60 Hz (for 1 min.)	


**Racking Handle**

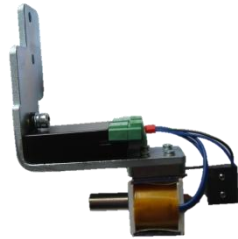
This device is used to manually rack the circuit breaker into the switchgear. One unit of this device can be used for all of the circuit breakers on a particular site.

Racking Handle	65A7023G01	
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## 7.4 Optional accessories

Table 7-4 Optional Accessories


<b>Shunt Opening Release #2 (ST2)</b>			
Like the shunt opening release, this device allows for remote opening control of the circuit breaker. It can be supplied by a circuit completely independent from the shunt opening release #1.			
	40kA and below	50kA	
24 VDC	65A7003G21	65A7003G31	
48 VDC	65A7003G22	65A7003G32	
60 VDC	65A7003G23	65A7003G33	
110/125 VDC	65A7003G24	65A7003G34	
220/250 VDC	65A7003G25	65A7003G35	
120 VAC	65A7003G26	65A7003G36	
220/230/240 VAC	65A7003G27	65A7003G37	
Attributes			
Ua (DC)	24-48-60-110-125-220-250 V		
Ua (AC)	120-220-230-240 V		
Operating Limits	70...110% Ua (DC) 85...110% Ua (AC)		
Insulating voltage	2000 V 50/60 Hz (for 1 min.)		

<b>Mechanism Electromagnetic Interlock (IC1)</b>			
This device protects the operating mechanism from being unsafely activated in the event that the control circuit is not energized.			
	40kA and below	50kA	
24 VDC	65A7030G01	65A7030G11	
48 VDC	65A7030G02	65A7030G12	
60 VDC	65A7030G03	65A7030G13	
110/125 VDC	65A7030G04	65A7030G14	
220/250 VDC	65A7030G05	65A7030G15	
120 VAC	65A7030G04	65A7030G14	
220/230/240 VAC	65A7030G05	65A7030G15	
Attributes			
Ua (DC)	24-48-60-110-125-220-250 V		
Ua (AC)	120-220-230-240 V		
Operating Limits	85...110% Ua		
Continuous Power (Pc)	DC= 5 W AC= 5 VA		
Insulating voltage	2000 V 50/60 Hz (for 1 min.)		




**Undervoltage Release (UVR)**

This device opens the circuit breaker when there is notable lowering or loss of its power supply. It can operate with both direct and alternating current.

	40kA and below	50kA	
24 VDC	65A7006G21	65A7003G31	
48 VDC	65A7006G22	65A7003G32	
60 VDC	65A7006G23	65A7003G33	
110/125 VDC	65A7006G24	65A7003G34	
220/250 VDC	65A7006G25	65A7003G35	
120 VAC	65A7006G24	65A7003G34	
220/230/240 VAC	65A7006G25	65A7003G35	
Attributes			
Ua (DC)	24-48-60-110-125-220-250 V		
Ua (AC)	120-220-230-240 V		
Operating Limits	35-0% Ua: UVR operates, circuit breaker opens 70-110% Ua: UVR does not operate		
Insulating voltage	2000 V 50/60 Hz (for 1 min.)		


**Cradle Electromagnetic Interlock (IC2)**

This device protects the operating cradle from being unsafely operated in the event that the control circuit is not energized.

		
24 VDC	65A7025G01	
48 VDC	65A7025G02	
60 VDC	65A7025G03	
110/125 VDC	65A7025G04	
220/250 VDC	65A7025G05	
120 VAC	65A7025G04	
220/230/240 VAC	65A7025G05	
Attributes		
Ua (DC)	24-48-60-110-125-220-250 V	
Ua (AC)	120-220-230-240 V	
Operating Limits	85...110% Ua	
Continuous Power (Pc)	DC= 5 W AC= 5 VA	
Insulating voltage	2000 V 50/60 Hz (for 1 min.)	

**Fixed Circuit Breaker Interlock**

This mechanical device is used to prevent a miss-closing of the circuit breaker by discharging the closing spring when racking the breaker in or out. It is used on fixed circuit breakers that are converted to draw-out circuit breakers by the customer

Fixed Circuit Breaker Interlock	65A7020G01	
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## 8 Appendix

Use the following charts to verify that the circuit breaker is in the correct operational status and that the received circuit breaker has the exact same equipment as ordered.

### 8.1 12 / 17.5 / 24 kV W-VACi Vacuum Circuit Breaker Operational Check List

Breaker Type: \_\_\_\_\_

# of Operations at Start: \_\_\_\_\_

List	Explanation	Result	Reference Section
1	Check the parts for any that are damaged/loose/distortion/missing		3.2
2	Operate manually-charged/close/open		4.3
3	Check insulation of main circuit and control circuit		4.5
4	Check resistance of main circuit		4.6
5	Check the nameplate		4.2
6	Operate electrical-charge/close/open		4.7
7	Check the chassis with breaker		3.2
8	The counter does not advance properly		5.2.2

# of Operations at End: \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

## 8.2 W-VACi Vacuum Circuit Breaker Equipment Check List

Customer Name:  
Customer PO :  
Date of Delivery :

Eaton Order:  
Quantity:  
YYYY\_\_\_\_\_ MM\_\_\_\_\_ DD\_\_\_\_\_

Technical Parameters of Breaker											
Type	W-VAC/R Fixed <input type="checkbox"/>			W-VAC/i Withdrawable <input type="checkbox"/>							
Rated Voltage (kV)	<input type="checkbox"/> 12	<input type="checkbox"/> 17.5	<input type="checkbox"/> 24								
Normal Current (A)	<input type="checkbox"/> 630	<input type="checkbox"/> 800	<input type="checkbox"/> 1250	<input type="checkbox"/> 1600	<input type="checkbox"/> 2000	<input type="checkbox"/> 2500	<input type="checkbox"/> 3150				
Short Circuit Breaking Current (kA)	<input type="checkbox"/> 20	<input type="checkbox"/> 25	<input type="checkbox"/> 26.3	<input type="checkbox"/> 31.5	<input type="checkbox"/> 40	<input type="checkbox"/> 50					
Pole To Pole (mm)* Distance	<input type="checkbox"/> 150	<input type="checkbox"/> 210	<input type="checkbox"/> 275								
Technical Parameters of UMA Mechanism											
Shunt Opening Release (Ua)	<input type="checkbox"/> 24V DC	<input type="checkbox"/> 48V DC	<input type="checkbox"/> 60V DC	<input type="checkbox"/> 110V DC	<input type="checkbox"/> 125V DC	<input type="checkbox"/> 220V DC	<input type="checkbox"/> 250V DC	<input type="checkbox"/> 120V AC	<input type="checkbox"/> 220V AC	<input type="checkbox"/> 230V AC	<input type="checkbox"/> 240V AC
Shunt Opening Release #2 (Ua)	<input type="checkbox"/> 24V DC	<input type="checkbox"/> 48V DC	<input type="checkbox"/> 60V DC	<input type="checkbox"/> 110V DC	<input type="checkbox"/> 125V DC	<input type="checkbox"/> 220V DC	<input type="checkbox"/> 250V DC	<input type="checkbox"/> 120V AC	<input type="checkbox"/> 220V AC	<input type="checkbox"/> 230V AC	<input type="checkbox"/> 240V AC
Shunt Closing Release (Ua)	<input type="checkbox"/> 24V DC	<input type="checkbox"/> 48V DC	<input type="checkbox"/> 60V DC	<input type="checkbox"/> 110V DC	<input type="checkbox"/> 125V DC	<input type="checkbox"/> 220V DC	<input type="checkbox"/> 250V DC	<input type="checkbox"/> 120V AC	<input type="checkbox"/> 220V AC	<input type="checkbox"/> 230V AC	<input type="checkbox"/> 240V AC
Charging Motor(Ua)	<input type="checkbox"/> 24V DC	<input type="checkbox"/> 48V DC	<input type="checkbox"/> 60V DC	<input type="checkbox"/> 110V DC	<input type="checkbox"/> 125V DC	<input type="checkbox"/> 220V DC	<input type="checkbox"/> 250V DC	<input type="checkbox"/> 120V AC	<input type="checkbox"/> 220V AC	<input type="checkbox"/> 230V AC	<input type="checkbox"/> 240V AC
Additional Equipment											
Under-Voltage Release	<input type="checkbox"/> 24V DC	<input type="checkbox"/> 48V DC	<input type="checkbox"/> 60V DC	<input type="checkbox"/> 110V DC	<input type="checkbox"/> 125V DC	<input type="checkbox"/> 220V DC	<input type="checkbox"/> 250V DC	<input type="checkbox"/> 120V AC	<input type="checkbox"/> 220V AC	<input type="checkbox"/> 230V AC	<input type="checkbox"/> 240V AC
Mechanism Electromagnetic Interlock for Mechanism	<input type="checkbox"/> 24V DC	<input type="checkbox"/> 48V DC	<input type="checkbox"/> 60V DC	<input type="checkbox"/> 110V DC	<input type="checkbox"/> 125V DC	<input type="checkbox"/> 220V DC	<input type="checkbox"/> 250V DC	<input type="checkbox"/> 120V AC	<input type="checkbox"/> 220V AC	<input type="checkbox"/> 230V AC	<input type="checkbox"/> 240V AC
Cradle Electromagnetic Interlock for Cradle	<input type="checkbox"/> 24V DC	<input type="checkbox"/> 48V DC	<input type="checkbox"/> 60V DC	<input type="checkbox"/> 110V DC	<input type="checkbox"/> 125V DC	<input type="checkbox"/> 220V DC	<input type="checkbox"/> 250V DC	<input type="checkbox"/> 120V AC	<input type="checkbox"/> 220V AC	<input type="checkbox"/> 230V AC	<input type="checkbox"/> 240V AC
<input type="checkbox"/> Racking Handle	<input type="checkbox"/> Second Set Breaker of Auxiliary Contacts			<input type="checkbox"/> UX Switchgear Door Interlock							

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