MGM TRANSFORMERS
BY FORGENT

BULLETIN
40

LIQUID-FILLED SUBSTATION TRANSFORMERS

OTHER PRODUCT EXAMPLES

Dry Substation
(Bulletin 30)

600 V Class
General Purpose
(Bulletin 10)

Custom 600V
Dry Type
(Bulletin 15)

ISO 9001 2015 CERTIFIED
U.S. DEPARTMENT OF ENERGY
made in USA
C SA US
c UL
UL
c UL Energy Verified
NAED

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MGM TRANSFORMERS BY FORGENT

Liquid Substation Transformers

Applications For Liquid-Filled Secondary Substation

ISO 9001 2015 CERTIFIED

TYPES OF TRANSFORMERS:

- *Multi-tapped*
- *K-Factor Rated*
- *Unit Substation*
- *Auto Transformers*
- *Scott-connected Transformer*
- *Zig-Zag Grounding Transformer*
- *Rectifier Duty (6, 12, 18 and 24 pulse)*

TRANSFORMER RATINGS:

- *Three Phase up to 34.5 kV*
- *Capacity - up to 10MVA*
- *50Hz, 60Hz, and 50/60Hz*

OTHER TYPICAL APPLICATIONS:

- *Integrated Primary/Secondary Switchgear*
- *High-current rectification*
- *Motor drive duty*
- *Retrofit*
- *Test*

The highest-quality materials and manufacturing processes combined with skilled and flexible custom-engineered design enables MGM Transformers to understand, design, manufacture and support to your exact specifications and requirements. We make certain that our world-renowned quality is exemplified by every product carrying our label. MGMT's three-phase liquid-filled secondary substation transformers are specifically designed to change distribution voltages to utilization voltages to meet any industrial or commercial application.

All of our products are designed to meet or exceed applicable NEMA, and IEEE standards and can be supplied with many combinations of terminal arrangements. Our mission is to ensure operational excellence, be the leader in quality transformer product and attain the shortest cycle times in the industry.

INDUSTRIAL

MGM Transformers is known by its many industrial customers for providing reliable, custom-built transformers with faster turn-around times than any other manufacturer. Our transformers will meet and exceed both your and your customers' expectations; whether needed for standard distribution loads or high-impact drives or process rectifiers.

COMMERCIAL

Contractors know they can depend on MGMT even when the job requires small footprints, low sound levels, non-standard documentation, matching dimensions or any other critical consideration. Reduced lead times are available as well through our **"Bull Rush"** program.

HARMONIC CONTENT

IEEE Standard operating conditions allow 5% maximum harmonic content of load current for standard distribution transformers. If the distribution load consists of electronic power supplies, electronic ballasts and adjustable speed motor control, it would be prudent to investigate the harmonic content and, perhaps, specify a **"K Rated"** transformer. MGMT can help you determine required **"K Factor"** from the applicable harmonic current spectrum.

Liquid-Filled Standard Features

- *Type I insulating mineral oil*
- *60 Hertz operation*
- *65°C average winding rise*
- *Side-mounted bushings*
- *HV /LV flange connections*
- *Stainless steel nameplate*
- *ANSI 61 paint finish, 5 mils thick*
- *Pressure relief valve*
- *Pressure-vacuum gauge*
- *Top filter press connections*
- *Liquid level gauge*
- *Liquid temperature gauge*
- *Provisions for jacking and lifting*
- *IEEE Ground Pad*
- *Panel-type radiators as required.*
- *Drain/filter valve with sampling device*
- *Base suitable for rolling and skidding*
- *Externally operated de-energized tap changer*
- *Standard with (2) 2.5% full-capacity taps above and below nominal*

Optional Features Available

- *55/65°C average winding rise*
- *Forced air cooling*
- *Future fan wiring and control*
- *Pressure relief device*
- *Winding temperature indicator*
- *Rapid rise pressure relay, cover mounted*
- *Devices with alarm contacts*
- *Top filter press valve*
- *HV lightning arresters in ATC*
- *Current transformers*
- *Special impedances*
- *HV & LV air terminal compartments*
- *Low loss*
- *Special/low sound level*
- *50 Hertz*
- *Specific dimensions*
- *Neutral grounding resistor*
- *Removable radiators*
- *Tertiary windings or five leg for Wye-Wye connections*
- *6, 12, 18, 24, 30 and 36 pulse drives applications*
- *Non-standard loading conditions (i.e. Harmonics/K-factor)*

MGM TRANSFORMERS
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Liquid Substation Transformers

Department Of Energy 2016 Efficiency Standards

U.S. DEPARTMENT OF ENERGY

PRODUCTS AFFECTED: Three-Phase 15 to 2500 kVA

Effective January l, 2016, Distribution transformers manufactured for use in the United States must comply with new Department of Energy guidelines.

BENEFITS OF THE NATIONAL EFFICIENCY STANDARD

Saves equivalent electrical usage of 40 million U.S. households per year

REDUCES GREENHOUSE GAS EMISSION OF — 238 MILLION TONS OF CO_2

Equivalent to removing 80% of all light vehicles for one year.

Greater than 46,000 tons of NO_2 (nitrous oxide).

Greater than 4 tons of Hg (mercury).

THREE-PHASE LIQUID-IMMERSED TRANSFORMERS	
kVA	*Three-Phase Efficiency*
15	98.65
30	98.83
45	98.92
75	99.03
112.5	99.11
150	99.16
225	9923
300	99.27
500	99.35
750	99.40
1000	99.43
1500	99.48
2000	99.51
2500	99.53

TRANSFORMER LOSSES

Transformer losses are a combination of no-load and load losses. No-load losses or core losses are a function of core design and load losses a function of resistance and resistive losses. The purpose of the DOE 2016 standards is to have higher efficiency/fewer losses. Analyzing this on a macro level, improved efficiency will translate into huge savings in cost of electricity. It also enables us to produce less electricity, less coal-fired power plants and much better green environment for all of us. The efficiency of all medium voltage transformers when tested at 50% of rated output shall not be less than the applicable value in the table to the right.

Dielectric Coolant Choices for Liquid-Filled Units

MINERAL OIL:

The oil-filled unit is the least expensive transformer, and is suitable for mounting outdoors or indoors enclosed in a vault. The oil used in MGMT meets all the requirements of ANSI 07.106 and ASTM D-3487, has high dielectric strength, is free from impurities, is durable and has a high flash point These features make it an excellent insulating liquid.

SILICONE FLUID:

The silicone fluid selected for use in MGMT is a clear, liquid silicone polymer (polydimethyl-siloxane) that has been specially processed to meet exacting dielectric specifications. To obtain an optimum combination of heat transfer and fire-resistant properties, the transformer silicone fluid has a viscosity of 50 centistokes at 250C. This fluid has a minimum fire point of 3000C and oxygen index of 21. The silicone fluid that we are using meets paragraph 450-23 (Less-Flammable Liquid- Insulated Transformers) of the National Electrical Code. OSHA by its Program Directive 10068 permits the use of silicone transformers as equivalent to askarel transformers in its enforcement of the National Electrical Code. Transformer silicone fluid has suitable dielectric characteristics, is compatible with other materials used in construction of transformers and has shown good thermal stability in accelerated aging tests with transformer materials.

ENVIRONMENTALLY FRIENDLY DIELECTRIC LIQUID FR3:

A Fire-Resistant Hydrocarbon Fluid (FRHF) dielectric coolant formulated for use in distribution transformers is available when its unique electrical, thermal and safety properties are advantageous. It is non-toxic and readily biodegradable. It is also referred to as a High Fire Point Fluid, a High Molecular Weight Hydrocarbon or a Less- Flammable Dielectric Liquid. The dielectric coolant is a listed less-flammable fluid meeting the requirements of National Electrical Code section 450-23, including a minimum fire point of 3000C and the requirements of the National Electrical Code (IEEE Q-1993). Section 15.

CORE AND COIL DESIGN

MGMT's step lap core is fabricated from high grade grain-oriented silicon steel, hand stacked to give low losses and excitation current, and tightly clamped and braced to mechanically strong coils fabricated from extruded rectangular conductors. In the larger units, full width strip is used in the low voltage windings, reducing short circuit stresses and providing improved heat transfer for cooler coil operation. Conditioned strip edges eliminates burrs and sharp edges. Only thermally upgraded insulation is used throughout for extended life at 65°C. Units rated 55/65°C when operated at 65°C have 20% added capacity, with normal life expectancy.

TANK CONSTRUCTION

MGMT tanks are rugged, constructed from precision cut steel and braced to withstand the stresses of shipping rolling and jacking. They will withstand a pressure or vacuum of 7 psi without damage, deterioration or leaking. All tank bases are designed to permit rolling in any direction perpendicular to a tank wall. A bolted hand hole is provided in the cover, which is welded on. Leak tests are performed before tanking and pressure tests prior to painting.

Any combination of throat, flange or terminal chamber are available to match the requirement of a variety of high voltage switches and low voltage distribution sections. Custom design termination is also available for matching existing switch gear in the case of PCB change-outs.

THE DUTY CYCLE

This information is given as a percentage of rated load applied over a specified time period: It is important to the transformers' design because it provides a picture of thermal and impact loading. It is important to identify regenerative modes as well. Care should be taken to identify stop times. A graph is very often the most convenient manner in which to disseminate this information.

DRIVE TYPE

It is important to identify whether the drive is an AC or DC drive (and whether it is 6, 12, 18 or 24 pulse), a cycloconverter or a load commutated inverter drive. This information provides valuable harmonic loading information we will use to select or create the ideal design for your specification.

DRIVE ISOLATION TRANSFORMERS

Advise your MGMT sales engineer of the drive application, i.e., steel rolling mill, paper machine winder, pumps, Banbury mixer, etc., so that they can identify potential areas of concern when providing a budgetary estimate. For instance, steel mill drives are known for high impact loading; chemical plant applications may require special corrosion-resistance features, etc.

QUALITY CONTROL — Test Procedures

All tests are performed in accordance with the latest revision of IEEE Standard C57.12.90 Standard Test Code for Liquid Immersed Distribution, Power, and Regulating Transformers.

- *Exciting current at rated voltage*
- *Polarity and phase-relation tests on the rated voltage connection*
- *Ratio tests on rated voltage connection and all tap connections*
- *No-load loss at rated voltage*
- *Resistance measurements of all windings*
- *Impedance and load loss*
- *Induced potential test*
- *Pressure leak test*
- *Applied potential tests*

OPTIONAL TESTS:

- *Lightening Implulse test*
- *Temperature Test*
- *Audible Sound Level*
- *Insulation Power Factor test*
- *Partial Discharge test*
- *Sweep Frequency Response Analysis (SFRA)*

STANDARD BIL LEVELS FOR LIQUID IMMERSED TRANSFORMERS

Nomino/ System Voltage (kV)	*Liquid — B/L (std)*	*Liquid — B/L (opt)*
5	60	95
15	95	110
25	125	150

WEIGHTS AND DIMENSIONS*

	kVA	*OA 55°*	*OA 65°*	*FB*	*Height*	*Width*	*Depth*	*Gallons*	*Ibs.*
Mineral Oil	500	500	560	N/A	75 1/2	66 1/2	59.0	295	5132
	750	750	840	1050	75 1/2	69 1/2	55.25	304	6151
	1000	1000	1120	1400	75 1/2	69 1/2	64.75	330	7099
	1500	1500	1680	2100	77 1/2	74 1/4	61.0	398	9088
	2000	2000	2240	2800	77 1/2	74 1/4	86.25	440	10,404
	2500	2500	2800	3500	77 1/2	80 1/4	86.25	474	11,832
	3000	3000	3360	4200	93 1/2	80 1/4	94.25	614	14,321
FR-3	*kVA*	*OA 55°*	*OA 65°*	*FB*	*Height*	*Width*	*Depth*	*Gallons*	*Ibs.*
	500	500	560	N/A	75 1/2	66 1/2	51.88	282	5437
	750	750	840	1050	75 1/2	69 1/2	60.88	325	6712
	1000	1000	1120	1400	75 1/2	69 1/2	59.00	327	7487
	1500	1500	1680	2100	77 1/2	74 1/4	78.50	405	9802
	2000	2000	2240	2800	77 1/2	74 1/4	82.25	415	11,057
	2500	2500	2800	3500	77 1/2	80 1/4	106.50	506	13,291
	3000	3000	3360	4200	93 1/2	80 1/4	104.50	636	15,494
Silicone Oil	*kVA*	*OA 55°*	*OA 65°*	*FB*	*Height*	*Width*	*Depth*	*Gallons*	*Ibs.*
	500	500	560	N/A	75 1/2	66 1/2	53.38	301	5426
	750	750	840	1050	75 1/2	69 1/2	60.88	312	6477
	1000	1000	1120	1400	75 1/2	69 1/2	61.00	339	7487
	1500	1500	1680	2100	77 1/2	74 1/4	80.50	415	9690
	2000	2000	2240	2800	77 1/2	74 1/4	86.25	457	11,047
	2500	2500	2800	3500	77 1/2	80 1/4	108.50	515	12,954
	3000	3000	3360	4200	93 1/2	80 1/4	106.50	641	15,249

*These weights and dimensions are approximate and not for construction purposes.

It Is Critical For The Transformer Manufacturer To Be Provided With Complete And Accurate Information Regarding The Application Of The Transformer.

LIQUID SOUND LEVELS

kVA	*dB*
501-700	57
701-1000	58
1001-1500	60
1501-2000	61
2001-2500	62
2501-3000	63
3001- 4000	64
4001-5000	65

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