Nameplate Verification

Brendon Davenport – Regional Sales Manager

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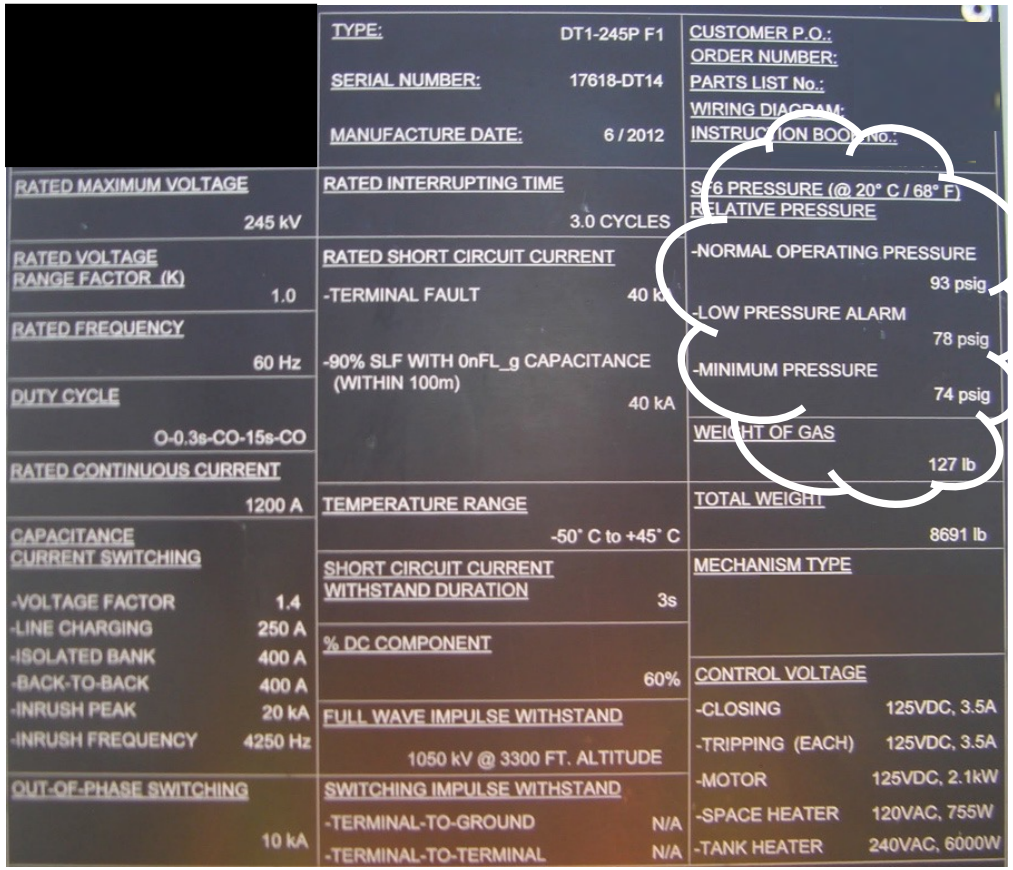
Nameplate Verification

Learning Objectives

- What the process for nameplate verification on a Gas Insulated Equipment is.
- What specific Gas Handling Equipment is required for a nameplate verification.
- What documentation should be completed to support a nameplate change.
- What is the difference between a Positive & a Negative emission

Nameplate Verification



[redacted]	TYPE: DT1-245P F1 SERIAL NUMBER: 17618-DT14 MANUFACTURE DATE: 6 / 2012	CUSTOMER P.O.: ORDER NUMBER: PARTS LIST No.: WIRING DIAGRAM: INSTRUCTION BOOK No.:
RATED MAXIMUM VOLTAGE 245 kV	RATED INTERRUPTING TIME 3.0 CYCLES	SF6 PRESSURE (@ 20° C / 68° F) RELATIVE PRESSURE -NORMAL OPERATING PRESSURE 93 psig -LOW PRESSURE ALARM 78 psig -MINIMUM PRESSURE 74 psig
RATED VOLTAGE RANGE FACTOR (K) 1.0	RATED SHORT CIRCUIT CURRENT -TERMINAL FAULT 40 kA	
RATED FREQUENCY 60 Hz	-90% SLF WITH 0nFL_g CAPACITANCE (WITHIN 100m) 40 kA	
DUTY CYCLE O-0.3s-CO-15s-CO		WEIGHT OF GAS 127 lb
RATED CONTINUOUS CURRENT 1200 A	TEMPERATURE RANGE -50° C to +45° C	TOTAL WEIGHT 8691 lb
CAPACITANCE CURRENT SWITCHING -VOLTAGE FACTOR 1.4 -LINE CHARGING 250 A -ISOLATED BANK 400 A -BACK-TO-BACK 400 A -INRUSH PEAK 20 kA -INRUSH FREQUENCY 4250 Hz	SHORT CIRCUIT CURRENT WITHSTAND DURATION 3s	MECHANISM TYPE
	% DC COMPONENT 60%	CONTROL VOLTAGE -CLOSING 125VDC, 3.5A -TRIPPING (EACH) 125VDC, 3.5A -MOTOR 125VDC, 2.1kW -SPACE HEATER 120VAC, 755W -TANK HEATER 240VAC, 6000W
	FULL WAVE IMPULSE WITHSTAND 1050 kV @ 3300 FT. ALTITUDE	
OUT-OF-PHASE SWITCHING 10 kA	SWITCHING IMPULSE WITHSTAND -TERMINAL-TO-GROUND N/A -TERMINAL-TO-TERMINAL N/A	

SF6 Gas Pressure @ Nominal

Weight of Gas in Lbs./kg

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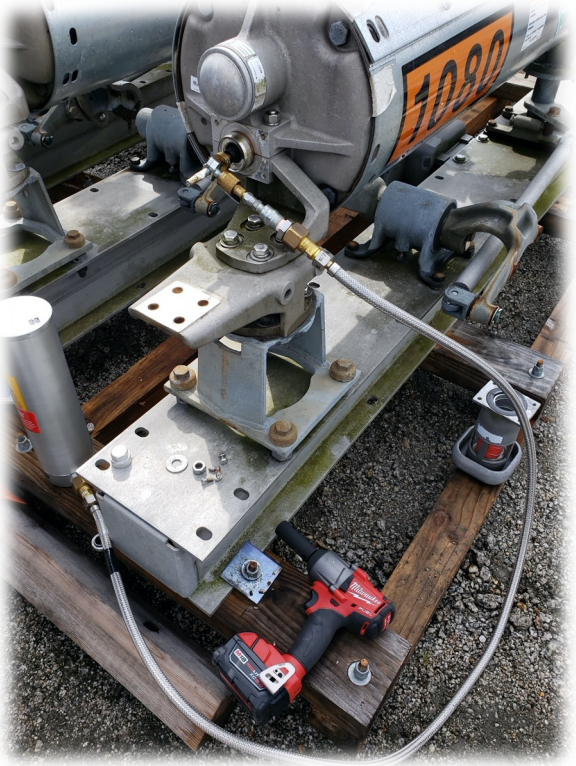
Nameplate Inaccuracies

Why do they exist?

- Mishandling and improper filling of GIE at time of commissioning, during maintenance or at time of retirement.

- Unidentified leaks at time of maintenance or retirement
- Main component replacement during major repairs or service
- Nameplate value inaccurate due to design changes, or manufacturing processes



Nameplate Verification

To better understand the process, understand what state & federal agencies are requiring

EPA – Today does not have a specific process in place (current new regulation in review)

MASS DEP – Today does not have a specific process in place

CARB– Has a specific process in place as of Jan 2022

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EPA – Today does not have a specific process in place (current new regulation in review)

The proposed changes for reporting is to support accountability of F-GHGs found in some of the SF6 gas alternatives. This new reporting requirements would help to improve the accuracy and completeness of the emissions reported under subpart DD and enhance the overall quality of the data collected under the GHGRP.

N. Subpart DD—Electrical Transmission and Distribution Equipment Use

1. Proposed Revisions to Improve the Quality of Data Collected for Subpart DD

For the reasons discussed in section II.A.3 of this preamble, we are proposing several revisions to subpart DD of part 98 (Electrical Transmission and Distribution Equipment Use) to improve the quality of the data collected from this subpart. These include adding F-GHGs other than SF_6 and PFCs to the monitoring, calculation, and reporting requirements of subpart DD (at 40 CFR 98.302, 98.303, 98.304, 98.305, and 98.306), clarifying the definition in 40 CFR 98.308 for "facility," adding definitions for "energized," "insulating gas," "new equipment," and "retired equipment," and specifying procedures in 40 CFR 98.303(b) for establishing user-measured nameplate capacity values for new and retiring equipment.

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(current new regulation in review)

Changes proposed include:

- Clarifications to definitions (for example):

  "**energized**" The proposed definition clarifies that energized equipment includes gas-insulated equipment (including hermetically-sealed pressure switchgear) that is connected through busbars or cables to an electrical power system or that is fully-charged, ready for service, and being prepared for connection to the electrical power system, and does not include spare GIE (including hermetically-sealed pressure switchgear) in storage that has been acquired by the facility, and is intended for use by the facility, but that is not being used or prepared for connection to the electrical power system.

  "**new equipment**" any GIE, including hermetically sealed pressure switchgear, that is not energized at the beginning of the reporting year, but is energized at the end of the reporting year

  "**retired equipment**" to mean any GIE, including hermetically-sealed pressure switchgear, that is energized at the beginning of the reporting year, but is not energized at the end of the reporting year.

"**new equipment**" may also include equipment that has been transferred while in use, meaning it has been added to the facility's inventory without being taken out of active service (*e.g.*, when the equipment is sold to or acquired by the facility while remaining in place and continuing operation), and,
(2) "**retired equipment**" may also include equipment that has been transferred while in use, meaning it has been removed from the facility's inventory without being taken out of active service (*e.g.*, when the equipment is acquired by a new facility while remaining in place and continuing operation).

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introduce the term "**insulating gas**" and to define it as follows:
"*Insulating gas,* for the purposes of this subpart, means any fluorinated GHG or fluorinated GHG mixture, including but not limited to SF_6 and PFCs, that is used as an insulating and/or arc quenching gas in electrical equipment."

The changes propose, to replace the existing nameplate capacity threshold (17,820lbs of installed SF6 gas) with an emissions threshold of 25,000 metric tons CO_2e per year of F-GHGs. To calculate their F-GHG emissions for comparison with the threshold, electrical equipment users would use one of two new equations in subpart DD at 40 CFR 98.301, proposed Equations DD-1 and DD-2. The proposed equations explicitly include not only the nameplate capacity of the equipment but also an updated default emission factor and the
GWP of each insulating gas.

$$E = \sum_i \sum_i NC_{EPS,i} * GHG_{i,w} * GWP_i * EF * 0.000453592$$

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EPA – Today does not have a specific process in place
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Electrical equipment users electing to measure the nameplate capacities of any new or retiring equipment would be required to measure the nameplate capacities of all eligible new and retiring equipment in that year and in all subsequent years.

Where a user-measured nameplate capacity differed from the rated nameplate capacity by two percent or more, the electrical equipment user would be required to adopt the user-measured nameplate capacity for that equipment for the remainder of the equipment's life.

Where a user-measured nameplate capacity differed from the rated nameplate capacity by less than two percent, the electrical equipment user would have the option to adopt the user measured nameplate capacity, but if they chose to do so they would be required to adopt the user-measured nameplate capacities for all new and retiring equipment whose user-measured nameplate capacity differed from the rated nameplate capacity by less than two percent

In order to ensure consistency, the EPA has proposed a process similar to that of CARB which was introduced into the regulation on January 1, 2022.

Nameplate Verification

If you are calculating the nameplate capacity pursuant to paragraph (b)(5)(iii)(B), use Equation DD-4 to do so.

$$NC_C = \frac{P_{NC}}{(P_i - P_f)} \times M_R \qquad \text{DD-4}$$

Where:

NC_C = Nameplate capacity of the equipment measured and calculated by the equipment user (pounds).

P_i = Initial temperature-compensated pressure of the equipment, based on the temperature-pressure curve for the insulating gas (psia).

P_f = Final temperature-compensated pressure of the equipment, based on the temperature-pressure curve for the insulating gas (psia). This may be equated to zero if the final temperature-compensated pressure of the equipment is equal to or lower than 0.068 psia (3.5 Torr).

P_{NC} = Temperature-compensated pressure of the equipment at the manufacturer-specified filling density of the equipment (*i.e.*, at the full and proper charge, psia).

M_R = Mass of insulating gas recovered from the equipment, measured in paragraph (b)(5)(vi) of this section (pounds).

Nameplate Verification

Case Study: Nameplate Value Verification

MFG Code	GIE Type	NP Gas Weight	Actual gas Fill	NP Pressue	NP Temp	Actual Fill	Temp	Blank-off pressure	Actual filled gas Weight	Comments/Notes
	Voltage Class	LBS	LBS	PSI	degrees F	PSI	degrees F	Torr	minus Nameplate Value	
M1	245kV DT	142	155.2	85	68	73.2	34	0.2	13.2	
S1	245kV DT	161	160.8	87	70	85.6	72	0.5	-0.2	
S1	72.5kV DT	33	24.9	65	68	65	62	3	-8.1	
S1	72.5kV DT	33	25	65	68	65	60	3	-8	
S2	245kV DT	161	159.2	87	70			0.5	-1.8	
G1	550kV DT	1437	1439	94	68	92/87/90	52/37/48	0.5	2	3 - Single poles
S1	72.5kV DT	75	131.7	87	68	87	44	3	56.7	
S1	72.5kV DT	33	25	65	68	67.5	76	0.5	-8	
S1	72.5kV DT	33	25.2	65	68	66.2	67	0.5	-7.8	
A1	72.5kV DT	25	16.4	65	68	61.3	61	0.5	-8.6	Recovery to Blank off pressure
S1	72.5kV DT	33	26.1	65	68	65.5	92	0.5	-6.9	
WH	72.5kV DT	15	11.9	80	70	78.1	63	0.5	-3.1	Recovery to Blank off pressure
S1	72.5kV DT	33	24.3	65	68	61.9	55	0.5	-8.7	
A1	72.5kV DT	25	17	65	68	61.9	66	0.5	-8	Recovery to Blank off pressure
S1	72.5kV DT	33	24.8	65	68	67	72	0.5	-8.2	
S1	72.5kV DT	33	24.9	65	68	67.8	70	0.5	-8.1	
A1	245kV DT	283	356	87	70	93.5	88	0.5	73	Recovery to Blank off pressure
S1	245kV DT	161	152.3	87	70	86	52	0.5	-8.7	
S1	245kV DT	161	123.5	87	70	96.8/96/96	95/97/98		-37.5	Failed Brkr Recovery
G1	550kV DT	1437	1447.1	94	68	102.2/102/102	101/100/104	0.5	10.1	3 - Single poles
S1	72.5kV DT	33	25.5	65	68	70.9	112	5	-7.5	
S1	72.5kV DT	33	24.9	65	68	69.4	111	5	-8.1	
S1	72.5kV DT	75	126.3	87	68	92	94	5	51.3	
S1	245kV DT	161	123.5	87	70	96.8/96/96	95/97/98	40	-37.5	Recovery to 5psi
A1	245kV DT	270	214.4	87	68	101.8	82	0.5	-55.6	Recovery to blank off pressure
MG	550kV DT	130	140.6	87	68	91/92/78	77/87/89	3	10.6	Recovery 3 single poles

Nameplate Verification

Nameplate Value Adjustment

Dave Wasson – Operations Manager DILO Direct, Casa Grande AZ

Nameplate Verification

CARB— Has a specific process in place as of Jan 2022

CARB Rule for Nameplate capacity adjustment.

This process is intended to be used to verify whether the nameplate capacity value is accurate and, if not, identify what the accurate value is.

Nameplate Verification

CARB— Has a specific process in place as of Jan 2022

GIE owners who elect to adjust the nameplate capacity value specified by the manufacturer on the nameplate attached to the GIE device, or within the manufacturer's official product specifications, may do so by undertaking the following process

- ❑ Record the initial pressure of the GIE with calibrated pressure gauge along with the temperature of the GIE. (Pressure gauges are required to be calibrated to +/- 1 psi, thermometers are required to be calibrated to +/- 1° F)

- ❑ Using the OEM's temperature/pressure curve chart, make note of the proper operating pressure.

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CARB— Has a specific process in place as of Jan 2022

- GIE that are under pressured must be filled to the proper operating pressure. (The amount filled to increase pressure would give you a negative emission)

- GIE that are over pressured must be recovered to the proper operating pressure. (Recovered SF6 to get to pressure is found gas, a positive emission)

Mass Flow meters are permitted to be used to preform Nameplate verification. It is important to keep the required flow rate of the Mass Flow Meter, to ensure accurate calculations.

Full recovery is achieved when the GIE has reached .75 torr at the GIE and is continued for an additional 5 minutes.

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- It is important to fully recover the residual SF6 from the recovery cart and weigh the cylinders.

  With the proper procedures and tools, you can provide accurate documentation to support a Name Plate change.

  How often can you make a name plate adjustment?
  - One time for the life of the GIE as it is.
  - One time for changes that may change the volume of the braker. (ie. Bushing change, interrupter change…)

  When can you make these changes?
  - At the time of install
  - At the time of maintenance
  - End of life of the GIE

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Run Video on Nameplate Verification

Nameplate Verification

Difference of Negative V. Phantom Emissions

Brendon Davenport– Regional Sales Manager DILO Company Inc.

Nameplate Verification

Difference of Negative V. Phantom Emissions

- Negative Loss = Actual loss of SF6 gas
  - Causes
    - GIE & Equipment Issues
      - Breaker seals, fittings and/or tubing damage causing leaks
      - GIE Maintenance
      - Age of GIE- Naturally occurring component failure over time
      - Catastrophic equipment failures (weather, impact , nature)

Nameplate Verification

Difference of Negative V. Phantom Emissions

- Phantom Loss = Perceived loss of gas
  - Causes
    - Gauge inaccuracies i.e., breaker gauge to calibrated gauge
    - Miss interpreting the Density Curve chart
    - No PSI reading on breaker gauge
    - Miss reporting and not documenting SF6 gas weight correctly.
    - Initial incorrect Nameplate value to begin with

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- How common mistakes lead to nameplate inaccuracies
  - Bad Gauges
    - Damaged
    - Out of calibration
    - Gauge selection
  - Improper gas handling techniques
    - Improper filling
    - Miss interpreting the Density Curve chart or Density gauge
      - No PSI reading on gauge and/or temperature compensated
    - Ensure your using the proper curve chart for that GIE
    - Not recovering the SF6 to an adequate level (i.e., ≤ .75 Torr)
      - Shipping pressure not recovered completely
    - Equipment damage (hoses, fittings, adaptors)

How Common Mistakes Lead To Nameplate Inaccuracies

- ***Example #1***
  - Inaccuracies on pressure gauges are not uncommon.

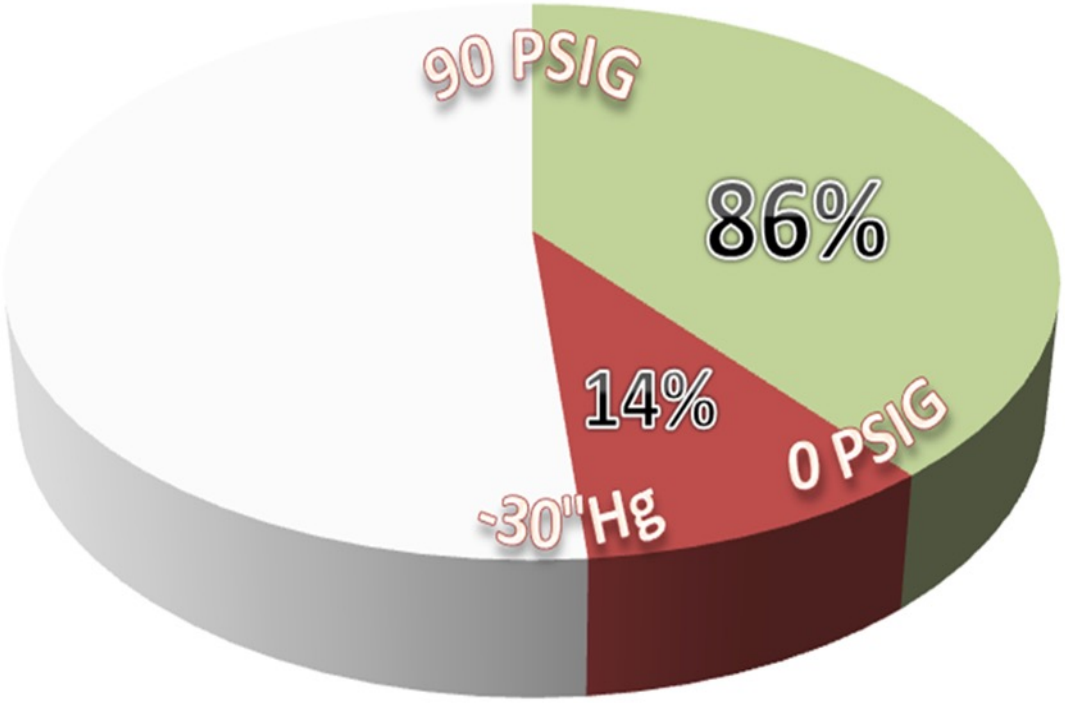
~69 PSIG - Breaker

66.89 PSIG – Calibrated Gauge

- Why not count on the OEM gauge?
  - Not calibrated annually.
  - Exposed to the elements.
  - May only be a temperature compensating gauge

How Common Mistakes Lead To Nameplate Inaccuracies

- ***Example #2***: SF6 Maintenance Equipment Issues
  - Older recovery systems not being able to recover 100% of SF6. Cannot reach Blank Off Pressure.
  - Inaccurate gauges on fill kit or recovery system
  - Lack of understanding Blank Off Pressure.
    - Residual SF6 will remain in a breaker at 0 PSI.
    - 0 PSIG does not equal 0 lbs. of SF6.

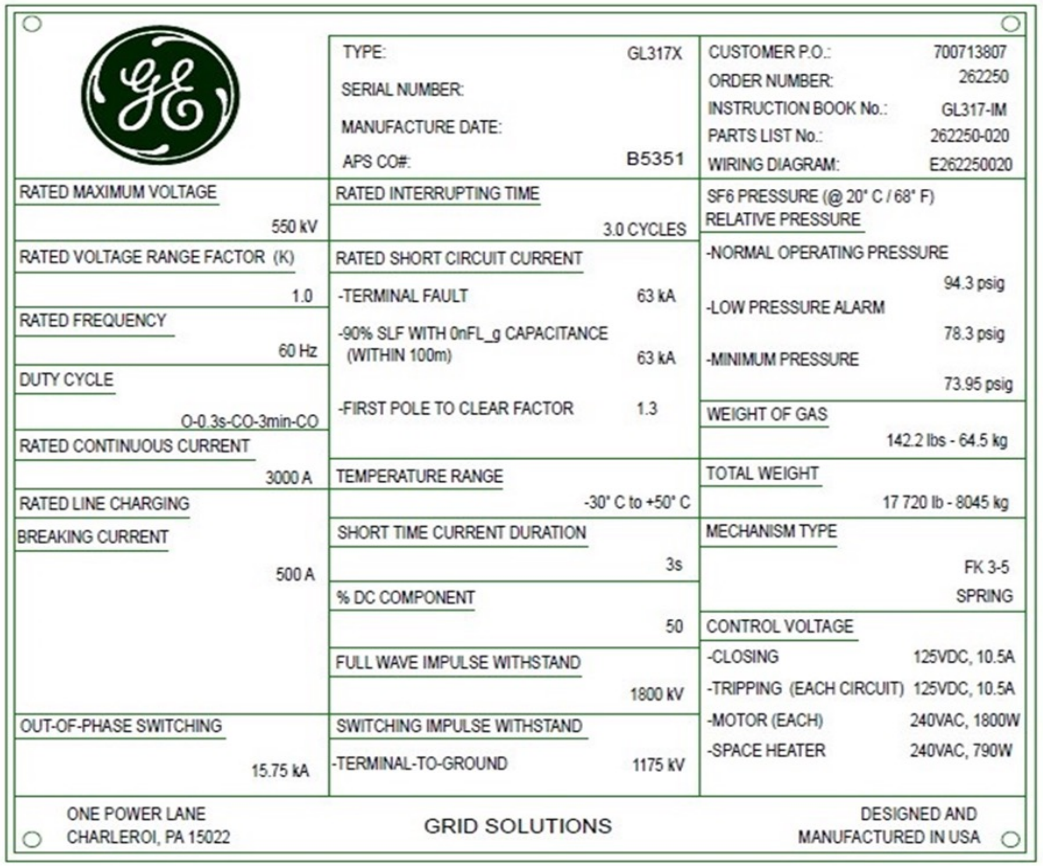


Difference of Negative V. Phantom Emissions

Continued

- How common mistakes lead to nameplate inaccuracies
  - Inaccurate nameplate gas weight NPGW
    - Misreading the nameplate or assuming its accuracy
    - Original fill gas handling procedure done incorrectly.
      - 20+ years ago
      - Lack of documentation
      - Human error
  - Simply incorrect nameplate value
    - Typically, this is a result of an updated design for later models, but volume was never corrected.
      - Bushing size changed and nameplate not adjusted
        - i.e., NPGW is 60lbs and technician uses 80lbs

How Common Mistakes Lead To Nameplate Inaccuracies



TYPE: GL317X	SERIAL NUMBER:	MANUFACTURE DATE:
APS CO#: B5351	CUSTOMER P.O.: 700713807	ORDER NUMBER: 262250
INSTRUCTION BOOK No.: GL317-IM	PARTS LIST No.: 262250-020	WIRING DIAGRAM: E262250020
RATED MAXIMUM VOLTAGE 550 kV	RATED INTERRUPTING TIME 3.0 CYCLES	SF6 PRESSURE (@ 20° C / 68° F) RELATIVE PRESSURE
RATED VOLTAGE RANGE FACTOR (K) 1.0	RATED SHORT CIRCUIT CURRENT	-NORMAL OPERATING PRESSURE 94.3 psig
RATED FREQUENCY 60 Hz	-TERMINAL FAULT 63 kA	-LOW PRESSURE ALARM 78.3 psig
DUTY CYCLE O-0.3s-CO-3min-CO	-90% SLF WITH 0nFL_g CAPACITANCE (WITHIN 100m) 63 kA	-MINIMUM PRESSURE 73.95 psig
RATED CONTINUOUS CURRENT 3000 A	-FIRST POLE TO CLEAR FACTOR 1.3	WEIGHT OF GAS 142.2 lbs - 64.5 kg
RATED LINE CHARGING BREAKING CURRENT 500 A	TEMPERATURE RANGE -30° C to +50° C	TOTAL WEIGHT 17 720 lb - 8045 kg
	SHORT TIME CURRENT DURATION 3s	MECHANISM TYPE FK 3-5 SPRING
	% DC COMPONENT 50	CONTROL VOLTAGE
	FULL WAVE IMPULSE WITHSTAND 1800 kV	-CLOSING 125VDC, 10.5A
OUT-OF-PHASE SWITCHING 15.75 kA	SWITCHING IMPULSE WITHSTAND	-TRIPPING (EACH CIRCUIT) 125VDC, 10.5A
	-TERMINAL-TO-GROUND 1175 kV	-MOTOR (EACH) 240VAC, 1800W
		-SPACE HEATER 240VAC, 790W
ONE POWER LANE CHARLEROI, PA 15022	GRID SOLUTIONS	DESIGNED AND MANUFACTURED IN USA

- ***Example #3***
- Who
  - Name of the Manufacture (OEM)
- What
  - Type of GIE
  - Serial Number
  - Voltage rating
  - Asset Identification
- When
  - Manufacture date (MM/YYYY)
- How Much
  - Name Plate Gas Weight (NPGW)
  - Operating PSI @ Temperature
  - Low PSI & Lockout Alarms

How Common Mistakes Lead To Nameplate Inaccuracies

- ***Example #4 :*** Original fill gas handling procedure done incorrectly.

- GIE – Nameplate 200 lbs. SF6 – 87 PSIG @ 68°F
  - Human error or gauge inaccuracy – Filled to 85 PSIG (Missing just 2 psi of gas)
  - GIE will only have about 196 lbs. of SF6
  - 30 years of service – Still at 85 PSIG @ 68°F
  - During decommission – Amount recovered using Mass Flow Meter was 196 lbs.
  - This results in a 4 lb. “Phantom Emission” – 2% emission over the lifetime of the breaker.