Use of appropriate Burden (VA) for Metering CTs

Specifications of VA burdens of CTs (Current scenario)
We often come across CTs with VA burdens with specified values of 10,15,20,30 VA. Seldom will you come across VA values specified as 5 VA and almost rare with 2.5 VA or lower.

How are these burdens values arrived at (Current Scenario):

The specs are decided / documented by end user, project engineers, process consultant, engineering consultants. The manner in which they arrive at these specs are…..

a) Looking at past drawings / documents of similar applications.
b) Making rough burden calculations, and inflating the value (to be on “safer” side).

Both these methods, invariably lead to selecting much higher burden values of CTs than actually required (scientifically).

Using CTs of burden values higher than required, is unscientific since it leads to inaccurate reading (meter) or inaccurate sensing of fault / reporting conditions.

Basically, such high value of design burden extends saturation characteristics of CT core leading to likely damage to the meter connected across it under overload conditiond. e.g. When we expect security factor (ISF) to be 5, the secondary current should be restricted to less than 5 times in case primary current shoots to more than 5 times its rated value. In such an overload condition, the core of CT is desired to go into saturation, restricting the secondary current thus the meter is not damaged. However, when we ask for higher VA, core doesn't go into saturation due to less load (ISF is much higher than desired) which may damage the meter.

To understand the effect on Accuracy aspect, let’s take an example of a CT with specified burden of 15 VA, and the actual burden is 2.5 VA:

i) 15 VA CT with less than 5 ISF will have saturation voltage of 15 Volts (15/5x5), and actual burden of 2.5 VA the saturation voltage required shall be (2.5/5 x 5) 2.5 Volts against 15 Volts resulting ISF = 30 against required of 5

ii) If low-ratio CT (below 400 A primary) having higher burden CT (15 VA) is connected to a meter with lead wires of 4 meters having actual Burden of less than 5 VA (e.g. Digital Meter 0.5 VA + lead Wire 2.0 VA = 2.5 VA in total) the effective CT accuracy is much on the higher side than that at the 100% rated Burden (15 VA). The sample

CT designed for ratio 100/5 A 15 VA Class 1.0 & tested with connected burden of 15 VA. Errors measured:

Rated Primary Current	Ratio Error	Phase Error	Accuracy Class
120%	-0.07	+ 21 min	0.5
100%	-0.05	+ 19 min	0.5
20%	-1.47	+ 65 min	1
5%	-3	+134 min	1

CT designed for ratio 100/5 A 15 VA Class 1.0 & tested with connected burden of 2.5 VA. Errors measured:

Rated Primary Current	Ratio Error	Phase Error	Accuracy Class
120%	2.77	+ 37 min	OUT
100%	2.75	+ 43 min	OUT
20%	2.59	+ 69 min	OUT
5%	2.4	+102 min	1

The above readings show that the use of CTs designed with higher burden if used for lower burden application, will show higher errors in measurements.

Often, metering Cores of CTs are connected to Ammeter and WATT/VAR meter other cases being Energy meter, Current Coil of P.F. Indicator.

(For CTs of higher Voltage Class other variety of meters may also be connected)

With the improvement in the technology subsequent to the publication of IS- 4201-1983- “Application Guide for Current Transformers”- the burden of individual instrument have reduced considerably. Table showing typical Burdens of various devices is given below.

Load	Burden (VA)
Ammeter Analogue	1
Ammeter Digital (widely used now)	0.5
Current Coil of WATT/VAR meter	1.5
Current Coil of Energy Meter	2
Current Coil of P.F. Indicator	2.5
Current Coil of Trivector Meter	3
Leads Between CT’s and Meters	
(@4 meters) (see formula)	2

Calculation of lead wire burden:

$$\text{Lead Wire Burden in VA} = \frac{I^2 * 2D}{CS \times 57}$$

Where:

- I = Secondary Current in Amps
- D = lead wire distance in meter.
- CS = cross section of lead wire.

It will be seen from the above that for most applications of indoor CTs, though the burden (VA) specified for the metering Core is 10/15 VA, it is unlikely to exceed 5 VA.

It is therefore suggested that the rated Burden for the Metering Core of the CT to be a standard value and as close to the connected Burden as possible.

BURDEN CALCULATION TABLE FOR SIEMENS 8PU FAMILY OF SWBs

LEAD WIRE BURDENS OF CTs					COMBINED BURDEN (VA) METER+LEAD-WIRE					
	Sec. Current	Wire Length	Wire C/S	Wire Burden	Analogue Ammeter	Digital Ammeter	Watt VAR	kWH	PF	Tri-V
	Amps	Meters	mm2	VA	1.0 VA	0.5 VA	1.5 VA	2.0 VA	2.5 VA	3.0 VA
L4.5	1	8.0	2.5	**0.11**	0.11	0.11	0.11	0.11	0.11	**0.11**
	1	8.0	4.0	**0.07**	0.07	0.07	0.07	0.07	0.07	**0.07**
	5	8.0	2.5	**2.81**	2.81	2.81	2.81	2.81	2.81	**2.81**
	5	8.0	4.0	**1.75**	1.75	1.75	1.75	1.75	1.75	**1.75**
S1.5	1	1.5	2.5	**0.02**	0.02	0.02	0.02	0.02	0.02	**0.02**
	1	1.5	4.0	**0.01**	0.01	0.01	0.01	0.01	0.01	**0.01**
	5	1.5	2.5	**0.53**	0.53	0.53	0.53	0.53	0.53	**0.53**
	5	1.5	4.0	**0.33**	0.33	0.33	0.33	0.33	0.33	**0.33**
F4.5	1	2.0	2.5	**0.03**	0.03	0.03	0.03	0.03	0.03	**0.03**
	1	2.0	4.0	**0.02**	0.02	0.02	0.02	0.02	0.02	**0.02**
	5	2.0	2.5	**0.70**	0.70	0.70	0.70	0.70	0.70	**0.70**
	5	2.0	4.0	**0.44**	0.44	0.44	0.44	0.44	0.44	**0.44**