SL. NO	NOMINAL DIAMETER "D" mm	TIGHTENING TORQUE ON GASKETED JOINT (Nm) (STEEL FASTENER)	TIGHTENING TORQUE ON WOODEN CORE CLAMP (Nm) (STEEL FASTENER)	TIGHTENING TORQUE ON STEEL FIXING STUD FOR BUSHING (Nm)	TIGHTENING TORQUE ON BUSHING STEM (Nm) (BRASS /COPPER)	TIGHTENING TORQUE ON COPPER BUSBAR (Nm) (STEEL FASTENER)
1	M6	5	-	-	-	-
2	M8	12	-	-	10	-
3	M10	22	22	15	-	25
4	M12	38	38	25	13	40
5	M16	90	90	40	-	90
6	M20	176	176	-	30	-
7	M24	304	304	-	-	-
8	M42	-	-	-	110	-
9	M48	-	-	-	180	-

Rated power ONAN (MVA)	Rated power ONAF (MVA)	No-Load Loss (kW)	Load loss ONAN (kW)	Load loss ONAF (kW)	Impedance Voltage ONAN (%)	Impedance Voltage ONAF (%)
10	16	13	55	141	9	14.4
12.5	20	15	60	153.6	9	14.4
16	25	17	65	158.7	10	15.6
20	31.5	20	70	173.6	10	12.6
25	40	24	80	204.8	10	16
31.5	50	28	86	216.7	10	15.9
40	63	35	102	253.0	10	15.8
50	80	41	110	281.6	10	16
63	100	49	126	317.5	10	15.9

Rated power ONAN (MVA)	Rated power ONAF (MVA)	Dimension LxWxH (mm)	Total weight (kg)	Oil weight (kg)	Shipping weight (kg)
10	16	5000x2650x4700	36,000	12,000	25,000
12.5	20	5200x2700x4800	40,000	12,500	28,000
16	25	5300x2750x5000	45,000	13,500	21,500
20	31.5	5400x2800x5200	51,000	14,000	35,700
25	40	5500x2900x5300	58,000	14,500	40,600
31.5	50	5600x2950x5400	65,000	17,000	45,000
40	63	5700x3000x5500	75,000	18,000	52,500
50	80	5800x3100x5600	90,000	20,500	63,000
63	100	5900x3200x5700	100,000	25,500	70,000

SERVICE

WHAT KEEPS YOUR TRANSFORMER OPERATIONAL?
PAPER

Paper is what keeps your transformer operating. Paper provides the mechanical strength holding this giant transformer together! It provides

- Mechanical strength
- Dielectric strength
- Dielectric spacing

MYTH
The Paper in a transformer is under no stress since transformers have no moving parts

FACT
Other than in load tap changers and regulating transformers, a transformer has no functional, mechanically moving parts, but the paper is under constant stress due to

- Mechanical vibration
- Switching surges
- Line surges
- Limited short circuits

The paper wrapping and spacers withstand this movement when your transformer is new. As your transformer ages, it loses this ability. IEEE defines your transformer's end of life when there is a 75% loss in paper tensile strength. Beyond this point your transformer may not reliably withstand the next surge load or short circuit.

WHAT PROVIDES DIELECTRIC STRENGTH, COOLING AND PROTECTS THE PAPER INSULATION?
MINERAL OIL

Mineral Oil Provides

- Dielectric Strength
- Cooling
- Protection to the Paper

When the oil is not providing one of these functions, servicing will be required to assure Maximum Transformer Life.
Before the oils' ability to provide Dielectric Strength and Cooling is reduced and before oxidizing compounds become established and decay the paper, the oil must be maintained in order that the Transformer Life is not reduced. Oil is an organic compound, which naturally oxidizes and decays.
Oil in a Transformer is encouraged to oxidize by the presence of acids, moisture, gases, lacquers and other contaminants. The same oxidants which exist in the oil also take up residence in the paper since the paper acts like a filter and absorb these decaying products, in turn destroying its own insulating properties!

SLUDGES

If allowed to continue unchecked, oil decay products will form sludge deposit in the transformer which acts to trap heat in the transformer, degrades the insulation and reduces dielectric gaps increasing the risk of failure.
Sludge can only be removed by Hot Oil Cleaning, preferably when the Transformer is energized. Filter all equipment offers the facility to redissolve oil decay products and remove them in order that clean as new Oil is returned to the transformer. This provides a thorough cleaning of the transformer internals, the insulating papers, the cooling fins and ducts by providing a continuous redissolving action of the oil decay products. Since the process also cleans the transformer internals, not just the oil, the ageing process is very much reduced providing for Extended Transformer Life.

Table 1 – Recognized minimum values of short-circuit impedance for transformers with two separate windings

Short-circuit impedance at rated current	
Rated Power kVA	**Minimum short-circuit impedance** **%**
Up to 630	4,0
631 to 1 250	5,0
1 251 to 2 500	6,0
2 501 to 6 300	7,0
6 301 to 25 000	8,0
25 001 to 40 000	10,0
40 001 to 63 000	11,0
63 001 to 100 000	12,5
Above 100 000	>12,5
NOTE 1 Values for rated power greater than 100 000 kVA are generally subjected to agreement between manufacturer and purchaser. NOTE 2 In case of single-phase units connected to from a three-phase bank, the value of rated power applies to three-phase bank rating.	

3.2.2.4 The short-circuit apparent power of the system at the transformer location should be specified by the purchaser in his enquiry in order to obtain the value of the symmetrical short-circuit current to be used for the design and tests.

If the short-circuit apparent power of the system is not specified, the values given in table 2 shall be used.

Table 2 - short-circuit apparent power of the system

Highest voltage for equipment, *U*m kV	**Short-circuit apparent power** MVA	
	Current European practice	**Current North American practice**
7,2; 12; 17,5 and 24	500	500
36	1 000	1 500
52 and 72,5	3 000	5 000
100 and 123	6 000	15 000
145 and 170	10 000	15 000
245	20 000	25 000
300	30 000	30 000
362	35 000	35 000
420	40 000	40 000
525	60 000	60 000
765	83 500	83 500
NOTE : If not specified, a valve between 1 and 3 should be considered for the ratio of zero-sequence to positive-sequence impedance of the system.		

3.2.2.5 For transformers with two separate windings, normally only the three-phase short circuit is taken into account, as the consideration of this case is substantially adequate to cover also the other possible types of fault (exception is made in the special case considered in the note to 3.2.5).

NOTE: In the case of winding in zigzag connection, the single-line-to-earth fault current may reach values higher than the three-phase short-circuits current. However, these high values are limited, in the two limbs concerned, to a half of the coil and furthermore the currents in the other star-connected winding are lower than for a three-phase short circuit. Electro dynamic hazard to the winding assembly may be higher either at three- or single-phase short circuit depending on the winding design. The manufacturer and the purchaser should agree which kind of short circuit is to be considered.