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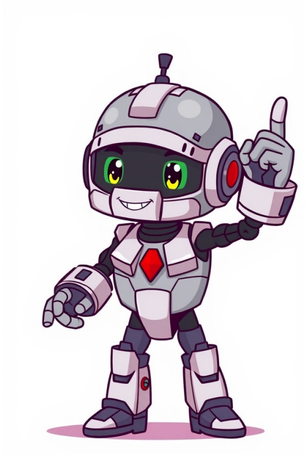

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Examples in Imperial and Metric Systems Read More ,the free encyclopedia that anyone can edit.294,705 active editors 7,099,184 articles in EnglishSMSPommern was a Deutschland-class pre-dreadnought battleship built for the Imperial German Navy at the AG Vulcan Stettin yard at Stettin, Germany. Named after the Prussian province of Pomerania, she was laid down on 22March 1904, launched on 2December 1905, and commissioned into the navy on 6August 1907. The ship was armed with four 28cm (11in) guns and had a top speed of 18 knots (33km/h; 21mph). Pommern was assigned to IIBattle Squadron of the High Seas Fleet. At the start of World WarI, she was stationed at the Elbe to support the defenses of the German Bight. She participated in sorties into the North Sea in attempts to destroy portions of the British Grand Fleet. These offensive operations culminated in the Battle of Jutland, where she was hit by torpedoes, which detonated one of her 17-centimeter (6.7in) gun magazines. The resulting explosion broke the ship in half and killed the entire crew. (Thisarticle is part of a featured topic: Battleships of Germany.)Recently featured: Julio and MarisolMechanical TurkKEXP-FMArchiveBy emailMore featured articlesAboutSoprillo... that the soprillo saxophone (example pictured) is about half the length of a soprano saxophone and pitched one octave higher?... that Stalin told the Turkestan Autonomy to invade the Soviet Commissariat in Tashkent instead of asking him to dissolve it?... that Josphe Jacquiot founded a museum that was named in her honour?... that Serbia's smallest passenger airport has only one year-round scheduled flight to Istanbul?... that Brandon Saad was the first Saginaw Spirit alumnus to win the Stanley Cup?... that a 2025 petition to the International Criminal Court alleges that 122 European politicians have committed crimes against humanity against migrants?... that "nobody among the secretaries of the Middle Ages could reach such a level of influence over kings" as Fernn Daz de Toledo?... that the 2003 series Trouble frequently appears on lists of the worst or most controversial Spider-Man storylines?... that in Mori culture a woman can end a speech during a pwhiri by walking in front of the speaker?ArchiveStart a new articleNominate an articleCyclone DitwahIn motorsport, Sbastien Ogier and Vincent Landais win the World Rally Championship.Flooding and landslides caused by Cyclone Ditwah (satellite image shown) leave at least 370 people dead across Sri Lanka and India.An apartment complex fire in Hong Kong leaves at least 151 people dead.In Guinea-Bissau, armed forces seize power in a military coup, arresting President Umaro Sissoco Embal and proclaiming Horta Inta-A Na Man as head of a transitional government.Ongoing: Gaza wartimelinegenocideRusso-Ukrainian wartimelineSudanese civil wartimelinemassacreRecent deaths: Bodil Nyboe AndersenDerek HolmesGondoo U Thein NaingKo Lay Inwa GonyiLorenzo BuffonDharmendraMore current eventsNominate an articleDecember 21928 Ford ModelA1823 U.S. president James Monroe issued the Monroe Doctrine, a proclamation of opposition to European colonialism in the New World.1927 The Ford Motor Company introduced the second version of the Model A (pictured), its first new model in 18 years.1950 Korean War: UN forces began a retreat from North Korea following defeat at the Battle of the Ch'ongch'on River.1989 The Malayan Communist Party and the Malaysian government signed a peace accord to end a 21-year communist insurgency.2015 In San Bernardino, California, a married couple carried out a mass shooting at a Christmas party before fleeing and dying in a shootout with police.Irene Vanbrugh (b.1872)Allen Wright (d.1885)Austen Deans (b.1915)Inori Minase (b.1995)More anniversaries: December 1December 2December 3ArchiveBy emailList of days of the yearAboutPedroII of Brazil (2December 1825 5December 1891), also known as Pedro the Magnanimous, was the second and last monarch of the Empire of Brazil, reigning for more than 58 years. Born in Rio de Janeiro as the seventh son of PedroI and Maria Leopoldina, PedroII inherited an empire on the verge of disintegration, but he turned Brazil into an emerging power in the international arena. The nation grew to be distinguished from its Hispanic neighbors on account of its political stability, freedom of speech, respect for civil rights, vibrant economic growth, and form of government a functional representative parliamentary monarchy. Pedro pushed through the abolition of slavery in Brazil despite opposition from powerful political and economic interests. He established a reputation as a vigorous sponsor of learning, culture, and the sciences, and he won the respect and admiration of people such as Charles Darwin, Victor Hugo, and Friedrich Nietzsche, and was a friend to Richard Wagner, Louis Pasteur, and Henry Wadsworth Longfellow, among others. Historians have regarded Pedro positively and several have ranked him as the greatest Brazilian. This 1872 painting by Pedro Amrico depicts PedroII delivering the speech from the throne in the General Assembly and wearing the Imperial Regalia.Painting credit: Pedro AmricoRecently featured: The Massacre of the MamelukesShirley ChisholmMany-worlds interpretationArchiveMore featured picturesCommunity portal The central hub for editors, with resources, links, tasks, and announcements.Village pump Forum for discussions about Wikipedia itself, including policies and technical issues.Site news Sources of news about Wikipedia and the broader Wikimedia movement.Teahouse Ask basic questions about using or editing Wikipedia.Help desk Ask questions about using or editing Wikipedia.Reference desk Ask research questions about encyclopedic topics.Content portals A unique way to navigate the encyclopedia.Wikipedia is written by volunteer editors and hosted by the Wikimedia Foundation, a non-profit organization that also hosts a range of other volunteer projects: CommonsFree media repository MediaWikiWiki software development Meta-WikiWikimedia project coordination WikibooksFree textbooks and manuals WikidataFree knowledge base WikinewsFree-content news WikiquoteCollection of quotations WikisourceFree-content library WikispeciesDirectory of species WikiversityFree learning tools WikivoyageFree travel guide WiktionaryDictionary and thesaurusThis Wikipedia is written in English. Many other Wikipedias are available; some of the largest are listed below. 1,000,000+ articles DeutschEspaolFranaisItalianoNederlandsPolskiPortugusSvenskaTing Vit 250,000+ articles Bahasa IndonesiaBahasa MelayuBn-lm-gCataletinaDanskEestiEsperantoEuskaraMagyarNorsk bokmlRomnSimple EnglishSloveninaSrpskiSrpskohrvatskiSuomiTrkeOzbekcha 50,000+ articles AsturianuAzrbaycancaBosanskiFryskGaeilgeGalegoHrvatskiKurdLatvieuLietuviNorsk nynorskShqipSloveninaRetrieved from " 2Naval gun 28 cm SK L/40 Forward Drh.L. C/01 turret of the DeutschlandTypeNaval gunCoast-defence gunRailway gunPlaceoforiginGerman EmpireService historyInservice19041945.[1]UsedbyGerman Empire Ottoman Empire Nazi GermanyWarsWorld War I World War IIProduction historyDesignerKruppDesigned1902[1]ManufacturerKruppProduced1902?1906?[a][1]SpecificationsMass45.3 metric tons (44.6 long tons; 49.9 short tons)Length11.2 meters (36ft 9in)Barrellength10.401 meters (34ft 1.5in) (bore length)Shellseparate-loading, cased chargeShell weight240284 kilograms (529626lb)Caliber283 millimeters (11.1in)Breechhorizontal sliding-wedgeMuzzlevelocity740 to 820m/s (2,400 to 2,700ft/s)The 28cm SK L/40[Note 1] was a German naval gun that was used in World War I and World War II as the main armament of the Braunschweig- and Deutschland-class pre-dreadnoughts.Profile drawing of the 28 cm SK L/40 gun in the naval mountingThe 28cm SK L/40 gun weighed 45.3 tonnes (44.6 long tons; 49.9 short tons), had an overall length of 11.2 meters (36ft 9in) and a bore length of 10.401 meters (34ft 1.5in). Although designated as 28cm (11in), its actual caliber was 28.3 centimeters (11.1in). It used Krupp's horizontal sliding-block, or "wedge", as it is sometimes referred to, breech design rather than the interrupted screw commonly used in heavy guns of other nations. This required that the propellant charge be loaded in a metal case (usually brass) which provides obturation, or sealing of the breech, to prevent escape of the expanding propellant gas. The 28cm SK L/40 was the last large German naval gun to load all its propellant in a single case; later guns required a fore charge in addition to the main charge in the cartridge case.[1]The C/01 turret was used by the Braunschweig- and Deutschland-class battleships, one twin gun turret at each end. Its guns could depress 4 and elevate 30 and could traverse about 150 on either side of the centerline. It could fire a 240kg (530lb) L/2.6 armor-piercing shell to a maximum range of 18,830 meters (20,590yd) at maximum elevation. These ships stowed 85 rounds per gun. The rate of fire for both types of turrets was about 2 rounds per minute.[1]The Treaty of Versailles allowed the Germans to retain four pre-dreadnoughts, although only two, Schleswig-Holstein and Schlesien, were rearmed with their original 28cm SK L/40 guns. The former fired the first shots of World War II when she began bombarding Polish defenses on the Westerplatte on 1 September 1939 while the latter also participated in the Polish Campaign. However both ships were relegated to training duties shortly afterwards.[2]A SK L/40 gun on a coastal defense mount in BelgiumSide view of a "Bruno" and its crew in 1918Some of the 28cm SK L/40 guns were transferred to the German Army from the Navy (Kaiserliche Marine) when the pre-dreadnoughts began to be disarmed and relegated to training duties in 1916 after the Battle of Jutland had proved that they were not suitable for contemporary naval combat. One obvious change made for land service was the placement of a large counterweight just forward of the trunnions to counteract the preponderance of weight towards the breech. This, although heavy, was simpler than adding equilibrators to perform the same function. It was fitted with a hydro-pneumatic system to absorb the recoil from firing and to return the gun to its firing position, ready for the next round. The first four guns were placed in Bettungsschiessgerst (firing platform) (BSG) mountings in 1917 for coast defense duties as part of "Batterie Graf Spee" on the island of Wangerooge. These were a semi-portable mount that could be emplaced anywhere after several weeks of labor to prepare the position. It rotated on a pivot at the front of the mount and the rear was supported by rollers resting on a semicircular rail and was sometimes equipped with a gun shield.[3] The gun's rate of fire in these mounts was about one round per five minutes.[4]During World War II only seven guns were used as coast defense duties on BSG mountings. The four guns of "Batterie Graf Spee" had survived World War I and were transferred to Brest, France in 1940.[5][6]Main article: 28 cm SK L/40 "Bruno"Approximately twenty other guns from the battleships were put on railroad mountings as the 28cm SK L/40 "Bruno" and used as railway guns. A number were kept by the Kaiserliche Marine and used on coastal defense duties, but the others were used by the Heer in more traditional roles as long-range heavy artillery.[3] Surviving weapons were used by the Germans in World War II as coast defense duties.[7]Before and during World War I, the gun used about 73kg (161lb) of RP C/12 (Rohr-Pulver tube powder)[1] propellant that was a mix of nitrocellulose, nitroglycerin and small amounts of other additives with a calorific value of 950 and an uncooled explosion temperature of 2975 kelvins. In World War II, it was replaced by RP C/38 that substituted diethylene glycol dinitrite for the nitroglycerine which had a calorific value of 810 and an uncooled explosion temperature of 2495 K. This had the virtue of being harder to ignite, lessening the risk of a catastrophic fire or explosion, and reduced the erosive effects of the gaseous propellant on the gun's bore.[8] Sources differ on the amount of RP C/38 used by the gun during World War II; Campbell says 70kg (154lb),[9] but Hogg says 67kg (148lb).[10]These guns mounted fired two types of shells during World War I: armor-piercing (AP) L/2.6 and high explosive (HE) L/2.9 types. During World War II, the guns fired a wider variety of shells, including high explosive L/2.9, L/4.3, and L/4.1 shells and a heavy HE L/4.4 projectile; the AP and HE rounds weighed 240kg (529lb), while the heavy projectile weighed 284kg (626lb).[1]Shell nameWeightFilling WeightMuzzle velocityRangeWorld War IArmor-piercing shell (Pzgr L/2.6)240kg (530lb)unknown820m/s (2,700ft/s)18,830m (20,590yd)high-explosive shell (Sprenggranate L/2.9)240kg (530lb)unknown820m/s (2,700ft/s)unknownWorld War IIbase-fused high-explosive shell with ballistic cap (Sprenggranate L/4.3 m. Bdz. (mit Haube))240kg (530lb)unknown820m/s (2,700ft/s)unknownnose-fused HE shell with ballistic cap (Sprenggranate L/4.1 m. Kz. (mit Haube))240kg (530lb)unknown820m/s (2,700ft/s)unknownbase- and nose-fused HE shell with ballistic cap (Sprgr L/4.4 m. Bdz. u. Kz. (mit Haube))284kg (626lb)18.7kg (41lb) (TNT)740m/s (2,400ft/s)25,640m (28,040yd) at 30Due to the greater elevation available in the BSG mount, the Sprgr L/4.4 m. Bdz. u. Kz. (mit Haube) had a maximum range of 27,750m (30,350yd).[9]One source credits the Pzgr L/2.6 shell with the ability to penetrate 160 millimeters (6.3in) of side armor at 12,000 meters (13,000yd).[1]List of naval guns^ SK - Schnelladekanone (quick loading cannon); L - Lnge in Kaliber (length in caliber)^ Exact dates of production are not known with any certainty, even if any guns were built after the last of the Deutschland-class ships was launched in 1906. Chesneau and Kolesnik, pp. 247249.^ a b c d e f g h "Germany 28 cm/40 (11") SK L/40". NavWeaps.com. 25 March 2009. Retrieved 19 August 2009.^ Gardiner and Gray, pp. 14142^ a b Franois, p. 38^ Gander and Chamberlain, p. 269^ Rolf (1998), p. 350^ Rolf (2004), p. 446^ Franois, pp. 62, 68^ Campbell, p. 221^ a b Campbell, p. 233^ Hogg, p. 239Reichs-Marine-Amt, ed. (1908). Bedienungsvorschrift fr die 28 cm Schnellade-Kanone L/40 in Drehscheibenlafette C/1901. Berlin: E. S. Mittler. OCLC252061411.Reichs-Marine-Amt, ed. (1905). Bedienungsvorschrift fr die 28 cm Schnellade-Kanone L/40 in Minimalscharten-Lafette C/1901. Berlin: E. S. Mittler. OCLC252060665.Reichs-Marine-Amt, ed. (1897). Bedienungsvorschrift fr die 28 cm Kanone L/40 und L/35 in Drehscheiben-Laffete C/92. Berlin: E. S. Mittler. OCLC252061127.Campbell, John (2002). Naval Weapons of World War Two. London: Conway Maritime Press. ISBN0-87021-459-4.Chesneau, Roger; Kolesnik, Eugene M., eds. (1979). Conway's All the World's Fighting Ships 18601905. Greenwich: Conway Maritime Press. ISBN0-8317-0302-4.}Franois, Guy (2006). Eisenbahnartillerie: Histoire de l'artillerie lourde sur voie ferre allemande des origines 1945 (in French). Paris: Editions Histoire et Fortifications.Gander, Terry; Chamberlain, Peter (1979). Weapons of the Third Reich: An Encyclopedic Survey of All Small Arms, Artillery and Special Weapons of the German Land Forces 19391945. New York: Doubleday. ISBN0-385-15090-3.Gardiner, Robert; Gray, Randal, eds. (1985). Conway's All the World's Fighting Ships 19061921. Annapolis, MD: Naval Institute Press. ISBN0-85177-245-5.Hogg, Ian V. (1997). German Artillery of World War Two (2nd correcteded.). Mechanicsville, PA: Stackpole Books. ISBN1-85367-480-X.Rolf, Rudi (1998). Der Atlantikwall: Bauten der deutschen Kstenbefestigungen 19401945 (in German). Osnabrck: Biblio. ISBN3-7648-2469-7.Rolf, Rudi (2004). A Dictionary on Modern Fortification: An Illustrated Lexicon on European Fortification in the Period 18001945. Middleburg, Netherlands: PRAK.Schmalenbach, Paul (1983). "German Navy Large Bore Guns Operational Ashore During World War I". Warship International. XX (2): 123153. ISSN0043-0374.Wikimedia Commons has media related to 28 cm SK L/40.SK L/40 at NavWeaps.comRetrieved from " 328 cm SK L/40 gun has been listed as one of the Warfare good articles under the good article criteria. If you can improve it further, please do so. 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You can use this page to start a discussion with others about how to improve the "28 cm SK L/40 gun" page.Start a discussionRetrieved from " 4GA toolboxAuthorshipCitation botCopyvio detectorExternal linksReviewingTemplatesCriteriaInstructionsvteArticle (edit | visual edit | history) Article talk (edit | history) WatchReviewer: Grandiose (me, talk, contribs) 19:30, 7 June 2011 (UTC)[reply]GA review see WP:WIAGA for criteriaAs an experienced contributor, Sturmvogel, you'll excuse me being quite concise on the review - if you want further clarification, I'm more than happy. Opening words - just a few small things, no reason why it can't pass shortly. Ideally, although it doesn't fall under anything below, I think words on a "jargon level" of 'trunnion' should be linked. Also, if you could put into the article, suitably referenced, the " 189091" design time, and the "18911904?" production time from the infobox, as new material ought'nt be in the infobox (can't find the relevant guideline, but I believe this to be the case). I'm honestly not sure whether that needs to be complied with for GA status, but solving it would answer that anyway.Cited, but not added added to the main body.--Sturmvogel 66 (talk) 03:00, 9 June 2011 (UTC)[reply]Is it reasonably well written?A. Prose quality: Fine.B. MoS compliance for lead, layout, words to watch, fiction, and lists: Lead needs to be slightly bigger - doesn't seem to reflect the Description section much.Hard to summarize a description without simply duplicating material in both sections.--Sturmvogel 66 (talk) 03:00, 9 June 2011 (UTC)[reply]Is it factually accurate and verifiable?A. References to sources: Could we have slight elaborate on the web references - such as the website name they came from? Helps with verifiability if they're broken and everything. Text sources are more the sufficient, by comparison. [I don't believe there's any need to keep the jarring block caps of the name.]Done.--Sturmvogel 66 (talk) 03:00, 9 June 2011 (UTC)[reply]B. Citation of reliable sources where necessary: Just the two points I'd like to see one; possibly outside requirements, but probably to your personal satisfaction.Added.--Sturmvogel 66 (talk) 03:00, 9 June 2011 (UTC)[reply]C. No original research: Is it broad in its coverage?A. Major aspects: Passes, although I think rather reliant on the "[does not need to] cover every major fact or detail" clause because of the brevity of the history section - the reader has some idea, but it's not great. I'd consider perhaps thinking about what history ends up in the "Description" section, and what ends up below. "The Treaty of Versailles allowed the Germans to retain four pre-dreadnoughts, although only two, Schleswig-Holstein and Schlesien, were rearmed" [my emphasis] means the History section sounds like we come in part way through, but this isn't the case you've read the Description section (hence why this isn't a blocking problem), but it would be preferable, I think, if the reader didn't have to do that, given the somewhat technical nature of the Description section.I agree and have reworked it in line with your suggestions. See how it reads.--Sturmvogel 66 (talk) 03:00, 9 June 2011 (UTC)[reply]B. Focused: Is it neutral?Fair representation without bias: Is it stable?No edit wars, etc: Does it contain images to illustrate the topic?A. Images are copyright tagged, and non-free images have fair use rationales: B. Images are provided where possible and appropriate, with suitable captions: Fine. Can't really imagine what additional images could add.Overall:Pass or Fail: Just a few things to sort out, so I'm placing the article on hold for now.Thanks for the review.--Sturmvogel 66 (talk) 03:00, 9 June 2011 (UTC)[reply]OK, that's everything covered. I added a sentence to the lead, although I appreciate the problem. All fine now. (Will pass shortly.) Grandiose (me, talk, contribs) 16:41, 9 June 2011 (UTC)[reply]Retrieved from " 5The following pages link to Talk:28 cm SK L/40 gun/GA1 External tools(link counttransclusion countsorted list) See help page for transcluding these entriesShowing 9 items.View (previous 50 | next 50) (20 | 50 | 100 | 250 | 500)Talk:28 cm SK L/40 gun (links | edit)User:Grandiose (links | edit)User:Grandiose/articles (links | edit)Wikipedia:WikiProject Military history/Article alerts/Archive 1 (links | edit)Wikipedia:WikiCup/History/2011/Running totals (links | edit)Wikipedia:WikiProject Military history/German military history task force/Article alerts/Archive 1 (links | edit)Wikipedia:WikiProject Military history/Maritime warfare task force/Article alerts/Archive 1 (links | edit)Wikipedia:WikiProject Military history/World War II task force/Article alerts/Archive 1 (links | edit)Wikipedia:WikiProject Military history/World War I task force/Article alerts/Archive 1 (links | edit)View (previous 50 | next 50) (20 | 50 | 100 | 250 | 500)Retrieved from " WhatLinksHere/Talk:28_cm_SK_L/40_gun/GA1"Calculate voltage ratios, power ratings, and efficiency of autotransformers. Features copper loss analysis, VA rating computation, and transformation ratio calculations for optimal design. An autotransformer works differentlyonly one winding is used for both the primary and secondary sides, resulting in better efficiency and a saving in size over two-winding transformers. With our calculator, engineers can find information about the transformation ratio, copper losses, and the VA rating of their equipment. Examining the regulation of voltage, core losses, and winding resistance allows you to make the best autotransformer design for various uses like regulation and power distribution, saving you money thanks to less wasteful use of materials.Buy me a for Source CodeYou can easily handle the design and analysis of autotransformers with our helpful calculator. You should be able to determine voltage ratios, the amount of copper loss, efficiency and voltage ratings accurately. The analysis covers the transformation ratio, calculates core loss and estimates the winding resistance. Electrical engineers, technicians and students specializing in power distribution will find this text very useful.Improve your energy distribution setup by using our autotransformer calculator. Get direct results for voltage ratio, winding specifications, and power output. Features provided are core loss analysis, efficiency measurement, and assessment of voltage regulation. This method suits the design of transformers with smaller copper loss and advanced performance.You may like these postsThis transformer calculator helps you to quickly and easily calculate the primary and secondary full-load currents of the transformer. It also determines the turns ratio and type of transformer.User Instructions:Select the number of phases from the drop-down menuEnter the transformer rating and select the appropriate unitEnter the primary and secondary transformer voltagesClick on the "Calculate" button to obtain the results.ResultsPrimary Full-Load Current:Secondary Full-Load Current:Turns Ratio:Transformer Type: Single Phase Step Up TransformerThe transformer calculator uses the following formulas:Single Phase Transformer Full-Load Current (Amps)= kVA 1000 / VThree Phase Transformer Full-Load Current (Amps) = kVA 1000 / (1.732 V)Where:kVA = transformer rating (kilovolt-amperes),V = voltage (volts).Turns Ratio = N1 / N2 = V1 / V2 = I2 / I1Where:N1 = number of turns on the primary,N2 = number of turns on the secondary,V1 = primary voltage,V2 = secondary voltage,I1 = primary current,I2 = secondary current.Example: A 50 kVA single-phase transformer has a 4000 V primary, and a 400 V secondary. Assuming an ideal transformer, determine (a) the primary and secondary full-load currents, (b) the transformer turns ratio.a) V1 = 4000 V, V2 = 400 V,Transformer Rating = 50 kVA = V1 I1 = V2 I2Primary full-load current, I1 = (50 1000 / 4000) = 12.5 ASecondary full-load current, I2 = (50 1000 / 400) = 125 Ab) Turns Ratio = N1 / N2 = V1 / V2 = (4000 / 400) = 10You may also be interested in our Voltage Divider Calculator or Motor FLA Calculator Autotransformers are the single winding transformer which has output and input will be in the same winding. Hence another winding can be eliminated, this is the major advantage of the autotransformer.Transformation ratio calculations:Auto Transformer winding diagramTransformation ratio k is equal to the ratio between secondary output voltage V2 in Volts to primary input voltage V1 in volts or ratio between primary current I1 in amps to Secondary output current I2 in amps or the ratio between secondary turns N2 to primary winding N1.Transformation ratio = primary input voltage / secondary output voltage = Primary current /secondary current = Secondary turns / primary turnsk = V1 / V2 = I2 / I1 = N2 / N1Also using above formula you can find the unknown value of the auto transformer.Power transformation formula:The total power S(Con-VA) in VA is conducted from the autotransformer is equal to the transformation ratio times of the product of the secondary voltage and secondary current.S(Con-VA) = k x V2 x I2At the same time,Power transformed in VA = V2 x I2 x (1 k) Volt-AmpRelationship between the autotransformer and two winding transformers:Autotransformer and two winding transformers can be used in place of each other. But autotransformers are having wide advantages such as low copper consumption, less voltage regulation, reduced VA rating, and low losses.Conductor Weight Calculation:The conductor Weight of the autotransformer is equal to the difference between the conductor weight of the two winding transformers to transformation times of the conductor weight of the two winding transformers.Autotransformer Conductor = (1 k) x two winding transformer conductorkVA rating calculation:kVA rating of the autotransformer is equal to the kVA rating of the two winding transformers divided by one minus transformation ratio.kVA Autotransformer = kVA of two winding transformer / (1 k)Loss Calculation:Loss of the autotransformer is equal to the difference between the loss of the two winding transformers to transformation times of the loss of the two winding transformers.Autotransformer loss = (1 k) x loss of the two winding transformerImpedance drop calculation:The impedance of the autotransformer is equal to the difference between the impedance of the two winding transformers to transformation times of the impedance of the two winding transformers.Autotransformer impedance = (1 k) x impedance of the two winding transformerVoltage regulation calculation:Autotransformer voltage regulation is equal to the difference between the voltage regulation of the two winding transformers to transformation times of the voltage regulation of the two winding transformers.Auto transformer voltage regulation = (1 k) x two winding transformer voltage regulation Unlike the conventional two-winding transformer we have considered so far, an autotransformer has a single continuous winding with a connection point called a tap between the primary and secondary sides. As a start, we will learn about the ideal autotransformer. 2Ideal Transformer ExamplesThe tap is often adjustable so as to provide the desired turns ratio for stepping up or stepping down the voltage. This way, a variable voltage is provided to the load connected to the autotransformer. An autotransformer is a transformer in which both the primary and the secondary are in a single winding. Figure.(1) shows a typical autotransformer.Figure 1. A typical autotransformerAs shown in Figure.(2), the autotransformer can operate in the step-down or step-up mode. The autotransformer is a type of power transformer. Its major advantage over the two-winding transformer is its ability to transfer larger apparent power.Figure 2. (a) Step-down autotransformer, (b) step-up autotransformer.Another advantage is that an autotransformer is smaller and lighter than an equivalent two-winding transformer.However, since both the primary and secondary windings are one winding, electrical isolation (no direct electrical connection) is lost. The lack of electrical isolation between the primary and secondary windings is a major disadvantage of the autotransformer. Some of the formulas we derived for ideal transformers apply to ideal autotransformers as well.For the step-down autotransformer circuit of Figure.(2a), we use the equation(1) As an ideal autotransformer, there are no losses, so the complex power remains the same in the primary and secondary windings:(2) Equation.(2) can also be expressed with rms values as(3) Thus, the current relationship is(4)For the step-up autotransformer circuit of Figire.(2b),(5) The complex power given by Equation.(2) also applies to the step-up autotransformer so that Equation.(3) again applies. Hence, the current relationship is(6) A major difference between conventional transformers and autotransformers is that the primary and secondary sides of the autotransformer are not only coupled magnetically but also coupled conductively. The autotransformer can be used in place of a conventional transformer when electrical isolation is not required.Read also : active and passive elements Let us review the ideal transformer examples below: Compare the power ratings of the two-winding transformer in Figure.(3a) and the autotransformer in Figure.(3b). Solution:Although the primary and secondary windings of the autotransformer are together as a continuous winding, they are separated in Figure.(3b) for clarity.We note that the current and voltage of each winding of the autotransformer in Figure.(3b) are the same as those for the two-winding transformer in Figure.(3a). This is the basis of comparing their power ratings. For the two-winding transformer, the power rating is For the autotransformer, the power rating is which is 21 times the power rating of the two-winding transformer. Refer to the autotransformer circuit in Figure.(4). Calculate: (a) I1, I2, and Io if ZL = 8 + j6 , and (b) the complex power supplied to the load. Solution:(a) This is a step-up autotransformer with N1 = 80, N2 = 120, V1 = 120 30, so Equation.(5) can be used to find V2 byorButorAt the tap, KCL givesor (b) The complex power supplied to the load is A three-phase star-connected autotransformer is shown in the figure. The three-phase autotransformers are used for small ratios of transformation. In practice, the star connected three-phase autotransformers are used and the delta connected autotransformers are avoided. The primary application of three phase autotransformers is for interconnecting two power systbs of different voltage levels such as 66 kV to 132 kV power systbs, 110 kV to 220 kV power systbs, 220 kV to 400 kV power systbs etc. A three-phase star-connected autotransformer supplies a balanced three-phase load of 100 kW at 380 V and at 0.85 power factor lagging. If the supply voltage is 440 V, Calculate the winding currents as well as the input and output line currents. Neglect the excitation current and the internal voltage drops in the transformer. Solution The connection diagram of the given autotransformer is shown in the figure. The three-phase power is given by, $$\mathrm{P \: = \: \surd 3 \: V_{L} \: I_{L} \: \cos \: \phi}$$ $$\mathrm{\therefore \: I_{L} \: = \: \frac{P}{\surd 3 \: V_{L} \: \cos \: \phi} \: = \: \frac{100 \: \times \:10^{3}}{\surd 3 \: \times \: 380 \: \times \: 0.85}}$$ $$\mathrm{\Rightarrow \: I_{L} \: = \: 178.75 \: A}$$ Thus, the output line current of the given three-phase autotransformer is 178.75 A. As the losses are neglected, therefore, $$\mathrm{\text{Input VA per Phase} \: (V_{H}I_{H})} \: = \: \text{ Output VA per Phase } \: (V_{L}I_{L}))}$$ $$\mathrm{\Rightarrow \: \frac{440}{\surd 3} \: \times \: I_{H} \: = \: \frac{380}{\surd 3}\: \times \: I_{L}}$$ $$\mathrm{\Rightarrow \: I_{H} \: = \: \frac{380}{440} \: \times \: 178.75 \: = \: 154.37\:A}$$ Thus, the input line current of the given three-phase autotransformer is 154.37 A. Now, the currents flowing from neutral point (N) to tapping points A, B and C are given by applying KCL at respective tapping point, thus, $$\mathrm{I_{NA} \: = \: I_{NB} \: = \: I_{NC} \:= \: I_{L} \: - \: I_{H} \: = \: 178.75\: - \:154.37\: = \: 24.38\:A}$$ Therefore, the currents flowing in the windings of the given transformer are equal to 24.38 A. This free online transformer calculator allows you to calculate the full load current in the primary and secondary transformer windings. The inputs are the transformer kVA (power), and the voltage in the primary and secondary windings. You can use this calculator for both single-phase and 3 phase transformer calculations, for calculating your turns ratio (windings ratio), as well as whether it is a step down transformer or a step up transformer.Note that all calculations below are for an ideal transformer, i.e. where the power factor is equal to 1.You can choose from a 3 phase transformer or a single-phase transformer. Note that this will affect the resulting calculation, as different equations are used. The formula for both three-phase and single phase transformers is given below.3 phase transformer current is equal to:I3ph = P3ph / (3 V3ph)Where:I3ph [kA] = the current flowing through the windingsP3ph [kVA] = the rated 3 phase power of the transformerV3ph [kV] = the 3 phase voltage at the windingsAnd single phase transformer current is equal to:I = P / V Where:I [kA] = the current flowing through the windingsP [kVA] = the rated single phase power of the transformerV [kV] = the single phase voltage at the windingsNote that both these formulas apply to both the primary and secondary sides respectively, but not combined. Do not mix the voltage/current on the primary side with the voltage/current on the secondary side.The transformer rating is the rated power of the transformer. This is usually given in kVA, but can equally be given in VA or MVA.The primary transformer voltage is the voltage in the primary windings of the transformer. This is usually given in kV, but can equivalently be given in V or MV.The secondary transformer voltage is the voltage in the secondary windings of the transformer. This is usually given in kV, but can equivalently be given in V or MV.The primary full load current is the current flowing through the primary windings of the transformer. This is usually given in Amperes (A), but can equivalently be given in kA or MA.For 3 phase transformers, the primary full load current (i.e. the current in the primary windings) is equal to:Ip = P / (3 Vp) WhereIp [kA] = the current flowing through the primary windingsP [kVA] = the rated 3 phase power of the transformerVp [kV] = the 3 phase voltage at the primary windingsFor single phase transformers, the primary full load current (i.e. the current in the primary windings) is equal to:Ip = P / Vp WhereIp [kA]= the current flowing through the primary windingsP [kVA] = the rated single-phase power of the transformerVp [kV] = the single-phase voltage at the primary windingsThe secondary full load current is the current flowing through the secondary windings of the transformer. This is usually given in Amperes (A), but can equivalently be given in kA or MA.For 3 phase transformers, the secondary full load current (i.e. the current in the secondary windings) is equal to:Is = P / (3 Vs)WhereIs [kA] = the current flowing through the secondary windingsP [kVA] = the rated 3 phase power of the transformerVs [kV] = the 3 phase voltage at the secondary windingsFor single phase transformers, the secondary full load current (i.e. the current in the secondary windings) is equal to:Is = P / VsWhereIs [kA]= the current flowing through the secondary windingsP [kVA] = the rated single-phase power of the transformerVs [kV] = the single-phase voltage at the secondary windingsThe transformer turns ratio (also known as the transformer windings ratio) represents the ratio between the primary and secondary windings of a transformer. This is important as it is directly proportional to the amount of voltage that will be stepped down or stepped up between the primary and secondary windings.The formula for the transformer turns ratio is:n = Vp / Vs = Np / Ns Wheren = the transformer turns ratioVp = the voltage at the primary windingsVs = the voltage at the secondary windingsNp = the number of windings on the primary side of the transformerNs = the number of windings of the secondary side of the transformerThe type of transformer can either be a step-down transformer or a step-up transformer.A step down transformer converts the high voltage and low current from the primary windings of the transformer to a low voltage and high current value in the secondary windings of the transformer. Hence a step-down transformer will have a primary transformer voltage that is greater than its secondary transformer voltage.A step up transformer converts the low voltage and high current from the primary windings of the transformer to a high voltage and low current value in the secondary windings of the transformer. Hence a step-up transformer will have a primary transformer voltage that is lower than its secondary transformer voltage. In this tutorial, we will learn about Autotransformers. This is a complete guide to theory and design of Autotransformer, its efficiency numbers, electrical symbols, starting technique, protection measures, advantages, disadvantages, applications and many more.Introduction To AutotransformerThe Transformers are electromagnetic devices that transfer electrical energy from one circuit to another by principle of mutual induction. Mutual induction is the coupling of inductances by their mutual magnetic fields. For example in a single-phase transformer there are two coils, a primary and a secondary coil.The primary coil will get the power from any electrical source like an AC generator. The magnetic field produced by the primary induces a voltage into the secondary coil. This secondary coil will be connected to the load and gets the supply accordingly. Transformers are used to increase the voltage up to a higher level and they are called step up transformers. In the same way the transformers decreases the voltage down to a lower level and they are called as Step down transformers. What is an Autotransformer?As stated above a normal transformer will have two windings which are physically separated but magnetically coupled together with the help of a magnetic core. As they are separately been isolated, they are called as primary winding which receives the voltage from the source and secondary winding which transfers to the output load. But the transformer in which there will be only one winding which is common to both primary and secondary is called Autotransformer. The term Auto here refers to that the voltage input variations will be automatically can be improved or can be reduced utilizing the single winding.Auto Transformers are used in applications where there is no requirement for electrical insulation between input and output windings. These are popular for industrial automation and marine applications.Autotransformer Theory and DesignIn the autotransformer, part of the energy is transferred by induction and the rest is by conduction. There are three types of auto transformers: step-up, step-down, and variable auto transformers which can be either step-up or step-down the voltage. Variable auto transformers are used in the laboratory and industry to provide a wide range of ac voltages from a single source. The above figures show step-up and step-down autotransformers.In the above Figures, the first winding is shown connected in an additive manner to the secondary winding. Now, the relationship between the voltage on the first winding and the voltage on the second winding is given by the turns ratio of the transformer. However, the voltage at the output of the whole transformer is the sum of the voltage on the first winding and the voltage on the second winding. The first winding here is called the common winding, because its voltage appears on both sides of the transformer. The small winding is called the series winding, because it is connected in series with the common winding.The voltage relationship in an autotransformer as shown in the above Figure (a) is given byV= Vc + Vse But,Vc / Vse = Nc / Nse ===> V = Vc + (Nc /Nse) * Vc; But,V = Vc ===>V = V + (Nc /Nse) * V1 = ((Nc +Nse)/ Nse) * V;The current relationship between two sides in an autotransformer as shown in above Figure (a) is given byI =Ic + Ise But,Ic = (Nse/Nc) * Ise===> I = Ise + (Nse/Nc) * Ise But,I = Ise===> I = I * (1 + (Nse/Nc))It is interesting to note that not all the power travelling from the primary to the secondary in the autotransformer goes through the windings. As a result, if a conventional transformer is reconnected as an autotransformer, it can handle much more power than it is originally rated for. Notice that the input apparent power to the autotransformer is given bySin = VI;and the output apparent power is given by,Sout = VI.It is easy to show that the input apparent power is equal the to the output apparent power so thatSin= Sout =SIOHere SIO is defined as the input and output apparent power of the transformer. The relationship between the power going into the primary of the transformer and actual windings can be found bySw =VcIc = VSE * ISESw =V * (I-I)Sw =VI V ISw = SIO* Nse / (Nse + Nc)For the better understanding purpose let us consider an example.An autotransformer of 500 Kva rating connecting 110 Kv line to 138 Kv line so Nc/Nse ratio will be 110/28. Now using the about derived formula of winding power and apparent power, we can calculate the actual power being travelled through the windings.Sw = Sio x Nse / (Nse + Nc)Sw = (5000) x 28/ (28+110) = 1015 KVAIt means actual winding power handling capacity is only 1015 KVA but this autotransformer can handle 5000 KVA means auto transformer can handle 5 times more power and 5 times smaller than a conventional 2 winding transformer.It means we have to design and select copper wire for only handling power up to 1015kva. If we have operating voltage 220 then apparent current will beApparent Current = 1015 Kva/220 = 1015 x 1000/220= 4613.63 A.We can select copper wire from SWG or AWG wire gauge table for proper current density.TheAuto transformercan also be constructed with more than one single tapping point. Auto-transformers can be used to provide different voltage points along its winding.Auto transformer with Multiple Tapping PointsThe following table will explain the different types of auto transformers according to their connection:Autotransformer Symbols1-Phase Autotransformer symbol3-Phase Autotransformer symbolTypes of AutotransformersThere are 3 general types of auto transformers categorised on the basis of the use of autotransformer:Step Up Auto transformerStep Down Auto transformerVariable Auto transformerStep Up Auto transformerIn this type of autotransformer input voltage is stepped up to the desired voltage and output voltage will depend on the turn ratio of the auto transformer.This is the connection diagram of Step-up auto transformer:As we have already discussed consider each loop of inductor as a battery more loops in the output circuit mean more ac voltage compared to the input. We know that the input and output apparent power is same so if we are going to step-up the voltage then definitely current will be decreased in order to maintain the power balance.Step Down Auto transformerConstruction is same for both step up and step down autotransformer but in this configuration primary voltage is high and secondary voltage is low thats why it is called step down transformer.Variable Auto transformer (Variac or Dimmer Set)Fixed turn ratio auto transformers are widely used for many applications but sometimes it is required to have variable output voltage capability. Such transformers are very useful because they can be adjusted to any required voltage by just rotating the knob. They can be used in the place of step up and step down auto transformer.The center part of this round inductor is the knob. The voltage varies by rotating the knob of the autotransformer. Variable autotransformer can be equipped with many taps as required by the particular application and act as Ac voltage regulator. By addition of some sensing circuitry these variable auto transformer can be used as automatic voltage regulator. This is also known as variac or dimmer set.Starting of AutotransformerWhen transformers are connected across the power line the starting current of the connected equipment will be 10 to 15 times more than the rated current of the equipment, then the total current flows through the 2 windings of the transformer for a fraction of time. In some steroidal transformers inrush current is 60 times more than its rated capacity. In large transformers this transient current can stay for a couple of seconds until the equilibrium or settling time is being achieved. In the same way in the autotransformer Inrush current also severe when the power supply is connected to transformer at an instant when the voltage is crossing the zero transit time where the load current depends on the resistance and inductance of the windings of the transformer. For large transformers with very high inductances compared to the load transient current time will also be large and vice versa.Auto transformer EfficiencyAuto transformer efficiency is much high as compared to the 2 winding transformers. Auto transformers efficiency sometimes reaches 99% with all comfortable conditions.Efficiency = (Pout / Pin) * 100Pout= Vs * Is * Cos()Power Factor= Cos()Pin= Pout +PlossLosses: In any kind of transformer there are mainly 2 types of losses Copper loss can be calculated by the short circuit test and iron or core loss is calculated by the open circuit test. Once both losses are calculated algebraic sum of both of these losses is the total loss in the autotransformer.Auto transformer Impedance CalculationAuto transformers have one addition disadvantage as compared to 2 winding transformers. It turns out to be for a given autotransformer the per unit impedance is less as compared to the 2 winding conventional transformer by the factor equal to the power advantage of the auto transformer over conventional one.This less internal impedance can be a serious problem in such cases where reducing the current in power system faults like short circuit so in this situation, it is highly desirable to limit the current to reduce the chance of more damage.Now let us calculate the internal impedance of the autotransformer.Auto transformer Impedance ExampleConventional transformer of 1000kva voltage ration 12/1.2 Kv, 60Hz now this transformer is to be used as 13.2/12 Kv autotransformer in power system now calculate the power advantage of this auto transformer and calculate the auto transformers series impedance per unit.2 winding transformer impedance is given= 0.01 + j0.08.Sol:Turn ration: Nc/Nse = 12/1.2 =10Sio= (Nse + Nc/Nse) * SwSio = (1+10/1) x 1000 = 11,000KvaSo power advantage factor is 11.As we know the 2 winding transformer impedance isZeq = 0.01 + j0.08So the autotransformer impedance will beZeq = (0.01+j0.08)/11 = 0.00091+ j0.00727We can see the internal impedance of autotransformer is 11 times less than the conventional 2 winding transformer.Auto Transformer Earthling or GroundingIt is also known as grounding auto transformers. It is mainly used to generate the neutral wire in 3 phase 3 wire ungrounded system. It is connected in the form of zigzag or T-connected transformers. These transformers have continues of phase and neutral current rating.Auto Transformer ExamplesAn 11,500/2300 V transformer is rated at 150 kVA as a two-winding transformer. If two windings are connected in series to form an autotransformer, what will be the voltage ration and the output?The two windings of a two-winding transformer can be connected in series to form an autotransformer. In two windings either of winding is used as a secondary. Therefore the voltage ratio and the output of the transformer will depend on the winding which is used as a secondary winding.Case-1:The 2300 winding is used as the secondary.The rating of the two-winding transformer St= 150kVAPrimary voltage of the autotransformer, V1 = 11500+2300 = 13.8 kVSecondary voltage of the autotransformer, V2 = 2.3 kVThe two winding transformer voltage ratio a = V1/V2 = N1/N2 = 11.5 / 2.3 = 5The autotransformer voltage ratio a = V1/V2 = (V1 V2 + V2)/ V2 =a + 1 = 6The turns ratio a = 13.8/2.3 = 6Rating of the transformer St = (V1 V2) * I1 = (I2 I1) * V2Rating of the auto transformer = Sat = V1 * I1 = V2 * I2But (I2-I1) / I1 = N1/N2 = aThen I1 = (1/(1+a))I2Therefore St= V2 ((V1/V2) 1) (1/ (1+a)) * I2= (a / (1+a)) SatTherefore Sat = ((1+a)/a) x 150 = 180kVA.Case 2:The 1150 V winding used as the secondary.V1 = 13.8 kVV2 = 11.5 kVVoltage ratio = a = 13.8/11.5 = 1.2Voltage ratio = a = (13.8 11.5) / 11.5 = 0.2Now Sat = ((1+a) / a) x 150 = 900 kVA3-Phase AutotransformerA three phase auto transformer is special type in which common winding is being shared by the high voltage and low voltage. Three phase AC being supplied at primary and output is collected at secondary. Three phase auto transformer is used for such application where small voltage is used in distribution system. There is no electrical isolation is provided between them. It is designed for step up and step down voltage and work on magnetic induction principle.The key features of three phase auto transformer are as follows:3 KVA to 500 KVA rating50/60 Hz frequencyThree phaseThree phase auto transformer is used in power application to connect system operating at voltage level ranging from 66Kv to 138Kv transmission line.The general 3 phase autotransformer will be as per the following diagram:Below is another type of connection and its Vector diagram:The following diagram explains different types of 3 phase autotransformer connections.3-Phase Autotransformer RatingIt is rated in KVA ranging its capacity from (1 KVA-500KVA). Its tolerance range (5%). The insulating resistance being used in 3 phase auto transformer is 2000M.To calculate the three phase KVA we use below formulaKVA = (volts*amp*1.73)/1000Autotransformer Starter of Induction MotorThe principle of auto transformer is similar to star delta starter method. The starting current is limited by using 3 phase auto transformer. Auto transformer can be replaced with the star delta starters and with other starters which are more expensive and being complicated in operation. Auto transformer is suitable for both star and delta connected motor, starting current and torque can be adjusted by taking correct tapping from auto transformer. It gives highest motor torque per line ampere.Additional Information on AutotransformersAutotransformer FeaturesRatings of autotransformer starters are less than the conventional motor starter ratings for the higher kilowatt motors. Main, size of auto transformer is very small, so effective material will reduce the cost. Effectively reducing the material makes the copper and iron losses less so auto transformer when compared to normal isolation transformers, have high efficiency.Auto transformer ProtectionNormal transformer Differential protection relays and accessories can be used for Auto transformer protection also. Transformer differential protection contains a number of additional functions (matching to transformation ratio and vector group, stabilisation (restraint) against inrush currents and over excitation) and therefore requires some fundamental consideration for configuration and selection of the setting values. The additional functions integrated per relay can be used to advantage. However, it must be considered that backup protection functions must be arranged in separate hardware (further relay) for reasons of hardware redundancy. This means that the over current-time protection in the differential protection can only be used as backup protection against external faults in the connected power system. The backup protection for the transformer itself must be provided as a separate over current relay. The Buchholz protection as fast short-circuit protection.Different types of auto-transformer differential protection schemes have been presented. Which scheme will be used is mostly determined by the availability of the main CTs in a particular installation. It is recommended that in addition to the standard differential protection scheme additional differential scheme is applied, which is sensitive to the faults close to the common winding star point. Another possible solution is to combine two different schemes which have different properties.Due to the size and importance of auto-transformers in modern power systems (e.g. mostly used as system intertie transformers) full duplication of the protection scheme is typically easily justified.Autotransformer Tertiary Winding ProtectionFrom the differential relay point of view, the differential protection scheme is same for normal isolation transformers and to the autotransformers. The only difference is that all three individual currents within tertiary delta winding are available to the relay. Consequently the tertiary delta winding can be loaded with such arrangement. Used equation and advantages of such differential scheme can be easily calculated and can be implemented. In auto transformer tertiary delta winding is used. It is used to limit the generation of harmonics voltages which are caused by magnetizing currents affecting the lower zero sequence impedance. The tertiary delta winding is one third rated through power of auto transformer. It redistributes the flow of current detected from fault. It also reduces the unbalancing being used in three phase load.Autotransformer Testing ProcedureWhen transformers are received from the factory or relocated from another location it is necessary to verify that each transformer is dry, no damage has occurred during shipping, internal connections have not been loosened, the transformer ratio, polarity, and impedance agree with its nameplate, its major insulation structure is intact, wiring insulation has not been bridged, and the transformer is ready for service.Physical size, voltage class, and kVA rating are the major factors that dictate the amount of preparation required to put transformers in service. Size and kVA rating also dictate the kind and number of auxiliary devices a transformer will require. All of these factors affect the amount of testing necessary to certify that a transformer is ready to be energized and placed in service.Some tests and procedures may be performed by specialists during the assembly phase. Special tests, other than the listed, may also be required. Many require special equipment and expertise that construction electricians do not have and are not expected to provide. Some tests are performed by an assembly crew, while other tests are done by the person(s) making the final electrical tests on the transformers.Also, the following test descriptions provide an anchor point from which to ask for help when needed. The following items are discussed or described:Nameplate DataPower MeggeringAuxiliary Components and Wire ChecksLightning ArrestorsHand MeggeringTemperature DevicesCT TestsWinding Temperature and Thermal ImageBushing Power FactoringRemote Temperature IndicationTransformer Power FactoringAuxiliary PowerVoltage RatioAutomatic Transfer SwitchPolarityCooling SystemTransformer-Turns RatioBushing Potential DeviceTap ChangersAuxiliary-Equipment Protection and AlarmsShort-Circuit ImpedanceOverall LoadingZero SequenceTrip ChecksWinding ResistanceFollowing is an approximate sequence for transformer testing:Inspect transformer and parts for shipping damage and moisture.Check nameplate and prints for proper voltages and external phasing connection to the line or bus.Check calibration of all thermal gauges and hot-spot heater, bridge RTDs and associated alarm contacts. Contact settings should be similar to the following.One stage runs all the time (forced cooling)2nd stage at 80C3rd stage at 90CHot-spot alarm 100C (trip at 110C when applicable)Top-oil alarm 80C at 55C rise and 75C at 65C riseOA = no fans or pumpsFA =fans runningFOA = fans and pumps runningCheck and Megger all wiring point to point: Fans, pumps, alarms, heaters, tap changers, and all other devices on the transformer and interconnecting cables.All banks above 150 MVA should be vacuum dried. Do not apply test voltages to the winding during the vacuum drying process. Make certain the terminals are shorted and grounded during oil circulation because of the large amount of static charge that can build up on the winding.After the tank has been filled with oil, confirm that an oil sample was sent to the Chemical Lab and that its results are entered in the bank test reports. Note the oil level and temperature at completion of filling.Power operate to verify proper rotation of pumps and fans and correct operation of the under load (UL) tap changer, when provided. Also, check heater, alarms and all other devices for proper operation.Following are the winding tests to be performed:ImpedanceDC winding resistanceMegger and Power Factor windings, bushing and arrestors.Note: Wait until 24 hours after completion of oil filling for Power Factor testing.Load CT circuits overall and flash for polarity.Before energization, trip-check bank protection schemes and make sure thegas collection relay is free of gas.When energizing a bank or picking up load, monitor bank currents and voltages, including UL tap-changer operation.Check proper phasing and voltage of the bank to the system before load is picked up. When possible, large transformers (>1 MVA) should remain energized for eight hours before carrying load.Make in-service checks on meters and relays.Release to Operations and report energization information to the TNE office.Turn in revised prints and test reports, which should include the following:All test dataMoisture and oil dataProblems incurredIn-service dataTime energized and release to operationAdvantages of AutotransformerLosses are decreased for given KVA capacity.Saving in size and weight.Size is very smaller.Voltage regulation is much better.Cost is low.Excitation current requirement is low.For designing auto transformer copper is used in less requirement.In conventional transformer step up and step down voltage are fixed while in auto transformer output vary as per the requirementDisadvantages of AutotransformerHigher levels of protection to the equipment and for human beings are required because of higher short circuit currents and because of low series impedance of the autotransformer which damages both equipment as well as threat to human-beings.If any winding of auto transformer short circuited the output voltages will swing to higher voltages than operating voltage causing a very huge damage.It consists of single winding around the iron core which develops change in voltage from one end to the other. There is no isolation of low and high voltages either at the input or at the output of the transformer. So any noise or voltage pertaining on one side will reflects on the other side. So Filtering circuits are necessary wherever auto transformer is used in electronic circuits.Autotransformer ApplicationsIt is used in synchronous and induction motors as a part of starting purpose.It is used in electrical apparatus testing labsIt is used as boosters in AC feeders to increase the desired voltage level.Used for starting of squirrel cage motors and slip-ring induction motors.For interconnecting systems that are operating in threshold voltages.As boosters to rise the incoming voltagesLimitations of AutotransformerCannot be used for isolated operable systems as the earth or ground is common for both input and output connected equipment.Safety concern issues stringently to be taken, as the common ground phenomenon may create a human threat.A failure of the winding insulation of the autotransformer will result in full input voltage applied to the output.SummaryAutotransformers are transformers in which the primary and secondary windings are coupled magnetically and electrically.This results in lower cost, and smaller size and weight. Autotransformers are the single winding transformer which has output and input will be in the same winding. Hence another winding can be eliminated, this is the major advantage of the autotransformer.Transformation ratio calculations:Auto Transformer winding diagramTransformation ratio k is equal to the ratio between secondary output voltage V2 in Volts to primary input voltage V1 in volts or ratio between primary current I1 in amps to Secondary output current I2 in amps or the ratio between secondary turns N2 to primary winding N1.Transformation ratio = primary input voltage / secondary output voltage = Primary current /secondary current = Secondary turns / primary turnsk = V1 / V2 = I2 / I1 = N2 / N1Also using above formula you can find the unknown value of the auto transformer.Power transformation formula:The total power S(Con-VA) in VA is conducted from the autotransformer is equal to the transformation ratio times of the product of the secondary voltage and secondary current.S(Con-VA) = k x V2 x I2At the same time,Power transformed in VA = V2 x I2 x (1 k) Volt-AmpLearn More: Rated Voltage Calculator, Formula, Voltage CalculationRelationship between the autotransformer and two winding transformers:Autotransformer and two winding transformers can be used in place of each other. But autotransformers are having wide advantages such as low copper consumption, less voltage regulation, reduced VA rating, and low losses.Conductor Weight Calculation:The conductor Weight of the autotransformer is equal to the difference between the conductor weight of the two winding transformers to transformation times of the conductor weight of the two winding transformers.Autotransformer Conductor = (1 k) x two winding transformer conductorkVA rating calculation:kVA rating of the autotransformer is equal to the kVA rating of the two winding transformers divided by one minus transformation ratio.kVA Autotransformer = kVA of two winding transformer / (1 k)Loss Calculation:Loss of the autotransformer is equal to the difference between the loss of the two winding transformers to transformation times of the loss of the two winding transformers.Autotransformer loss = (1 k) x loss of the two winding transformerImpedance drop calculation:The impedance of the autotransformer is equal to the difference between the impedance of the two winding transformers to transformation times of the impedance of the two winding transformers.Autotransformer impedance = (1 k) x impedance of the two winding transformerVoltage regulation calculation:Autotransformer voltage regulation is equal to the difference between the voltage regulation of the two winding transformers to transformation times of the voltage regulation of the two winding transformers.Auto transformer voltage regulation = (1 k) x two winding transformer voltage regulation Share copy and redistribute the material in any medium or format for any purpose, even commercially. 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For example, other rights such as publicity, privacy, or moral rights may limit how you use the material. An autotransformer is not like the traditional voltage transformer. Normally a voltage transformer has two distinct windings. These windings are called the primary and the secondary.But with an autotransformer things are a bit different because it only has one single winding that actually does the job of both the primary and the secondary.Now this single winding is pretty clever because it has taps at various points along its length. This allows it to take a part of the primary voltage and send it over to what we call the secondary load.It still uses the typical magnetic core that you would expect but since there is only one winding, both the primary and secondary circuits are all connected together.Meaning in an autotransformer you have both the primary and secondary parts linked together not just electrically but also magnetically. One of the really great things about this design is that it can be made at a lower cost yet still providing the same VA rating that you would get from a traditional transformer.But there is a downside to this setup, you do not get that isolation between the primary and secondary windings that you would normally find in a regular transformer that has two separate windings.Let me explain how the winding works in an autotransformer. So the part of the winding that we call the primary is hooked up to the AC power source. Now because the secondary is actually part of this same primary winding, both parts are connected such that it allows them to work together.Now you can also use an autotransformer to adjust the supply voltage either up or down just by switching around the tapped winding connections.Imagine this,

when you have the primary as the entire winding and it is connected to a power supply and then you connect the secondary circuit across just a portion of that winding, what happens is that the voltage at the secondary side gets stepped-down.We can understand this through the following example:When the primary current which is called IP, moves through the single winding in the direction of the arrow shown in the diagram, the secondary current known as IS, flows in the completely opposite direction.Because of this, in the section of the winding that produces the secondary voltage labeled as VS, the current coming out of that winding ends up being the difference between IP and IS.Now about the Autotransformer, it doesnt have to stick to just one single tapping point. You can totally build it with multiple tapping points if needed.This lets the Autotransformer provide various voltage levels along its winding or even boost the supply voltage compared to the original supply voltage marked as VP in the diagram.This can be understood by seeing the following diagram.The usual way to label the windings on an autotransformer is by using big capital letters. For instance you might see letters like A, B, Z, and so on to show the supply end.Most of the time, the shared neutral connection gets marked with either N or sometimes a small n. When it comes to marking the secondary tapping points, numbers are added as suffixes to identify each one.These numbers are used for all the tapping points along the primary winding of the autotransformer.Typically the numbering starts at 1 and then goes up in order for each tapping point, just like in the following diagram.So an autotransformer is basically a device that helps us tweak line voltages. It can either change the voltage to a different level or keep it steady at the same level.When we are making a small adjustment to the voltage whether we are increasing it a bit or decreasing it a bit, the transformer ratio is pretty small because the primary voltage (VP) and the secondary voltage (VS) are almost the same. This also means that the currents on both sides which we call IP and IS, are nearly equal too.Now because of this close match in currents, the part of the winding that deals with the difference between these two currents does not need to be very big.We can use a much smaller conductor for that part since the currents involved are quite low. This is a great way to save money compared to using a regular double wound transformer which would need bigger conductors.On top of that when we look at things like regulation, leakage inductance, and even the physical size of an autotransformer, we find that for the same VA or KVA rating, an autotransformer is actually less bulky and has better performance than a double wound transformer.Autotransformers are definitely a lot more affordable compared to the traditional double wound transformers that have the same VA rating. When you are trying to figure out whether to go with an autotransformer or stick with a double wound type it is pretty common to look at how much they cost in comparison.To do this comparison we usually take a close look at how much copper we save in the winding process. If we define the ratio n as the ratio of the lower voltage to the higher voltage it turns out that we can calculate the savings in copper as n multiplied by 100 percent.For instance if we were to look at the following two different autotransformers we could calculate how much copper we are saving based on this ratio.Lets say we want to use an autotransformer to increase a voltage from 200 volts to 240 volts. The transformer we are working with has a total of 2200 turns on its primary winding. Our task is to calculate where the primary tapping point should be located as well as the primary and secondary currents when the output is rated at 10 KVA. Additionally we want to look into how much copper wire we can save in this process.We will begin by Determining the Position of the Primary Tapping PointThe autotransformer steps up voltage from 200V to 240V. The position of the primary tapping point corresponds to the fraction of the total winding that represents the primary voltage.Primary turns = (Primary voltage / Secondary voltage) Total turnsBy Substituting the values we get:Primary turns = (200 / 240) 22000 = 18333.33 turns (approximately 18333 turns).Now let us Calculate Primary and Secondary CurrentsSecondary Current (I2):I2 = Output power / Secondary voltageI2 = 10000 / 240 = 41.67 APrimary Current (I1):I1 = Output power / Primary voltageI1 = 10000 / 200 = 50 AFinally Let us Calculate Economy of Copper SavedThe economy of copper saved in an autotransformer depends on the ratio of the voltage difference to the secondary voltage.Copper saving = (1 Voltage difference / Secondary voltage) 100%Voltage difference = Secondary voltage Primary voltage = 240 200 = 40 VCopper saving = (1 40 / 240) 100%Copper saving = (1 0.1667) 100% = 83.33%.The Required Final Results are as follows:Primary Tapping Point: 18333 turnsPrimary Current: 50 ASecondary Current: 41.67 AEconomy of Copper Saved: 83.33%The biggest drawback here is that, unlike a traditional double wound transformer an autotransformer does not provide isolation between the primary and secondary windings.This lack of isolation means that you cannot safely use an autotransformer to step down higher voltages to much lower voltages that would be suitable for smaller loads.Now heres another important point if the winding on the secondary side happens to become open-circuited, this means that the load current will stop flowing through the primary winding.When this happens the transformer action essentially comes to a halt and you end up with the full primary voltage being applied directly to the secondary terminals which can be quite dangerous.Additionally if there is a short-circuit condition on the secondary circuit, this would lead to a primary current that is significantly larger than what you would see with a traditional double wound transformer.This increase in current is caused by the greater flux linkage which can end up damaging the autotransformer itself.Another thing to consider is that because the neutral connection is shared between both the primary and secondary windings, if you earth the secondary winding it automatically means that you are also earthing the primary winding.This lack of isolation can be problematic especially since double wound transformers are often used specifically to isolate equipment from earth for safety reasons.Autotransformers are greatly versatile and serve a variety of purposes. They are often used for starting induction motors which is a common application.Also they play a significant role in regulating the voltage of transmission lines to help maintain a stable power supply. Another important use of autotransformers is to step up or step down voltages especially in situations where the voltage ratio between the primary and secondary windings is nearly equal to one.Interestingly we can build an an autotransformer by modifying a regular two-winding transformer. We can do this by connecting the primary winding and the secondary winding in series with each other.How the connection is made determines the effect on the voltage. The secondary voltage can either increase or decrease the primary voltage depending on the arrangement of the windings.So we know that an autotransformer has a fixed or tapped secondary that gives us a voltage output at a certain level.But we can also use these devices to create a variable AC voltage from a steady AC supply.We often see this type of variable autotransformer in labs and science classrooms and we usually call it a Variac.The way a variable autotransformer or Variac is built is pretty similar to a fixed autotransformer. It has one primary winding wrapped around a laminated magnetic core just like the fixed version.The big difference is that instead of being stuck at one tapping point, we get the secondary voltage through a movable carbon brush.This carbon brush can move around either by rotating or sliding along part of the primary winding that is exposed. As it moves, it makes contact and gives us the voltage level we want.Basically a variable autotransformer has this movable tap in the form of a carbon brush that travels along the primary winding.This movement alters how long the secondary winding is, letting us adjust the output voltage from the primary supply all the way down to zero volts.We usually find that a variable autotransformer has a lot of primary windings. This lets us adjust the secondary voltage from several volts all the way down to tiny fractions of a volt for each turn.This flexibility comes from the carbon brush or slider that stays in constant contact with one or more turns of the primary winding.Since the turns of the primary coil are spread out evenly along its length, the output voltage changes directly based on how much we rotate it.So now we know how variac works? It is really great because it can smoothly change the voltage that goes to whatever load you are using.It can adjust this voltage from zero all the way up to the rated supply voltage.Now here is something interesting, if you tap into the supply voltage at a certain point along the primary winding, it is actually possible for the output secondary voltage to be higher than the actual supply voltage itself.People also use variable autotransformers for dimming lights and in those cases they often call them dimmerstats.When you are in electrical or electronics workshops or laboratories variacs become super useful because they give you a variable AC supply that you can adjust as needed.But here is an important thing to keep in mind. It is really necessary to have proper fuse protection in place.This is to make sure that there is not a high supply voltage showing up at the secondary terminals when something goes wrong or during fault conditions.Autotransformers have a bunch of advantages when you compare them to the traditional double-wound transformers.They usually show higher efficiency for the same VA rating which is pretty impressive.They also take up less physical space which is a big plus if you are working with limited room.Plus they use less copper in their construction which helps keep costs down when you look at double-wound transformers that have the same VA ratings.On top of that their core and copper losses which are represented as IR are kept to a minimum because of lower resistance and leakage reactance.This means they can do a better job at voltage regulation compared to the standard two-winding transformers.References:AutotransformerAutotransformers Overview 25 Oct 2024 Tags: Electrical Engineering Electrical Machines Transformers Autotransformer Design Calculation Popularity: Autotransformer Design Calculation This calculator provides the calculation of various parameters for an autotransformer design. Explanation Calculation Example: An autotransformer is a type of transformer where the primary and secondary windings share a common portion. This design allows for a more efficient and compact transformer compared to a conventional two-winding transformer. The calculations involved in autotransformer design determine the secondary voltage, secondary current, and apparent power based on the primary voltage, primary current, and the turns ratio of the windings. Q: What are the advantages of using an autotransformer? A: Autotransformers offer several advantages over conventional transformers, including reduced size and weight, higher efficiency, and lower cost. They are particularly suitable for applications where a small voltage change is required. Q: How does the turns ratio affect the performance of an autotransformer? A: The turns ratio (N2/N1) determines the voltage transformation in an autotransformer. A higher turns ratio results in a larger voltage step-up or step-down. The turns ratio also influences the current flow and the apparent power of the transformer. Variables Symbol Name Unit V Primary Voltage V N1 Number of Primary Turns N2 Number of Secondary Turns I1 Primary Current A Calculation Expression Apparent Power: The apparent power of the autotransformer is given by S = V * I1. Secondary Voltage: The secondary voltage is given by V2 = (N2 / N1) * V. Secondary Current: The secondary current is given by I2 = (N1 / N2) * I1. Calculator Calculated values Considering these as variable values: N1=200.0, N2=100.0, V=240.0, I1=10.0, the calculated value(s) are given in table below Derived Variable Value Secondary Voltage 120.0 Apparent Power 2400.0 Secondary Current 20.0 Similar Calculators Explore Calculator Apps Transformation Ratio (K) \[K = \frac{V_2}{V_1} = \frac{N_2}{N_1} = \frac{I_1}{I_2}\] Current Relations \[I_{AB} = I_1\] \[I_{BC} = I_2 - I_1\] Turns Relations \[N_1 = N_{AB} + N_{BC}\] \[N_2 = N_{BC}\] Input KVA \[\text{KVA}_{\text{input}} = V_1 I_1\] Output KVA \[\text{KVA}_{\text{output}} = V_2 I_2\] Inductive (Transformed) Power \[\text{KVA}_{\text{ind}} = (V_1 - V_2) I_1\] Conductive Power \[\text{KVA}_{\text{cond}} = V_2 I_1 = K \cdot V_1 I_1\] Power Transformation Ratio \[\frac{\text{KVA}_{\text{ind}}}{\text{KVA}_{\text{input}}} = 1 - K\] Power Conduction Ratio \[\frac{\text{KVA}_{\text{cond}}}{\text{KVA}_{\text{input}}} = K\] Copper Weight in Section AB \[W_{AB} \propto (N_1 - N_2) I_1\] Copper Weight in Section BC \[W_{BC} \propto (I_2 - I_1) N_2\] Total Copper Weight (Autotransformer) \[W_{\text{auto}} \propto I_1(N_1 - N_2) + (I_2 - I_1)N_2\] Total Copper Weight (Two-Winding) \[W_{\text{2-wdg}} \propto I_1 N_1 + I_2 N_2\] Weight Ratio \[\frac{W_{\text{auto}}}{W_{\text{2-wdg}}} = 1 - K\] Copper Saving \[\text{Saving} = K \times W_{\text{2-wdg}}\] \[\text{Saving (\%)} = K \times 100\%\] Full-Load Copper Losses \[P_{cu(\text{auto})} = (1 - K) \times P_{cu(\text{2-wdg})}\] Core/Iron Losses \[P_i = \text{Same as 2-winding}\] Core losses remain unchanged as flux density is same Efficiency \[\eta = \frac{\text{Output}}{\text{Output + Losses}} \times 100\%\] \[\eta = \frac{V_2 I_2 \cos\phi_2}{V_2 I_2 \cos\phi_2 + P_i + P_{cu}} \times 100\%\] Maximum Efficiency Condition \[P_i = P_{cu}\] \[x = \sqrt{\frac{P_i}{P_{cu(\text{FL})}}}\] where x = fraction of full load Equivalent Impedance \[Z_{\text{eq(auto)}} = (1 - K) \times Z_{\text{eq(2-wdg)}}\] Percentage Impedance \[(\% Z)_{\text{auto}} = (1 - K) \times (\% Z)_{\text{2-wdg}}\] Voltage Regulation \[\text{VR} = \frac{V_2(\text{NL}) - V_2(\text{FL})}{V_2(\text{FL})} \times 100\%\] Approximate Voltage Regulation \[\text{VR} \approx \frac{I_2 R_{eq} \cos\phi + I_2 X_{eq} \sin\phi}{V_2} \times 100\%\] Short Circuit Current \[I_{SC} = \frac{I_{\text{rated}}}{\% Z / 100}\] Autotransformer Rating from 2-Winding \[\text{KVA}_{\text{auto}} = \frac{\text{KVA}_{\text{2-wdg}}}{1 - K}\] Rating Multiplication Factor \[\text{Factor} = \frac{1}{1 - K} = \frac{V_1}{V_1 - V_2}\] Turns Ratio (Step-Up) \[a = \frac{N_1}{N_2} = \frac{V_1}{V_2} = \frac{1}{K}\] No-Load Current \[I_0 = \sqrt{I_w^2 + I_m^2}\] Iw = working component, Im = magnetizing component Equivalent Resistance (Primary) \[R_{eq1} = R_1 + K^2 R_2\] Equivalent Reactance (Primary) \[X_{eq1} = X_1 + K^2 X_2\] Lower Cost: Requires (1-K) times less copper compared to two-winding transformer Higher Efficiency: Lower copper losses result in better efficiency Compact Size: Smaller physical dimensions due to reduced material Better Regulation: Lower impedance leads to improved voltage regulation Lower Losses: Copper losses are (1-K) times that of two-winding type Higher KVA Rating: Can handle larger power with same core and copper No Electrical Isolation: Primary and secondary are electrically connected Higher Short Circuit Current: Lower impedance results in higher fault currents Safety Concerns: Transfer of high voltage to low voltage side during faults Limited Transformation Range: Economical only when K > 0.5 (voltage ratio close to unity) Unstable Neutral: Issues with grounding in three-phase systems Typical Uses: Starting of induction motors (reduced voltage starting) Interconnection of power systems with small voltage differences Voltage regulation in distribution systems (boosters) Laboratory voltage variations (variable autotransformers/Variacs) Audio systems and impedance matching Autotransformer is economical when K > 0.5 Saving increases as K approaches 1 (voltage ratio near unity) All quantities (weight, losses, impedance) scale by factor (1-K) KVA rating increases by factor 1/(1-K) compared to 2-winding Not suitable where electrical isolation is required Core losses remain same as two-winding transformer

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