

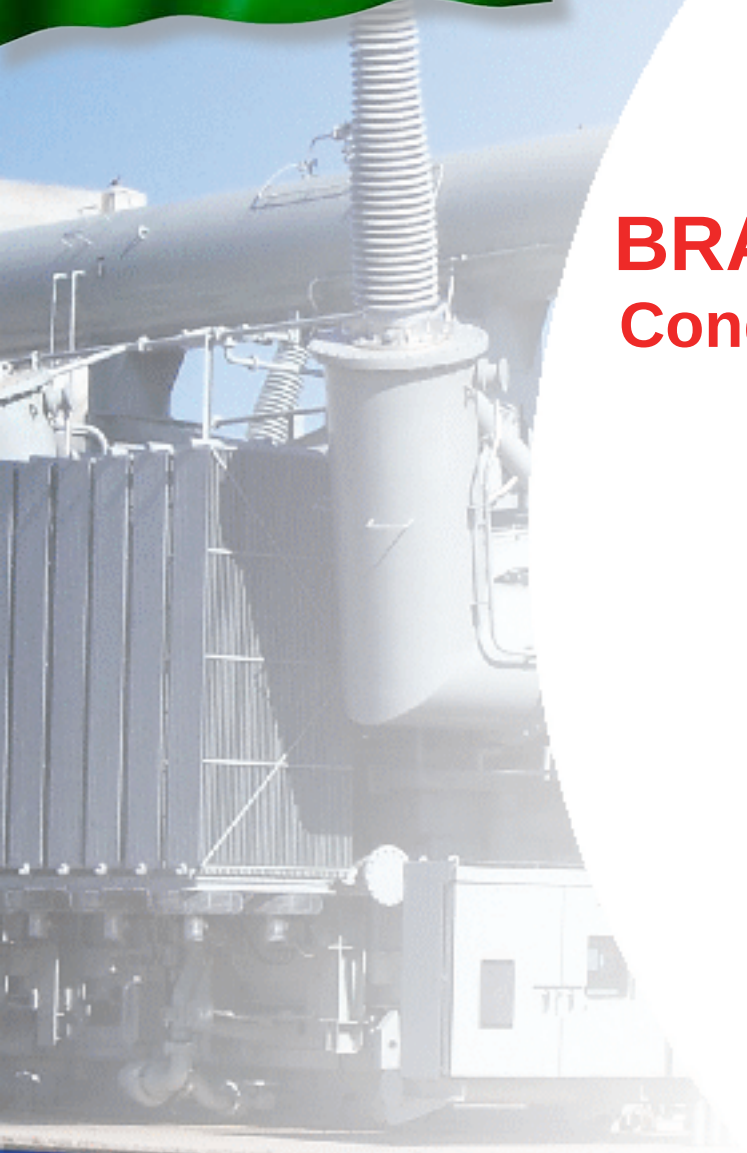

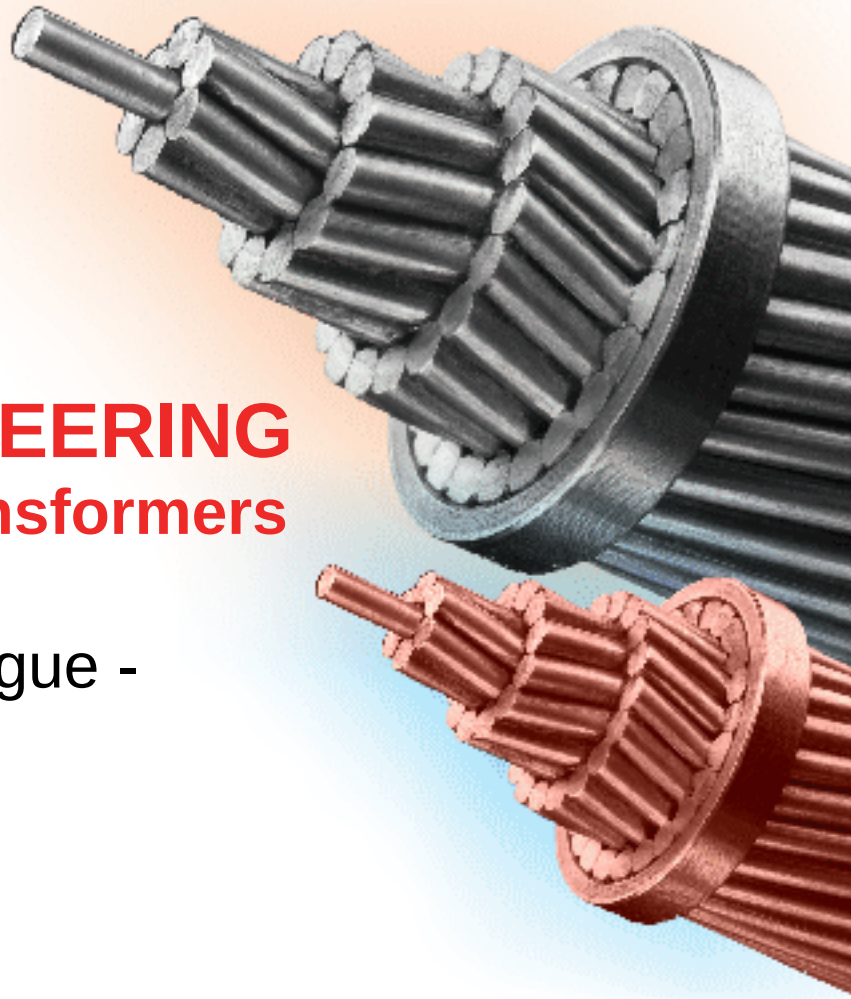

BRAND INDIA ENGINEERING

Conductors & Power Transformers

- India Product Catalogue -

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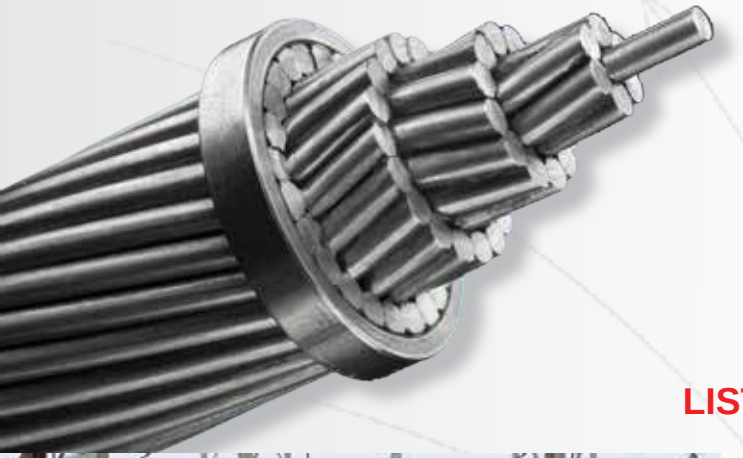



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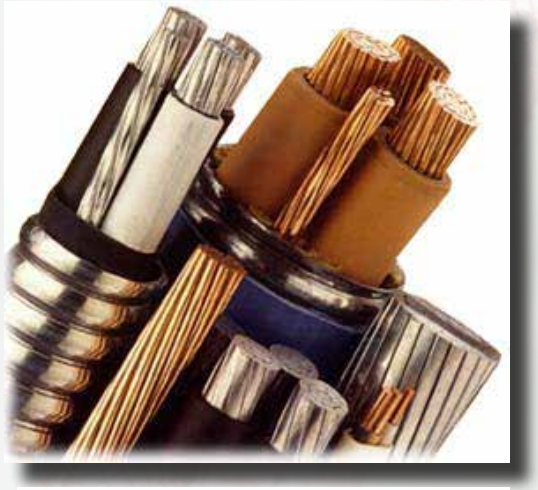
INTRODUCTION OF INDIAN ELECTRICAL INDUSTRY





The total market size of T&D equipment during FY2013-14 was Rs132,737Cr. Of which Cables has the largest share and contributed more than 22% of the total market for all T&D equipment. It has been observed that only Switchgear and TLT & Conductor industry has shown continuous increase in Industry Size over past 4 years. The total export of major T&D equipment (excluding other T&D items) during FY 2013-14 was Rs 19,266 Cr. Rotating machines are the largest exported T&D equipment, it accounts for around 27% of the total export for major T&D equipment during FY 2013-14. Capacitors and Energy meters was the least exported T&D equipment by India during FY 2013-14(4%). TLT / conductors and cables are the two most exported T&D items over the period of last three years.

- Industry Production (Estimated) for 2014-15: INR 1,28,000crores; Exports: US$ 5.3 billion
- 9.9% of manufacturing sector is terms of value and 1.4% of India's GDP
- Direct employment to 5 lakh persons, indirect to 10 lakhs, and over 50 lakhs across the entire value chain
- Diversified, matured and strong manufacturing base, with robust supply chain
- Rugged performance design of equipment to meet tough network demand
- Presence of major foreign players, either directly or through technical collaborations with Indian manufacturers
- State-of-art technology in most sub-sectors at par with global standards
- Major Export Markets: United States of America, United Arab Emirates, Germany, United Kingdom, Nigeria, Saudi Arabia, Australia, Brazil, Canada, France.
- Major Export Products:, Switchgear and Controlgear, Transformers & Parts, Industrial Electronics, Cables, Transmission Line Towers, Conductors, Rotating Machines (Motors, AC Generators, Generating Sets) & Parts
- For the rapid development of the domestic electrical equipment industry, encompassing the complete value chain in power generation, transmission and distribution, a holistic Mission Plan launched by the Department of Heavy Industry (DHI), Government of India, with support from IEEMA
- The Mission Plan lays down a clear roadmap for enhancing the competitiveness of the domestic electrical equipment industry
- Vision 2022: To make India the country of choice for the production of electrical equipment and reach an output of US$100 billion by balancing exports and imports

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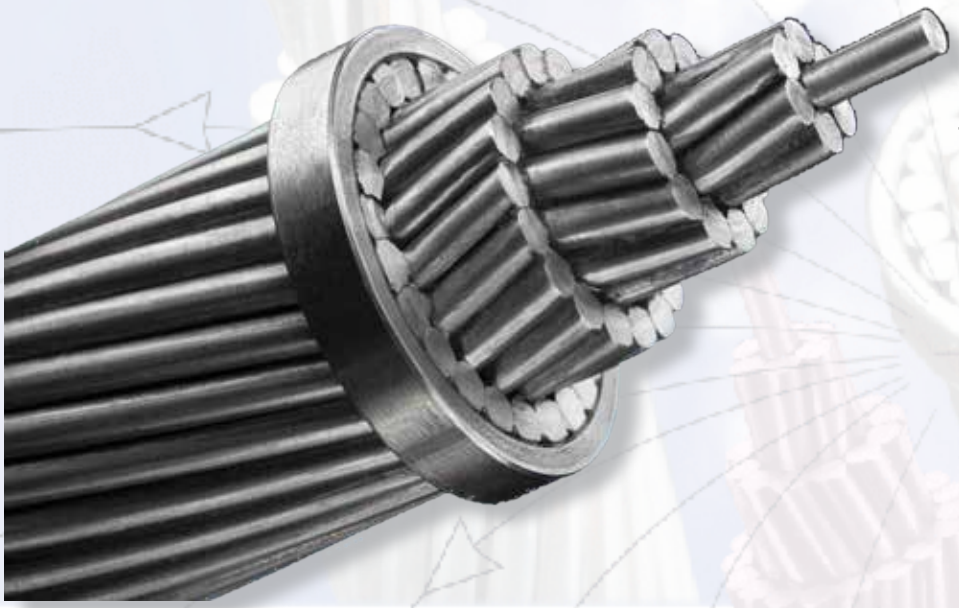
CONDUCTORS

CONDUCTORS INTRODUCTION



The conductor industry has been range bound in last five years, numbers reveal that industry produced around 4.2 Lac MT of conductors in year 2010-11 and production figure peaked in the year 2012-13 (around 5.5 Lac MT), while industry witnessed production settle at the levels of around 4 Lac MT in last two years. Largely, the trend is reflection of PowerGrid conductor contracts until 2011-12 and bulge in its inventory levels in the following years. Another significant change the conductor industry underwent in last 2-3 years is large manufacturers reducing their dependence on PowerGrid to broader cross-section of customers to exports generally. India has exported more than Rs 4983Cr. Of conductors over past five years. More than 42%of export of Indian Conductors have been to African countries during FY14. Kenya is the only country that has consistently remained amongst the top 10 Indian conductor importers over the last five years. The total export to Kenya has been around Rs 580Cr. Which is around 12%of the total conductor export by India during past five years.



Name of the company: Apar Industries Limited

Company profile:
Mr Dharamsinh D. Desai (1916-1980), the founder of the group started his industrial activities in 1942 as a sole proprietor of the Hindustan Electric Co. Ltd., which today is well known as **Asia Brown Boveri (ABB)**, of which he was the founder chairman. In 1958, a family company **Power Cables Pvt. Ltd.** now known as **Apar Industries** Limited.

Located at Silvassa (UT of DNH), Apar is the largest producer of aluminium conductor in India with about more than 25% market share and among the top five in the world. Aluminium alloy rods and conductors were developed first time in India by Apar through its in-house R&D initiatives. Factors that enabled Apar to emerge as the most cost effective producer of aluminium conductors include increase in capacity, strategic manufacturing location, economic advantage for the region through tax incentives, backward integration and the most efficient in-house business operations. Apar enjoys the reputations of being reliable long-term business partner for world leader companies in power infrastructure EPC.

Products manufactured:
Overhead Transmission & Distribution Conductors, High Performance Conductors.

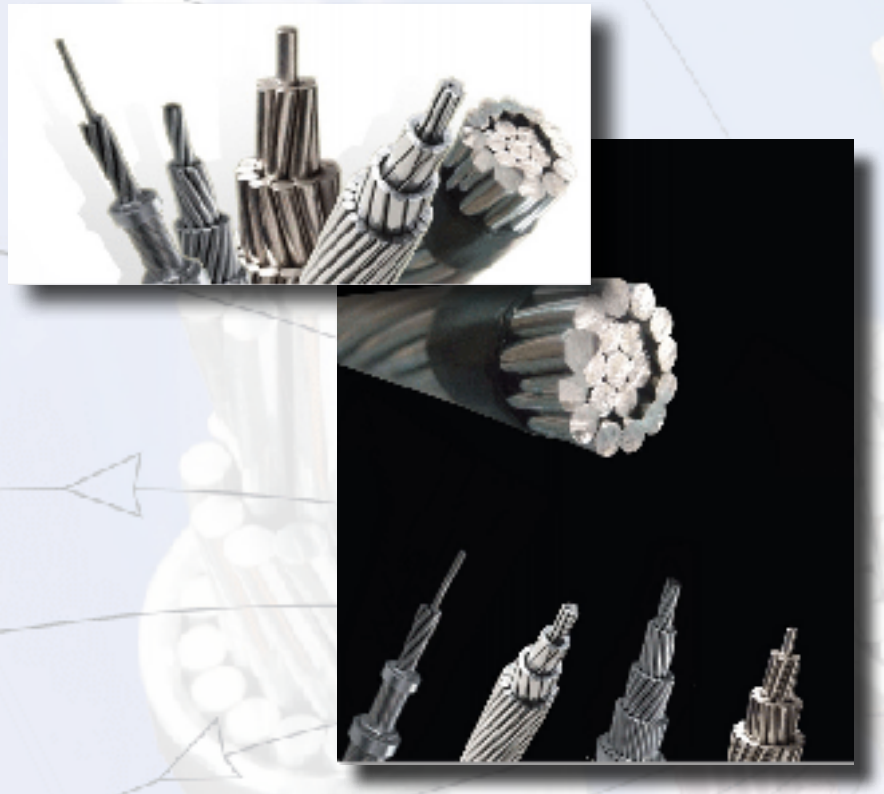
Contact person:
(For International Business Queries)
Mr. Ashwin Shah, Sr. Vice President

Contact details:

Address	:	301, Panorama Complex, R. C. Dutt Road, Alkapuri, Vadodara, Gujarat, India - 390 001
Phone	:	+91-265-2323175/76
Fax	:	+91-265-2330309
E-Mail	:	ashwin.shah@apar.com
Website	:	**www.apar.com**

Products Manufactured: All type of conductors.
Product Brochure: Click here to view
Technical specifications: IS, BS, ASTM, IEC, DIN and all other international standard.
ITC number:
Sectors of Interest: Electrical item.

GUPTA POWER
Making life better on Earth



Name of the company: Gupta Power Infrastructure Limited

Company profile:
Gupta Power Infrastructure Ltd is a time-honoured name in the manufacturing dome with its array of Cables & Conductors. An ISO 9001:2008 & ISO 14001:2004 BSOHSAS 18001:2007 accredited company, Gupta Power has striven over 50 years and developed a diversified, mature and strong manufacturing base with robust & a rugged performance design of products. With a Star Export House Certification that stands proof to our Export activities, Gupta Power has now soared to newer heights.
Gupta Power offers a single window solution for all types of Electrical needs through its inimitable product offering that includes Overhead Conductors, HT-LT Power Cables upto and including 66 KV, Instrumentation Cables, Mining Cables, Thermocouple Cables, Airfield Lighting Cables, Railway Signalling Cables & Specialized Cables. With its own EPC Division, Gupta Power provides complete solutions to Power Infrastructure Projects.

With the installation of CCV line procured from TROESTER Germany & by entering into strategic agreement with "Mercury Cables & Energy" of USA for manufacturing HTLS, Gupta Power has sailed through myriad of oddities with its stead-fast working culture & has surfaced with better sagacity of exhilaration with progressively amplified Sales Volume & is the Profit Earner by far that adds to its Testimony par Brilliance.

We introduce ourselves as "Manufacturers" of EHV/HT/LT Cables & High Voltage Al Conductors with 50 yrs. Time Tested excellence utilized for Electrical Transmission & Distribution lines.

Products manufactured:
Overhead Transmission & Distribution Conductors, High Performance Conductors.

Contact person:
(For International Business Queries)
V. Gupta, Vice President -International Marketing & Exports

Contact details:

Address	:	GUPTA POWER INFRASTRUCTURE LIMITED, 122, 1st floor, DLF Galleria, Mayur Vihar, Phase 1, Extn, Delhi - 110091
Phone	:	+91-971 77 00198
E-Mail	:	gupta10111@gmail.com; guptav@guptapower.com
Website	:	**www.guptapower.com**

Products Manufactured: All type of Al conductors.
Product Brochure: Click here to view
Technical specifications: IS 398 : 1996, IEC 61089, ASTM B-230, ASTM B-502, TM B-549, ASTM B231-78
ITC number: 76149000, 76042910, 76141000
Sectors of Interest: Electrical power utility, EPC, stockiest, Traders, dealers etc.

Hindusthan Urban Infrastructure Limited



Name of the company: Hindusthan Urban Infrastructure Limited

Company profile:
Established in 1959, Hindusthan Urban Infrastructure Limited (Formerly Hindusthan Vidyut Products Ltd.) is a leading manufacturer of overhead conductors & electro – porcelain high tension insulators. We are an ultra – modern, highly quality – conscious, professionally managed company with sophisticated European, American & Indian manufacturing & testing machinery. We are reputed for our impeccable timely Quality Product Delivery & Performance conforming to National & International standards. We provide solutions to a diverse set of clients across India & the Globe with their requirements of Conductors & Insulators.
We have received IMS Certification - ISO 9001:2008, Environment Management System Certification ISO: 14001 : 2004 & BS OHSAS18001:2007 by BVQI, apart from having the ISI Mark Certification for Over Head Conductors such as AAC, ACSR, AAAC, AACSR, ACAR, AL59 and HTLS Conductors up to 800 KV Lines. We are also Member of the Standing Committee for overhead Conductors up to 800 kV of Bureau of Indian Standards, Government of India for the last two decades.
The company also boasts of World Class Plants and Machinery for a wide range of sophisticated products.
At present, we manufacture Bare Conductors for transmission lines & HT Insulators such as Solid Core Insulator, Hollow (Bushing Insulator). Four units located at Faridabad (Haryana), Gwalior (M.P.), North Guwahati (Assam) and Khurda (Odisha) have manufacturing facility for bare conductors. Our manufacturing facility for insulators is situated at Mandideep (M.P.).

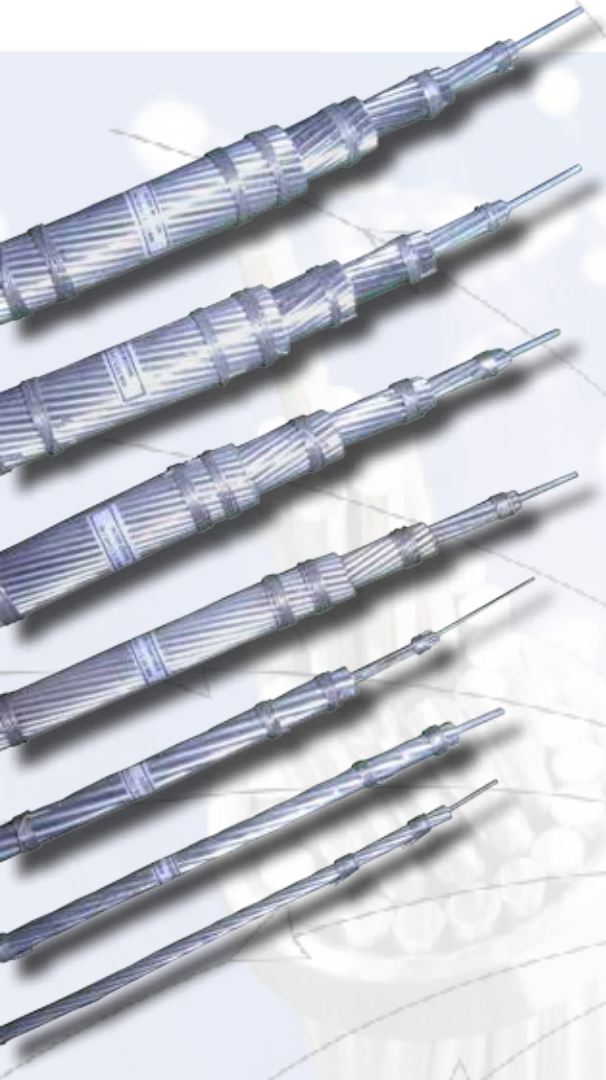
Products manufactured:
Overhead Transmission & Distribution Conductors, High Performance Conductors.

Contact person:
(For International Business Queries)
Mr. Rajeev Kaushal, General Manager-sales

Contact details:

Address	:	Hindusthan Urban Infrastructure Ltd. Kanchenjunga, (7th Floor), 18, Barakhamba Road, New Delhi – 110001, India
Phone	:	+91-11-233100001-05
Website	:	**www.thehindusthangroup.com**

Products Manufactured: All type of AI conductors.
Product Brochure: Click here to view
Technical specifications: ISO 9001:2008, ISO 14001: 2004, BS OHSAS18001:2007 certified by BVQI U.K.
ITC number:
Sectors of Interest:



Name of the company: JSK Industries Private Limited

Company profile:
JSK INDUSTRIES PRIVATE LIMITED who have been one of the leading manufacturers of Overhead Bare Aluminium Conductors for Power Transmission & Distribution Lines worldwide with most reliable latest technology. After four and a half decades of establishing its leadership in the aluminium sector, the group has now set a mark in the power sector. JSK Industries Pvt Limited made a debut as one of the key suppliers to Power Grid Corporation of India Limited and today aims to be an important part of the 'Power for all' vision. As a company, we are poised to lead our way; driven by a strong set of values, continuous product innovation, value addition and all-round corporate social responsibility that sets us apart from the rest - as a company, that's cut out to play a vital role in tomorrow's power generation scenario.

Products manufactured:
Overhead Transmission & Distribution Conductors, High Performance Conductors

Contact person:
(For International Business Queries)
Mr. Navendu K. Bhardwaj

Contact details:

Address	:	9, A.K.Naik Marg, C.S.T. Mumbai: 400 001
Phone	:	022-66253700
Mobile	:	+91-9891103836
Fax	:	+91-22-66550780
E-Mail	:	navendu@jskindia.in
Website	:	**www.jskindia.in**

Products Manufactured: AAC/AAAC conductors.
Product Brochure: Click here to view
Technical specifications: ISO 9001:2000 Company
ITC number: 7614.9000
Sectors of Interest:



Name of the company: NECCON Power & Infra Ltd.

Company profile
An established manufacturer and exporter of premium quality aluminium conductors and cables. We guarantee durability, performance, reliability in each product we manufacture.

Implementing new technology of manufacturing, enables us to maintain high quality standards in all our product range. Regular market research is done to make better decision in development and marketing of products.

We have built up a very good record of accomplishment of performance since its inception and has been continuously on more to improve its performance and to achieve excellence in all the spheres of activities. Both the conductor units were received the “Best Productivity Performance Award” in 1997, conferred by the National Productivity Council of India.

Products manufactured:
All type of overhead transmission AAAC conductors, AAC conductors, ACSR conductors upto 400 KV lines.

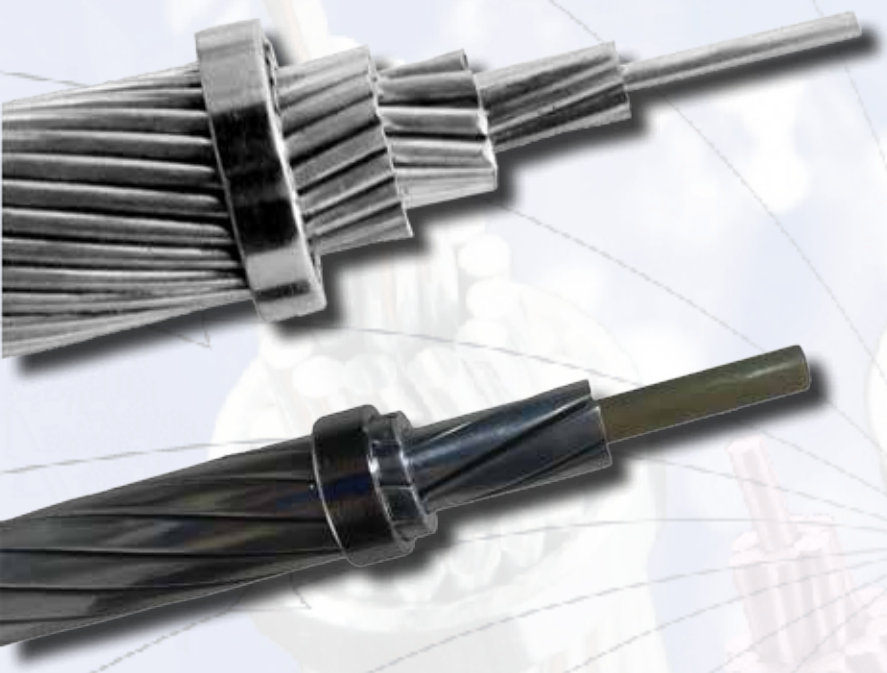
Contact person:
(For International Business Queries)
Mr. P. K Khetan Director

Contact details:

Address	:	Neccon power and infra Limited, 416, (4th floor), City Plaza, (Space Cinema Complex), Banipark, Jaipur, Rajasthan- 302 016, India
Phone	:	+91-141-2281654
Fax	:	+91-141-2281540
E-Mail	:	necconjpr@yahoo.com
Website	:	**www.khetan-group.com**

Products Manufactured: ACSR Conductors
Product Brochure: Click here to view
Technical specifications: ACSR Conductors as per IS:398
ITC number: 76042910
Sectors of Interest: Supply and contracts

Name of the company: Sterlite Technologies Ltd



Company profile:
Sterlite Technologies Limited (STL) develops & delivers products, solutions and infrastructure for telecom & power transmission networks, globally. STL is among the global leaders in all its business areas of Power Conductors, High Performance Conductors (HPC), OPGW Cables, HV / EHV Power Cables, Optical Fiber, Fiber Optic Cables, System Integration through its operations in India, China & Brazil. We have an annual manufacturing capacity of 1,60,000 Metric tonne for conductors and over 12000Km for OPGW Cable.

Sterlite is a one stop solution provider, providing futuristic solutions like High Performance Conductors and OPGW cable along with customized passive accessories for efficient transmission of electricity. We also have certified in-house trainers with over 600km of installation experience in HPC.

As the most integrated optical fiber company in the world, STL is pioneering Fiber-to-the-Home (FTTH) deployment in the country to enable high speed broadband connectivity. STL is developing several transmission infrastructure projects spanning over 5000 Circuit Kms, across India.

We have strong market presence in over 75 countries.

Products manufactured:
Overhead Transmission & Distribution Conductors, High Performance Conductors.

Contact person:
(For International Business Queries)
Mr. Alok Sharma

Contact details:

Address	:	Sterlite Technologies Limited | Enterprise Center, 2nd Floor 202-204, Near Vedanta, Nehru Rd, Vile Parle (E) Mumbai 400099,
Phone	:	+91-22-61140503|
Fax	:	+91-22-67347765
E-Mail	:	alok.sharma@sterlite.com; sterlite.communications@sterlite.com
Website	:	**www.sterlitetechlologies.com**

Products Manufactured: Overhead Transmission & Distribution Conductors
Product Brochure: Click here to view
Technical specifications: IEC, BS, ASTM, CAN-CSA, DIN, IS, and AS astandards
ITC number: ACSR/AACSR- 76141000, ACAR, AAC, AAAC, ACCC - 76149000
Sectors of Interest: Transmission & Distribution, Renewable Energy, Smart Grid

POWER TRANSFORMERS

POWER TRANSFORMERS INTRODUCTION



The power transformers market revenues in India are expected to grow at the CAGR of 14% till 2018. Under the 12th Five Year Plan (2012-17), the government plans to spend USD 200 Billion on developing and strengthening power infrastructure in India. Similarly, IEEMA (Indian Electrical and Electronics Manufacturers Association) along with government framed a policy to limit the imports of transformers from China and Korea along with changing government policies on import duty for CRGO steel is likely to further promote the domestic transformers industry in India. Indian transformer industry continues to face tough competition from the Chinese manufacturers. However, with the continuous support from the government to promote the power transformer industry through investments, tax benefits, subsidies etc. will help the industry to grow over the coming years. India has exported more than Rs 4316 Cr of Power Transformers over past five years. Around 29% of the total Power Transformers export (From FY10 to FY14) has been to three countries–Nigeria, Oman and Malaysia. The total export to three countries–Oman, Nigeria and Malaysia has been around Rs1243Cr.during past five years. Nigeria and Oman are the two countries that have consistently remained amongst the top 10 Indian Power T/F importers over the last five years.

Name of the company: Bharat Heavy Electricals Limited

Company profile :
Incorporated in 1964, **BHEL** is India's largest engineering and manufacturing company of its kind engaged in the design, engineering, manufacture, construction, testing, commissioning and servicing of a wide range of products, systems and services for the core sectors of the economy, viz. Power, Transmission, Industry, Transportation, Renewable Energy, Oil & Gas and Defence.

The company has been earning profits continuously since 1971-72 and paying dividends uninterruptedly since 1976-77. In recognition of its consistent high performance, BHEL has been conferred with the 'Maharatna' status by the Government of India. With a widespread network of 17 manufacturing units, two repair units, four regional offices, eight service centres, eight overseas offices, 15 regional centres, seven joint ventures, and infrastructure to execute more than 150 project sites across India and abroad, BHEL provides products, systems and services to customers efficiently and at competitive prices and has established capability to deliver 20,000 MW per annum of power equipment.

Most of BHEL's manufacturing units and other entities have been accredited to Quality Management Systems (ISO 9001:2008), Environmental Management Systems (ISO 14001:2004) and Occupational Health & Safety Management Systems (OHSAS 18001:2007). BHEL places strong emphasis on innovation and development of new technologies. Its research and development (R&D) efforts enables a strong customer orientation for responding to changes in the market.





Products manufactured:
Power Transformers upto 765 kV Class. 1200 KV Class tested successfully

Contact person:
(For International Business Queries)
Mr. Rajeev K. Gupta

Contact details:

Address	:	Additional General Manager, International Operations Division, Bharat Heavy Electricals Limited, Integrated Office Complex, Lodhi Road, New Delhi – 110003
Phone	:	+91-11-41793346
Fax	:	+91-11-24368406
E-Mail	:	rajeev@bhel.in
Website	:	**www.bhel.com**

Products Manufactured: Power Transformers
Product Brochure: Click here to view
Technical specifications: ISO 9001:2008, ISO 14001:2004, OHSAS 18001:2007
ITC number:
Sectors of Interest:

Smart solutions.
Strong relationships.

Name of the company: Crompton Greaves Limited

Company profile:
A global electrical company in 85 countries, with 9,500 people. It has a collective experience of 100+ years, spanning the entire spectrum of electricity and its applications. The journey starts from where electricity is generated: a river, the sun, the wind or a thermal plant. CG manages and tends electricity, preparing it to travel great distances, directing it intelligently to the end user and helping convert it efficiently back into motive power, heat or light.

CG is among the world's leading makers of ultra high voltage transformers and switchgear, a leading electricity provider in Europe to offshore wind farms, and among the most trusted names in electrical equipment in the burgeoning Indian market. CG's technology runs intelligent grids in Latin America's largest photovoltaic farm in Chile and smartly distributes power to the Indian hinterland. CG manages the pumps that operate on Amsterdam's waterways, its motors grind stone for cement and chillies for dinner, its street lighting solutions save crores of rupees for the Puducherry administration in India. Wherever CG operates, it makes electricity generation and consumption smarter, cleaner and more efficient.





Products manufactured:
All types of Power Transformers ranging from 500 kVA upto 1500 MVA, upto 765 kV

Contact person:
(For International Business Queries)
Mrs. Netra Bag (AGM, International Marketing)

Contact details:

Address	:	Power Transformer Division (T1), Kanjur Marg East, Mumbai 400042, Maharashtra, India
Phone	:	+91-22-67558366
Mobile	:	+91-9820456958
E-Mail	:	netra.bag@cgglobal.com
Website	:	**www.cgglobal.com**

Products Manufactured:
Product Brochure: Click here to view
Technical specifications:
ITC number:
Sectors of Interest:

IMP Powers Ltd.





Name of the company: IMP Power Limited

Company profile
IMP established in 1961 is having state of art plant at Silvassa, manufacturing entire range of Power and EHV Transformers. Continuous R&D, adoption of new technology keeps IMP products one of the best in the field.

IMP's Silvassa works is amongst the most modern transformer plant built to manufacture HV & EHV power transformers upto 400 kV Class 315 MVA & has extensive testing facilities utilising highest quality test equipment. IMP Power has a total installed capacity of 12000 MVA/annum. IMP has adequate capacity to manufacture transformers for a wide range of applications thus ensuring timely deliveries as per customer requirements.

Products manufactured:
All type of Power Transformers upto400 KV Class

Contact person:
(For International Business Queries)
Mr. Anant Bare, Sr. Manager (Commercial)

Contact details:

Address	:	35/C Popular Press Building, 2nd Floor, Pt. M.M Malviya Road, Tardeo, Mumbai - 400034
Phone	:	+91-22-23539180-84
Fax	:	+91-22-23539186-87
E-Mail	:	info@imp-powers.com
Website	:	**www.imp-powers.com**

Products Manufactured:
Product Brochure: Click here to view
Technical specifications:
ITC number:
Sectors of Interest:

SIEMENS



Name of the company: Siemens Limited, India

Company Profile:
Siemens Limited, India having works at Siemens Limited, Transformer Works, Thane-Belapur Road, Airoli – Navi Mumbai – 400708, Maharashtra, India produces Power Transformers, System / Grid / Network Transformers, Reactors, HVDC Transformers, Traction Transformers in the range upto 1200kV Type

Products manufactured:
Power Transformers upto 1200kV

Contact person:
(For International Business Queries)
Mr. Arvind Batra (Head – Sales & Marketing)

Contact details:

Address	:	Siemens Limited, Transformer Works, Thane – Belapur Road, Airoli – 400708, Navi Mumbai, Maharashtra, India
Phone	:	+ 91-22-39608740
Fax	:	+91-22-39608703
Website	:	**www.siemens.co.in**

Products Manufactured: Transformers and Shunt Reactors up-to 1200kV class.
Product Brochure: Click here to view
Technical specifications:
ITC number: 85042320, 85042330 and 85042340.
Sectors of Interest: Transformers and Shunt Reactors

Name of the company: Technical Associate Limited





Company profile

Technical Associates Limited(TAL) is one of India's oldest manufacturer of Power and Distribution Transformers. We have capability including Design, manufacture and testing of EHV Power Transfomrerupto 765KV Class. We have sucessfullysuplied more than 600,000 (approx. 50,000MVA) transformers over its 40 year old history. Our Testing laboratories are NABL- IEC 17025 Certified.

Products manufactured:
All type of Power Transformers upto 765 KV Class

Contact person:
(For International Business Queries)
Mr. S. C. Bhatt

Contact details:

Address	:	8th KM, Faizabad Road, Ismailganj, Lucknow - 226016
Phone	:	+91-522-40253600
Fax	:	+91-522-4053601
E-Mail	:	marketing@gmail.com
Website	:	**www.techasso.com**

Products Manufactured: Transformrs
Product Brochure: Click here to view
Technical specifications: IS : 1180, IS : 2026, IEC : 60076
ITC number: 850421, 850422, 850423
Sectors of Interest: Transmission & Distribution, Renual Energy, Power Generation & Power Distribution transformers

TOSHIBA
Leading Innovation



Name of the company:
Toshiba Transmission & Distribution Systems (India) Pvt. Limited

Company Profile:
Toshiba Transmission & Distribution Systems group is a world leader in the supply of integrated solutions for energy Transmission &Distribution. Toshiba has developed its superior technology and has a history of high product quality in this market throughout the course of more than 100 years, manufacturing its first transformer in 1894 and its first switchgear in 1902.

TTDI is a leading manufacturer of T&D equipment which includes Power and Distribution Transformers from 5 KVA to 1000 MVA, 1200 kV class, Switch gear Products (GIS, SA, CT, PT, and VCB etc.).
Our vast experience and continued expansion has allowed us to gain immense trust and appreciation from customers around the world. Toshiba continues to serve the people and the planet that we call home.

TTDI is emerging as the global production hub of Toshiba Corporation to cater product and component requirements across the world.

Toshiba Corporation acquired Vijai Electricals ltd Hyderabad in December 2013, and established Toshiba T&D Systems India Private Limited, (TTDI) Hyderabad, India. TTDI is currently running the acquired businesses and provide them with Toshiba's latest state-of-the-art design, development and production capabilities in order to supply a wide range of T&D products globally.

Products manufactured:
Power Transformers from 5 KVA to 1000 MVA, upto 1200 KV Class

Contact person:
(For International Business Queries)
Mr. K. Sharat Chandra, G.M - Marketing & Sales, EHV Transformers Division

Contact details:

Address	:	Toshiba Transmission & Distribution Systems (I) Pvt. Ltd. Rudraram Village| Patancheru Mandal | Medak Dist. | Telangana – 502329
Phone	:	+91-40-3071 7230
Mobile	:	+91-9392158373
Fax No	:	+91-40-30717263
E-Mail	:	sharatchandra.kolla@toshiba-ttdi.com
Website	:	**www.toshiba-ttdi.com**

Products Manufactured:
Product Brochure: Click here to view
Technical specifications:
ITC number: 85042200, 85042310, 85042320, 85042330, 85042340
Sectors of Interest: Industries, Power Generating Stations, Receiving Stations, Substations & Railways



315 MVA, 400/220/33 kV Auto Transformer



100 MVA, 220/132/33 kV Auto Transformer

Name of the company: Transformers & Rectifiers Limited

Company profile:
Transformers & Rectifiers (India) Ltd. was incorporated in 1981 and with 3 major units are amongst the top 5 transformer manufacturers in India & have manufactured & supplied more than 9000 transformers, which are installed across the globe. We have well diversified product range comprising of Power Transformers right up to 1000MVA, 1200kV class, Distribution transformers of rating 315kVA & more, Furnace transformers up to 120kA, rectifier transformers up to 160kA, Reactors up to 765kV class & other Special Duty Transformers.

We are having State Of Art manufacturing facilities with ultra-modern testing laboratory and is duly accredited by National Accreditation Board for testing & calibration laboratories (NABL) to perform all the routine & type tests for transformer ratings up to 1000MVA, 1200kV class.

Bureau Veritas has certified our management systems, for their conformance to quality standards ISO 9001:2008, ISO 14001:2004 and BS OHSAS 18001:2007, which ensures the quality deliverables in terms of our products & services to our customers.

We have our global presence in terms of transformer supplies with the countries like United States of America, Canada, United Kingdom, Belgium, Latin America, Nigeria, Ghana, Kenya, Tanzania, Zimbabwe, South Africa, Philippines, Sri Lanka, UAE, Bangladesh, Australia & many more. Transformers designed, manufactured and tested by us ranging from 315 KVA to 500 MVA (up to 1200kV class) are in successful operations throughout the length and breathe of the India as well as in the above mentioned countries, as specified by us.

The offered transformers are of proven designed and are well known for Power perfect. The transformers manufactured are generally in accordance with latest global standards like IEC, IEEE (ANSI), CSA & Indian Standards (IS).

Products manufactured:
All types of Power Transformers ranging from 315 kVA upto 1000 MVA, 1200 kV

Contact person:
(For International Business Queries)
Mr. Varun Thakkar

Contact details:

Address	:	Survey No. 427 P/3-4, & 431 P/1-2, Sarkhej-Bavla Highway, Village, Moraiya, Tal. Sanand, Dist., Ahmedabad - 382213
Phone	:	+91-2717 661 500/501/661/534
Fax	:	+91-2717 661 716
E-Mail	:	varun.thakkar@transformerindia.com
Website	:	**www.transformerindia.com**

Products Manufactured: Transformers
Product Brochure: Click here to view
Technical specifications:
ITC number:
Sectors of Interest: Power and Electrical small, medium and heavy industries.

Transformers And Electricals Kerala Ltd.
(A Joint Venture of Government of Kerala & NTPC Ltd)



Name of the company: Transformers & Electrical Kerala Limited

Company Profile:

Transformers & Electrical Kerala Ltd wasincorporation in 1963 in technical & financial collaboration with M/s Hitachi Ltd, Japan. The key milestones of the Company are as follows:

1966 - Supplied & installed First Power Transformer (4 MVA, 66/11 kV) to KSEB

1972 - Entered into International Business at first and exported 2 Nos. 50MVA Power Transformer to Tanzania

1978 - Installed first 400 kV Class Power Transformers & Cts
4 X 83.3 MVA 420/220 kV Single phase Tie Transformers to Slapper, BCB (BBMB). 10x60 MVA ,420/11 kV Generator transformers to Slapper, BCB (BBMB)
4 X 150 MVA 420/220kV single phase Auto transformers to Panipat Substation, BCB (BBMB)

1982 - Installed 600 MVA (3 X Single Phase Bank) for India's first 500 MW, 220kV Thermal Power Station at Trombay for TATA

2003 - Installed Largest Capacity Generator Transformer in India 630MVA Transformers (3 x Single phase Bank) India's first 400kV,500MW Nuclear Power Station at Tarapur in 2003

2009 - Became a Joint Venture of Govt. of Kerala & NTPC Limited

2010 - TELK has become the first Power equipment manufacturer in who have conducted short circuit Test on 315MVA, 400/220/33kV Transformer having 1425 kVp Basic Insulation Level, at KEMA Netherlands with first attempt

Products manufactured:

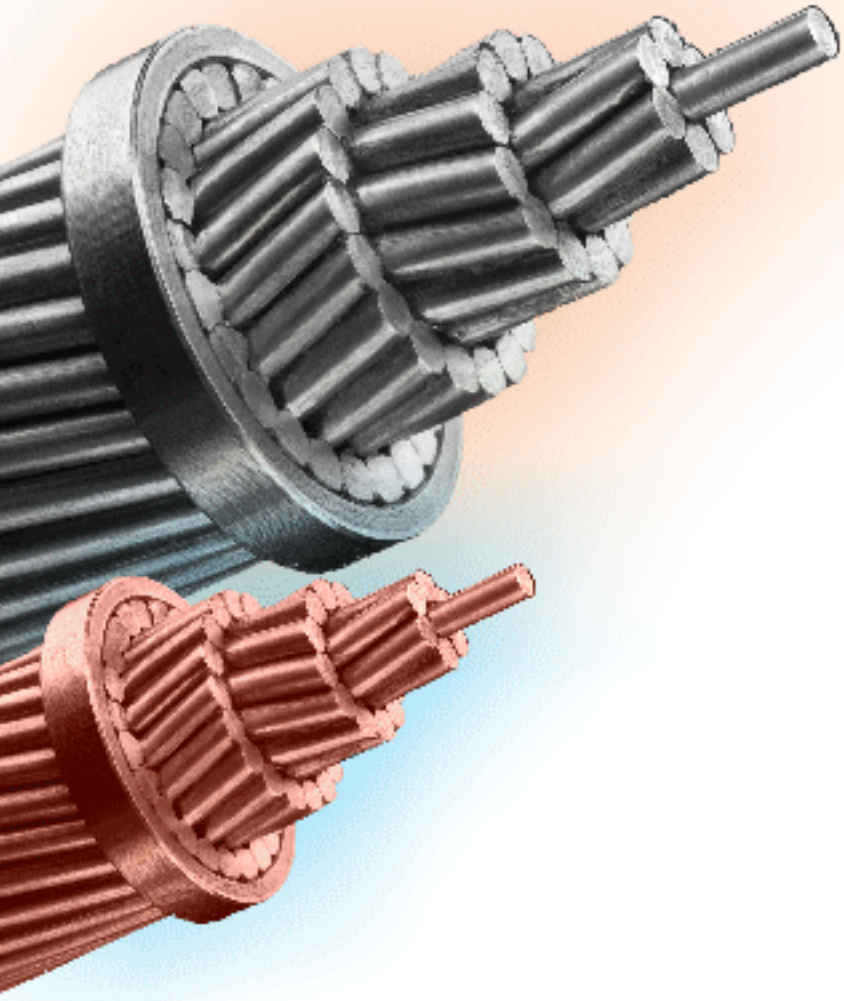
Power Transformers with MVA ranges from 20 MVA to 315 MVA 3 phase / 825 MVA single phase bank and Voltage class ranges from 33 kV to 400 kV

Contact Person:
(For International Business Queries)
Mr. Cyriac George, AGMS1, Marketing

Contact details:

Address : Transformers and Electricals Kerala Ltd
Angamally South P.O., Ernakulam District, Kerala, India – 683573
Phone : +91-484-2510343, 2510251
Fax : +91-484-2452873, 2452363, 2458995
E-Mail : cyriac@telk.com
Website : **www.telk.com**

Products Manufactured:
Product Brochure: Click here to view
Technical specifications:
ITC number:
Sectors of Interest:



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Apar Industries Limited

THE GREAT VISIONARY



Mr. Dharamsinh D. Desai (1916-1980), the founder of the Group stared his industrial activity in 1942 as a Sole Proprietor of the Hindustan Electric Co. Ltd., which today is well known as Asea Brown Boveri of which he was the founder Chairman. In 1958, he established a family Company – Power Cables Pvt. Ltd. now known as the Apar Group. As an engineer and highly respected industrialist, he founded many schools, Institute of Technology (recognized as deemed University) and headed the Government of India's – Development Council for Heavy Electrical Industries, New Delhi. He also was an outstanding Member of Parliament (2 term-Lok Sabha). He planted 5,00,000 mango trees, provided dams, canals and hundreds of wells, built thousands of kms of roads and free schools and farmers' training institutions, in his constituency kheda Dist. of Gujarat. He was a member of the important Finance Ministry's Advisory Council and championed reforms, privatizations, tax reduction, building up the vast "Money for the People" by creating higher wealth saving for our nation. He established about 25 factories all over India. Indeed a great visionary.

Board Of Directors

DR. N. D. DESAI, CHAIRMAN	B.Sc(Hons), London, M.S.Ele.Engg., PH.D., Penn., USA, Sigma XI, A.A.M.I.E.E.
MR. K. N. DESAI, MD	B.Sc (Hons.), (Electrical Engg.), B.S. (Econ.) Hons., Wharton, USA.
MR. C. N. DESAI, Jt. MD	B.Sc (Hons.), (Chem. Engg.), USA B.S. (Econ.) Hons., Wharton, USA.
MR. H.N.SHAH, DIRECTOR	B.Com F.C.A
MR. M.M.PATEL, DIRECTOR	B.Sc. (Bom), A.N.C.R.T., A.I.R.I., (London), FPRI (UK) FISI(India).
MR. V.A.GORE, DIRECTOR	B.Com, M.F.M.
MR. N.K.THINGALAYA, DIRECTOR	Ph.D. (Economics)
MR. F.B.VIRANI, DIRCTOR	B.E. (Chem. Engg.), M.S. (Chem.Engg.) USA, M.B.A. (USA).
Mr. M.N.KAMAT	Nominee Director of IDBI
MR. RICHARD OWEN PVYIS	INVESTOR DIRECTOR
MR. JOSEPHINE PRICE,	ALTERNATE DIRECTOR



MR. KISHAL N. DESAI
Managing director



Dr. Narendra D. Desai
Chairman



MR. CHAITANYA N. DESAI
Jt. Managing director

Born on 21st February, 1967, Mr. Kushal N. Desai, is the Managing Director of Apar Industries Limited. He is a Bachelor of Science in Electrical Engineering from Moore School, University of Penn., USA and a Bachelor of Science in Economics from the Wharton School, University of Penn., USA.

Before joining the Company, Mr. Kushal N. Desai was holding senior management positions in General Electric India from 1993 to 1996, including the position of Managing Director of GE Lighting Private Limited, now known as GE Lighting India Limited. He was also a Chairman and Managing Director of Ness Technologies (India) Limited, an Indian counterpart of Ness Technologies, USA, an USA incorporated IT software services Company.

Born on 22nd November, 1940, Dr. Narendra D. Desai is a Chairman of Apar Industries Limited. He is an Engineer with Honors Degree from the University of London and Masters and Ph. D. from U.S.A. He did his Wharton School Cost Accounting with Business Management credits, which went towards his Ph. D. Degree.

Dr. Desai was the Chairman of GE Apar Lighting Private Limited, now known as GE Lighting India Limited. He was also Chairman of Apar Infotech, USA and Ness Technologies (India) Ltd. He is past President of ELCOMA (Electrical Lamp and Component Manufacturers Association), AMPS (Association of Manufacturers of Petroleum Specialities), etc. He is currently the President of Association of Domestic Industries Affected by Dumping.

Dr. Desai is the Managing Trustee of Dharmsinh Desai Institute of Technology, Nadiad (University), having an MBA Programme linked with IIM, Ahmedabad.

For the last 25 years, Dr. Desai has often been visiting speaker at various institutions in India and abroad such as Carnegie Melon, USA, etc.

Born on 16th July, 1971, Mr. Chaitanya N. Desai is the Joint Managing Director of Apar Industries Limited. He is a Bachelor of Science in Chemical Engineering from Moore School, University of Penn., USA and a Bachelor of Science in Economics from the Wharton School, University of Penn., USA

Mr. Chaitanya N. Desai, was conferred with many awards such as, Summa Cum Laude for both degrees, Prize for Best Senior from American Chemical Society, Molstad Prize for Best Senior Design Project, Prize for Best Junior from American Institute of Chemical Engineers and the like.

APAR Group stands tall at the forefront of the industries in India and overseas, operating in the diverse fields of electrical, metallurgical, chemical engineering, polymers, speciality oils, thermoplastic elastomers and information technology. Apar Group, established in the year 1954, has built an enviable reputation for quality, integrity and far-sightedness.

Our Corporate Philosophy & Culture

"**Tomorrow's progress To-day**", is more than a philosophy. It is a way of life - ultra modern and sophisticated with the most advanced technologies the world has to offer.

Determination, courage and **enthusiasm** are out standing characteristics of the corporate. All activities in R & D, production and Marketing have one objective "**Customer's Satisfaction**". Constant high quality product with top class quality in consulting, **Customers satisfaction and service are top priority.**

"We believe in **Doing what anyone can do**"

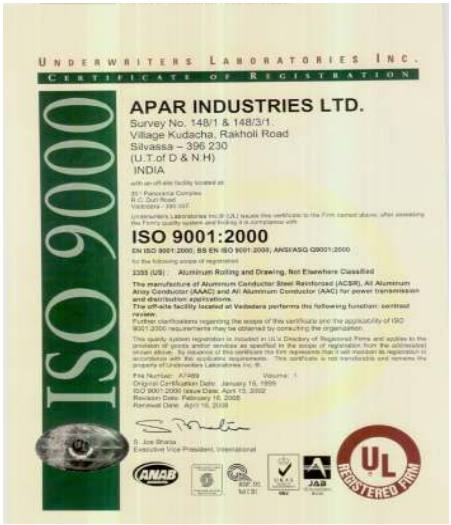
Serving Quality Throughout the world you will find that just one call to APAR gets you, Wire Rod or Conductor you want.

The people of APAR believe that service quality is one of the corner stone of a Successful Business. "**Customer satisfaction is our most important Goal**", whether it means competitive pricing, just in time delivery or Customer's specific requirement. **Apar want to provide exactly what your need when you need and how you need.**

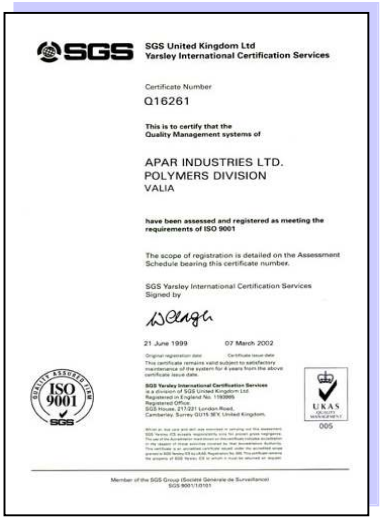
Our Quality Policy

"To Satisfy Customer needs and retain leadership by manufacturing and supplying Quality Products through continuous Improvement by motivated Employees"

Our Accolades Speak For Themselves & We Have The Quality Certificates To Prove Them


UNDERWRITERS LABORATORIES INC.
CERTIFICATE OF REGISTRATION
APAR INDUSTRIES LTD.
Survey No. 148/1 & 148/3/1
Village Kudacha, Rakholi Road
Silvassa – 396 230
(U.T.of D & N.H)
INDIA
ISO 9001:2000
ISO 9000


SGS United Kingdom Ltd
Yarsley International Certification Services
ASSESSMENT SCHEDULE
Q16261
Assessment Standard: ISO 9001: 2000
Company: APAR INDUSTRIES LTD. POLYMERS DIVISION
Location: Village Dungri, Taluka Valia Dist. Bharuch Gujarat - 393 135 India
Product Area Assessed: Manufacture & Supply of Synthetic Rubbers & Latices (including in Powder Form).
Authorised by
Director
Issue No: 2
07 March 2002
Page 1 of 1
Further clarifications regarding the scope of this certificate and the applicability of ISO 9001:2000 requirements may be obtained by consulting the organisation.


SGS United Kingdom Ltd
Yarsley International Certification Services
Certificate Number
Q16261
This is to certify that the Quality Management systems of
APAR INDUSTRIES LTD.
POLYMERS DIVISION
VALIA
have been assessed and registered as meeting the requirements of ISO 9001
The scope of registration is detailed on the Assessment Schedule bearing this certificate number.
SGS Yarsley International Certification Services
Signed by
21 June 1999
07 March 2002

COMPANY PROFILE CLASSIFICATION

Apar Industries Limited - Group Business Activities

1. SPECIALITY OIL DIVISION

Mfg. Location: Unit-I Silvassa. Unit-II Rabale Mumbai.



Special Oil Refinery (SOR) was established originally in technical collaboration with M/s. Sun Oil Co. of U.S.A and has an annual capacity to manufacture over 100,000 tonnes of Speciality Oils. We use new generation hydroteated imported naphthenic base oils to produce Transformer oil.

Our 'POWEROIL' Transformer Oil, manufactured through a multistage continuous refining, clay contacting and vacuum filtration process, is the undisputed brand leader in India with more than 50% market share and with OEM approvals form all major transformer manufacturers, in India and abroad.

The heart of SOR Division is our Quality Control and R&D laboratories. These departments function in close cooperation with leading transformer manufacturers. We proactively work with OEMs to develop and introduce new grades, meeting latest national and international standards. Our comprehensive range of Transformer Oils has been approved by ABB, Siemens and all major Indian transformer manufacturers like BHEL, Crompton Greaves, TELK (Hitachi Licencee), ALSTOM and others.

Moreover POWEROIL Transformer Oils meet the stringent requirements of

- IS-335, IS-12463,
- IEC-296 Class I, IA, II & IIA,
- BS-148 Class. I, IA, II, IIA, III, IIIA,
- ASTM D3487,
- IEC 60296,
- DIN 57370/VDE 037'
- Shell Diala A/AX, B/BX, D/DX and Nynas /X, GBN Equivalents.





POWEROIL SPECTRUM

- **TRANSFORMER OILS**
- **WHITE OILS**
- **LIQUID PARAFFINS**
- **RUBBER PROCESSING OILS**
- **INK OILS**
- **ENGINE OILS**
- **TURBINE OILS**
- **HYDRAULIC OILS**
- **GEAR LUBRICANTS**
- **METAL WORKING FLUIDS**
- **HEAT TRATMENT OILS**

Apar Industries Limited - Group Business Activities

2. POLYMER DIVISION

Mfg. Location: Valia, Nr. Ankleshwar, Gujarat.



Polymer division of Apar Industrires Ltd. is situated at Village Dungri, Taluka Valia, Dist. Bharuch of Gujarat state and it is a state-of-the-art polymer manufacturing facility. As on date, this division is having annual capacity of total 23,000 MT for the production of various polymers and their admixtures. The division is having ISO 9001-2000 accreditation.

Manufacturing of Acrylonitrile Butadiene Rubbers (NBR) was established in technical collaboration with Goodyear Tire & Rubber Co. U.S.A. and is being produced under the brand name of APARENE. This caters to the stringent needs of the Railway, Defence, Automotive and Dehusking Industries.

High Styrene Rubber (HSR) & admixtures developed through in-house R&D and is being produced under the brand name of POWERENE. Powerene is mainly used in the footwear industry to manufacture Hawai Chappals. It is also used to make ebonites, battery boxes and micro cellular sheets and mats.

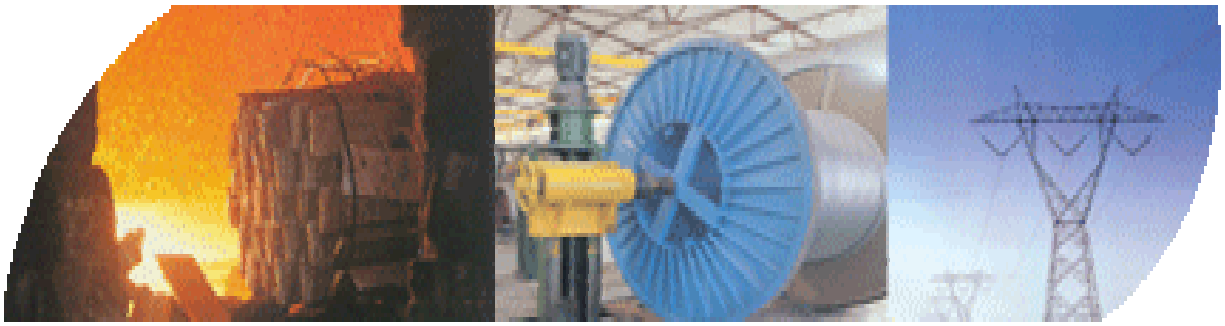
Admixtures of NBR/SBR – PVC polyblends, Speciality lattices, Powdered nitile rubbers are used for footwear, automotive, paper coating, carpet backing, cement concrete applications, printer adhesive for insulation tape, adhesives & friction materials etc.



Our Quality has acceptance world over and we export to Japan, U.S.A, Germany, France, Italy, Spain, Middle-East Countries and Srilanka etc.



Apar Industries Limited - Group Business Activities
3. CONDUCTOR DIVISION
Mfg. Location: Unit I Silvassa, Unit II Nalagarh, HP.



Apar Conductor Division was established in 1954. Today we are well-established manufacturer of International repute of bare conductors for Overhead Power Transmission & Distribution. We have manufactured and supplied Bare Conductors to various utilities/National Grid/Power Transmission & Distribution companies world wide. We have manufactured 200,000 KMS or more Transmission Line Conductors and 550,000 KMS or more Distribution Conductors for various projects of 11kV to 800 kV Power Transmission & Distribution Systems. We are among top 10 Companies in the world manufacturing & supplying Power Transmission & Distribution Conductors.

➢ CONDUCTOR DIVISION HIGHLIGHTS (EXPORT/DOMESTIC PERFORMANCE)

We have so far manufactured & supplied more than 200,000 Km of HV Power Transmission Conductors (i.e. 132 kV Class & above) Out of this volume we have produced & supplied:

- 175,000 Km. (Approx.) for 400kV AC/DC Transmission System.
- 20,000 km. (Approx.) for the 500 kV AC/DC Transmission System.
- 5.000 km. for the 800 kV AC/DC transmission System.

Also, we have manufactured and supplied more than 550,000 Km. Distribution conductors (i.e. 11/33/66 kV Class)

➢ Manufacturing Locations

Our production facility is spread in two large size factories, located at,

1. UNIT No. I at SILVASSA-RAKHOLI ROAD, Village: KUDACHA, SILVASSA – 396 230 (U.T. Dadara & Nagar Haveli) India.
2. UNIT No. II at Tec. Nalagarh, P.O. Manjhauli (Jagatkhana) Dist. Solan (Himachal Pradesh) – 174 101, India.

➢ Production Kaleidoscope

Wire Rods (In 9.5 mm conventional size & 7.6 mm for better drawability)

- EC Grade Aluminium Wire Rods.
- Aluminium Alloy Wire Rods (6201 Alloy Rod in T-4 temper - online solutionised).
- Aluminium Alloy Wire Rods (6201 Alloy Rod in M temper).

Overhead bare Conductors for Transmission & Distribution of power – (Tailor made as per customer specifications followed with International Standards viz. ASTM/IEC/DIN/BS/French etc. & Indian Standards i.e. BIS and/or Customer Specifications)

- All Aluminium Conductors (AAC),
- Aluminium Conductors Galvanized Steel Reinforced (ACSR),
- All Aluminium Alloy Conductors (AAAC),
- Aluminium Alloy Conductors Galvanised Steel Reinforced (AACSR), (Also with extra high strength Galvanised Steel Wire as per customer requirements).
- Aluminium Conductors Aluminium Clad Steel Reinforced (ACSR-AS).
- Galvanised Stranded Steel Earth wire, Guy Wire/ Spacer Cables & Stay Wire. (Also with extra high strength Galvanised Steel Wire as per customer requirements), &
- Mechanical Grade Alloy Wire Bundles (T – 81 temper).

➢ Installed Capacity

Particulars	Silvassa Per annum	Nalagarh Per Annum	Total Per Annum
Continuous Casting & Rolling Mill (CC &R) (for conversion of Aluminum Ingots to Aluminum wire rods/Aluminium Ingots to Aluminium Alloy online solution treated wire rods of T-4 & M Temper)	60,000 MT	18,000 MT	78,000 MT
Wire drawing Machine (Including High Speed W/D) (Duly supported with pointing machine, stringing Machine, spools, Die sets, Die polishing machine, steel spooling machine)	36,000 Kms Multi Strand Conductor & 64,200 Kms 7/19 strand conductor.	5,400 Kms. Multi strand Conductor & 36,000 Kms. 7/19 strand conductor	41,400 Kms. Multi strand Conductor & 100,000 Kms. 7/19 strand conductor
Aluminum Alloy Ageing Capacity: Electric Ageing Furnace	18,000 MT	6,000 MT	24,000 MT
Conductor Stranding Section: • For Multi Stranding ACSR/AAA/AAC conductor* ➢ Including 800 RPM High Speed Stranding Machine • For seven strand conductor AAC/ACSR/AAAC/GSW ➢ Tubular Machine ➢ Skip Machine	36,000 Kms. 78,000 Kms	6,000 Kms 36,000 Kms	42,000 Kms 114,000 Kms

*Including Sun & Planetary Machine to strand conductor up to 89 Wires in single operation & having take-up to accommodate Drum/reel weighing up to 12 MT.



➢ Plant & Machinery

Particulars	Silvassa Works	Nalagarh Works	Grand Total
Continues Casting & Rolling Mill (CC & R) (for conversion of Aluminum Ingots to Aluminum wire rods/Aluminium Ingots to Aluminium Alloy online solution treated wire rods of T-4 & M Temper)	3 Units	1 Unit	4 Units
Wire drawing Machine (Including High Speed W/D) (Duly supported with pointing machine, stringing Machine, spools, Die sets, Die polishing machine, steel spooling machine)	15 Nos.	6 Nos.	21 Nos.
Aluminum Alloy Ageing Capacity: Electric Ageing Furnace	5 Nos.	2 Nos.	7 Nos.
Continuous multi cage Stranding Machines For manufacturing 37/61/89 Strand Conductors for Power Transmission (220 KV to 800 KV)	6 Nos.	2 Nos.	8 Nos.
Tubular + Skip Machines (For 7/19 Strand Distribution Conductors & Steel stranding) ➢ Tubular Machine ➢ 19 Strand Machine ➢ SKIP Machines	 6 3 2	 4 - 2	 10 3 4

➢ Quality Assurance & Testing Equipment's

We are ISO 9001 : 2000 Company. ISO 9001 : 2000 Certificate is awarded by UNDERWRITERS LABORATORIES Inc. (UL), USA. The certification agency is having International reputation & is well known for its very stringent Norms of Quality Control System.

In-House Testing Facilities available at our Works.

- Chemical Composition of EC Grade Aluminum/Aluminum Alloy Metal by Spectrometer.
- Micro Structure Test on EC Grade Aluminum/Aluminum Alloy Metal/Rods/Drawn & Aged wires.
- Surface Condition of Aluminum Rods/ Aluminum Alloy Rods.
- Dimension, Tensile Strength, Percentage elongation and Resistivity of Aluminum Rods/ Aluminum Alloy Rods.
- Dimension, Tensile Strength, Wrap Test, elongation, torsion and galvanizing test of Steel Wire/Core for incoming raw-material.
- Dimension Tensile Strength, Wrap Test and Resistance of Aluminum/ Aluminum Alloy drawn wire.
- Lay Ratio/ Lay Direction during stranding process and at finished Conductor stage.
- Dimension, Tensile Strength, Wrap Test and Resistance of Aluminum Wire taken from Finished Conductor sample.
- Dimension, Tensile Strength, Wrap Test, elongation, torsion and galvanizing test of Steel Wire/Core taken from Finished Conductor sample.

Testing Equipments available at our Works.

- We have all the latest and sophisticated equipments including 3 Nos. Spectrometers for complete chemical analysis of EC Grade Aluminium & Aluminium Alloy.
- We are quipped with latest computerized Tensile Testing Machines, Calvin Bridges etc.
- All the measuring equipments are calibrated at regular intervals through independent testing laboratories/ certification agency.

SPECTRO ANALYSIS



DC RESISTANCE ON STRAND



Type Test at Independent 3rd Party Testing Laboratories.

Normally we conduct Type Test as per Customer Specification at Tag Corporation, Chennai, CPRI & ERDA. These are independent testing laboratories conducting type test up to 400 kV AC & 500 kV HVDC Systems. However, to meet customer requirements, we have conducted Type Test at EDF, France, CESI, Italy, Metropolitan Electricity Authority, Bangkok, NETFA-South Africa.

Type Test normally carried out on AAC/ACSR/AAA Conductors:
1. UTS & Surface Condition test on Complete Conductor.
2. Corona & RIV Test (For 400 kV to 800 kV).
3. D.C. Resistance Test on Complete Conductor.
4. Stress Strain Test of Composite Conductor & Steel Core.
5. Any other test viz. Creep Test etc. as per Customer requirement.

UTS TEST ON CONDUCTOR



DC RESISTANCE ON COND.



CORONA & RIV TEST



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AAC

ALL ALUMINIUM CONDUCTORS (AAC)
AS PER CSA C-49 1965

Cord word	Conductor size CM or AWG	Stranding Nos. / mm	Calculated sectional area mm²	Overall diameter mm	Weight kg/km	Ultimate strength kg	Calculated DC resistance at 20°C Ohm/km
Rose	(4)	7/1.96	21.12	5.88	57.83	416	1.356
Lily	(3)	7/2.20	26.61	6.60	72.82	515	1.076
Iris	(2)	7/2.47	33.54	7.41	91.83	637	0.8535
Pansy	(1)	7/2.78	42.49	8.34	116.4	777	0.6738
Poppy	(1/0)	7/3.12	53.52	9.36	146.5	938	0.5360
Aster	(2/0)	7/3.50	67.35	10.50	184.4	1,180	0.4252
Phlox	(3/0)	7/3.93	84.91	11.79	232.5	1,440	0.3372
Oxlip	(4/0)	7/4.42	107.4	13.26	294.0	1,810	0.2667
Valerian	250,000	19/2.91	126.4	14.55	374.6	2,260	0.2277
Laurel	266,800	19/3.01	135.2	15.05	371.9	2,430	0.2128
Peony	300,000	19/3.19	151.2	15.95	417.8	2,660	0.1895
Tulip	336,400	19/3.38	170.5	16.90	469.0	3,000	0.1688
Daffodil	350,000	19/3.45	177.6	17.25	488.8	3,120	0.1620
–	400,000	19/3.69	203.1	18.45	559.0	3,500	0.1417
Coldenluft	450,000	19/3.91	228.2	19.55	627.8	3,860	0.1261
Cosmos	477,000	19/4.02	241.1	20.10	663.4	4,070	0.1193
Zinnia	500,000	19/4.12	253.3	20.60	696.9	4,280	0.1136
Dahlia	556,500	19/4.35	282.3	21.75	777.0	4,770	0.1019
–	550,000	37/3.10	279.3	21.70	769.9	4,920	0.1032
Meadowsweet	600,000	37/3.23	303.2	22.61	835.9	5,330	0.09508
Orchid	636,000	37/3.33	322.2	23.31	888.4	5,660	0.08946
Heuchera	650,000	37/3.37	330.0	23.59	909.9	5,810	0.08736
Verbena	700,000	37/3.49	353.9	24.43	976.0	6,220	0.08146
Petunia	750,000	37/3.62	380.7	25.34	1,050	6,550	0.07573
–	800,000	37/3.73	402.2	26.11	1,115	6,960	0.07129
Cockscomb	900,000	37/3.96	455.8	27.22	1,257	7,700	0.06324
Hawkweed	1,000,000	37/4.18	507.6	29.26	1,400	8,550	0.05679
–	1,100,000	61/3.41	557.1	30.69	1,539	9,820	0.05185
–	1,200,000	61/3.56	607.2	32.04	1,678	10,490	0.04758
–	1,300,000	61/3.71	659.4	33.39	1,822	11,350	0.04381
–	1,400,000	61/3.85	710.0	34.65	1,961	11,960	0.04068
–	1,500,000	61/3.98	758.8	35.82	2,086	12,810	0.03807
–	1,600,000	61/4.11	809.5	36.99	2,236	13,660	0.03569
–	1,700,000	61/4.24	861.3	38.16	2,380	14,520	0.03354
–	1,800,000	91/3.57	910.9	39.27	2,519	15,650	0.03175

ALL ALUMINIUM CONDUCTORS (AAC)
AS PER SWEDISH SPECIFICATION - SS 424 08 02 - 1978

Code name	Designation (nominal area) mm²	Area mm²	Number of Wires	Diam. of wire mm	Overall diam. mm	Breaking load kN	°DC resistance at 20°C ohm/km	Weight kg/km
Linnea	31	31.14	7	2.38	7.1	5.79	0.916	85
Konvalj	49	49.48	7	3.00	9.0	8.75	0.577	135
Vitsippa	62	62.44	7	3.37	10.1	10.7	0.457	170
Kattfot	99	99.31	7	4.25	12.8	16.6	0.287	271
Gullviva	157	158.6	19	3.26	16.3	27.4	0.181	436
Vallmo	234	241.2	19	4.02	20.1	40.3	0.119	663
Renfana	329	330.0	37	3.37	23.6	56.6	0.0875	910
Aklejа	454	454.5	61	3.08	27.7	80.5	0.0636	1260
Hampdam	593	593.6	61	3.52	31.7	102	0.0487	1640
Stormhatt	774	774.2	61	4.02	36.2	129	0.0374	2140
Solros	910	910.7	61	4.36	39.2	152	0.0318	2520

Based on resistivity - 28.264 Ohm mm²/km ● Conductivity 61.00% I.A.C.S.

COMPANY PROFILE CLASSIFICATION

AAC

ALL ALUMINIUM CONDUCTOR (AAC)

Characteristics of A 1 conductors as per IEC 1089/91 TYPE A 1

Code number	Area	Number of wires	Diameter		Linear mass	Rated strength	*D. C. resistance
			Wire	Cond.			
	mm^2		mm	mm	kg / km	kN	Ohm/km
10	10	7	1.35	4.05	27.4	1.95	2.8633
16	16	7	1.71	5.12	43.8	3.04	1.7896
25	25	7	2.13	6.40	88.4	4.50	1.1453
40	40	7	2.70	8.09	109.4	6.80	0.7158
63	63	7	3.39	10.20	172.3	10.39	0.4545
100	100	19	2.59	12.90	274.8	17.00	0.2877
125	125	19	2.89	14.50	343.6	21.25	0.2302
160	160	19	3.27	16.40	439.8	26.40	0.1798
200	200	19	3.66	18.30	549.7	32.00	0.1439
250	250	19	4.09	20.50	687.1	40.00	0.1151
315	315	37	3.29	23.00	867.9	51.97	0.0916
400	400	37	3.71	26.00	1102.0	64.00	0.0721
450	450	37	3.94	27.50	1239.8	72.00	0.0641
500	500	37	4.15	29.00	1377.6	80.00	0.0577
560	560	37	4.39	30.70	1542.9	89.60	0.0515
630	630	61	3.63	32.60	1739.3	100.80	0.0458
710	710	61	3.85	34.60	1959.1	113.60	0.0407
800	800	61	4.09	36.80	2207.4	128.00	0.0361
900	900	61	4.33	39.00	2488.3	144.00	0.0321
1000	1000	61	4.57	41.10	2759.2	160.00	0.0289
1120	1120	91	3.96	43.50	3093.5	179.20	0.0258
1250	1250	91	4.18	46.00	3452.6	200.00	0.0231
1400	1400	91	4.43	48.70	3866.9	224.00	0.0207
1500	1500	91	4.58	50.40	4143.1	240.00	0.0193

*ALUMINIUM Resistivity at 20°C 28.264 Ohm mm^2/km ● Conductivity 61% I.A.C.S.

AAC

ALL ALUMINIUM CONDUCTORS (AAC)
AS PER ASTM B231-78

Cord word	Conductor size CM or AWG	Stranding Nos. / mm	Sectional area mm^2	Overall diameter mm	Weight kg/km	Ultimate strength kg	Calculated DC resistance at 20°C Ohm/km
Bluebonnet	3,500,000	127/4.216	1,773	54.81	4,983	26,700	0.01653
Trillium	3,000,000	127/3.904	1,520	50.75	4,274	22,800	0.01927
Bitterroot	2,750,000	91/4.415	1,393	48.57	3,879	20,900	0.02083
Lupine	2,500,000	91/4.209	1,266	46.30	3,525	19,000	0.02292
Sagebrush	2,250,000	91/3.993	1,139	43.92	3,173	17,100	0.02547
Cowslip	2,000,000	91/3.764	1,013	41.40	2,819	15,600	0.02866
Jessamine	1,750,000	61/4.303	886.9	38.73	2,446	13,500	0.03239
Coreopsis	1,590,000	61/4.100	805.2	36.90	2,221	12,200	0.03568
Gladiolus	1,510,500	61/3.998	765.6	35.98	2,111	11,600	0.03752
Carnation	1,431,000	61/3.891	725.3	35.02	2,000	11,000	0.03961
Columbine	1,315,500	61/3.780	684.4	34.02	1,887	10,600	0.04197
Narcissus	1,272,000	61/3.668	644.8	33.01	1,777	9,900	0.04458
Hawthorn	1,192,500	61/3.551	604.1	31.96	1,665	9,550	0.04757
Marigold	1,113,000	61/3.432	564.3	30.89	1,556	8,950	0.05092
Bluebell	1,033,500	37/4.244	523.6	29.71	1,443	8,050	0.05489
Larkspur	1,033,500	61/3.307	523.9	29.76	1,445	8,290	0.05485
Hawkweed	1,000,000	37/4.176	506.9	29.23	1,397	7,780	0.05671
Camellia	1,000,000	61/3.251	506.4	29.26	1,396	8,020	0.05675
Magnolia	954,000	37/4.097	483.6	28.55	1,333	7,410	0.05944
Goldenrod	954,000	61/3.178	483.9	28.60	1,334	7,630	0.05939
Cockscomb	900,000	37/3.962	456.2	27.73	1,257	7,000	0.06299
Sanpdragon	900,000	61/3.086	456.3	27.77	1,258	7,190	0.06297
Arbutus	795,000	37/3.724	402.9	26.07	1,111	6,330	0.07129
Lilac	795,000	61/2.901	403.2	26.11	1,112	6,480	0.07127
Petunia	750,000	37/3.617	380.4	25.32	1,048	5,960	0.07559
Cattail	750,000	61/2.817	380.2	25.35	1,048	6,150	0.07558
Violet	715,500	37/3.533	362.7	24.73	1,000	5,790	0.07923
Nasturtium	715,500	61/2.751	362.6	24.76	999.9	5,980	0.07926
Verbena	700,000	37/3.493	354.6	24.45	977.5	5,660	0.08105
Flag	700,000	61/2.720	354.5	24.48	977.5	5,820	0.08106
Heuchera	650,000	37/3.368	329.6	23.58	908.8	5,290	0.08717
Orchid	636,000	37/3.330	322.2	23.31	888.4	5,150	0.08918
Meadowsweet	600,000	37/3.233	303.7	22.63	837.5	4,850	0.09461
Dahlia	556,500	19/4.346	281.8	21.73	777.1	4,420	0.1019
Mistletoe	556,500	37/3.114	281.8	21.80	777.1	4,510	0.1020
Zinnia	500,000	19/4.120	253.3	20.60	698.5	3,980	0.1134
Hyacinth	500,000	37/2.951	253.1	20.66	697.8	4,140	0.1136
Cosmos	477,000	19/4.023	241.5	20.12	665.9	3,780	0.1190
Syringa	477,000	37/2.883	241.5	20.18	666.1	3,940	0.1190
Goldentuft	450,000	19/3.909	228.0	19.55	628.7	3,570	0.1260
Canna	397,500	19/3.675	201.6	18.38	555.6	3,230	0.1426
Daffodil	350,000	19/3.447	177.3	17.24	488.8	2,900	0.1621
Tulip	336,400	19/3.381	170.6	16.91	470.4	2,790	0.1685
Peony	300,000	19/3.193	152.1	15.97	419.4	2,490	0.1889
Daisy	266,800	7/4.961	135.3	14.88	373.1	2,190	0.2123
Laurel	266,800	19/3.010	135.2	15.05	372.7	2,260	0.2125
Sneezewort	250,000	7/4.801	126.7	14.40	349.4	2,050	0.2267
Valerian	250,000	19/2.913	126.6	14.57	349.0	2,100	0.2269
Oxlip	(4/0)	7/4.417	107.2	13.25	295.7	1,740	0.2680
Phlox	(3/0)	7/3.932	84.96	11.80	234.3	1,380	0.3381
Aster	(2/0)	7/3.503	67.47	10.51	186.0	1,140	0.4259
Poppy	(1/0)	7/3.119	53.48	9.357	147.4	900	0.5372
Pansy	(1)	7/2.776	42.36	8.328	116.8	746	0.6783
Iris	(2)	7/2.474	33.65	7.422	92.75	614	0.8539
Rose	(4)	7/1.961	21.14	5.883	58.29	400	1.359
Peachbell	(6)	7/1.554	13.28	4.662	36.61	255	2.164

ALL ALUMINIUM CONDUCTORS (AAC)
AS PER BS 215 : Part 1 : 1970

Nominal aluminium area (1) mm²	Stranding and wire diameter (2) mm	Sectional area (3) mm²	Approxi-mate overall diameter (4) mm	Approxi-mate mass per km (5) kg	Calculated D. C. resistance at 20° C per km (6) Ohm	Calculated breaking load (7) kN
22	7/2.06	23.33	6.18	64	1.227	3.99
50	7/3.10	52.83	9.30	145	0.541 9	8.28
60	7/3.40	63.55	10.20	174	0.450 5	9.90
100	7/4.39	106.0	13.17	290	0.270 2	16.00
150	19/3.25	157.6	16.25	434	0.182 5	25.70
200	19/3.78	213.2	18.90	587	0.134 9	32.40
250	19/4.22	265.7	21.10	731	0.108 3	40.40
300	19/4.65	322.7	23.25	888	0.089 16	48.75
400	37/3.78	415.2	26.46	1146	0.069 44	63.10

ALL ALUMINIUM CONDUCTORS (AAC)
AS PER IS 398 : Part 1 : 1996

Nominal aluminium area (1) mm²	Stranding and wire diameter (2) mm	Sectional area (3) mm²	Approxi-mate overall diameter (4) mm	Approxi-mate mass per km (5) kg	Calculated D. C. resistance at 20° C per km (6) Ohm	Calculated breaking load (7) kN
25	7/2.21	26.85	6.63	74	1.096	4.52
50	7/3.10	52.83	9.30	145	0.552 5	8.25
100	7/4.39	106.0	13.17	290	0.275 2	15.96
150	19/3.18	150.9	15.90	415	0.194 2	23.28
240	19/3.99	237.6	19.95	654	0.123 5	35.74
300	19/4.65	322.7	23.25	888	0.091 07	48.74

ALL ALUMINIUM CONDUCTORS (AAC)
AS PER DIN 48201 Blatt 5 - 1965

Conductor size mm²	Standing No. / mm	Calculated sectional area mm²	Overall diameter mm	Ultimate strength kP	Weight kg/km	Calculated electrical resistance at 20° C Ohm/km
16	7/1.7	15.89	5.1	290	44	1.798
25	7/2.1	24.25	6.3	425	67	1.177
35	7/2.5	34.36	7.5	585	94	0.831
50	7/3	49.48	9.0	810	135	0.577
50	19/1.8	48.36	9.0	860	133	0.596
70	19/2.1	65.82	10.5	1,150	181	0.438
95	19/2.5	93.27	12.5	1,595	256	0.309
120	19/2.8	117.0	14.0	1,910	322	0.246
150	37/2.25	147.1	15.7	2,570	406	0.197
185	37/2.5	181.6	17.5	3,105	501	0.160
240	61/2.25	242.5	20.2	4,018	670	0.120
300	61/2.5	299.4	22.5	4,850	827	0.0999
400	61/2.89	400.1	26.0	6,190	1,105	0.0730
500	61/3.23	499.8	29.1	7,600	1,381	0.0580
625	91/2.96	626.2	32.6	9,690	1,733	0.0462
800	91/3.35	802.1	36.8	12,055	2,219	0.0361
1,000	91/3.74	999.7	41.1	14,845	2,766	0.0290

COMPANY PROFILE CLASSIFICATION

ALL ALUMINIUM CONDUCTOR AAC (HAL)
AS PER JAPANESE INDUSTRIAL STANDARD - JIS C 3109 (1978)

Conductor size mm²	Stranding No./mm	Calculated sectional area mm²	Overall diameter mm	Weight kg/km	Ultimate strength kg	Electrical resistance Ohm/km
30	7/2.3	29.09	6.9	79.48	469	0.983
38	7/2.6	37.16	7.8	101.5	576	0.769
55	7/3.2	56.29	9.6	153.8	838	0.507
95	7/4.2	96.95	12.6	264.9	1,410	0.295
150	19/3.2	152.8	16.0	418.7	2,270	0.188
200	19/3.7	204.3	18.5	559.8	3,040	0.140
240	19/4.0	238.8	20.0	654.5	3,470	0.120
300	37/3.2	297.6	22.4	820.1	4,430	0.0969
400	37/3.7	397.8	25.9	1,097	5,930	0.0726
510	37/4.2	512.5	29.4	1,413	7,460	0.0563
660	61/3.7	655.8	33.3	1,812	9,770	0.0441
850	61/4.2	844.9	37.8	2,334	12,300	0.0342
980	19/3.7	978.3	40.7	2,716	14,580	0.0297
1,260	91/4.2	1,260	46.2	3,499	18,350	0.0230

ALL ALUMINIUM CONDUCTOR (AAC)
AS PER USSR STANDARD

Conductor size, mm²		Stranding No./mm	Overall diameter	Calculated electrical resistance /km, 20° C	Rated strength, N	Weight 1 km, kg
Nominal	Calculated					
16	15.9	7/1.70	5.10	1.8007	3021	43.0
25	24.9	7/2.13	6.40	1.1498	4500	68.0
35	34.3	7/2.50	7.50	0.8347	5913	94.0
50	49.5	7/3.00	9.00	0.5784	8198	135.0
70	69.3	7/3.55	10.70	0.4131	11288	189.0
95	92.4	7/4.10	12.10	0.3114	14784	252.0
120	117.0	19/2.80	14.00	0.2459	19890	321.0
150	148.0	19/3.15	15.80	0.1944	24420	406.0
185	182.8	19/3.50	17.50	0.1574	29632	502.0
240	236.7	19/4.00	20.00	0.1205	38192	655.0
300	288.3	37/3.15	22.10	0.1000	47569	794.0
350	345.8	37/3.45	24.20	0.0833	57057	952.0
400	389.2	37/3.66	25.60	0.0740	63420	1072.0
450	449.1	37/3.90	27.30	0.0642	71856	1206.0
500	500.5	37/4.15	29.10	0.0576	80000	1378.0
500	544.0	61/3.37	30.30	0.0539	89760	1500.0
600	586.8	61/3.50	31.50	0.0491	95632	1618.0
650	641.7	61/3.66	32.90	0.0450	104575	1771.0
700	691.7	61/3.80	34.20	0.0417	112725	1902.0
750	747.4	61/3.95	35.60	0.0386	119584	2062.0
800	805.2	61/4.10	36.90	0.0365	127483	2020.0

ACSR

ALUMINIUM CONDUCTOR STEEL REINFORCED (ACSR)

Characteristics of A1/S1 A conductors as per IEC 1089/91 TYPE A1/S1 A

Code number	Steel ratio	Areas			No. of wires		Wire diam.		Diameter		Linear mass	Rated strength	D. C. resistance
		Alum.	Steel	Total	Al	St	alum.	steel	Core	Cond.			
	%	mm²	mm²	mm²			mm	mm	mm	mm	kg/km	kN	Ohm/km
16	17	16	2.67	18.7	6	1	1.84	1.84	1.84	5.53	64.6	6.08	1.7934
25	17	25	4.17	29.2	6	1	2.30	2.30	2.30	6.91	100.9	9.13	1.1478
40	17	40	6.67	46.7	6	1	2.91	2.91	2.91	8.74	161.5	14.40	0.7174
63	17	63	10.5	73.5	6	1	3.66	3.66	3.66	11.0	254.4	21.63	0.4555
100	17	100	16.7	117.0	6	1	4.61	4.61	4.61	13.8	403.8	34.33	0.2869
125	6	125	6.94	132	18	1	2.97	2.97	2.97	14.9	397.9	29.17	0.2304
125	16	125	20.4	145	26	7	2.47	1.92	5.77	15.7	503.9	45.69	0.2310
160	6	160	8.89	169	18	1	3.36	3.36	3.36	16.8	509.3	36.18	0.1600
160	16	160	26.1	166	26	7	2.80	2.18	6.53	17.7	644.9	57.69	0.1805
200	6	200	11.1	211	18	1	3.76	3.76	3.76	18.8	636.7	44.22	0.1440
200	16	200	32.6	233	26	7	3.13	2.43	7.30	19.8	806.2	70.13	0.1444
250	10	250	24.6	275	22	7	3.80	2.11	6.34	21.6	860.6	68.72	0.1154
250	16	250	40.7	291	26	7	3.50	2.72	8.16	22.2	1007.7	87.67	0.1155
315	7	315	21.8	337	45	7	2.99	1.99	5.97	23.9	1039.6	79.03	0.0917
315	16	315	51.3	366	26	7	3.93	3.05	9.16	24.9	1269.7	106.83	0.0917
400	7	400	27.7	428	45	7	3.36	2.24	6.73	26.9	1320.1	98.36	0.0722
400	13	400	51.9	452	54	7	3.07	3.07	9.21	27.6	1510.3	123.04	0.0723
450	7	450	31.1	481	45	7	3.57	2.38	7.14	28.5	1485.2	107.47	0.0642
450	13	450	58.3	508	54	7	3.28	3.26	9.77	29.3	1699.1	138.42	0.0643
500	7	500	34.6	535	45	7	3.76	2.51	7.52	30.1	1650.2	119.41	0.0578
500	13	500	64.8	665	54	7	3.43	3.43	10.3	30.9	1887.9	153.80	0.0578
560	7	560	38.7	599	45	7	3.98	2.65	7.96	31.8	1848.2	133.74	0.0516
560	13	560	70.9	631	54	19	3.63	2.18	10.9	32.7	2103.4	172.59	0.0516
630	7	630	43.6	674	45	7	4.22	2.81	8.44	33.8	2079.2	150.45	0.0459
630	13	630	79.8	710	54	19	3.85	2.31	11.6	34.7	2366.3	191.77	0.0459
710	7	710	49.1	759	45	7	4.48	2.99	8.96	35.9	2343.2	169.56	0.0407
710	13	710	89.9	800	54	19	4.09	2.45	12.3	36.8	2666.8	216.12	0.0407
800	4	800	34.0	835	72	7	3.76	2.51	7.52	37.6	2480.2	167.41	0.0361
800	8	800	66.7	867	84	7	3.48	3.48	10.4	38.3	2732.7	205.33	0.0362
800	13	800	101	901	54	19	4.34	2.61	13.0	39.1	3004.9	243.52	0.0362
900	4	900	38.9	939	72	7	3.99	2.66	7.98	39.9	2790.2	188.33	0.0321
900	6	900	75.0	975	84	7	3.69	3.69	11.1	40.6	3074.2	226.50	0.0322
1000	4	1000	43.2	1043	72	7	4.21	2.80	8.41	42.1	3100.3	209.26	0.0289
1120	4	1120	47.3	1167	72	19	4.45	1.78	8.90	44.5	3464.9	234.53	0.0258
1120	8	1120	91.2	1211	84	19	4.12	2.47	12.4	45.3	3811.5	283.17	0.0258
1250	8	1250	102	1352	84	19	4.35	2.61	13.1	47.9	4253.9	316.04	0.0232
1250	4	1250	52.8	1303	72	19	4.70	1.88	9.40	47.0	3867.1	261.75	0.0231

With Regular Strength Steel & Zinc Coating Class 1

ACSR

ALUMINIUM CONDUCTOR STEEL REINFORCED (ACSR)

Characteristics of A1/S1 B conductors as per IEC 1089/91 TYPE A1/S1 B

Code number	Steel ratio	Areas			No. of wires		Wire diam.		Diameter		Linear mass	Rated strength	D. C. resis-tance
		Alum.	Steel	Total	Al	St	alum.	steel	Core	Cond.			
	%	mm²	mm²	mm²			mm	mm	mm	mm	kg/km	kN	Ohm/km
16	17	16	2.67	18.7	6	1	1.84	1.84	1.84	5.53	64.6	6.08	1.7934
25	17	25	4.17	29.2	6	1	2.30	2.30	2.30	6.91	100.9	9.13	1.1478
40	17	40	6.67	46.7	6	1	2.91	2.91	2.91	8.74	161.5	14.40	0.7174
63	17	63	10.5	73.5	6	1	3.66	3.66	3.66	11.0	254.4	21.63	0.4555
100	17	100	16.7	117	6	1	4.61	4.61	4.61	13.8	403.8	34.33	0.2869
125	6	125	6.94	132	18	1	2.97	2.97	2.97	14.9	397.9	29.17	0.2304
125	16	125	20.4	145	26	7	2.47	1.92	5.77	15.7	503.9	45.69	0.2310
160	6	160	8.89	169	18	1	3.36	3.36	3.36	16.8	509.3	36.18	0.1800
160	16	160	26.1	186	26	7	2.80	2.18	6.53	17.7	644.9	57.69	0.1805
200	6	200	11.1	211	18	1	3.76	3.76	3.76	18.8	636.7	44.22	0.1440
200	16	200	32.6	233	26	7	3.13	2.43	7.30	19.8	806.2	70.13	0.1444
250	10	250	24.6	275	22	7	3.80	2.11	6.34	21.6	880.6	68.72	0.1154
250	16	250	40.7	291	26	7	3.50	2.72	8.16	22.2	1007.7	87.67	0.1155
315	7	315	21.8	337	45	7	2.99	1.99	5.97	23.9	1039.6	79.03	0.0917
315	16	315	51.3	366	26	7	3.93	3.05	9.16	24.9	1269.7	106.83	0.0917
400	7	400	27.7	428	45	7	3.38	2.24	6.73	26.9	1320.1	98.36	0.0722
400	13	400	51.9	452	54	7	3.07	3.07	9.21	27.6	1510.3	123.04	0.0723
450	7	450	31.1	481	45	7	3.57	2.38	7.14	28.5	1485.2	107.47	0.0642
450	13	450	58.3	508	54	7	3.26	3.26	9.77	29.3	1699.1	138.42	0.0643
500	7	500	34.6	535	45	7	3.76	2.51	7.52	30.1	1650.2	119.41	0.0578
500	13	500	64.6	565	54	7	3.43	3.43	10.3	30.9	1887.9	153.80	0.0578
560	7	560	38.7	599	45	7	3.95	2.65	7.96	31.8	1848.2	133.74	0.0516
560	13	560	70.9	631	54	19	3.63	2.18	10.9	32.7	2103.4	172.59	0.0516
630	7	630	43.6	674	45	7	4.22	2.81	8.44	33.8	2079.2	150.45	0.0459
630	13	630	79.8	710	54	19	3.85	2.31	11.6	34.7	2366.3	191.77	0.0459
710	7	710	49.1	759	45	7	4.48	2.99	8.96	35.9	2343.2	169.56	0.0407
710	13	710	89.9	800	54	19	4.09	2.45	12.3	36.8	2666.8	216.12	0.0407
800	4	800	34.0	835	72	7	3.76	2.51	7.52	37.6	2480.2	167.41	0.0361
800	8	800	66.7	867	84	7	3.48	3.48	10.4	36.3	2732.7	205.33	0.0362
800	13	800	101	901	54	19	4.34	2.61	13.0	39.1	3004.9	243.52	0.0362
900	4	900	38.9	939	72	7	3.99	2.66	7.98	39.9	2790.2	188.33	0.0321
900	8	900	75.0	975	84	7	3.69	3.69	11.1	40.6	3074.2	226.50	0.0322
1000	4	1000	43.2	1043	72	7	4.21	2.80	8.41	42.1	3100.3	209.26	0.0289
1120	4	1120	47.3	1167	72	19	4.45	1.78	8.90	44.5	3464.9	234.53	0.0258
1120	8	1120	91.2	1211	84	19	4.12	2.47	12.4	45.3	3811.5	283.17	0.0258
1250	4	1250	52.8	1303	72	19	4.70	1.68	9.40	47.0	3867.1	261.75	0.0231
1250	8	1250	102	1352	84	19	4.35	2.61	13.1	47.9	4253.9	308.91	0.0232

With Regular Strength Steel & Zinc Coating Class 2

ACSR

ALUMINIUM CONDUCTOR STEEL REINFORCED (ACSR)

Characteristics of A1/S2 A conductors as per IEC 1089/91 TYPE A1/S2 A

Code number	Steel ratio	Areas			No. of wires		Wire diam.		Diameter		Linear mass	Rated strength	D. C. resis-tance
		Alum.	Steel	Total	Al	St	alum.	steel	Core	Cond.			
	%	mm²	mm²	mm²			mm	mm	mm	mm	kg/km	kN	Ohm/km
16	17	16	2.67	18.7	6	1	1.84	1.84	1.84	5.53	64.6	6.45	1.7934
25	17	25	4.17	29.2	6	1	2.30	2.30	2.30	6.91	100.9	9.71	1.1478
40	17	40	6.67	46.7	6	1	2.91	2.91	2.91	8.74	161.5	15.33	0.7174
63	17	63	10.5	73.5	6	1	3.66	3.66	3.86	11.0	254.4	22.37	0.4555
100	17	100	16.7	117	6	1	4.61	4.61	4.61	13.8	403.8	35.50	0.2869
125	6	125	6.94	132	18	1	2.97	2.97	2.97	14.9	397.9	30.14	0.2304
125	16	125	20.4	145	26	7	2.47	1.92	5.77	15.7	503.9	48.54	0.2310
160	6	160	8.89	169	18	1	3.36	3.38	3.36	16.8	509.3	37.42	0.1800
160	16	160	26.1	186	26	7	2.80	2.18	6.53	17.7	644.9	61.34	0.1805
200	6	200	11.1	211	18	1	3.76	3.76	3.76	18.8	636.7	45.00	0.1440
200	16	200	32.6	233	26	7	3.13	2.43	7.30	19.8	806.2	74.69	0.1444
250	10	250	24.6	275	22	7	3.80	2.11	6.34	21.6	880.6	72.16	0.1154
250	18	250	40.7	291	26	7	3.50	2.72	8.16	22.2	1007.7	99.87	0.1155
315	7	315	21.8	337	45	7	2.99	1.99	5.97	23.9	1039.6	82.08	0.0917
315	16	315	51.3	366	26	7	3.93	3.05	9.16	24.9	1269.7	114.02	0.0917
400	7	400	27.7	428	45	7	3.36	2.24	6.73	26.9	1320.1	102.23	0.0722
400	13	400	51.9	452	54	7	3.07	3.07	9.21	27.6	1510.3	130.30	0.0723
450	7	450	31.1	481	45	7	3.57	2.38	7.14	28.5	1485.2	111.82	0.0642
450	13	450	58.3	508	54	7	3.26	3.26	9.77	29.3	1699.1	146.58	0.0643
500	7	500	34.6	535	45	7	3.76	2.51	7.52	30.1	1850.2	124.25	0.0578
500	13	500	64.8	565	54	7	3.43	3.43	10.3	30.9	1887.9	162.87	0.0578
560	7	560	38.7	599	45	7	3.95	2.85	7.96	31.8	1848.2	139.16	0.0516
560	13	560	70.9	631	54	19	3.63	2.18	10.9	32.7	2103.4	182.52	0.0516
630	7	630	43.6	674	45	7	4.22	2.81	8.44	33.8	2079.2	156.55	0.0459
630	13	630	79.8	710	54	19	3.85	2.31	11.6	34.7	2366.3	202.94	0.0459
710	7	710	49.1	759	45	7	4.48	2.99	8.96	35.9	2343.2	176.43	0.0407
710	13	710	89.9	800	54	19	4.09	2.45	12.3	36.8	2666.8	228.71	0.0407
800	4	800	34.6	835	72	7	3.76	2.51	7.52	37.6	2480.2	172.25	0.0361
800	8	800	66.7	867	84	7	3.48	3.48	10.4	38.3	2732.7	214.67	0.0362
800	13	800	101	901	54	19	4.34	2.61	13.0	39.1	3004.9	257.71	0.0362
900	4	900	38.9	939	72	7	3.99	2.66	7.98	39.9	2790.2	193.78	0.0321
900	8	900	75.0	975	84	7	3.69	3.69	11.1	40.6	3074.2	231.75	0.0322
1000	4	1000	43.2	1043	72	7	4.21	2.80	8.41	42.1	3100.3	215.31	0.0289
1120	4	1120	47.3	1167	72	19	4.45	1.78	8.90	44.5	3464.9	241.15	0.0258
1120	8	1120	91.2	1211	84	19	4.12	2.47	12.4	45.3	3811.5	295.94	0.0258
1250	4	1250	52.8	1303	72	19	4.70	1.88	9.40	47.0	3867.1	269.14	0.0231
1250	8	1250	102	1352	84	19	4.35	2.61	13.1	47.9	4253.9	330.29	0.0232

With High Strength Steel & Zinc Coating Class 1

COMPANY PROFILE CLASSIFICATION

ACSR

ALUMINIUM CONDUCTOR STEEL REINFORCED (ACSR)

Characteristics of A1/S2 B conductors as per IEC 1089/91 TYPE A1/S2 B

Code number	Steel ratio	Areas			No. of wires		Wire diam.		Diameter		Linear mass	Rated strength	D. C. resis-tance
		Alum.	Steel	Total	Al	St	alum.	steel	Core	Cond.			
	%	mm²	mm²	mm²			mm	mm	mm	mm	kg/km	kN	Ohm/km
16	17	16	2.67	18.7	6	1	1.84	1.84	1.84	5.53	64.6	6.27	1.7934
25	17	25	4.17	29.2	6	1	2.30	2.30	2.30	6.91	100.9	9.42	1.1478
40	17	40	6.67	46.7	6	1	2.91	2.91	2.91	8.74	161.5	14.87	0.7174
63	17	63	10.5	73.5	6	1	3.66	3.66	3.66	11.0	254.4	21.63	0.4555
100	17	100	16.7	117	6	1	4.61	4.61	4.61	13.8	403.8	34.33	0.2869
125	6	125	6.94	132	18	1	2.97	2.97	2.97	14.9	397.9	29.65	0.2304
125	16	125	20.4	145	26	7	2.47	1.92	5.77	15.7	503.9	47.12	0.2310
160	6	160	8.89	169	18	1	3.36	3.36	3.36	16.8	509.3	36.80	0.1800
160	16	160	26.1	186	26	7	2.80	2.18	6.53	17.7	644.9	59.51	0.1805
200	6	200	11.1	211	18	1	3.76	3.76	3.76	18.8	636.7	44.22	0.1440
200	16	200	32.6	233	26	7	3.13	2.43	7.30	19.8	806.2	72.41	0.1444
250	10	250	24.6	275	22	7	3.80	2.11	6.34	21.6	880.6	70.44	0.1154
250	16	250	40.7	291	26	7	3.50	2.72	8.16	22.2	1007.7	90.52	0.1155
315	7	315	21.8	337	45	7	2.99	1.99	5.97	23.9	1039.6	80.55	0.0917
315	16	315	51.3	366	26	7	3.93	3.05	9.16	24.9	1269.7	110.43	0.0917
400	7	400	27.7	428	45	7	3.36	2.24	6.73	26.9	1320.1	100.29	0.0722
400	13	400	51.9	452	54	7	3.07	3.07	9.21	27.6	1510.3	126.67	0.0723
450	7	450	31.1	481	45	7	3.57	2.38	7.14	28.5	1485.2	109.64	0.0642
450	13	450	58.3	508	54	7	3.26	3.26	9.77	29.3	1699.1	142.50	0.0643
500	7	500	34.6	535	45	7	3.76	2.51	7.52	30.1	1650.2	121.83	0.0578
500	13	500	64.8	565	54	7	3.43	3.43	10.3	30.9	1887.9	158.33	0.0578
560	7	560	38.7	599	45	7	3.95	2.65	7.96	31.8	1848.2	136.45	0.0516
560	13	560	70.9	631	54	19	3.63	2.18	10.9	32.7	2103.4	177.56	0.0516
630	7	630	43.6	674	45	7	4.22	2.81	8.44	33.8	2079.2	153.50	0.0459
630	13	630	79.8	710	54	19	3.85	2.31	11.6	34.7	2366.3	197.36	0.0459
710	7	710	49.1	759	45	7	4.48	2.99	8.96	35.9	2343.2	127.99	0.0407
710	13	710	89.9	800	54	19	4.09	2.45	12.3	36.8	2666.8	222.42	0.0407
800	4	800	34.0	835	72	7	3.76	2.51	7.52	37.6	2480.2	169.83	0.0361
800	8	800	66.7	867	84	7	3.48	3.48	10.4	38.3	2732.7	210.00	0.0362
800	13	800	101	901	54	19	4.34	2.61	13.0	39.1	3004.9	250.61	0.0362
900	4	900	38.9	939	72	7	3.99	2.66	7.98	39.9	2790.2	191.06	0.0321
900	8	900	75.0	975	84	7	3.69	3.69	11.1	40.6	3074.2	226.50	0.0322
1000	4	1000	43.2	1043	72	7	4.21	2.80	8.41	42.1	3100.3	212.28	0.0289
1120	4	1120	47.3	1167	72	19	4.45	1.78	8.90	44.5	3464.9	237.64	0.0258
1120	8	1120	91.2	1211	84	19	4.12	2.47	12.4	45.3	3811.5	298.55	0.0258
1250	4	1250	52.8	1303	72	19	4.70	1.88	9.40	47.0	3867.1	265.44	0.0231
1250	6	1250	102	1352	64	19	4.35	2.61	13.1	47.9	4253.9	323.16	0.0232

With High Strength Steel & Zinc Coating Class 2

ACSR

ALUMINIUM CONDUCTOR STEEL REINFORCED (ACSR)

Characteristics of A1/S3 A conductors as per IEC 1089/91 TYPE A1/S3 A

Code number	Steel ratio	Areas			No. of wires		Wire diam.		Diameter		Linear mass	Rated strength	D. C. resis-tance
		Alum.	Steel	Total	Al	St	alum.	steel	Core	Cond.			
	%	mm²	mm²	mm²			mm	mm	mm	mm	kg/km	kN	Ohm/km
16	17	16	2.67	18.7	6	1	1.84	1.84	1.84	5.53	64.6	6.83	1.7934
25	17	25	4.17	29.2	6	1	2.30	2.30	2.30	6.91	100.9	10.25	1.1478
40	17	40	6.67	46.7	6	1	2.91	2.91	2.91	8.74	161.5	16.20	0.7174
63	17	63	10.5	73.5	6	1	3.66	3.66	3.66	11.0	254.4	24.15	0.4555
100	17	100	16.7	117	6	1	4.61	4.61	4.61	13.8	403.8	38.33	0.2869
125	6	125	6.94	132	18	1	2.97	2.97	2.97	14.9	397.9	31.04	0.2304
125	16	125	20.4	145	26	7	2.47	1.92	5.77	15.7	603.9	51.39	0.2310
160	6	160	8.89	169	18	1	3.36	3.36	3.36	16.8	509.3	38.67	0.1800
160	16	160	26.1	186	26	7	2.80	2.18	6.53	17.7	644.9	64.99	0.1805
200	6	200	11.1	211	18	1	3.76	3.76	3.76	18.8	636.7	46.89	0.1440
200	16	200	32.6	233	26	7	3.13	2.43	7.30	19.8	806.2	78.93	0.1444
250	10	250	24.6	275	22	7	3.80	2.11	6.34	21.6	880.6	75.60	0.1154
250	16	250	40.7	291	26	7	3.50	2.72	8.16	22.2	1007.7	96.66	0.1155
315	7	315	21.8	337	45	7	2.99	1.99	5.97	23.9	1039.6	85.13	0.0917
315	16	315	51.3	366	26	7	3.93	3.05	9.16	24.9	1269.7	121.20	0.0917
400	7	400	27.7	428	45	7	3.36	2.24	6.73	26.9	1320.1	106.10	0.0722
400	13	400	51.9	452	54	7	3.07	3.07	9.21	27.6	1510.3	137.56	0.0723
450	7	450	31.1	481	45	7	3.57	2.38	7.14	28.5	1485.2	115.87	0.0642
450	13	450	58.3	508	54	7	3.26	3.26	9.77	29.3	1699.1	154.75	0.0643
500	7	500	34.6	535	45	7	3.76	2.51	7.52	30.1	1650.2	128.76	0.0578
500	13	500	64.8	565	54	7	3.43	3.43	10.3	30.9	1887.9	171.94	0.0578
560	7	560	38.7	599	45	7	3.95	2.65	7.96	31.8	1848.2	144.19	0.0516
560	13	560	70.9	631	54	19	3.63	2.18	10.9	32.7	2103.4	192.45	0.0516
630	7	630	43.6	674	45	7	4.22	2.81	8.44	33.8	2079.2	162.21	0.0459
630	13	630	79.8	710	54	19	3.85	2.31	11.6	34.7	2366.3	213.32	0.0459
710	7	710	49.1	759	45	7	4.48	2.99	8.96	35.9	2343.2	182.81	0.0407
710	13	710	89.9	800	54	19	4.09	2.45	12.3	36.8	2666.8	240.41	0.0407
800	4	800	34.0	835	72	7	3.76	2.61	7.52	37.6	2480.2	176.74	0.0361
800	8	800	66.7	867	84	7	3.48	3.48	10.4	38.3	2732.7	224.00	0.0362
800	13	800	101	901	64	19	4.34	2.61	13.0	39.1	3004.9	270.88	0.0362
900	4	900	38.9	939	72	7	3.99	2.66	7.98	39.9	2790.2	198.83	0.0321
900	8	900	75.0	975	84	7	3.69	3.69	11.1	40.6	3074.2	244.50	0.0322
1000	4	1000	43.2	1043	72	7	4.21	2.80	8.41	42.1	3100.3	220.93	0.0289
1120	4	1120	47.3	1167	72	19	4.45	1.78	8.90	44.5	3464.9	247.77	0.0258
1120	8	1120	91.2	1211	84	19	4.12	2.47	12.4	45.3	3811.5	307.79	0.0258
1250	4	1250	62.8	1303	72	19	4.70	1.88	9.40	47.0	3867.1	276.53	0.0231
1250	8	1250	102	1352	84	19	4.35	2.16	13.1	47.9	4253.9	343.52	0.0232

With Extra High Strength Steel & Zinc Coating Class 1

COMPANY PROFILE CLASSIFICATION

ACSR

ALUMINIUM CONDUCTOR STEEL REINFORCED (ACSR)
AS PER CANADIAN SPECIFICATION CSA C - 49 - 1965

Code word	Cross sectional areas				Equivalent copper area	Stranding and wire diameter		Diameter		Weight per km.			Per cent weight		Ultimate strength of con.	DC resist. at 20°C
	Aluminium		Steel	Total		Aluminium N. °x Ø mm.	Steel N. °x Ø mm.	Complete con. mm	Steel Core mm.	Aluminium Kgs.	Steel Kgs.	Total Kgs.	Aluminium	Steel	Kgs.	ohm /km
	Mil. cir. Ø A.W.G.	mm²	mm²	mm²	mm²											
Wren	8	8,37	1,44	9,81	5,26	6x1,33	1x1,33	3,99	1,33	22,89	10,88	33,77	67,9	32,1	340	3,423
Warbler	7	10,55	1,77	12,32	6,63	6x1,50	1x1,50	4,50	1,50	28,86	13,67	42,53	67,9	32,1	425	2,714
Turkey	6	13,30	2,16	15,46	8,37	6x1,68	1x1,68	5,04	1,68	36,39	17,22	53,61	67,9	32,1	530	2,154
Thrush	5	16,77	2,78	19,55	10,55	6x1,89	1x1,89	5,67	1,89	45,88	21,76	67,64	67,9	32,1	660	1,707
Swan	4	21,15	3,56	24,71	13,30	6x2,12	1x2,12	6,36	2,12	57,89	27,42	85,31	67,9	32,1	830	1,354
Swallow	3	26,67	4,43	31,10	16,77	6x2,38	1x2,38	7,14	2,38	72,97	34,61	107,6	67,9	32,1	1.025	1,074
Sparrow	2	33,62	5,60	39,22	21,15	6x2,67	1x2,67	8,01	2,67	92,02	43,63	135,6	67,9	32,1	1.265	0,8507
Robin	1	42,41	7,07	49,48	26,67	6x3,00	1x3,00	9,00	3,00	116,1	55,0	171,1	67,9	32,1	1.585	0,6754
Raven	1/0	53,49	8,69	62,38	36,62	6x3,37	1x3,37	10,11	3,37	146,5	69,4	215,9	67,9	32,1	1.940	0,5351
Quail	2/0	67,43	11,21	78,64	42,41	6x3,78	1x3,78	11,34	3,78	184,6	87,5	272,1	67,9	32,1	2.425	0,4245
Pigeon	3/0	85,01	14,22	99,23	53,49	6x4,25	1x4,25	12,75	4,25	232,7	110,2	342,9	67,9	32,1	3.030	0,3367
Penguin	4/0	107,2	17,9	125,1	67,43	6x4,77	1x4,77	14,31	4,77	293,5	139,0	432,5	67,9	32,1	3.820	0,2671
Partidge	266.800	135,2	22,0	157,2	85,01	26x2,57	7x2,00	16,28	6,00	373,5	171,9	545,4	68,5	31,5	5.100	0,2137
Owl	266.800	135,2	17,5	152,7	85,01	6x5,36	7x1,79	16,09	5,37	370,1	136,7	506,8	73,0	27,0	4.330	0,2118
Waxwing	266.800	135,2	7,4	142,6	85,01	18x3,09	1x3,09	15,47	3,09	371,5	583,4	429,8	86,4	13,6	3.210	0,2126
Piper	300.000	152,0	35,5	187,5	95,6	30x2,54	7x2,54	17,78	7,62	420,2	276,8	697,0	60,3	39,7	7.000	0,1902
Ostrich	300.000	152,0	24,7	176,7	95,6	26x2,73	7x2,12	17,28	6,36	419,7	193,0	612,7	68,5	31,5	5.730	0,1900
Oriole	336.400	170,5	39,8	210,3	107,2	30x2,69	7x2,69	18,83	8,07	471,3	310,3	781,3	60,3	39,7	7.735	0,1696
Linnet	336.400	170,5	27,8	198,3	107,2	26x2,89	7x2,25	18,31	6,75	470,7	216,7	687,4	68,5	31,5	6.375	0,1894
Merlin	336.400	170,5	9,4	179,9	107,2	18x3,47	1 x3,4 7	17,37	3,47	468,4	73,6	542,0	86,4	13,6	4.060	0,1686
Chicadee	397.500	201,4	11,2	212,6	126,7	18x3,77	1x3,77	18,87	3,77	554,4	87,1	641,5	86,4	13,6	4.717	0,1427
Lark	397.500	201,4	47,0	248,4	126,7	30x2,92	7x2,92	20,44	8,76	556,6	366,7	923,3	60,3	39,7	9.060	0,14q5
Ibis	397.500	201,4	32,8	234,2	126,7	26x3,14	7x2,44	19,88	7,32	556,1	255,6	811,7	68,5	31,5	7.340	0,1434
Pelican	477.000	241,7	13,4	255,1	152,0	18x4,14	1x4,14	20,68	4,14	663,3	104,6	770,9	86,4	13,6	5.579	0,1189
Flicker	477.000	241,7	31,3	273,0	152,0	24x3,58	7x2,39	21,49	7,17	669,7	244,4	914,1	73,2	26,8	7.802	0,1195
Hen	477.000	241,7	56,4	298,1	152,0	30x3,20	7x3,20	22,40	9,60	668	440	1.108	60,3	39,7	10.590	0,1196
Hawk	477.000	241,7	39,4	281,1	152,0	26x3,44	7x2,68	21,80	8,04	667,4	307,5	974,9	68,5	31,5	8.820	0,1195
Heron	500.000	253,3	59,1	312,4	159,4	30x3,28	7x3,28	22,96	9,84	701	461	1.162	60,3	39,7	11.090	0,1141
Osprey	556.500	282,0	15,7	297,7	177,4	18x4,47	1x4,47	22,33	4,47	776,8	122	898,8	86,4	13,6	6.509	0,1018
Parakeet	556.500	282,0	36,5	318,5	177,4	24x3,87	7x2,58	23,22	7,74	781	286	1.067	73,2	26,8	9.004	0,1025
Eagle	556.500	282,0	65,8	347,5	177,4	30x3,46	7x3,46	24,22	10,38	779	514	1.293	60,3	39,7	12.360	0,1025
Dove	556.500	282,0	45,9	327,9	177,4	26x3,72	7x2,89	23,55	8,67	779	358	1.137	68,5	31,5	10.190	0,1025
Peacock	605,000	306,6	39,8	346,4	192,8	24x4,03	7x2,69	24,21	6,07	850	309	1.159	73,1	26,9	9.798	0,09420
Squab	605.000	306,6	49,9	356,5	192,8	26x3,87	7x3,01	24,54	9,03	850	308	1.268	68,5	31,5	10.954	0,09420
Teal	605.000	306,6	69,9	376,5	192,8	30x3,61	19x2,16	25,25	10,80	851	546	1,397	60,8	39,2	13.630	0,09432
Duck	605.000	306,6	39,8	436,6	192,8	54x2,69	7x2,69	24,21	8,07	848	310	1.158	73,2	26,8	10.210	0,09439
Rook	636.000	322,3	41,70	364,0	202,7	24x4,14	7x2,76	24,82	8,28	893	326	1.219	73,2	26,8	10.274	0,08966
Egret	636.000	322,3	73,30	395,6	202,7	30x3,70	19x2,22	25,90	11,10	891	575	1.466	60.8	39.2	14.330	0,08973
Grosbeck	636,000	322,3	52,40	374,7	202,7	26x3,97	7x3,09	25,15	9,27	890	409	1.299	68,5	31,5	11.340	0,08966
Goose	636,000	322,3	41,70	364,0	202,7	54x2,76	7x2,76	24,84	8,28	892	326	1.218	73,2	26,8	10.730	0.08979
Flamingo	666,600	337,8	43,80	381,6	212,3	24x4,23	7x2,82	25,38	8,46	936	341	1.277	73,2	26,8	10.773	0,08550
Gull	666.600	337,8	43,70	381,5	212,3	54x2,82	7x2,62	25,38	8,46	935	341	1.276	73,2	26,8	11.140	0,08569
Redwing	715.500	362,5	82,60	445,1	228,0	30x3,92	19x2,35	27,43	11,75	1.002	646	1.648	60,8	39,2	15.690	0,07978
Starling	715.500	362,5	59,10	421,6	228,0	26x4,21	7x3,28	26,68	9,84	1.001	461	1.462	68,5	31,5	12.750	0,07966
Crow	715.500	362,5	47,00	409,5	228,0	54x2,92	7x2,92	26,28	8,76	1.003	367	1.370	73,2	26,8	11.950	0,07985
Tern	795.000	402,8	27,90	430,7	253,4	45x3,38	7x2,25	27,00	6,75	1.116	217	1.333	83.7	16,3	10.410	0,07177
Mallard	795.000	402,8	91,90	494,7	253,4	30x4,14	19x2,48	28,96	12,40	1.114	719	1.833	60,5	39,2	17.440	0,07177
Drake	795.000	402,8	65,70	486,5	253,4	26x4,44	7x3,45	28,14	10,35	1.113	512	1.624	68,5	31,5	14.175	0,0717

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ACSR

ALUMINIUM CONDUCTOR STEEL REINFORCED (ACSR)
AS PER CANADIAN SPECIFICATION CSA C - 49 - 1965

Code word	Cross sectional areas				Equivalent copper area	Stranding and wire diameter		Diameter		Weight per km.			Per cent weight		Ultimate strength of con.	DC resist. at 20°C
	Aluminium		Steel	Total		Aluminium N. °x Ø mm.	Steel N. °x Ø mm.	Complete con. mm	Steel Core mm.	Aluminium Kgs.	Steel Kgs.	Total Kgs.	Aluminium	Steel	Kgs.	ohm /km
	Mil. cir. Ø A.W.G.	mm²	mm²	mm²	mm²											
Condor	795.000	402,8	52,30	455,1	253,4	54x3,08	7x3,08	27,76	9,24	1.114	406	1.522	73,2	26,8	12.950	0,07183
Crane	874.500	443,1	57,50	500,6	278,7	54x3,23	7x3,23	29,11	9,69	1.226	448	1.674	73,2	26,8	14.245	0,06531
Canary	900.000	456,1	59,10	515,2	286,8	54x3,28	7x3,28	29,51	9,84	1.262	461	1.723	73,2	26,8	14.650	0,06344
Rail	954.000	483,4	33,40	516,8	304,0	45x3,70	7x2,47	29,59	7,41	1.339	261	1.600	83,7	16,3	12.202	0,05981
Cardinal	954.000	483,4	62,70	546,1	304,0	54x3,38	7x3,38	30,38	10,14	1.337	489	1.826	73,2	26,8	15.535	0,05988
Ortlan	1.033.500	523,7	76,20	599,9	329,4	45x3,85	7x2,57	30,81	7,71	1.456	283	1.734	83,7	16,3	13.041	0,05522
Curlew	1.033.500	523,7	67,90	591,6	329,4	54x3,82	7x3,52	31,65	10,56	1.449	530	1.979	73,2	26,8	16.850	0,05527
Bluejay	1.113.000	563,9	39,10	603,0	354,7	45x4,00	7x2,66	31,98	7,98	1.570	305	1.875	83,6	16,4	14.039	0,05127
Finch	1.113.000	563,9	71,60	635,5	354,7	54x3,65	19x2,19	32,84	10,95	1.560	560	2.120	73,6	26,4	18.235	0,05133
Bunting	1.192.500	604,3	41,70	646,0	380,0	45x4,14	7x2,76	33,07	8,26	1.671	326	2.007	83,7	16,3	15.059	0,04785
Grackle	1.192.500	604,3	76,50	680,8	380,0	54x3,77	19x2,27	33,99	11,35	1.672	599	2.271	73,6	26,4	19.550	0,04790
Bittern	1.727.000	644,5	44,60	689,1	405,4	46x4,27	7x2,85	34,16	8,55	1.795	348	2.143	83,7	16,3	16.057	0,04486
Pheasant	1.272.000	644,5	81,70	726,2	450,4	84x3,90	19x2,34	35,36	11,70	1.783	639	2.422	73,6	26,4	20.320	0,04490
Dipper	1.351.500	654,8	47,50	732,3	430,7	45x4,40	7x2,92	35,18	8,76	1.906	369	2.275	83,8	16,2	17.010	0,04222
Martin	1.351.500	664,9	86,70	771,5	430,7	54x4,02	19x2,41	36,17	12,05	1.895	679	2.574	73,6	26,4	21.590	0,04227
Bobilink	1.431.000	725,1	50,40	775,5	456,0	45x4,53	7x3,02	36,25	9,05	2.019	329	2.411	83,7	16,3	18.053	0,03985
Plover	1.431.000	725,1	91,90	817,0	456,0	54x4,14	19x2,46	37,21	12,40	2.006	719	2.726	73,6	26,4	22.860	0,03992
Nuthatch	1.510.500	765,4	52,70	818,1	484,1	45x4,65	7x3,10	37,21	9,30	2.131	412	2.543	83,7	16,3	18.175	0,03778
Parrot	1.510.500	765,4	97,00	862,4	481,4	54x4,25	19x2,55	38,25	12,75	2.118	759	2.877	73,6	26,4	24.175	0,03782
Lapwing	1.590.090	805,7	55,60	861,3	506,7	45x4,77	7x3,18	38,15	9,54	2.243	434	2.677	83,2	16,8	19.867	0,03589
Falcon	1.590.000	805,7	102,10	907,8	506,7	54x4,36	19x2,62	39,24	13,10	2.229	799	3.028	73,6	26,4	25.445	0,03592
Chukar	1.780.000	901,9	73,60	975,5	567,0	84x3,70	19x2,22	40,69	11,10	2.510	676	3.086	81,1	15,9	24.312	0,03212

ALUMINIUM CONDUCTOR STEEL REINFORCED (ACSR)
(Extra Strong)
AS PER CANADIAN SPECIFICATION CSA C - 49 - 1965

Code word	Cross sectional areas				Equivalent copper area	Stranding and wire diameter		Diameter		Weight per km.			Per cent weight		Ultimate strength of con.	DC resist. at 20°C
	Aluminium		Steel	Total		Aluminium N. °x Ø mm.	Steel N. °x Ø mm.	Complete con. mm	Steel Core mm.	Aluminium Kgs.	Steel Kgs.	Total Kgs.	Aluminium	Steel	Kgs.	ohm /km
	Mil. cir. Ø A.W.G.	mm²	mm²	mm²	mm²											
Bantam	13.125	6.65	8.83	15.48	4.16	3x1.660	4x1.660	5.03	-	18.21	69.59	87.8	20.7	79.3	1.191	4.303
Magpie	20.870	10.58	14.13	24.71	6.65	3x2.118	4x1.118	6.35	-	28.9	110.8	139.7	20.7	79.3	1.894	2.707
Shrike	33.185	16.84	22.45	39.29	10.57	3x2.672	4x2.672	8.03	-	46.0	176.3	222.3	20.7	79.3	2.911	1.705
Snipe	52.770	26.71	35.68	62.39	16.81	3x3.371	4x3.371	10.11	-	73.2	280.4	353.6	20.7	79.3	4.479	1.070
Loon	66.540	33.74	44.97	78.71	21.20	3x3.765	4x3.765	11.35	-	92.3	353.6	445.9	20.7	79.3	5.639	0.849
Grouse	80.000	40.52	14.13	54.65	25.49	8x2.540	1 x4.242	9.32	4.24	111.2	109.9	221.1	50.3	49.7	2.361	0.707
Petrel	101.800	51.61	30.07	81.69	32.51	12x2.339	7x2.339	11.71	7.02	142.1	234.8	376.9	37.7	62.3	4.470	0.557
Minorca	110.800	56.31	32.77	88.90	35.32	12x2.441	7x2.441	12.22	7.32	154.7	255.6	410.3	37.7	62.3	4.866	0.512
Leghorn	134.600	68.19	39.81	108.0	42.87	12x2.690	7x2.690	13.46	8.07	188.0	310.3	498.3	37.7	62.3	5.865	0.422
Guinea	159.000	80.58	46.92	127.5	50.67	12x2.924	7x2.924	14.63	8.77	222.1	366.7	588.8	37.7	62.3	6.890	0.358
Dotterel	176.900	89.61	52.29	141.9	56.35	12x3.084	7x3.084	15.42	9.25	346.9	407.8	654.7	37.7	62.3	7.455	0.321
Drokling	190.800	96.71	56.39	153.1	60.80	12x3.204	7x3.204	16.03	9.61	266.3	440.3	706.6	37.7	62.3	8.043	0:299
Auk	203.000	102.8	27.80	130.6	64.71	6x4.046	7x2.248	14.83	6.74	282.1	216.7	498.9	56.4	38.6	5.060	0.278
Brahma	203.200	103.0	91.80	194.8	64.76	16x2.863	19x2.863	18.14	12.41	285.5	719.5	1.005	28.4	71.8	12.496	0.281
Cochin	211.300	107.7	62.40	169.5	67.34	12x3.371	7x3.371	16.87	10.11	295.1	487.3	782.4	37.7	62.3	8.912	0.270

COMPANY PROFILE CLASSIFICATION

ACSR

ALUMINIUM CONDUCTORS STEEL REINFORCED (ACSR)
AS PER ASTM B-232 M - 1992

Size mm²	Stranding design	Aluminium		Steel wire		Nominal outside dia. of conductors, mm	Linear density kg/km	D.C. Resistance Ohm/km	Rated Tensile Strength kN
		Number	Diameter mm	Number	Diameter mm				
1250	84/19	84	4.35	19	2.61	47.85	4274	0.0232	306
1250	76/19	76	4.58	19	2.14	47.34	4023	0.0232	269
1250	72/7	72	4.70	7	3.13	46.99	3901	0.0232	250
1120	84/19	84	4.12	19	2.47	45.31	3883	0.0259	275
1120	76/19	76	4.33	19	2.02	44.74	3595	0.0259	240
1120	72/7	72	4.45	7	2.97	44.51	3499	0.0259	226
1000	84/19	84	3.89	19	2.33	42.77	3416	0.0291	245
1000	72/7	72	4.21	7	2.81	42.11	3132	0.0289	202
900	64/19	84	3.69	19	2.21	40.57	3073	0.0323	226
900	72/7	72	3.99	7	2.66	39.9	2812	0.0319	181
800	54/19	54	4.34	19	2.60	39.04	3015	0.0363	240
600	45/7	45	4.76	7	3.17	38.07	2652	0.0361	186
710	54/19	54	4.09	19	2.45	36.79	2678	0.04090	213
710	45/7	45	4.48	7	2.99	35.85	2351	0.04070	167
630	54/19	54	3.85	19	2.31	34.65	2375	0.0462	189
630	45/7	45	4.22	7	2.81	33.75	2084	0.0459	148
560	54/19	54	3.63	19	2.18	32.68	2112	0.0519	173
560	45/7	45	3.98	7	2.65	31.83	1854	0.0515	132
500	54/7	54	3.43	7	3.43	30.87	1889	0.0578	154
500	45/7	45	3.76	7	2.51	30.09	1656	0.0578	118
450	54/7	54	3.26	7	3.26	29.34	1706	0.0641	139
450	45/7	45	3.57	7	2.38	28.56	1492	0.0641	108
400	30/19	30	4.12	19	2.47	28.83	1824	0.0724	170
400	26/7	26	4.43	7	3.45	28.07	1622	0.0721	139
400	24/7	24	4.61	7	3.07	27.65	1515	0.0721	123
355	30/19	30	3.88	19	2.33	27.17	1620	0.0816	151
355	26/7	26	4.17	7	3.24	26.4	1435	0.0813	123
355	24/7	24	4.34	7	2.89	26.03	1343	0.0813	111
315	30/19	30	3.66	19	2.20	25.64	1443	0.0917	138
315	26/7	26	3.93	7	3.06	24.9	1277	0.0915	110
315	24/7	24	4.09	7	2.73	24.55	1194	0.0915	96.7
315	18/1	18	4.72	1	4.72	23.6	1014	0.0912	68.0
280	30/7	30	3.45	7	3.45	24.15	1291	0.1030	122
280	26/7	26	3.70	7	2.88	23.44	1131	0.1033	100
280	24/7	24	3.85	7	2.57	23.11	1058	0.1033	87.5
280	18/1	18	4.45	1	4.45	22.25	901.0	0.1026	60.4
250	30/7	30	3.26	7	3.26	22.82	1152	0.1153	190
250	26/7	26	3.50	7	2.72	22.16	1011	0.1154	89.5
250	24/7	24	3.64	7	2.43	21.85	946.0	0.1156	79.4
250	18/1	18	4.21	1	4.21	21.05	806.4	0.1147	54.1
224	30/7	30	3.08	7	3.08	21.56	1029	0.1292	97.4
224	26/7	26	3.31	7	2.57	20.95	904.0	0.1291	80.0
224	24/7	24	3.45	7	2.30	20.7	849.2	0.1287	72.0
224	18/1	18	3.98	1	3.98	19.9	720.7	0.1283	48.3
200	30/7	30	2.91	7	2.91	20.37	918.2	0.1447	89.7
200	26/7	26	3.13	7	2.43	19.81	808.3	0.1443	71.5
200	24/7	24	3.26	7	2.17	19.55	757.6	0.1441	64.2
200	18/1	18	3.76	1	3.76	16.8	643.2	0.1438	43.1

ACSR

ALUMINIUM CONDUCTORS STEEL REINFORCED (ACSR)
AS PER CHINESE SPECIFICATION GB 1179 - 74 (CHINA)

Type	Conductor size	Stranding Nos. / mm		Calculated sectional area mm²		Overall diameter mm		Weight kg/km			Ultimate strength	Calculated D. C. resi. at 20°C
	mm²	Alu-minium	Steel	Alu-minium	ACSR	ACSR	Steel	ACSR	Alu-minium	Steel	kg	Ohm/km
LGJ	10	6/1.50	1/1.5	10.60	12.37	4.50	1.5	42.9	29.1	13.8	367	2.708
	16	6/1.80	1/1.8	15.27	17.81	5.40	1.8	61.7	41.9	19.8	530	1.881
	25	6/2.20	1/2.2	22.81	26.61	6.60	2.2	92.2	62.5	29.7	790	1.259
	35	6/2.80	1/2.8	36.95	43.10	8.40	2.8	149	101	48.0	1,190	0.7772
	50	6/3.20	1/3.2	48.25	56.30	9.60	3.2	195	132	62.7	1,550	0.5950
	70	6/3.80	1/3.8	68.05	79.39	11.40	3.8	275	187	88.4	2,130	0.4220
	95	28/2.07	7/1.8	94.23	112.0	13.68	5.4	401	261	140	3,490	0.3065
	95 (I)	7/4.14	7/1.8	94.23	112.0	13.68	5.4	396	259	139	3,310	0.3049
	120	18/2.30	7/2.0	116.3	138.3	15.20	6.0	495	323	172	4,310	0.2483
	120 (I)	7/4.60	7/2.0	116.3	138.3	15.20	6.0	492	320	172	4,090	0.2470
	150	28/2.53	7/2.2	140.8	167.4	16.72	6.6	598	389	209	5,080	0.2052
	185	18/2.88	7/2.5	182.4	216.8	19.02	7.5	774	505	269	6,570	0.1584
	240	28/3.22	7/2.8	228.0	271.1	21.28	8.4	969	631	338	7,860	0.1267
	300	28/3.80	19/2.0	317.6	377.2	25.20	10.0	1,348	879	469	11,120	0.09094
	400	28/4.17	19/2.2	382.4	454.6	27.68	11.0	1,626	1,056	568	13,430	0.07552
LGJQ	150	24/2.76	7/1.8	143.6	161.4	16.44	5.4	537	397	140	4,155	0.2010
	185	24/3.06	7/2.0	176.5	198.5	18.24	6.0	661	489	172	5,110	0.1635
	240	24/3.67	7/2.4	253.9	285.6	21.88	7.2	951	703	248	7,120	0.1137
	300	54/2.65	7/2.6	297.8	335.0	23.70	7.8	1,116	825	291	8,630	0.09706
	300 (I)	24/3.98	7/2.6	298.6	335.8	23.72	7.8	1,117	826	291	8,360	0.09662
	400	54/3.06	7/3.0	397.1	446.6	27.36	9.0	1,487	1,099	388	11,080	0.07279
	400 (I)	24/4.60	7/3.0	398.9	448.3	27.40	9.0	1,491	1,103	388	10,730	0.07233
	500	54/3.36	19/2.0	478.8	538.5	30.16	10.0	1,795	1,326	469	13,870	0.06037
	600	54/3.70	19/2.2	580.6	652.8	33.20	11.0	2,175	1,607	568	16,250	0.04979
	700	54/4.04	19/2.4	692.2	778.2	36.24	12.0	2,592	1,916	676	19,360	0.04176
LGJJ	150	30/2.50	7/2.5	147.3	181.6	17.50	7.5	677	408	269	6,170	0.1963
	185	30/2.80	7/2.8	184.7	227.8	19.60	8.4	850	512	338	7,200	0.1565
	240	30/3.20	7/3.2	241.3	297.6	22.40	9.6	1,110	669	441	9,410	0.1198
	300	30/3.67	19/2.2	317.4	389.6	25.68	11.0	1,446	878	568	12,500	0.09132
	400	30/4.17	19/2.5	409.7	503.0	29.18	12.5	1,866	1,135	733	16,140	0.07074

ACSR

ALUMINIUM CONDUCTOR STEEL REINFORCED (ACSR)
AS PER JAPANESE INDUSTRIAL STANDARD - JIS C 3110 - 1978

Conductor size mm²	Stranding Nos. / mm		Calculated sectional area mm²		Overall diameter mm		Weight kg/km			Ultimate strength Kg	Calculated D. C. resistance at 20° C Ohm/km
	Aluminium	Steel	Aluminium	Steel	ACSR	Steel	ACSR	Aluminium	Steel		
25	6/2.3	1/2.3	24.93	29.09	6.9	2.3	100.7	68.29	32.42	907	1.15
32	6/2.6	1.26	31.85	37.16	7.8	2.6	128.6	87.18	41.41	1,140	0.899
58	6/3.5	1/3.5	57.73	67.35	10.5	3.5	233.1	158.1	75.04	1,980	0.497
80	6/4.2	1/4.2	83.10	96.95	12.6	4.2	335.5	227.5	108.0	2,770	0.345
95	6/4.5	1/4.5	95.40	111.3	13.5	4.5	385.2	261.2	124.0	3,180	0.301
120	30/2.3	7/2.3	124.7	153.8	16.1	6.9	573.7	345.7	228.0	5,540	0.233
160	30/2.6	7/2.6	159.3	196.5	18.2	7.6	732.8	441.5	291.3	6,980	0.182
* 200	30/2.9	7/2.9	198.2	244.4	20.3	6.7	911.7	549.3	362.4	8,640	0.147
240	30/3.2	7/3.2	241.3	297.6	22.4	9.6	1,110	666.9	441.3	10,210	0.120
330	26/4.0	7/3.1	326.8	379.6	25.3	9.3	1,320	905.4	414.2	10,950	0.0888
410	26/4.5	7/3.5	431.4	480.8	28.5	10.5	1,673	1,145	527.9	13,910	0.0702
520	54/3.5	7/3.5	519.5	586.9	31.5	10.5	1,969	1,441	527.9	15,600	0.0559
610	54/3.8	7/3.6	612.4	691.8	34.2	11.4	2,320	1,696	627.3	18,350	0.0474
* 810	45/4.8	7/3.2	814.5	870.6	36.4	9.6	2,700	2,259	441.3	18,480	0.0356
* 950	84/3.8	7/3.8	952.6	1,032	41.8	11.4	3,271	2,649	622.2	23,100	0.0305
* 1,106	84/4.2 *	7/4.2	1,163	1,260	46.2	12.6	3,996	3,236	759.8	27,830	0.0250
* 1 ,520	84/4.8	7/4.8	1, 520	1,647	52.8	14.4	5,222	4,228	993.3	36,390	0.0191

ALUMINIUM CONDUCTOR STEEL REINFORCED (ACSR)
AS PER AUSTRALIAN STANDARD 1220 PART 1 - 1973

Code Word	Con-ductor size mm²	Stranding Nos. / mm		Calculated sectional area mm²		Overall diameter mm		Weight kg/km			Ultimate strength kN	Calculated D. C. resistance at 20° C Ohm/km
		Aluminium	Steel	Aluminium	ACSR	ACSR	Steel	ACSR	Aluminium	Steel		
Quince	7	3/1.75	4/1.75	7.215	16.84	5.25	-	95.9	19.60	76.30	12.7	3.14
Raisin	15	3/2.50	4/2.50	14.73	34.36	7.50	-	193	40.11	152.6	24.4	1.58
Sultanan	28	4/3.00	3/3.00	26.28	49.48	9.00	-	242	76.80	165.6	28.3	0.893
Walnut	44	4/3.75	3/3.75	44.16	77.31	11.25	-	379	120.2	258.9	43.9	0.570
Almond	29	6/2.50	1/2.50	29.45	34.36	7.50	2.50	119	81.0	38	10.5	0.975
Apple	42	6/3.00	1/3.00	42.41	49.48	9.00	3.00	171	116.3	55	14.9	0.677
Banana	66	6/3.75	1/3.75	66.28	77.31	11.25	3.75	268	182.1	86	22.8	0.433
Cherry	106	6/4.75	7/1.60	106.32	120.40	14.3	4.80	404	291.8	112.5	33.0	0.271
Grape	147	30/2.50	7/2.50	147.27	181.60	17.5	7.5	675	404.9	267.2	63.7	0.196
Lemon	212	30/3.00	7/3.00	212.07	261.50	21.0	9.0	973	585.8	386.8	90.1	0.1365
Lime	289	30/3.50	7/3.50	286.63	356.0	24.5	10.5	1,325	797.4	527.4	121	0.100
Mango	382	54/3.00	7/3.00	381.73	431.2	27.0	9.0	1 ,442	1,055	386.8	118	0.0756
Orange	448	54/3.25	7/3.25	447.98	506.0	29.3	9.75	1,694	1,237	457.1	137	0.0646
Olive	520	54/3.50	7/3.50	519.35	586.9	31.5	10.5	1,963	1 ,436	527.4	159	0.0557
Pawpaw	596	54/3.75	19/2.25	596.16	671.7	33.8	11.25	2,245	1,651	593.7	179	0.0485
Peach	957	54/4.75	19/2.85	956.88	1,085	42.8	14.25	3,661	2,646	1,015	292	0.0303

COMPANY PROFILE CLASSIFICATION

ACSR

ALUMINIUM CONDUCTORS STEEL REINFORCED (ACSR)
AS PER ASTM B-232 M - 1992

Size mm²	Stranding design	Aluminium		Steel wire		Nominal outside dia. of conductors, mm	Linear density kg/km	D.C. Resistance Ohm/km	Rated Tensile Strength kN
		Number	Diameter mm	Number	Diameter mm				
180	30/7	30	2.76	7	2.76	19.32	826.0	0.1609	80.7
180	26/7	26	2.97	7	2.31	18.81	728.6	0.1603	65.4
180	24/7	24	3.09	7	2.06	18.54	681.2	0.1604	57.8
180	18/1	18	3.57	1	3.57	17.85	579.9	0.1595	40.4
160	30/7	30	2.61	7	2.61	18.27	738.6	0.1799	72.9
160	26/7	26	2.80	7	2.16	17.74	648.0	0.1803	58.9
160	24/7	24	2.91	7	1.94	17.46	604.2	0.1809	52.0
160	18/1	18	3.36	1	3.36	16.8	513.7	0.1800	35.8
140	26/7	26	2.62	7	2.04	16.6	567.4	0.206	52.2
140	24/7	24	2.73	7	1.82	16.38	531.8	0.2055	46.4
140	18/1	18	3.15	1	3.15	15.75	451.5	0.2050	31.5
125	26/7	26	2.47	7	1.92	15.64	503.7	0.2318	46.9
125	24/7	24	2.58	7	1.72	15.48	474.9	0.2301	41.5
125	18/1	18	2.97	1	2.97	14.85	401.3	0.2304	28.8
100	16/19	16	2.82	19	2.44	17.84	972.4	0.2890	123
100	12/1	12	3.26	7	3.26	16.3	734.1	0.2883	85.9
100	6/1	6	4.61	1	4.61	13.83	404.6	0.2855	34.6
90	12/7	12	3.09	7	3.09	15.45	659.5	0.3209	77.2
80	12/7	12	2.91	7	2.91	14.55	584.9	0.3618	70.6
80	6/1	6	4.12	1	4.12	12.36	323.3	0.3575	27.6
71	12/7	12	2.74	7	2.74	13.7	518.6	0.408	62.9
63	12/7	12	2.59	7	2.59	12.95	463.4	0.457	56.2
63	6/1	6	3.66	1	3.66	10.98	255.2	0.453	22.1
56	12/7	12	2.44	7	2.44	12.2	411.2	0.515	50.2
50	12/7	12	2.30	7	2.30	11.5	356.4	0.579	45.4
50	6/1	6	3.26	1	3.26	9.78	202.4	0.571	18.1
40	8/1	6	2.52	1	4.20	9.24	217.9	0.720	22.5
40	6/1	6	2.91	1	2.91	8.73	161.3	0.716	14.9
31.5	7/1	7	2.39	1	3.19	7.97	148.4	0.910	15.1
31.5	6/1	6	2.59	1	2.59	7.77	127.8	0.905	11.9
25	7/1	7	2.13	1	2.84	7.1	117.8	1.146	12.3
25	6/1	6	2.30	1	2.30	6.9	100.8	1.147	9.65
20	7/1	7	1.91	1	2.55	6.37	94.80	1.426	10.0
20	6/1	6	2.06	1	2.06	6.18	80.83	1 .430	7.84
16	6/1	6	1.84	1	1.84	5.52	64.49	1.792	6.33
12.5	6/1	6	1.63	1	1.63	4.89	50.61	2.283	4.94



ALUMINIUM CONDUCTORS STEEL REINFORCED (ACSR)
AS PER CHINESE SPECIFICATION GB 1179 - 83 (CHINA)

Conductor size	Stranding Nos. / mm		Calculated sectional area mm²		Overall diameter mm		Weight kg/km			Calculated breaking load		Calculated electrical resistance at 20°C Ohm/km
mm²	Aluminium	Steel	Aluminium	ACSR	ACSR	Steel	ACSR	Aluminium	Steel	N	kg	
10/2	6/1.50	1/1.60	10.60	12.37	4.50	1.50	42.9	29.1	13.8	4,120	420	2.706
16/3	6/1.85	1/1.85	16.13	18.82	5.55	1.85	65.2	44.3	21.0	6,130	624	1.779
25/4	6/2.32	1/2.32	25.36	29.59	6.96	2.32	102.6	69.6	33.0	9,290	947	1.131
35/6	6/2.72	1/2.72	34.86	40.67	8.16	2.72	141.0	95.7	45.3	12,630	1,288	0.8230
50/8	6/3.20	1/3.20	48.25	56.29	9.60	3.20	195.1	132.4	62.7	16,870	1,720	0.6946
50/30	12/2.32	7/2.32	60.73	80.32	11.80	6.96	372.0	140.1	231.9	42,620	4,346	0.5692
70/10	6/3.80	1/3.80	68.05	79.39	11.40	3.80	275.2	186.7	88.5	23,390	2,385	0.4217
70/40	12/2.72	7/2.72	69.73	110.40	13.60	8.16	511.3	192.6	318.7	58,300	5,945	0.4141
95/15	26/2.15	7/1.67	94.39	109.72	13.61	5.01	380.8	260.6	120.1	35,000	3.596	0.3058
95/20	7/4.16	7/1.85	95.14	113.96	13.87	5.55	408.9	261.5	147.4	37,200	3,799	0.3019
95/55	12/3.20	7/3.20	96.51	152.81	16.00	9.60	707.7	266.5	441.1	78,110	7,964	0.2992
120/7	18/2.90	1/2.90	118.89	125.50	14.50	2.90	379.0	327.4	51.5	27,570	2.611	0.2422
120/20	26/2.38	7/1.85	115.67	134.49	15.07	5.55	466.8	319.4	147.4	41 ,000	4,331	0.2496
120/25	7/4.72	7/2.10	122.48	146.73	15.74	6.30	526.6	336.6	190.0	47,880	4,921	0.2345
120/70	12/3.60	7/3.60	122.15	193.40	18.00	10.80	695.6	337.3	558.3	98,370	10,030	0.2364
150/8	18/3.20	1/3.20	144.76	152.80	16.00	3.20	461.4	398.7	62.7	32,860	3,351	0.1989
150/20	24/2.78	7/1.85	145.68	164.50	16.67	5.55	549.4	402.0	147.4	46,630	4,754	0.1980
150/25	26/2.70	7/2.10	148.86	173.11	17.10	6.30	601.0	411.0	190.0	54,110	5,517	0.1939
160/35	30/2.50	7/2.50	147.26	181.82	17.50	7.50	676.2	406.9	269.2	65,020	6,637	0.1962
185/10	18/3.60	1/3.60	183.22	193.40	18.00	3.60	584.0	504.6	79.4	40,880	4,168	0.1572
185/25	24/3.15	7/2.10	187.04	211.29	18.90	6.30	706.1	516.1	190.0	59,420	6,058	0.1542
185/30	26/2.98	7/2.32	181.34	210.93	18.88	6.96	732.6	500.7	231.9	64,320	6,552	0.1592
185/45	30/2.80	7/2.60	164.73	227.63	19.60	8.40	848.2	510.5	337.7	80,190	8,177	0.1564
210/10	18/3.80	1/3.80	204.14	215.48	19.00	3.80	650.7	562.2	88.5	45,140	4,603	0.1411
210/25	24/3.33	7/2.22	209.02	236.12	19.98	6.66	789.1	576.8	212.3	65,990	6,729	0.1380
210/35	26/3.22	7/2.50	211.73	246.09	20.38	7.50	853.9	584.6	269.2	74,250	7,564	0.1363
210/50	30/2.98	7/2.98	209.24	258.06	20.86	8.94	960.8	578.2	382.6	90,830	9,262	0.1381
240/30	24/3.60	7/2.40	244.29	275.96	21.60	7.20	922.2	674.1	248.1	75,620	7,704	0.1181
240/40	26/3.42	7/2.66	238.85	277.75	21.66	7.98	964.3	659.5	304.8	83,370	8,501	0.1209
240/55	30/3.20	7/3.20	241.27	297.57	22.40	9.60	1,108	666.7	441.1	102,100	10,410	0.1198
300/15	42/3.00	7/1.67	296.88	312.21	23.01	5.01	939.8	819.7	120.1	68,060	6,939	0.09724
300/20	45/2.93	7/1.95	303.42	324.33	23.43	5.85	1,002	836.0	163.8	75,680	7,717	0.09520
300/25	48/2.85	7/2.22	306.21	333.31	23.76	6.66	1,058	846.0	212.3	83,410	8,505	0.09433
300/40	24/3.99	7/2.66	300.09	338.99	23.94	7.98	1,133	828.0	304.8	92,220	9,404	0.09614
300/50	26/3.83	7/2.88	299.54	345.36	24.26	8.94	1,210	827.1	382.6	1 03,400	10,550	0.09636
300/70	30/3.60	7/3.60	305.36	376.61	25.20	10.80	1,402	843.8	558.3	126,000	13,050	0.09463
400/20	42/3.51	7/1.95	406.40	427.31	26.91	5.85	1,266	1,122	163.8	88,850	9,204	0.07104
400/25	45/3.33	7/2.22	391.91	491.01	26.64	6.66	1,295	1,082	212.3	95,940	9,783	0.07370
400/35	48/3.22	7/2.50	390.88	425.24	26.82	7.50	1,349	1,080	269.2	103,900	10,590	0.07390
400/50	54/3.07	7/3.07	399.73	451.55	27.63	9.21	1,511	1,105	406.0	123,400	12,590	0.07232
400/65	26/4.42	7/3.44	398.92	464.00	28.00	10.62	1,611	1,102	509.8	135,200	13,910	0.07236
400/95	30/4.16	19/2.50	407.75	501.02	29.14	12.50	1,860	1,127	733.2	171,200	17,470	0.07087
500/35	45/3.75	7/2.50	497.01	531.37	30.00	7.50	1,642	1,373	269.2	119,500	12,190	0.05812
500/45	48/3.60	7/2.80	486.58	531.68	30.00	8.40	1,688	1,350	337.7	128,100	13,060	0.05912
500/65	54/3.44	7/3.44	501.88	566.94	30.96	10.32	1,897	1,388	509.8	154,000	15,700	0.05760
630/45	45/4.20	7/2.80	623.45	666.55	33.60	8.40	2,060	1 ,722	337.7	148,700	15,160	0.04633
630/55	48/4.12	7/3.20	639.92	696.22	34.32	9.60	2,209	1,768	441.1	164,400	16,760	0.04514
630/80	54/3.87	19/2.32	635.90	715.51	34.82	11.60	2,388	1,156	631.4	192,900	19,670	0.04551
800/55	45/4.80	7/3.20	841.30	870.60	36.40	9.60	2,890	2,249	441.1	191,500	19,790	0.03547
800/70	48/4.63	7/3.80	808.15	879.40	38.56	10.80	2,791	2,233	558.3	207,000	21,370	0.03574
800/100	54/4.33	19/2.60	795.71	896.05	38.98	13.00	2,991	2,198	793.0	241,100	24,840	0.03635

ACSR

ALUMINIUM CONDUCTOR STEEL REINFORCED (ACSR)
AS PER BRITISH STANDARD SPECIFICATION BS 215 PART 2 - 1970

ACSR code word	Cond-uctor size mm²	Stranding Nos./mm		Calculated sectional area mm²		Overall diameter mm		Weight kg/km			Ultimate strength		Calculated electrical resistance at 20°C Ohm/km
		Alu-minium	Steel	Alu-minium	ACSR	ACSR	Steel	ACSR	Alu-minium	Steel	kN	kg	
Gopher	25	6/2.36	1/2.36	26.24	30.62	7.08	2.36	106	72.0	34.1	9.61	980	1.093
Weasel	30	6/2.59	1/2.59	31.61	36.88	7.77	2.59	128	86.7	41.1	11.45	1,170	0.9077
Ferret	40	6/3.00	1/3.00	42.41	49.48	9.00	3.00	172	116.4	55.1	15.20	1,550	0.6766
Rabbit	50	6/3.35	1/3.35	52.88	61.70	10.05	3.35	214	145.1	68.8	18.35	1,870	0.5426
Horse	70	12/2.79	7/2.79	73.37	116.2	13.95	8.37	538	202.7	335.4	61.20	6,240	0.3936
Dog	100	6/4.72	7/1.57	105.0	118.5	14.15	4.71	394	288.1	106.2	32.70	3,330	0.2733
Wolf	150	30/2.59	7/2.59	158.1	194.9	18.13	7.77	726	436.7	288.9	69.20	7,060	0.1828
Dingo	150	18/3.35	1/3.35	158.7	167.5	16.75	3.35	506	436.7	68.75	35,70	3,640	0.1815
Lynx	175	30/2.79	7/2.79	183.4	226.2	19.53	8.37	842	507.0	335.4	79.80	8,140	0.1576
Caracal	175	18/3.61	1/3.61	184.3	194.5	18.05	3.61	587	507.5	79.84	41.10	4,190	0.1563
Panther	200	30/3.00	7/3.00	212.1	261.5	21.00	9.00	974	586.1	387.7	92.25	9,410	0.1363
Jaguar	200	18/3.86	1/3.86	210.6	222.3	19.30	3.86	671	580.1	91.28	46.55	4,750	0.1367
Zebra	400	54/3.18	7/3.18	428.9	484.5	28.62	9.54	1,621	1,185.8	435.6	131.9	13,450	0.06740

ALUMINIUM CONDUCTOR STEEL REINFORCED ACSR
(Semistandard Size)
AS PER BRITISH STANDARD SPECIFICATION BS 215 PART 2 - 1970

ACSR code word	Cond-uctor size mm²	Stranding Nos./mm		Calculated sectional area mm²		Overall diameter mm		Weight kg/km			Ultimate strength		Calculated electrical resistance at 20°C Ohm/km
		Alu-minium	Steel	Alu-minium	ACSR	ACSR	Steel	ACSR	Alu-minium	Steel	kN	kg	
Fox	35	6/2.79	1/2.79	36.68	42.80	8.37	2.79	148	100.7	47.69	13.15	1,340	0.7822
Mink	60	6/3.66	1/3.66	63.12	72.64	10.98	3.66	255	173.2	82.06	21.80	2,220	0.4546
Skunk	60	12/2.59	7/2.59	63.23	100.1	12.95	7.77	464	174.6	288.9	52.90	5,400	0.4568
Beaver	75	6/3.99	1/3.99	75.00	87.50	11.97	3.99	303	205.8	97.50	25.75	2,630	0.3826
Raccoon	75	6/4.09	1/4.09	78.98	91.98	12.27	4.09	319	216.3	102.5	27.05	2,760	0.3639
Otter	80	6/4.22	1/4.22	83.94	97.93	12.66	4.22	339	230.3	109.1	28.80	2,940	0.3418
Cat	95	6/4.50	1/4.50	95.40	111.3	13.50	4.50	386	261.8	124.0	32.65	3,330	0.3008
Hare	105	6/4.72	1/4.72	105.0	122.5	14.16	4.72	425	288.1	136.5	35.95	3,670	0.2733
Hyena	105	7/4.39	7/1.93	106.0	126.5	14.57	5.79	451	290.8	160.5	41.00	4,180	0.2707
Leopard	130	6/5.28	7/1.75	131.4	148.2	15.61	5.25	492	360.5	131.9	40.75	4,160	0.2196
Tiger	130	30/2.36	7/2.36	131.2	161.8	16.52	7.08	602	362.5	239.9	58.00	5,910	0.2202
Coyote	130	26/2.54	7/1.91	131.7	151.8	15.89	5.73	521	363.9	157.2	46.35	4,730	0.2191
Lion	235	30/3.18	7/3.18	238.9	293.9	22.26	9.54	1,094	658.5	435.6	100.4	10,240	0.1213
Bear	260	30/3.35	7/3.35	264.4	326.1	23.45	10.05	1,214	730.6	483.5	111.2	11 ,340	0.1093
Batang	300	18/4.78	7/1.68	323.1	338.6	24.16	5.04	1,015	889.9	121.8	69.6	7,097	0.0892
Goat	320	30/3.71	7/3.71	324.3	400.0	25.97	11.13	1,489	896.2	592.9	135.8	13,850	0.08912
Antelope	370	54/2.97	7/2.97	374.1	422.6	26.73	8.91	1,415	1,034.5	380.0	118.5	12,080	0.07728
Sheep	375	30/3.99	7/3.99	375.0	462.5	27.93	11.97	1,722	1,036.3	685.6	156.3	15,940	0.07705
Bison	380	54/3.00	7/3.00	381.7	431.2	27.00	9.00	1 ,443	1,055.4	387.7	120.9	12,330	0.07574
Deer	425	30/4.27	7/4.27	429.6	529.8	29.89	12.81	1,973	1,187.2	785.5	178.6	16,210	0.06727
Camel	475	54/3.35	7/3.35	476.0	537.7	30.15	10.05	1 ,799	1,315.6	483.5	145.9	14,880	0.06074
Elk	475	30/4.50	7/4.50	477.0	588.3	31.50	13.50	2,190	1,318.2	872.0	198.3	20,220	0.06059
Moose	525	54/3.35	7/3.53	528.5	597.0	31.77	10.59	1,998	1,460.8	536.9	161.0	16,420	0.05470

ACSR

ALUMINIUM CONDUCTOR STEEL REINFORCED (ACSR)

AS PER DIN SPECIFICATION DIN 48204 - 1974

Conductor size mm²		Ratio of Al/St	Stranding Nos. / mm		Calculated sectional area mm²		Overall diameter mm		Weight kg/km				Ultimate strength N	Calculated resistance 20° C Ohm/km
Nominal Al/St	Calculated Total		Aluminium	Steel	Aluminium	ACSR	ASCR	Steel	ACSR	Aluminium	Steel	Grease		
16/25	17.85	6	6/1.8	1/1.8	15.3	17.9	5.4	-	62.4	41.8	19.9	0.7	5,950	1.879
25/4	27.8	6	6/2.25	1/2.25	23.8	27.8	6.8	-	97.5	65.4	31.0	1.1	9,200	1.203
35/6	40	6	6/2.7	1/2.7	34.4	40.0	8.1	-	140.5	94.2	44.7	1.6	12,650	0.6352
44/32	75.7	1.4	14/2	7/2.4	44	75.7	11.2	7.2	376.8	121.4	248.2	7.2	45,000	0.6573
50/8	56.3	1.4	6/3.2	1/3.2	48.3	56.3	9.6	-	197.2	132.2	62.7	2.3	17,100	0.5947
50/30	81	1.7	12/2.33	7/2.33	51.2	81.0	11.7	6.99	382.5	141.1	233.9	7.5	43,800	0.5644
70/12	81.3	1.7	26/1.85	7/1.44	69.9	81.3	11.7	4.32	285.1	192.8	89.4	2.9	26,800	0.4130
95/15	109.7	6	26/2.15	7/1.67	94.4	109.7	13.8	5.01	384.8	260.3	120.1	3.9	35,750	0.3058
95/55	152.8	1.7	12/3.2	7/3.2	96.25	152.8	16	9.6	721.4	266.2	441.1	14.1	79,350	0.2993
105/75	181.5	1.4	14/3.1	19/2.25	105.7	181.5	17.5	11.25	906.7	291.8	594.0	20.9	108,450	0.2590
120/20	141.4	6	26/2.44	7/1.9	121.6	141.4	15.5	5.7	496.0	335.5	155.5	5.0	45,650	0.2374
120/70	193.3	1.7	12/3.6	7/3.6	122	193.3	18	10.8	913.2	337.0	558.3	17.9	100,000	0.2363
125/30	157.7	4.3	30/2.33	7/2.33	127.9	157.7	16.1	6.99	594.4	353.0	233.9	7.5	57,600	0.2259
150/25	173.1	6	26/2.7	7/2.1	148.9	173.1	17.1	6.31	606.7	410.6	190.0	6.1	55,250	0.1939
170/40	211.9	4.3	30/2.7	7/2.7	171.8	211.9	18.9	8.1	798.3	474.2	314.0	10.1	76,750	0.1682
185/30	213.6	6	26/3	7/2.33	183.8	213.6	19	6.99	748.5	507.5	233.9	7.6	66,200	0.1570
210/35	243.2	6	26/3.2	7/2.49	209.1	243.2	20.3	7.47	852.3	576.6	267.1	8.6	74,900	0.1381
210/50	261.6	4.3	30/3	7/3	212.1	261.6	21	9	985.7	585.5	387.7	12.5	93,900	0.1363
230/30	260.7	7.7	24/3.5	7/2.33	230.9	260.7	21	6.99	878.0	636.5	233.9	7.6	73,100	0.1250
240/40	282.5	6	26/3.45	7/2.68	243	282.5	21.9	8.04	989.8	670.4	309.4	10.0	86,400	0.1181
265/35	297.5	7.7	24/3.74	7/2.49	263.7	297.8	22.4	7.47	1,002.7	726.9	267.1	8.7	83,050	0.1094
300/50	353.7	6	26/3.86	7/3	304.3	353.7	24.5	9	1,239.2	839.0	387.7	12.5	107,000	0.0949
305/40	344.1	7.7	54/2.68	7/2.68	304.6	344.1	24.1	8.04	1,160.6	841.2	309.4	10.0	99,400	0.0949
340/30	369.1	11.3	48/3	7/2.33	339.9	369.1	25	6.99	1,178.2	936.8	233.9	7.5	92,900	0.0851
380/50	431.5	7.7	54/3	7/3	382	431.5	27	9	1,454.5	1,054.3	367.7	12.5	123,100	0.0757
385/35	420.1	11.3	48/3.2	7/2.49	386	420.1	26.7	7.47	1,341.1	1,065.4	267.1	8.6	104,600	0.0748
435/55	490.6	7.7	54/3.2	7/3.2	434.3	490.6	28.8	9.6	1,654.2	1,199.0	441.1	14.2	136,450	0.0666
450/40	468.2	11.3	48/3.45	7/2.68	448.7	488.2	28.7	8.04	1,557.1	1,238.6	309.4	9.1	120,750	0.0644
490/65	553.9	7.7	54/3.4	7/3.4	490.3	553.9	30.6	10.2	1,867.7	1,353.7	498.0	16.0	153,100	0.0590
495/35	528.2	14.5	45/3.74	7/2.49	494.1	528.2	29.9	7.47	1,644.0	1,368.2	267.2	8.6	121,800	0.0584
510/45	555.5	11.3	48/3.68	7/2.87	510.2	555.5	30.7	8.61	1,774.6	1,408.1	355.1	11.4	136,650	0.0565
550/70	621.3	7.7	54/3.6	7/3.6	550	621.3	32.4	10.6	2,094.6	1,518.3	558.3	18.0	170,600	0.0526
560/50	611.2	11.3	48/3.86	7/3	561.7	611.2	32.2	9	1,950.4	1,550.2	387.7	12.5	148,950	0.0514
570/40	610.7	14.5	45/4.02	7/2.68	571.2	610.7	32.2	8.04	1,727.5	1,561.7	309.4	10.0	136,200	0.0511
650/45	696.6	14.5	45/4.3	7/2.87	653.5	698.8	34	8.61	2,172.4	1,805.9	355.1	11.4	155,500	0.0443
680/85	764.6	7.7	54/4	19/2.4	678.6	764.6	36	12	2,572.5	1,874.5	675.8	22.2	206,250	0.0426
1,045/45	1,090.9	23.1	72/4.3	7/2.87	1,045.6	1,090.9	43	8.61	3,273.6	2,907.1	355.1	11.4	217,600	0.0279

ACSR

ALUMINIUM CONDUCTORS, STEEL-REINFORCED (ACSR)
AS PER SWEDISH SPECIFICATION - SS 424 08 07 - 1978

code name	Design (nomL area) mm²	Area			Numb. and diam. of wires				Calc. Over-all diam. mm	Weight			Break-ing load kN	*DC resistance at 20° C Ohm/km
					Aluminium		Steel							
		Alu-minium mm²	Steel mm²	Total mm²	Numb.	mm	Numb.	mm		Alu-minium kg/km	Steel kg/km	Total kg/km		
Swallow	31	26.69	4.45	31.14	6	2.38	1	2.38	7.1	73	35	108	10.0	1.07
Robin	49	42.41	7.07	49.48	6	3.00	1	3.00	9.0	116	55	171	15.6	0.675
Raven	62	53.52	8.92	62.44	6	3.37	1	3.37	10.1	146	70	216	19.0	0.535
Pigeon	99	85.12	14.19	99.31	6	4.25	1	4.25	12.8	232	111	343	29.8	0.336
Partridge	157	134.9	22.0	156.9	26	2.57	7	2.00	16.3	372	173	545	50.2	0.214
Ibis	234	201.3	32.7	234.0	26	3.14	7	2.44	19.9	555	257	812	72.9	0.143
Dove	329	282.6	45.9	328.5	26	3.72	7	2.89	23.6	780	360	1140	99.7	0.102
Condor	454	402.3	52.2	454.5	54	3:08	7	3.08	27.7	1113	409	1522	129	0.0720
Curlew	593/68	525.5	68.1	593.6	54	3.52	7	3.52	31.7	1455	535	1990	165	0.0551
Skata	774/89	685.4	88.8	774.2	54	4.02	7	4.02	36.2	1895	697	2592	212	0.0422
Falcon	910/102	806.2	102.4	908.6	54	4.36	19	2.62	39.3	2230	810	3040	251	0.0361
Morkulla	593/29	562.7	29.1	591.8	42	4.13	7	2.30	31.7	1554	228	1782	128	0.0514
Ripa	774/38	734.7	37.7	772.6	42	4.72	7	2.62	36.2	2030	294	2324	162	0.0393
Orre	910/44	864.7	44.3	909.0	42	5.12	7	2.84	39.2	2338	348	2736	191	0.0334
Dotterel	142	89.4	52.2	141.6	12	3.08	7	3.08	15.4	247	409	655	73.2	0.322
Oden	185	116.8	68.1	184.9	12	3.52	7	3.52	17.6	320	535	855	94.9	0.247
Atle	241	152.3	88.8	241.1	12	4.02	7	4.02	20.1	418	697	1115	123	0.189
Ymer	319	251.0	68.1	319.1	32	3.16	7	3.52	23.2	693	535	1228	119	0.115

*Based on resistivity - 28.264 Ohm mm²/km ı Conductivity 61.00% I.A.C.S.

ALUMINIUM CONDUCTORS, STEEL REINFORCED (ACSR)
AS PER FRENCH SPECIFICATION - NF C 34-120 - 1976

Designation (nominal area) mm²	Area			Aluminium		Steel		Over-all diam. mm	Weight			Break-ing load kN	*DC resistance at 20° C Ohm/km
	Alu-minium mm²	Steel mm²	Total mm²	Numb. of wires	Diam. of wire mm	Numb. of wires	Diam. of wire mm		Alu-minium kg/km	Steel kg/km	Total kg/km		
CANNA 37.7	28.27	9.42	37.69	9	2.0	3	2.0	8.3	78	77	155	15.4	1.02
CANNA 59.7	37.70	21.99	59.69	12	2.0	7	2.0	10	104	172	276	30.5	1.765
CANNA 75.5	47.71	27.83	75.54	12	2.25	7	2.25	11.25	130	218	348	36.4	0.605
CANNA 116.2	94.25	21.99	116.24	30	2.0	7	2.0	14	260	172	432	41.5	0.306
CROCUS 116.2	94.25	21.99	116.24	30	2.0	7	2.0	14	260	172	432	47.4	0.306
CANNA 147.1	119.28	27.83	147.11	30	2.25	7	2.25	15.75	329	218	547	52.0	0.243
CROCUS 147.1	119.28	27.83	147.11	30	2.25	7	2.25	15.75	329	218	547	59.5	0.243
CANNA 181.6	147.26	34.36	181.62	30	2.5	7	2.5	17.5	407	268	675	62.6	0.197
CROCUS 181.6	147.26	34.36	181.62	30	2.5	7	2.5	17.5	407	268	675	72.9	0.197
CANNA 228	184.72	43.1	227.82	30	2.8	7	2.8	19.6	510	338	848	77.1	0.157
CROCUS 228	184.72	43.1	227.82	30	2.8	7	2.8	19.6	510	338	848	90.0	0.157
CANNA 288	233.80	54.55	288.35	30	3.15	7	3.15	22.05	646	428	1074	96.0	0.1225
CROCUS 288	233.80	54.55	288.35	30	3.15	7	3.15	22.05	646	428	1074	113.2	0.1225
CROCUS 297	221.67	75.54	297.21	36	2.8	19	2.25	22.45	615	603	1218	139.5	0.1305
CROCUS 412	325.72	85.95	411.67	32	3.6	19	2.4	26.4	910	683	1593	169.6	0.0698
CROCUS 612	506.97	104.79	611.76	42	2.61	19	2.65	32.2	1406	835	2241	169.6	0.0566
				20	4.24								
CROCUS 865	717.33	148.06	865.39	66	3.72	19	3.15	38.1	1955	1179	3174	318.9	0.0405
CROCUS 1185	958.6	227.82	1184.48	54	2.8	37	2.8	44.7	2654	1824	4478	469.4	0.0303
				66	3.47								

*Based on resistivity - 28.264 Ohm mm²/km ● Conductivity 61.00% I.A.C.S.

ACSR

ALUMINIUM CONDUCTOR STEEL REINFORCED (ACSR)
AS PER USSR STANDARD

Conductor size mm²		Stranding, No/mm		Overall diameter, mm		Calculated electrical resistance /km. 20° C	Rated strength, N	Weight 1 km. kg		
Nominal Al/St	Calculated Al/St	Aluminium	Steel	A.C.S.R.	Steel core			Aluminium	Steel	Total
10/1.8	10.6/1.77	6/1.50	1/1.50	4.5	1x1.5	2.7064	4089	28.9	13.8	42.7
16/2.7	16/2.69	6/1.85	1/1.85	5.6	1.9	1.7818	6220	44.0	20.9	64.9
25/4.2	24.9/4.15	6/2.30	1/2.30	6.9	2.3	1.1521	9296	67.9	32.4	100.3
35/6.2	36.9/6.15	6/2.80	1/2.80	8.4	2.8	0.7774	13524	100.0	48.0	148.0
50/8.0	48.2/8.04	6/3.20	1/3.20	9.6	3.2	0.5951	17112	132.0	63.0	195.0
70/11	68/11.3	6/3.80	1/3.80	11.4	3.8	0.4218	24130	188.0	88.0	276.0
70/72	68.4/72.7	18/2.20	19/2.20	15.4	11.0	0.4194	96826	188.0	567.0	755.0
96/16	95.4/15.9	6/4.50	1/4.50	13.5	4.5	0.3007	33369	261.0	124.0	385.0
95/141	91.2/141	24/2.20	37/2.20	19.8	15.4	0.3146	180775	251.0	1106.0	1357.0
120/19	118/18.8	16/2.40	7/1.85	15.2	5.6	0.2440	41521	324.0	147.0	471.0
120/27	114/26.6	30/2.20	7/2.20	15.4	6.6	0.2531	49465	320.0	208.0	528.0
150/19	148/18.8	24/2.80	7/1.85	16.8	5.6	0.2046	46307	407.0	147.0	554.0
150/24	149/24.2	26/2.70	7/2.10	17.1	6.3	0.2039	52279	409.0	190.0	599.0
150/34	147/34.3	30/2.50	7/2.50	17.5	7.5	0.2061	62643	406.0	269.0	675.0
185/24	187/24.2	24/3.15	7/2.10	18.9	6.3	0.1540	58075	515.0	190.5	705.0
185/29	181/29	26/2.98	7/2.30	18.8	6.9	0.1591	62055	500.0	228.0	728.0
185/43	185/43.1	30/2.80	7/2.80	19.6	8.4	0.1559	77767	509.0	337.0	846.0
185/128	187/128	54/2.10	37/2.10	23.1	14.7	0.1543	183816	517.0	1008.0	1525.0
205/27	205/26.6	24/3.30	7/2.20	19.8	6.6	0.1407	63740	566.0	208.0	774.0
240/32	244/31.7	24/3.60	7/2.40	21.6	7.2	0.1182	75050	673.0	248.0	921.0
240/39	236/38.6	26/3.40	7/2.65	21.6	8.0	0.1222	80895	650.0	302.0	952.0
240/56	241/56.3	30/3.20	7/3.20	22.4	9.6	0.1197	98253	665.0	441.0	1106.6
300/39	301/38.6	24/4.00	7/2.65	24.0	8.0	0.0958	90574	830.0	302.0	1132.0
300/48	295/47.8	26/3.80	7/2.95	24.1	8.9	0.0978	100623	812.0	374.0	1186.0
300/66	288.5/65.8	30/3.50	19/2.10	24.5	10.5	0.1000	117520	796.0	517.0	1313.0
300/67	288.5/67.3	30/3.50	7/3.50	24.5	10.5	0.1000	126270	796.0	527.0	1323.0
300/204	298/204	54/2.65	37/2.65	29.2	18.6	0.0968	284579	823.0	1605.0	2428.0
330/30	335/29.1	48/2.98	7/2.30	24.8	6.9	0.0881	88848	924.0	228.0	1152.0
330/43	332/43.1	54/2.80	7/2.80	25.2	8.4	0.0869	103784	918.0	337.0	1255.0
400/18	318/18.8	42/3.40	7/1.85	26.0	5.6	0.0758	85600	1052.0	147.0	1199.0
400/22	394/22	76/2.57	7/2.00	26.6	6.0	0.0733	95115	1089.0	172.0	1261.0
400/51	394/51.1	54/3.05	7/3.05	27.5	9.2	0.0733	120481	1090.0	400.0	1490.0
400/64	390/63.5	26/4.37	7/3.40	27.7	10.2	0.0741	129183	1074.0	498.0	1572.0
400/93	406/93.2	30/4.15	19/2.50	29.1	12.5	0.0711	173715	1119.0	732.0	1851.0
450/56	434/56.3	54/3.20	7/3.20	28.8	9.6	0.0666	131370	1199.0	441.0	1640.0
500/26	502/26.6	42/3.90	7/2.20	30.3	6.6	0.0575	112548	1384.0	208.0	1592.0
500/27	481/26.6	76/2.84	7/2.20	29.4	6.6	0.0600	112188	1329.0	208.0	1537.0
500/64	490/63.5	54/3.40	7/3.40	30.6	10.2	0.0588	148257	1354.0	498.0	1852.0
500/204	496/204	90/2.65	37/2.65	34.5	18.6	0.0580	319609	1374.0	1605.0	2979.0
500/336	490/336	54/3.40	61/2.65	37.5	23.9	0.0588	466649	1355.0	2650.0	4005.0
550/71	549/71.2	54/3.60	7/3.60	32.4	10.8	0.0526	166164	1518.0	558.0	2076.0
600/72	580/72.2	54/3.70	19/2.20	33.2	11.0	0.0498	183835	1603.0	567.0	2170.0
650/79	634/78.9	96/2.90	19/2.30	34.7	11.5	0.0456	200451	1752.0	620.0	2372.0
700/86	687/85.9	96/3.02	19/2.40	36.2	12.0	0.0420	217775	1900.0	675.0	2575.0
750/93	748/93.2	96/3.15	19/2.50	37.7	12.5	0.0386	234450	2068.0	732.0	2800.0
800/105	821/105	96/3.30	19/2.65	39.7	13.3	0.0352	266073	2269.0	441.0	3210.0
1000/56	1003/56.3	76/4.10	7/3.20	42.5	9.6	0.0288	244047	2769.0	441.0	3210.0
1000/645	944/643	54/4.72	91/3.00	51.9	33.0	0.03060	962220	2600.0	5120.0	7720.0
1200/67	1208/67.4	76/4.50	7/3.50	46.5	10.5	0.02392	271872	3338.0	528.0	3866.0

ACSR

ALUMINIUM CONDUCTORS STEEL-REINFORCED (ACSR)
AS PER IS 398 (PART - 2) 1996

Nominal Aluminium	Stranding and wire dia.		Sectional Area of Aluminium	Total Sectional Area	Approx. diameter	Approx. Mass	Calculated Resistance at 20°C C, Max	Approx. Calculated Breaking Load
	Aluminium	Steel						
(1) mm²	(2) mm	(3) mm	(4) mm	(5) mm	(6) mm	(7) Kg/km	(8) Ohm/km	(9) kN
10	6/1.50	1/1.50	10.60	12.37	4.50	43	2.780	3.97
18	6/1.96	1/1.96	18.10	21.12	5.88	73	1.618	6.74
20	6/2.11	1/2.11	20.98	24.48	6.33	85	1.394	7.16
30	6/2.59	1/2.59	31.61	36.88	7.77	128	0.928 9	11.12
50	6/3.35	1/3.35	52.88	61.70	10.05	214	0.552 4	18.25
80	6/4.09	1/4.09	78.83	91.97	12.27	319	0.371 2	26.91
100	6/4.72	7/1.57	105.0	118.5	14.15	394	0.279 2	32.41
150	30/2.59	7/2.59	158.1	194.9	18.13	726	0.187 1	67.34
200	30/3.00	7/3.00	212.1	261.5	21.00	974	0.139 0	89.67
400	42/3.50	7/1.96	404.1	425.2	26.88	1281	0.073 11	88.79
420	54/3.18	7/3.18	428.9	484.5	28.62	1621	0.068 68	130.32
520	54/3.53	7/3.53	528.5	597.0	31.77	1998	0.055 95	159.60
560	42/4.13	7/2.30	562.7	591.7	31.68	1781	0.052 31	120.16

Extra High voltage
400 KV and above)

ALUMINIUM CONDUCTORS STEEL-REINFORCED (ACSR)
AS PER IS 398 (PART - 5) 1992

Nominal Aluminium	Stranding and wire dia.		Sectional Area of Aluminium	Total Sectional Area	Approx. diameter	Approx. Mass	Calculated Resistance at 20°C C, Max	Approx. Calculated Breaking Load
	Aluminium	Steel						
(1) mm²	(2) mm	(3) mm	(4) mm	(5) mm	(6) mm	(7) Kg/km	(8) Ohm/km	(9) kN
520	54/3.53	7/3.53	528.5	597.0	31.77	2.004	0.05552	161.20
560	42/4.13	7/2.30	562.7	591.7	31.68	1.787	0.05199	120.18
690	42/4.57	7/2.54	688.9	724.4	35.04	2.187	0.0424	146.87

COMPANY PROFILE CLASSIFICATION

AAAC

ALL ALUMINIUM ALLOY CONDUCTOR (AAAC)

CHARACTERISTICS OF A2 CONDUCTORS AS PER IEC 1089/91 TYPE A2

Code number	Area	Number of wires	Diameter		Linear mass	Rated strength	*D. C. resistance
			Wire	Cond.			
	mm²		mm	mm	kg / km	kN	Ohm/km
16	16.40	7	1.83	5.49	50.4	5.43	1.7896
25	28.8	7	2.29	6.86	78.7	8.49	1.1453
40	46.0	7	2.89	8.68	125.9	13.58	0.7158
63	72.5	7	3.63	10.90	198.3	21.39	0.4545
100	115	19	2.78	13.90	316.3	33.95	0.2877
125	144	19	3.10	15.5	395.4	42.44	0.2302
160	184	19	3.51	17.6	506.1	54.32	0.1798
200	230	19	3.93	19.6	632.7	67.91	0.1439
250	288	19	4.39	22.0	790.8	84.88	0.1151
315	363	37	3.53	24.7	998.9	106.95	0.0916
400	460	37	3.98	27.9	1268.4	135.81	0.0721
450	518	37	4.22	29.6	1426.9	152.79	0.0641
500	575	37	4.45	31.2	1585.5	169.76	0.0577
560	645	61	3.67	33.0	1778.4	190.14	0.0516
630	725	61	3.89	35.0	2000.7	213.90	0.0458
710	817	61	4.13	37.2	2254.8	241.07	0.0407
800	921	61	4.38	39.5	2540.6	271.62	0.0361
900	1036	91	3.81	41.8	2861.1	305.58	0.0321
1000	1151	91	4.01	44.1	3179.0	339.53	0.0289
1120	1289	91	4.25	46.7	3560.5	380.27	0.0258
1250	1439	91	4.49	49.4	3973.7	424.41	0.0231

*ALUMINIUM ALLOY Resistivity at 20°C 32.530 Ohm mm²/km
Conductivity 53% I.A.C.S.

AAAC

ALL ALUMINIUM ALLOY CONDUCTOR (AAAC)
Characteristics of A3 conductors as per IEC 1089/91 TYPE A3

Code number	Area	Number of wires	Diameter		Linear mass	Rated strength	*D. C. resistance
			Wire	Cond.			
	mm²		mm	mm	kg / km	kN	Ohm/km
16	16.6	7	1.84	5.52	50.8	6.04	1.7896
25	29.0	7	2.30	6.90	79.5	9.44	1 .1453
40	46.5	7	2.91	8.72	127.1	15.10	0.7158
63	73.2	7	3.65	10.9	200.2	23.06	0.4545
100	116	19	2.79	14.0	319.3	37.76	0.2877
125	145	19	3.12	15.6	399.2	47.20	0.2302
160	186	19	3.53	17.6	511.0	58.56	0.1798
200	232	19	3.95	19.7	638.7	73.20	0.1439
250	290	19	4.41	22.1	798.4	91.50	0.1151
315	366	37	3.55	24.8	1 008.4	115.29	0.0916
400	465	37	4.00	28.0	1280.5	146.40	0.0721
450	523	37	4.24	29.7	1440.5	164.70	0.0641
500	581	37	4.47	31.3	1600.6	183.00	0.0577
560	651	61	3.69	33.2	1795.3	204.96	0.0516
630	732	61	3.91	35.2	2019.8	230.58	0.0458
710	825	61	4.15	37.3	2276.2	259.86	0.0407
800	930	61	4.40	39.6	2564.8	292.80	0.0361
900	1046	91	3.83	42.1	2888.3	329.40	0.0321
1000	1162	91	4.03	44.4	3209.3	366.00	0.0289
1120	1301	91	4.27	46.9	3594.4	409.92	0.0258

*ALUMINIUM ALLOY Resistivity at 20°C 32.84 Ohm mm²/km
Conductivity 52.5% I.A.C.S.

AAAC

ALL ALUMINIUM ALLOY CONDUCTORS (AAAC)
AS PER ASTM B 399 - 92

Conductor Size, mm²	Required construction		Weight per km. kg	Rated Strength kN	D. C. Resistance Ohm/km
	Number of wires	Diameter mm			
886.7	61	4.30	2429	253	0.0378
760.0	61	3.98	2081	217	0.0441
633.3	61	3.63	1733	180	0.0531
506.7	37	4.18	1388	146	0.0659
456.0	37	3.96	1249	132	0.0735
405.4	37	3.73	1109	117	0.0828
380.0	37	3.62	1041	110	0.0879
354.7	37	3.49	970.6	102	0.0946
329.4	37	3.37	901.3	99.1	0.1015
304.0	37	3.23	632.0	91.5	0.1104
278.7	37	3.10	762.9	83.9	0.1199
253.4	19	4.12	693.6	74.7	0.1322
228.0	19	3.91	624.4	67.3	0.1468
202.7	19	3.69	555.1	59.8	0.1648
177.3	19	3.45	485.5	52.3	0.1686
152.0	19	3.19	416.6	46.8	0.2205
126.7	19	2.91	346.9	39.0	0.2650
107.2	7	4.42	293.7	32.7	0.3118
85.0	7	3.93	232.7	25.9	0.394
67.4	7	3.50	184.7	20.5	0.497
53.5	7	3.12	146.5	17.0	0.6259
33.6	7	2.47	92.14	10.7	0.9986
21.1	7	1.96	57.89	6.72	1.586
13.3	7	1.55	36.44	4.22	2.536

AAAC

ALUMINIUM ALLOY CONDUCTORS (AAAC)
AS PER DIN SPECIFICATION - DIN 48201 - PART 6 - 1981

Designation (nominal area) mm^2	Area mm^2	Number of Wires	Diam. of wire mm	Overall diam. mm	Breaking load kN	*DC resistance at 20°C Ohm/km	Weight kg/km
16	15.89	7	1.70	5.1	4.44	2.090	43
25	24.25	7	2.10	6.3	6.77	1.370	66
35	34.36	7	2.50	7.5	9.60	0.9666	94
50	49.48	7	3.00	9.0	13.82	0.6712	135
50	48.35	19	1.80	9.0	13.50	0.6903	133
70	65.81	19	2.10	10.5	18.36	0.5071	181
95	93.27	19	2.50	12.50	26.05	0.3578	256
120	116.99	19	2.80	14.0	32.68	0.2853	322
150	147.11	37	2.25	15.8	41.09	0.2274	406
185	181.62	37	2.50	17.5	50.73	0.1842	500
240	242.54	61	2.25	20.3	67.74	0.1382	670
300	299.43	61	2.50	22.5	83.63	0.1120	827
400	400.14	61	2.89	26.0	111.76	0.08378	1104
500	499.83	61	3.23	29.1	139.60	0.06707	1379
625	626.20	91	2.96	32.6	174.90	0.05365	1732
800	802.09	91	3.35	36.9	224.02	0.04189	2218
1000	999.71	91	3.74	41.1	279.22	0.03361	2767

*ALUMINIUM ALLOY Resistivity 32.79 Ohm mm^2/km
Conductivity 52.58% I.A.C.S.

ALL ALUMINIUM ALLOY CONDUCTORS (AAAC)
AS PER BS - 3242 - 1970

Nominal aluminium area (1) mm^2	Stranding and wire diameter (2) mm	Sectional area (3) mm^2	Approximate overall diameter (4) mm	Approximate mass per km (5) kg	Calculated d.c. resistance at 20°C per km (6) Ohm	Calculated breaking load (7) kN	Nominal aluminium area (8) mm^2
25	7/2.34	30.10	7.02	82	1.091	8.44	25
30	7/2.54	35.47	7.62	97	0.928 1	9.91	30
40	7/2.95	47.81	8.85	131	0.888 0	13.40	40
50	7/3.30	59.87	9.90	161	0.549 8	16.80	50
100	7/4.65	118.9	13.05	325	0.276 9	33.30	100
150	19/3.48	180.7	17.10	497	0.1830	50.65	150
175	19/3.76	211.0	18.80	580	0.1568	59.10	175
300	37/3.53	362.1	21.71	997	0.09155	101.5	300

COMPANY PROFILE CLASSIFICATION

AAAC

ALL ALUMINIUM ALLOY CONDUCTORS (AAAC)
AS PER FRENCH SPECIFICATION - NF C 34 - 125 - 1976

Designation (nominal area)	Area mm²	Number of Wires	Diam. of wire mm	Overall diam. mm	Breaking load kN	*DC resistance at 20°C Ohm/km	Weight kg/km
ASTER 22	21.99	7	2.0	6	7.10	1.50	60.2
ASTER 34.4	34.36	7	2.5	7.5	11.05	0.958	94
ASTER 54.6	54.55	7	3.15	9.45	17.55	0.603	149
ASTER 75.5	75.54	19	2.25	11.25	24.30	0.438	208
ASTER 117	116.99	19	2.8	14	37.65	0.283	322
ASTER 148	148.07	19	3.15	15.75	47.65	0.224	407
ASTER 181.6	181.62	37	2.5	17.5	58.45	0.183	500
ASTER 228	227.83	37	2.8	19.6	73.40	0.146	627
ASTER 288	288.34	37	3.15	22.05	92.80	0.115	794
ASTER 366	366.22	37	3.55	24.85	117.85	0.0905	1009
ASTER 570	570.24	61	3.45	31.05	183.60	0.0583	1574
ASTER 851	850.69	61	3.45	37.95	273.90	0.0391	2354
ASTER 1144	1143.54	91	4.0	44	362.60	0.0292	3164
ASTER 1600	1595.93	127	4.0	52	506.40	0.0209	4425

*ALUMINIUM ALLOY Resistivity 32.5 Ohm mm²/km : Conductivity 53.05% I.A.C.S.

ALL ALUMINIUM ALLOY CONDUCTORS (AAAC)
AS PER SWEDISH SPECIFICATION - SS 424 08 12 - 1978

Designation (nominal area) mm²	Area mm²	Number of Wires	Diam. of wire mm	Overall diam. mm	Weight kg/km	Breaking load kN	*DC resistance at 20°C Ohm/km
31	31.14	7	2.38	7.1	85	9.80	1.06
49	49.48	7	3.00	9.0	135	15.5	0.670
62	62.44	7	3.37	10.1	170	19.6	0.531
99	99.31	7	4.25	12.8	271	30.2	0.334
157	158.6	19	3.26	16.3	436	49.8	0.210
234	241.2	19	4.02	20.1	663	73.3	0.138
329	330.0	37	3.37	23.6	910	104	0.101
454	454.5	61	3.08	27.7	1260	143	0.0739
593	593.6	61	3.52	31.7	1640	181	0.0565
774	774.2	61	4.02	36.2	2140	235	0.0434
910	910.7	61	4.36	39.2	2520	277	0.0369

*Based on resistivity - 32.8 Ohm mm²/km
Conductivity 52.56% I.A.C.S.

AAAC

ALL ALUMINIUM ALLOY CONDUCTORS (AAAC)

AS PER IS 398 - Part 4 - 1994

Sl. No.	Actual Area mm²	Stranding and wire dia mm	Approx overall dia mm	Approx mass kg/km	Calculated maximum resistance at 20° C Ohm/km	Approx calculated breaking load kN
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	15	3/2.50	5.39	40.15	2.304 0	4.33
2.	22	7/2.00	6.00	60.16	1.541 0	6.45
3.	34	7/2.50	7.50	94.00	0.990 0	10.11
4.	55	7/3.15	9.45	149.20	0.621 0	16.03
5.	80	7/3.81	11.43	218.26	0.425 0	23.41
6.	100	7/4.26	12.78	272.86	0.339 0	29.26
7.	125	19/2.89	14.45	342.51	0.273 5	36.64
8.	148	19/3.15	15.75	406.91	0.229 0	43.50
9.	173	19/3.40	17.00	474.02	0.196 9	50.54
10.	200	19/3.66	18.30	549.40	0.171 0	58.66
11.	232	19/3.94	19.70	636.67	0.147 1	68.05
12.	288	37/3.15	22.05	794.05	0.118 2	84.71
13.	346	37/3.45	24.15	952.56	0.098 4	101.58
14.	400	37/3.71	25.97	1 101.36	0.082 9	117.40
15.	485	37/4.00	28.00	1 280.50	0.073 4	136.38
16.	525	81/3.31	29.79	1 448.39	0.065 1	146.03
17.	570	61/3.45	31.05	1 573.71	0.059 8	158.68
18.	604	61/3.55	31.95	1 666.00	0.058 8	167.99
19.	642	81/3.66	32.94	1 771.38	0.053 4	178.43
20.	695	61/3.81	34.29	1 919.13	0.049 2	193.25
21.	767	61/4.00	36.00	2 115.54	0.044 6	213.01

ACAR

ALUMINIUM CONDUCTOR ALUMINIUM ALLOY REINFORCED (ACAR)
Characteristics of A1/A2 conductors as per IEC 1089/91

Code number	Diameter		Number of Wires		Areas			Linear mass	Rated strength	*D.C. resistance
	Wire	Cond.	A1	A2	A1	A2	Total			
	mm	mm			mm²	mm²	mm²	kg/km	kN	Ohm/km
16	1.76	5.28	4	3	9.73	7.30	17.0	46.6	3.85	1.7896
25	2.20	6.60	4	3	15.2	11.4	26.6	72.8	5.93	1.1453
40	2.78	8.35	4	3	24.3	18.3	42.6	116.5	9.25	0.7158
63	3.49	10.5	4	3	38.3	28.7	87.1	183.5	14.38	0.4545
100	4.40	13.2	4	3	60.8	45.6	106	291.2	22.52	0.2863
125	2.97	14.9	12	7	83.3	48.6	132	362.7	27.79	0.2302
160	3.36	16.8	12	7	107	62.2	169	464.2	35.04	0.1798
200	3.76	18.8	12	7	133	77.8	211	580.3	43.13	0.1439
250	4.21	21.0	12	7	167	97.2	264	725.3	53.92	0.1151
250	3.04	21.3	18	19	131	138	269	742.2	60.39	0.1154
315	3.34	23.4	30	7	263	61.3	324	892.6	60.52	0.0916
315	3.42	23.9	18	19	165	174	339	935.1	76.09	0.0916
400	3.76	26.3	30	7	334	77.8	411	1133.5	75.19	0.0721
400	3.85	27.0	18	19	210	221	431	1187.5	95.58	0.0721
450	3.99	27.9	30	7	375	87.6	463	1275.2	84.59	0.0641
450	4.08	28.8	18	19	236	249	485	1335.9	107.52	0.0641
500	4.21	29.4	30	7	417	97.3	514	1416.9	93.98	0.0577
500	4.31	30.1	18	19	262	277	539	1484.3	119.47	0.0577
560	4.45	31.2	30	7	467	109	576	1586.9	105.26	0.0515
560	3.45	31.0	54	7	504	65.4	570	1571.9	101.54	0.0516
630	3.71	33.4	42	19	454	205	660	1820.0	130.25	0.0458
630	3.79	34.1	24	37	271	417	688	1897.5	160.19	0.0458
710	3.94	35.5	42	19	512	232	743	2051.2	146.78	0.0407
710	4.02	36.2	24	37	305	470	775	2138.4	180.53	0.0407
800	4.18	37.6	42	19	577	261	838	2311.2	165.39	0.0361
800	4.27	38.4	24	37	344	530	873	2409.5	203.41	0.0361
900	4.43	39.9	42	19	649	294	942	2600.1	186.06	0.0321
900	3.66	40.2	54	37	567	388	955	2638.4	199.54	0.0321
1000	3.80	41.8	72	19	816	215	1032	2849.1	190.94	0.0289
1000	3.85	42.4	54	37	630	432	1061	2931.6	221.71	0.0289
1120	4.02	44.2	72	19	914	241	1115	3191.0	213.85	0.0258
1120	4.08	44.9	54	37	705	483	1189	3283.4	248.32	0.0258
1250	4.25	48.7	72	19	1020	269	1289	3561.4	238.68	0.0231
1250	4.31	47.4	54	37	787	539	1327	3664.5	277.14	0.0231
1400	4.50	49.4	72	19	1143	302	1444	3988.8	267.32	0.0207

*ALUMINIUM ALLOY Resistivity 32.53 Ohm mm²/km ● Conductivity 53% I.A.C.S.
ALUMINIUM Resistivity 28.264 Ohm mm²/km ● Conductivity 61% I.A.C.S.

ACAR

ALUMINIUM CONDUCTOR ALUMINIUM ALLOY REINFORCED (ACAR)

Characteristics of A1/A2 conductors as per IEC 1089/91

Code number	Diameter		Number of Wires		Areas			Linear mass	Rated strength	*D.C. resistance
	Wire	Cond.	A1	A3	A1	A3	Total			
	mm	mm			mm²	mm²	mm²	kg/km	kN	Ohm/km
16	1.76	5.29	4	3	9.78	7.33	17.1	46.8	4.07	1.7896
25	2.21	6.62	4	3	15.3	11.5	26.7	73.1	6.29	1.1453
40	2.79	8.37	4	3	24.4	18.3	42.8	117.0	9.82	0.7158
63	3.50	10.5	4	3	38.5	28.9	67.4	184.3	14.80	0.4545
100	4.41	13.2	4	3	61.1	45.8	107	292.5	23.49	0.2863
125	2.98	14.9	12	7	83.7	48.8	132	364.1	29.29	0.2302
160	3.37	18.9	12	7	107	62.5	170	466.0	36.95	0.1798
200	3.77	18.8	12	7	134	78.1	212	582.5	44.78	0.1439
250	4.21	21.1	12	7	167	97.6	265	728.1	55.98	0.1151
250	3.05	21.4	18	19	132	139	271	746.0	64.67	0.1154
315	3.34	23.4	30	7	263	61.4	325	894.4	62.40	0.0916
315	3.43	24.0	18	19	168	175	341	940.0	81.48	0.0916
400	3.77	26.4	30	7	334	78.0	412	1135.8	76.82	0.0721
400	3.86	27.0	18	19	211	222	433	1193.7	100.30	0.0721
450	3.99	28:0	30	7	376	87.7	464	1277.8	86.42	0.0641
450	4.10	28.7	18	19	237	250	487	1342.9	112.84	0.0641
500	4.21	29.5	30	7	418	97.5	515	1419.8	96.03	0.0577
500	4.32	30.2	18	19	263	278	542	1492.1	125.38	0.0577
560	4.46	31.2	30	7	468	109	577	1590.1	107.55	0.0515
560	3.45	31.1	54	7	505	65.5	570	1573.9	103.53	0.0516
630	3.72	33.4	42	19	456	206	662	1826.0	134.59	0.0458
630	3.80	34.2	24	37	272	420	692	1909.0	169.14	0.0458
710	3.95	35.5	42	19	514	232	746	2057.8	151.68	0.0407
710	4.03	36.3	24	37	307	473	780	2151.4	190.61	0.0407
800	4.19	37.7	42	19	579	262	840	2318.7	170.90	0.0361
800	4.28	38.5	24	37	346	533	879	2424.2	214.78	0.0361
900	4.44	40.0	42	19	651	294	945	2608.5	192.27	0.0321
900	3.66	40.3	54	37	569	390	959	2649.5	207.79	0.0321
1000	3.80	41.8	72	19	818	216	1034	2855.4	195.47	0.0289
1000	3.86	42.5	54	37	632	433	1066	2943.9	230.88	0.0289
1120	4.02	44.3	72	19	916	242	1158	3198.1	218.92	0.0258
1120	4.09	45.0	54	37	708	485	1194	3297.2	258.58	0.0258
1250	4.25	46.8	72	19	1022	270	1292	3569.3	244.33	0.0231
1250	4.32	47.5	54	37	791	542	1332	3679.9	288.60	0.0231
1400	4.50	49.5	72	19	1145	302	1447	3997.6	273.65	0.0207

*ALUMINIUM ALLOY Resistivity 32.84 Ohm mm²/km ● Conductivity 52.5 % I.A.C.S.
ALUMINIUM Resistivity 28.264 Ohm mm²/km ● Conductivity 61 % I.A.C.S.

COMPANY PROFILE CLASSIFICATION

ACAR

ALUMINIUM CONDUCTOR ALUMINIUM ALLOY REINFORCED (ACAR)
AS PER ASTM B 524M - 1992

Conductor size, mm²	Diameter of wires, mm	Conductor diameter, mm	Linear Density			Rated Strength kN	D.C. Resistance Ohm/km
			1350, kg/km	6201, kg/km	Total kg/km		
Stranding 72/19							
1600	4.73	52.03	3559	934	4493	283	0.01888
1400	4.43	48.73	3092	812	3904	248	0.0213
1250	4.18	45.98	2753	723	3476	221	0.0239
1120	3.96	43.56	2471	648	3119	198	0.02667
1000	3.74	41.14	2204	578	2782	180	0.02990
Stranding 63/28							
1600	4.73	52.03	3114	1377	4491	300	0.01916
1400	4.43	48.73	2705	1196	3901	263	0.0216
1250	4.18	45.98	2409	1065	3474	234	0.0243
1120	3.96	43.56	2162	956	3118	210	0.02707
1000	3.74	41.14	1928	852	2780	190	0.0303
Stranding 54/37							
1600	4.73	52.03	2669	1819	4488	323	0.01944
1400	4.43	48.73	2319	1580	3899	283	0.02196
1250	4.18	45.98	2065	1407	3472	253	0.02466
1120	3.96	43.56	1653	1263	3116	226	0.02747
1000	3.74	41.14	1653	1126	2779	204	0.0308
Stranding 54/7							
1000	4.57	41.13	2468	318	2786	166	0.0295
900	4.33	38.97	2194	214	2478	148	0.0325
800	4.09	36.81	1957	252	2209	133	0.0364
710	3.85	34.64	1734	224	1958	118	0.0411
630	3.63	32.67	1542	199	1741	107	0.04627
560	3.42	30.78	1369	176	1545	96.1	0.05213
500	3.23	29.07	1221	157	1378	86.5	0.05844
Stranding 48/13							
1000	4.57	41.13	2194	591	2786	178	0.02990
900	4.33	38.97	1950	525	2475	159	0.03298
800	4.09	36.81	1740	469	2209	142	0.03696
710	3.85	34.65	1542	415	1957	126	0.0417
630	3.63	32.67	1371	369	1740	114	0.04693
560	3.42	30.78	1217	328	1545	102	0.05288
500	3.23	29.07	1085	292	1377	93.6	0.05928
Stranding 42/19							
1000	4.57	41.13	1919	864	2783	192	0.0303
900	4.33	38.97	1706	768	2474	173	0.03374
800	4.09	36.81	1522	685	2207	154	0.03751
710	3.85	34.65	1349	607	1956	137	0.0423
630	3.63	32.67	1199	540	1739	123	0.04762
560	3.42	30.78	1065	479	1544	110	0.05365
500	3.23	29.07	950	427	1377	100	0.06015

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ACAR

ALUMINIUM CONDUCTOR ALUMINIUM ALLOY REINFORCED (ACAR)
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Conductor size, mm^2	Diameter of wires, mm	Conductor diameter, mm	Linear Density			Rated Strength kN	D.C. Resistance Ohm/km
			1350, kg/km	6201, kg/km	Total kg/km		
Stranding 33/28							
1000	4.57	41.13	1508	1273	2781	208	0.0310
900	4.33	38.97	1341	1131	2472	187	0.0342
800	4.09	36.81	1196	1009	2205	167	0.0383
710	3.85	34.65	1060	894	1954	148	0.0433
630	3.63	32.67	942	795	1737	133	0.04869
560	3.42	30.78	836	706	1542	119	0.05486
500	3.23	29.07	746	630	1376	109	0.0615
Stranding 33/4							
630	4.66	32.62	1553	187	1740	104	0.0462
560	4.39	30.73	1378	166	1544	92.4	0.0521
500	4.15	29.05	1232	148	1380	82.6	0.0583
450	3.94	27.58	1110	134	1244	74.4	0.0646
400	3.71	25.97	984	119	1103	67.3	0.07296
355	3.50	24.50	876	106	982	60.8	0.0819
315	3.29	23.03	774	93	867	53.7	0.0927
280	3.10	21.70	687	63	770	46.1	0.1045
250	2.93	20.51	614	74	688	42.9	0.1169
Stranding 30/7							
630	4.66	32.62	1412	328	1740	113	0.0468
560	4.39	30.73	1253	291	1544	100	0.0527
500	4.15	29.05	1119	260	1379	89.5	0.0590
450	3.94	27.58	1009	234	1243	80.6	0.0654
400	3.71	25.97	895	208	1103	72.7	0.0738
355	3.50	24.50	796	185	981	65.5	0.0829
315	3.29	23.03	704	163	867	57.9	0.0938
260	3.10	21.70	625	145	770	52.1	0.1057
250	2.93	20.51	556	130	688	46.6	0.1183
Stranding 24/13							
630	4.66	32.62	1129	606	1737	125	0.0479
560	4.39	30.73	1002	540	1542	111	0.0540
500	4.15	29.05	896	483	1379	98.8	0.0604
450	3.94	27.58	807	435	1242	89.0	0.0670
400	3.71	25.97	716	386	1102	79.9	0.0756
355	3.50	24.50	637	343	980	71.7	0.0849
315	3.29	23.03	563	303	866	63.4	0.09612
280	3.10	21.70	500	269	769	57.6	0.1083
250	2.93	20.51	446	240	686	51.4	0.1212
Stranding 18/19							
630	4.66	32.62	847	889	1736	139	0.0491
560	4.39	30.73	752	769	1541	123	0.0553
500	4.15	29.05	672	705	1377	110	0.0619
450	3.94	27.58	606	636	1242	99.2	0.0687
400	3.11	25.97	537	563	1100	88.7	0.0775
355	3.50	24.50	478	501	979	79.5	0.0871
315	3.29	23.03	422	443	865	70.2	0.0985
280	3.10	21.70	375	393	768	64.2	0.1110
250	2.93	20.51	335	352	687	57.4	0.1242

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COMPANY PROFILE CLASSIFICATION

ALUMINIUM CONDUCTOR ALUMINIUM ALLOY REINFORCED (ACAR)
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Conductor size, mm^2	Diameter of wires, mm	Conductor diameter, mm	Linear Density			Rated Strength kN	D.C. Resistance Ohm/km
			1350, kg/km	6201, kg/km	Total kg/km		
Stranding 12/7							
280	4.33	21.65	488	283	771	57.6	0.1084
250	4.09	20.46	435	252	687	51.4	0.1214
224	3.87	19.35	389	226	615	46.0	0.1357
200	3.66	18.30	348	202	550	41.6	0.1517
180	3.47	17.35	313	182	495	37.8	0.1687
160	3.27	16.35	278	161	439	33.5	0.1900
140	3.06	15.30	242	141	384	30.1	0.2170
Stranding 15/4							
280	4.33	21.65	609	162	771	50.8	0.1059
250	4.09	20.45	544	144	688	45.3	0.1186
224	3.87	19.35	487	129	616	40.6	0.1325
200	3.68	18.30	435	115	550	36.9	0.1482
180	3.47	17.35	391	104	495	33.6	0.1648
160	3.27	16.35	348	92	440	29.8	0.1856
140	3.06	15.30	340	81	385	26.5	0.2119

ALUMINIUM CONDUCTOR ALUMINIUM ALLOY REINFORCED (ACAR)
AS PER ASTM B 524M - 1992

Conductor size, mm^2	Diameter of wires, mm	Conductor diameter, mm	Linear Density			Rated Strength kN	D.C. Resistance Ohm/km
			1350, kg/km	6201, kg/km	Total, kg/km		
125	4.77	14.31	197.2	147.1	344.3	26.7	0.2446
112	4.51	13.53	176.3	131.5	307.8	23.9	0.2736
100	4.26	12.78	157.3	117.3	274.6	17.2	0.3066
80.0	3.81	11.43	125.8	93.9	219.7	17.2	0.3834
63.0	3.39	10.17	99.6	74.3	173.9	13.7	0.4842
50.0	3.02	9.06	79.1	59.0	138.1	11.2	0.6102
40.0	2.70	8.10	63.2	47.1	110.3	8.95	0.7635
31.5	2.39	7.17	49.5	36.9	86.4	7.01	0.9744
25.0	2.13	6.39	39.3	29.3	68.6	5.57	1.227
20.0	1.91	5.73	31.6	23.6	55.2	4.48	1.526
16.0	1.71	5.13	25.3	18.9	44.2	3.59	1.903

AACSR

ALUMINIUM ALLOY CONDUCTOR STEEL REINFORCED (AACSR)

Characteristics of A2/S1 A Conductors as per IEC 1089/91

Code number	Steel ratio	Areas			No. of wires		Wire diam.		Diameter		Linear mass	Rated strength	*D.C. resis-tance
		Alum.	Steel	Total	Al	St.	alum.	steel	Core	Cond.			
	%	mm²	mm²	mm²			mm	mm	mm	mm	kg/km	kN	Ohm/km
16	17	18.4	3.07	21.5	6	1	1.98	1.98	1.98	5.93	74.4	9.02	1.7934
25	17	28.8	4.80	33.6	6	1	2.47	2.47	2.47	7.41	116.2	13.96	1.1478
40	17	46.0	7.67	53.7	6	1	3.13	3.13	3.13	9.38	185.9	22.02	0.7174
63	17	72.5	12.1	84.6	6	1	3.92	3.92	3.92	11.8	292.8	34.68	0.4555
100	6	115	6.39	121	18	1	2.85	2.85	2.85	14.3	366.4	41.24	0.2880
125	6	144	7.99	152	18	1	3.19	3.19	3.19	16.0	458.0	51.23	0.2304
125	16	144	23.4	167	26	7	2.65	2.08	6.19	18.8	579.9	89.86	0.2310
160	6	184	10.2	194	18	1	3.61	3.61	3.61	18.0	588.2	65.58	0.1800
160	16	184	30.0	214	26	7	3.00	2.34	7.01	19.0	742.3	88.52	0.1805
200	6	230	12.8	243	18	1	4.04	4.04	4.04	20.2	732.8	81.97	0.1440
200	16	230	37.5	268	26	7	3.36	2.61	7.83	21.3	927.9	110.64	0.1444
250	10	288	28.3	316	22	7	4.08	2.27	6.80	23.1	1013.5	117.09	0.1154
250	16	288	46.9	335	26	7	3.75	2.92	8.76	23.8	1159.8	138.31	0.1155
315	7	363	25.1	388	45	7	3.20	2.14	6.41	25.6	1196.5	136.28	0.0917
315	16	363	59.0	422	26	7	4.21	3.28	9.83	26.7	1461.4	171.90	0.0917
400	7	460	31.8	492	45	7	3.61	2.41	7.22	28.9	1519.4	172.10	0.0722
400	13	460	59.7	520	54	7	3.29	3.29	9.88	29.7	1738.3	201.46	0.0723
450	7	518	35.8	554	45	7	3.83	2.55	7.66	30.6	1709.3	193.61	0.0642
450	13	518	67.1	565	54	7	3.49	3.49	10.5	31.5	1955.6	226.64	0.0643
500	7	575	39.8	615	45	7	4.04	2.69	8.07	32.3	1899.3	215.12	0.0578
500	13	575	74.6	650	54	7	3.68	3.68	11.1	33.2	2172.9	251.82	0.0578
560	7	645	44.6	689	45	7	4.27	2.85	8.54	34.2	2127.2	240.93	0.0516
560	13	645	81.6	728	54	19	3.90	2.34	11.7	35.1	2420.9	283.21	0.0518
630	4	725	31.3	756	72	7	3.58	2.39	7.16	35.8	2248.0	249.62	0.0459
630	13	725	91.8	817	54	19	4.13	2.48	12.4	37.2	2723.5	318.61	0.0459
710	4	817	35.3	852	72	7	3.80	2.53	7.60	38.0	2533.4	281.32	0.0407
710	13	817	104	921	54	19	4.39	2.63	13.2	39.5	3069.4	359.06	0.0407
800	4	921	39.8	961	72	7	4.04	2.69	8.07	40.4	2854.6	316.98	0.0351
800	8	921	76.7	997	84	7	3.74	3.74	11.2	41.1	3145.1	356.03	0.0362
900	4	1036	44.8	1081	72	7	4.28	2.85	8.56	42.8	3211.4	356.60	0.0321
900	8	1036	86.3	1122	84	7	3.96	3.96	11.9	43.6	3538.3	400.53	0.0322
1000	8	1151	93.7	1245	84	19	4.18	2.51	12.5	45.9	3916.8	446.37	0.0289
1120	8	1289	105	1394	64	19	4.42	2.65	13.3	48.6	4386.8	499.93	0.0258

*ALUMINIUM ALLOY Resistivity 32.53 Ohm mm²/km ● Conductivity 53.0 % I.A.C.S.
With Regular Strength Steel & Zinc Coating Class 1

AACSR

ALUMINIUM ALLOY CONDUCTOR STEEL REINFORCED (AACSR)

Characteristics of A2/S1 B Conductors as per IEC 1089/91

Code number	Steel ratio	Areas			No. of wires		Wire diam.		Diameter		Linear mass	Rated strength	*D.C. resistance
		Alum.	Steel	Total	Al	St.	alum.	steel	Core	Cond.			
	%	mm²	mm²	mm²			mm	mm	mm	mm	kg/km	kN	Ohm/km
16	17	18.4	3.07	21.5	6	1	1.98	1.98	1.98	5.93	74.4	9.02	1.7934
25	17	28.8	4.80	33.6	6	1	2.47	2.47	2.47	7.41	116.2	13.96	1.1478
40	17	46.0	7.67	53.7	6	1	3.13	3.13	3.13	9.38	185.9	22.02	0.7174
63	17	72.5	12.1	84.6	6	1	3.92	3.92	3.92	11.8	292.8	34.68	0.4555
100	6	115	6.39	121	18	1	2.85	2.85	2.85	14.3	366.4	41.24	0.2880
125	6	144	7.99	152	18	1	3.19	3.19	3.19	16.0	458.0	51.23	0.2304
125	16	144	23.4	167	26	7	2.85	2.06	8.19	16.8	579.9	69.86	0.2310
160	6	184	10.2	194	18	1	3.61	3.61	3.61	18.0	586.2	65.58	0.1800
160	16	184	30.0	214	26	7	3.00	2.34	7.01	19.0	742.3	88.52	0.1805
200	6	230	12.8	243	18	1	4.04	4.04	4.04	20.2	732.8	81.97	0.1440
200	16	230	37.5	268	26	7	3.36	2.61	7.83	21.3	927.9	110.64	0.1444
250	10	288	28.3	316	22	7	4.08	2.27	6.80	23.1	1013.5	117.09	0.1154
250	16	288	46.9	335	26	7	3.75	2.92	8.76	23.8	1159.8	138.31	0.1155
315	7	383	25.1	388	45	7	3.20	2.14	8.41	25.6	1196.5	136.28	0.0917
315	16	363	59.0	422	26	7	4.21	3.28	9.83	26.7	1461.4	171.90	0.0917
400	7	460	31.8	492	45	7	3.61	2.41	7.22	28.9	1519.4	172.10	0.0722
400	13	460	59.7	520	54	7	3.29	3.29	9.88	29.7	1738.3	201.46	0.0723
450	7	518	35.8	554	45	7	3.83	2.55	7.66	30.6	1709.3	193.61	0.0642
450	13	518	67.1	585	54	7	3.49	3.49	10.5	31.5	1955.6	226.64	0.0643
500	7	575	39.8	615	45	7	4.04	2.69	8.07	32.3	1899.3	215.12	0.0578
500	13	575	74.6	650	54	7	3.68	3.68	11.1	33.2	2172.9	251.82	0.0578
560	7	645	44.6	689	45	7	4.27	2.85	8.54	34.2	2127.2	240.93	0.0516
560	13	645	81.6	726	54	19	3.90	2.34	11.7	35.1	2420.9	283.21	0.0516
630	4	725	31.3	756	72	7	3.58	2.39	7.16	35.8	2248.0	249.62	0.0459
630	13	725	91.8	817	54	19	4.13	2.48	12.4	37.2	2723.5	318.61	0.0459
710	4	817	35.3	852	72	7	3.80	2.53	7.60	38.0	2533.4	281.32	0.0407
710	13	817	104	921	54	19	4.39	2.63	13.2	39.5	3069.4	359.06	0.0407
800	4	921	39.8	961	72	7	4.04	2.69	8.07	40.4	2854.6	316.98	0.0361
800	8	921	76.7	997	84	7	3.74	3.74	11.2	41.1	3145.1	356.03	0.0362
900	4	1036	44.8	1081	72	7	4.28	2.85	8.56	42.8	3211.4	356.60	0.0321
900	8	1036	86.3	1122	84	7	3.96	3.96	11.9	43.6	3538.3	400.53	0.0322
1000	8	1151	93.7	1245	84	19	4.18	2.51	12.5	45.9	3916.8	446.37	0.0289
1120	8	1289	105	1394	84	19	4.42	2.65	13.3	48.6	4386.8	499.93	0.0258

*ALUMINIUM ALLOY Resistivity 32.53 Ohm mm²/km ● Conductivity 53.0 % I.A.C.S.
With Regular Strength Steel & Zinc Coating Class 2

AACSR

ALUMINIUM ALLOY CONDUCTOR STEEL REINFORCED (AACSR)

Characteristics of A2/S3 A Conductors as per IEC 1089/91

Code number	Steel ratio	Areas			No. of wires		Wire diam.		Diameter		Linear mass	Rated strength	*D.C. resis-tance
		Alum.	Steel	Total	Al	St.	alum.	steel	Core	Cond.			
	%	mm²	mm²	mm²			mm	mm	mm	mm	kg/km	kN	Ohm/km
16	17	18.4	3.07	21.5	6	1	1.98	1.98	1.98	5.93	74.4	9.88	1.7934
25	17	28.8	4.80	33.8	6	1	2.47	2.47	2.47	7.41	116.2	15.25	1.1478
40	17	48.0	7.67	53.7	6	1	3.13	3.13	3.13	9.38	185.9	24.17	0.7174
63	17	72.5	12.1	84.6	6	1	3.92	3.92	3.92	11.8	292.8	37.58	0.4555
100	8	115	6.39	121	18	1	2.85	2.85	2.85	14.3	366.4	42.97	0.2880
125	6	144	7.99	152	18	1	3.19	3.19	3.19	16.0	458.0	53.47	0.2304
125	16	144	23.4	167	26	7	2.65	2.06	6.19	16.8	579.9	76.42	0.2310
160	6	184	10.2	194	18	1	3.61	3.61	3.61	18.0	586.2	68.03	0.1800
160	16	184	30.0	214	26	7	3.00	2.34	7.01	19.0	742.3	96.61	0.1805
200	6	230	12.8	243	18	1	4.04	4.04	4.04	20.2	732.8	85.04	0.1440
200	16	230	37.5	268	26	7	3.36	2.61	7.83	21.3	927.9	120.77	0.1444
250	10	288	28.3	316	22	7	4.08	2.27	6.80	23.1	1013.5	124.72	0.1154
250	16	288	46.9	335	26	7	3.75	2.92	8.76	23.8	1159.8	150.96	0.1155
315	7	363	25.1	388	45	7	3.20	2.14	6.41	25.6	1196.5	143.30	0.0917
315	16	363	59.0	422	26	7	4.21	3.28	9.83	26.7	1461.4	188.40	0.0917
400	7	460	31.8	492	45	7	3.61	2.41	7.22	28.9	1519.4	160.69	0.0722
400	13	460	59.7	520	54	7	3.29	3.29	9.88	29.7	1738.3	218.17	0.0723
450	7	518	35.8	554	45	7	3.83	2.55	7.66	30.6	1709.3	203.28	0.0642
450	13	516	67.1	585	54	7	3.49	3.49	10.5	31.5	1955.6	245.44	0.0643
500	7	575	39.8	615	45	7	4.04	2.69	8.07	32.3	1899.3	225.86	0.0578
500	13	575	74.6	650	54	7	3.68	3.68	11.1	33.2	2172.9	269.73	0.0578
560	7	645	44.6	689	45	7	4.27	2.85	8.54	34.2	2127.2	252.97	0.0516
560	13	645	81.6	726	54	19	3.90	2.34	11.7	35.1	2420.9	305.25	0.0516
630	4	725	31.3	756	72	7	3.58	2.39	7.16	35.8	2248.0	258.08	0.0459
630	13	725	91.8	817	54	19	4.13	2.48	12.4	37.2	2723.5	343.40	0.0459
710	4	817	35.3	852	72	7	3.80	2.53	7.60	38.0	2533.4	290.85	0.0407
710	13	817	104	921	54	19	4.39	2.63	13.2	39.5	3069.4	387.01	0.0407
800	4	921	39.8	961	72	7	4.04	2.69	8.07	40.4	2854.6	327.72	0.0361
800	8	921	76.7	997	84	7	3.74	3.74	11.2	41.1	3145.1	374.44	0.0362
900	4	1036	44.8	1081	72	7	4.28	2.85	8.56	42.8	3211.4	368.69	0.0321
900	8	1036	86.3	1122	84	7	3.96	3.96	11.9	43.6	3538.3	421.25	0.0322
1000	8	1151	93.7	1245	84	19	4.18	2.51	12.5	45.9	3916.8	471.67	0.0289
1120	8	1289	105	1394	84	19	4.42	2.65	13.3	48.6	4386.8	528.27	0.0258

*ALUMINIUM ALLOY Resistivity 32.53 Ohm mm²/km ● Conductivity 53 % I.A.C.S.
With Extra High Strength Steel & Zinc Coating Class 1

COMPANY PROFILE CLASSIFICATION

AACSR

ALUMINIUM ALLOY CONDUCTOR STEEL REINFORCED (AACSR)

Characteristics of A3/S1 A Conductors as per IEC 1089/91

Code number	Steel ratio	Areas			No. of wires		Wire diam.		Diameter		Linear mass	Rated strength	*D.C. resis-tance
		Alum.	Steel	Total	Al	St	alum.	steel	Core	Cond.			
	%	mm²	mm²	mm²			mm	mm	mm	mm	kg/km	kN	Ohm/km
16	17	18.6	3.10	21.7	6	1	1.99	1.99	1.99	5.96	75.1	9.67	1.7934
25	17	29.0	4.84	33.9	6	1	2.48	2.48	2.48	7.45	117.3	14.96	1.1478
40	17	46.5	7.75	54.2	6	1	3.14	3.14	3.14	9.42	187.7	23.63	0.7174
63	17	73.2	12.2	85.4	6	1	3.94	3.94	3.94	11.8	295.6	36.48	0.4555
100	6	116	6.46	123	18	1	2.87	2.87	2.87	14.3	369.9	45.12	0.2880
125	6	145	8.07	153	18	1	3.21	3.21	3.21	16.0	462.3	56.08	0.2304
125	16	145	23.7	169	26	7	2.67	2.07	6.22	16.9	585.4	74.88	0.2310
160	6	186	10.3	196	18	1	3.63	3.63	3.63	18.1	591.8	69.92	0.1800
160	16	186	30.3	218	26	7	3.02	2.35	7.04	19.1	749.4	94.94	0.1805
200	6	232	12.9	245	18	1	4.05	4.05	4.05	20.3	739.8	87.40	0.1440
200	16	232	37.8	270	26	7	3.37	2.62	7.87	21.4	936.7	118.67	0.1444
250	10	290	28.5	319	22	7	4.10	2.28	6.83	23.2	1023.2	124.02	0.1154
250	16	290	47.3	338	26	7	3.77	2.93	8.80	23.9	1170.9	145.43	0.1155
315	7	366	25.3	391	45	7	3.22	2.15	6.44	25.7	1207.9	148.56	0.0917
315	16	366	59.6	426	26	7	4.23	3.29	9.88	26.8	1475.3	180.86	0.0917
400	7	465	32.1	497	45	7	3.63	2.42	7.25	29.0	1533.9	183.03	0.0722
400	13	465	60.2	525	54	7	3.31	3.31	9.93	29.8	1754.9	217.32	0.0723
450	7	523	36.1	559	45	7	3.85	2.56	7.69	30.8	1725.6	205.91	0.0642
450	13	523	67.8	591	54	7	3.51	3.51	10.5	31.6	1974.2	239.26	0.0643
500	7	581	40.2	621	45	7	4.05	2.70	8.11	32.4	1917.3	228.79	0.0578
500	13	581	75.3	656	54	7	3.70	3.70	11.1	33.3	2193.6	265.84	0.0578
560	7	651	45.0	696	45	7	4.29	2.86	8.58	34.3	2147.4	256.24	0.0516
560	13	651	82.4	733	54	19	3.92	2.35	11.8	35.3	2444.0	298.92	0.0516
630	4	732	31.6	764	72	7	3.60	2.40	7.20	36.0	2269.4	266.64	0.0459
630	13	732	92.7	825	54	19	4.15	2.49	12.5	37.4	2749.5	336.28	0.0459
710	4	825	35.6	861	72	7	3.82	2.55	7.64	38.2	2557.6	300.50	0.0407
710	13	825	104	929	54	19	4.41	2.65	13.2	39.7	3098.6	378.98	0.0407
800	4	930	40.2	970	72	7	4.05	2.70	8.11	40.5	2881.8	338.59	0.0361
800	8	930	77.5	1007	84	7	3.75	3.75	11.3	41.3	3175.1	378.01	0.0362
900	4	1046	45.2	1091	72	7	4.30	2.87	8.60	43.0	3242.0	380.91	0.0321
900	8	1046	87.1	1133	84	7	3.98	3.98	11.9	43.8	3572.0	425.26	0.0322
1000	8	1162	94.6	1257	84	19	4.20	2.52	12.6	46.2	3954.1	473.86	0.0289
1120	8	1301	106	1407	84	19	4.44	2.66	13.3	48.9	4428.6	530.72	0.0258

*ALUMINIUM ALLOY Resistivity 32.84 Ohm mm²/km ● Conductivity 52.5 % I.A.C.S.
With Regular Strength Steel & Zinc Coating Class 1

AACSR

ALUMINIUM ALLOY CONDUCTOR STEEL REINFORCED (AACSR)
Characteristics of A3/S1 B Conductors as per IEC 1089/91

Code number	Steel ratio	Areas			No. of wires		Wire diam.		Diameter		Linear mass	Rated strength	*D.C. resistance
		Alum.	Steel	Total	Al	St	alum.	steel	Core	Cond.			
	%	mm²	mm²	mm²			mm	mm	mm	mm	kg/km	kN	Ohm/km
16	17	18.6	3.10	21.7	6	1	1.99	1.99	1.99	5.96	75.1	9.45	1.7934
25	17	29.0	4.84	33.9	6	1	2.48	2.48	2.48	7.45	117.3	14.62	1.1478
40	17	46.5	7.75	54.2	6	1	3.14	3.14	3.14	9.42	187.7	22.85	0.7174
63	17	73.2	12.2	85.4	6	1	3.94	3.94	3.94	11.8	295.6	35.26	0.4555
100	6	116	6.46	123	18	1	2.87	2.87	2.87	14.3	369.9	44.67	0.2880
125	6	145	8.07	153	18	1	3.21	3.21	3.21	16.0	462.3	55.27	0.2304
125	16	145	23.7	169	26	7	2.67	2.07	8.22	16.9	585.4	73.22	0.2310
160	6	186	10.3	196	18	1	3.63	3.63	3.63	18.1	591.8	88.89	0.1800
160	18	186	30.3	218	26	7	3.02	2.35	7.04	19.1	749.4	92.82	0.1805
200	6	232	12.9	245	18	1	4.05	4.05	4.05	20.3	739.8	86.11	0.1440
200	16	232	37.8	270	28	7	3.37	2.62	7.87	21.4	936.7	116.02	0.1444
250	10	290	28.5	319	22	7	4.10	2.28	6.83	23.2	1023.2	122.02	0.1154
250	16	290	47.3	338	28	7	3.77	2.93	8.80	23.9	1170.9	142.12	0.1155
315	7	366	25.3	391	45	7	3.22	2.15	6.44	25.7	1207.9	146.78	0.0917
315	16	366	59.6	426	28	7	4.23	3.29	9.88	26.8	1475.3	174.90	0.0917
400	7	465	32.1	497	45	7	3.63	2.42	7.25	29.0	1533.9	180.78	0.0722
400	13	465	60.2	525	54	7	3.31	3.31	9.93	29.8	1754.9	211.29	0.0723
450	7	523	36.1	559	45	7	3.85	2.56	7.69	30.8	1725.6	203.38	0.0642
450	13	523	67.8	591	54	7	3.51	3.51	10.5	31.6	1974.2	232.48	0.0643
500	7	581	40.2	621	45	7	4.05	2.70	6.11	32.4	1917.3	225.98	0.0578
500	13	581	75.3	656	54	7	3.70	3.70	11.1	33.3	2193.6	258.31	0.0578
560	7	651	45.0	696	45	7	4.29	2.86	8.58	34.3	2147.4	253.09	0.0516
560	13	651	82.4	733	54	19	3.92	2.35	11.8	35.3	2444.0	293.15	0.0516
630	4	732	31.6	764	72	7	3.60	2.40	7.20	36.0	2269.4	264.42	0.0459
630	13	732	92.7	825	54	19	4.15	2.49	12.5	37.4	2749.5	329.79	0.0459
710	4	825	35.6	861	72	7	3.82	2.55	7.64	38.2	2557.6	298.00	0.0407
710	13	825	104	929	54	19	4.41	2.65	13.2	39.7	3098.6	371.67	0.0407
800	4	930	40.2	970	72	7	4.05	2.70	8.11	40.5	2881.8	335.78	0.0361
800	8	930	77.5	1007	84	7	3.75	3.75	11.3	41.3	3175.1	370.26	0.0362
900	4	1046	45.2	1091	72	7	4.30	2.87	8.60	43.0	3242.0	377.75	0.0321
900	8	1046	87.1	1133	84	7	3.98	3.98	11.9	43.8	3572.0	416.54	0.0322
1000	8	1162	94.8	1257	84	19	4.20	2.52	12.6	48.2	3954.1	487.24	0.0289
1120	8	1301	106	1407	84	19	4.44	2.66	13.3	48.9	4428.6	523.30	0.0258

*ALUMINIUM ALLOY Resistivity 32.84 Ohm mm²/km ● Conductivity 52.5 % I.A.C.S.
With Regular Strength Steel & Zinc Coating Class 2

AACSR

ALUMINIUM ALLOY CONDUCTOR STEEL REINFORCED (AACSR)

Characteristics of A3/S3 A Conductors as per IEC 1089/91

Code number	Steel ratio	Areas			No. of wires		Wire diam.		Diameter		Linear mass	Rated strength	*D.C. resistance
		Alum.	Steel	Total	Al	St	alum.	steel	Core	Cond.			
	%	mm²	mm²	mm²			mm	mm	mm	mm	kg/km	kN	Ohm/km
16	17	18.6	3.10	21.7	6	1	1.99	1.99	1.99	5.96	75.1	10.53	1.7934
25	17	29.0	4.84	33.9	6	1	2.48	2.48	2.48	7.45	117.3	16.27	1.1478
40	17	46.5	7.75	54.2	6	1	3.14	3.14	3.14	9.42	187.7	25.79	0.7174
63	17	73.2	12.2	85.4	6	1	3.94	3.94	3.94	11.8	295.6	39.41	0.4555
100	6	116	6.48	123	18	1	2.87	2.87	2.87	14.3	369.9	46.86	0.2880
125	6	145	8.07	153	18	1	3.21	3.21	3.21	16.0	462.3	58.34	0.2304
125	16	145	23.7	169	26	7	2.67	2.07	6.22	16.9	585.4	81.50	0.2310
160	6	186	10.3	196	18	1	3.63	3.63	3.63	18.1	591.8	72.40	0.1800
180	16	186	30.3	216	26	7	3.02	2.35	7.04	19.1	749.4	103.11	0.1805
200	6	232	12.9	245	18	1	4.05	4.05	4.05	20.3	739.8	90.50	0.1440
200	16	232	37.8	270	26	7	3.37	2.82	7.87	21.4	936.7	128.89	0.1444
250	10	290	28.5	319	22	7	4.10	2.28	6.83	23.2	1023.2	131.72	0.1154
250	16	290	47.3	338	26	7	3.77	2.93	8.80	23.9	1170.9	158.21	0.1155
315	7	366	25.3	391	45	7	3.22	2.15	6.44	25.7	1207.9	155.64	0.0917
315	16	366	59.6	426	28	7	4.23	3.29	9.88	28.8	1475.3	197.55	0.0917
400	7	465	32.1	497	45	7	3.63	2.42	7.25	29.0	1533.9	191.71	0.0722
400	13	465	60.2	525	54	7	3.31	3.31	9.93	29.8	1754.9	234.19	0.0723
450	7	523	36.1	559	45	7	3.85	2.58	7.69	30.8	1725.6	215.67	0.0642
450	13	523	67.8	591	54	7	3.51	3.51	10.5	31.6	1974.2	255.52	0.0643
500	7	581	40.2	621	45	7	4.05	2.70	8.11	32.4	1917.3	239.63	0.0578
500	13	581	75.3	656	54	7	3.70	3.70	11.1	33.3	2193.6	283.91	0.0578
560	7	651	45.0	696	45	7	4.29	2.86	8.58	34.3	2147.4	268.39	0.0516
560	13	651	82.4	733	54	19	3.92	2.35	11.8	35.3	2444.0	321.17	0.0516
630	4	732	31.6	764	72	7	3.60	2.40	7.20	36.0	2269.4	275.18	0.0459
630	13	732	92.7	825	54	19	4.15	2.49	12.5	37.4	2749.5	361.32	0.0459
710	4	825	35.6	861	72	7	3.82	2.55	7.64	38.2	2557.6	310.12	0.0407
710	13	825	104	929	54	19	4.41	2.65	13.2	39.7	3098.6	407.20	0.0407
800	4	930	40.2	970	72	7	4.05	2.70	8.11	40.5	2881.8	349.43	0.0361
800	8	930	77.5	1007	84	7	3.75	3.75	11.3	41.3	3175.1	396.60	0.0362
900	4	1046	45.2	1091	72	7	4.30	2.87	8.60	43.0	3242.0	393.11	0.0321
900	8	1046	87.1	1133	84	7	3.98	3.98	11.9	43.8	3572.0	446.17	0.0322
1000	8	1162	94.6	1257	84	19	4.20	2.52	12.6	46.2	3954.1	499.40	0.0289
1120	8	1301	106	1407	84	19	4.44	2.68	13.3	48.9	4428.6	559.33	0.0258

*ALUMINIUM ALLOY Resistivity 32.84 Ohm mm²/km ● Conductivity 52.5 % I.A.C.S.
With Extra High Strength Steel & Zinc Coating Class 1

AACSR

ALUMINIUM ALLOY CONDUCTORS STEEL REINFORCED (AACSR)
AS PER ASTM B 711 - 1993

Conductor Area, mm²			Stranding and Wire Diameter				Dia. of Cond. mm	Rated Strength kN	Linear Density kg/km	D. C. Resistance Ohm/km
Alloy Nominal	Steel	Total	Alloy		Steel					
			Number	mm	Number	mm				
1250	102	1352	84	4.35	19	2.61	47.8	490	4255	0.02710
1120	91	1211	84	4.12	19	2.47	45.3	439	3816	0.03020
1000	81	1081	84	3.89	19	2.33	42.8	391	3400	0.0319
900	73	973	84	3.69	19	2.21	40.6	355	3060	0.0376
800	101	901	54	4.34	19	2.60	39.0	363	3003	0.0423
710	90	800	54	4.09	19	2.45	36.8	322	2664	0.0477
630	80	710	54	3.85	19	2.31	34.6	286	2365	0.0538
560	71	631	54	3.63	19	2.18	32.7	257	2104	0.0605
500	63	563	54	3.43	19	2.06	30.9	229	1878	0.0678
450	59	509	54	3.26	19	1.98	29.5	215	1706	0.0750
400	91	491	30	4.12	19	2.47	28.8	237	1818	0.0844
400	65	465	26	4.43	7	3.45	28.1	207	1616	0.0840
355	81	436	30	3.88	19	2.33	27.2	211	1614	0.0951
355	58	413	26	4.17	7	3.24	26.4	183	1430	0.0948
315	72	387	30	3.66	19	2.20	25.6	190	1438	0.1069
315	52	367	26	3.93	7	3.06	24.9	163	1272	0.1067
280	65	345	30	3.45	7	3.45	24.2	171	1286	0.1203
280	46	326	26	3.70	7	2.88	23.4	144	1127	0.1204
250	58	308	30	3.26	7	3.26	22.8	156	1149	0.1347
250	41	291	26	3.50	7	2.72	22.2	129	1008	0.1346
224	52	276	30	3.08	7	3.08	21.6	139	1025	0.1509
224	36	260	26	3.31	7	2.57	21.0	118	901	0.1504
200	47	247	30	2.91	7	2.91	20.4	124	915	0.1691
200	32	232	26	3.13	7	2.43	19.8	106	805	0.1682
180	42	222	30	2.76	7	2.76	19.3	112	823	0.1880
180	29	209	26	2.97	7	2.31	18.8	95.1	731	0.1868
160	38	198	30	2.61	7	2.61	18.3	106	736	0.2102
160	26	186	28	2.80	7	2.18	17.7	85.6	646	0.2102
140	33	173	30	2.44	7	2.44	17.1	87.4	643	0.2405
140	23	163	26	2.62	7	2.04	16.6	75.0	565	0.2401

AACSR

ALUMINIUM ALLOY CONDUCTORS STEEL REINFORCED (AACSR)
AS PER FRENCH STEEL C-34-125

Description of the cable	Nominal-cross Section (mm²)		Construction			Diameter of cable	Ultimate stress of aluminium alloy wire	Ultimate tensile stress of steel wire	Nominal breaking load of cable	Electrical resistance at 20°C per km	Weight per km (kg)
	Aluminium alloy wires	Steel wires	Number of wires: Aluminium alloy	Number of wires: Steel	Nominal diameter of wire (mm)	(mm)	(hbar)	(hbar)	(daN)	(Ohm)	
PHLOX 37.7	28.27	9.42	9	3	2	8.3	32.4	156.8	2 360	1.17	155
PHLOX 59.7	37.70	21.99	12	7	2	10	32.4	156.8	4 560	0.880	276
PHLOX 75.5	47.71	27.83	12	7	2.25	11.25	32.4	156.8	5 770	0.695	348
PHLOX 116.2	56.55	59.69	18	19	2	14	32.4	156.8	10 815	0.580	636
PHLOX 147.1	71.57	75.54	18	19	2.25	15.75	32.4	156.8	13 685	0.466	802
PASTEL 147.1	119.28	27.83	30	7	2.25	15.75	32.4	156.8	8 185	0.279	547
PHLOX 181.6	88.36	93.27	18	19	2.5	17.5	32.4	156.8	16 895	0.378	990
PASTEL 181.6	147.26	34.36	30	7	2.5	17.5	32.4	156.8	10 120	0.227	675
PHLOX 228	110.83	116.99	18	19	2.8	19.6	32.4	156.8	21 200	0.300	1244
PASTEL 228	184.72	43.10	30	7	2.8	19.6	32.4	156.8	12 680	0.180	848
PHLOX 288	140.28	148.07	18	19	3.15	22.05	32.4	156.8	26 800	0.237	1570
PASTEL 288	233.80	54.55	30	7	3.15	22.05	32.4	156.8	16 050	0.142	1074
PASTEL 299	206.17	93.27	42	19	2.5	22.5	32.4	156.8	20 875	0.162	1320
PHLOX 376	147.78	227.83	24	37	2.8	25.2	32.4	156.8	38 960	0.225	2211

ALUMINIUM ALLOY CONDUCTORS STEEL REINFORCED (AACSR)
AS PER FRENCH SPECIFICATION C - 34 - 125

Description of the cable	Nominal-cross Section (mm²)		Construction		External diameter of cable	Ultimate stress of aluminium alloy wire (hbar)	Ultimate tensile stress of steel wire (hbar)	Nominal breaking load of cable	Electrical resistance at 20°C per km	Weight per km (kg)
	Aluminium alloy wires	Steel wires	Number of wires: Aluminium alloy	Number of wires: Steel	(mm)			(daN)	(Ohm)	
PHLOX 94.1	51.95	42.12	15 x 2.10	19 x 1.68	12.8	32.4	156.8	8035	0.642	481
PASTEL 412	325.72	85.95	32 x 3.6	19 x 2.4	26.4	32.4	156.8	23 830	0.103	1593
PETUNIA 612	507.10	104.79	42X 2.61 20 x 4.24	19 x 2.65	32.2	32.4 31.9	156.8	32 690	0.0651	2241
PETUNIA 865	717.33	148.06	66 x 3.72	19 x 3.15	38.1	32.4	156.8	46 000	0.0465	3174
POLYGONUM 1185	956.86	227.82	54 x 2.8 66 x 3.47	37 x 2.8	44.7	32.4	156.8	86 385	0.0349	4475

GSW EARTHWIRE

GALVANISED STANDERED STEEL UTILIZED FOR
(a) Earthwire (b) Guywire (c) Staywire

Code Name	Area (Sqmm)	Number of wires	Diameter		Linear mass	Rated Strength KN	
			Wire (mm)	GSW (mm)	Kg / Km	Grade 1300	Grade 1100
50	49.5	7	3.00	9.00	390	64.32	54.43
55	55	7	3.15	9.45	430	70.92	60.01
58	58	7	3.25	9.75	458	75.49	63.88
62	62	7	3.35	10.05	488	80.21	67.87
70	89	7	3.55	10.65	545	90.07	76.21
75	74	7	3.66	10.98	582	95.74	81.01
88	88	7	4.00	12.00	695	114.35	96.76
60	60	19	2.00	10.00	475	77.6	65.66
80	79	19	2.30	11.50	627	102.62	86.83
93	93	19	2.50	12.50	740	121.25	102.59
100	96	19	2.54	12.70	764	125.16	105.90
105	104	19	2.64	13.20	827	135.21	114.41
150	151	19	3.18	15.90	1199	196.17	165.99
210	217	19	3.80	19.00	1715	280.13	237.03
240	239	19	4.00	20.00	1900	310.39	262.64
300	294	19	4.44	22.20	2340	382.43	323.59
465	465	37	4.00	28.00	3699	604.44	511.45
							* Grade 1400
150	151	19	3.18	15.90	1199	211.26	–
240	239	19	4.00	20.00	1900	334.27	–
300	294	19	4.44	22.20	2340	411.85	–

* Specially Utilized as Stay Wire

Standard Terminology

Relating to Uninsulated Metalic Electrical Conductors

ABBREVIATIONS

AAC	- all aluminum conductor.
AACSR	- aluminum alloy conductor, steel reinforced.
ACAR	- aluminum conductor, aluminum alloy reinforced.
ACSR	aluminum conductor, steel reinforced.
AW	aluminum clad steel wire.
AZ	aluminum coated (aluminized) steel wire.
COMP	compact construction.
GA	zinc coated (galvanized) steel wire, coating class A.
GB	zinc coated (galvanized) steel wire, coating class B.
GC	zinc coated (galvanized) steel wire, coating class C.
HS	zinc coated (galvanized) high strength steel wire.
MA	zinc-5 % aluminum-mischmetal alloy coated steel wire, coating class A.
MB	zinc-5 % aluminum-mischmetal alloy coated steel wire, coating class B.
MC	zinc-5 % aluminum-mischmetal alloy coated steel wire, coating class C.
MS	zinc-5 % aluminum-mischmetal alloy coated high strength steel wire.
SD	self dampening construction.
SIW	single input wire construction.
TW	trapezoidal spades wire.
Zn-5Al-MM	zinc-5 % aluminum-mischmetal alloy coating.

TERMINOLOGY

Aeolian vibration - resonant vibration of a conductor caused by the alternate shedding of wind-induced vortices from opposite sides of the conductor. (Frequency is usually less than 200 Hz and amplitude rarely exceeds one conductor diameter.)

Annealed wire - see soft wire.

Area density - mass per unit area.

Bare conductor - a conductor having no nonmetallic covering.

Brazing - the joining of ends of two wires, rods, or group of wires with a nonferrous filler metal at temperatures above 800°F (427°C)

Breaking strength - the maximum load that a conductor attains when tested in tension to rupture.

Bunch-stranded conductor - a conductor composed of wires twisted together with a given length and direction of lay in such manner that the respective wires at successive cross sections along the length of the conductor do not necessarily form a symmetrical geometric pattern, nor necessarily occupy the same positions relative to each other.

Circular mil (cmil) - a unit of area equal to the area of a circle one mil (0.001 in., 0.0254 mm) in diameter. The area of a circle in circular mils is equal to the square of the diameter in mils [area (cmils)] = diameter (mils)^2], 1 cmil = 7.854×10^{-7} in^2 (5.067×10^{-10} m^2).

Coated wire - wire comprised of a given metal covered with a relatively thick application of a different metal.

Clad wire - wire comprised of a given metal covered with a relatively thin application of a different metal.

Cold-drawing - reducing the cross section by pulling through a die or dies, at a temperature lower than the recrystallization temperature.

Combination stranded conductor - a conductor constructed with wires of different diameters with such differences occurring either within a single layer or from layer to layer.

Compact stranded conductor - a unidirectional or conventional concentric conductor manufactured to a specified diameter, approximately 8 to 10 % below the nominal diameter of a noncompact conductor of the same cross sectional area.

Compressed stranded conductor - a conventional concentric conductor manufactured to a diameter not more than 3 % below the nominal diameter of a noncompressed conductor of the same cross-sectional area.

Composite conductor - a conductor consisting of two or more types of wire, each type of wire being plain, clad, or coated; stranded together to operate mechanically and electrically as a single conductor.

Concentric-lay conductor - conductor constructed with a central core surrounded by one or more layers of helically laid wires. Several types are as follows:

Compact round conductor - a conductor constructed with a central core surrounded by one or more layers of helically laid wires and formed into final shape by rolling, drawing, or other means.

Conventional concentric conductor - conductor constructed with a round central core surrounded by one or more layers of helically laid round wires. The direction of lay is reversed in successive layers, and generally with an increase in length of lay for successive layers.

Equally conductor - conductor constructed with a central core surrounded by more than one layer of helically laid wires, all layers having a common length of lay, direction of lay being reversed in successive layers.

Parallel core conductor - conductor constructed with a central core of parallel-laid wires surrounded by one layer of helically laid wires.

Rope-lay conductor - conductor constructed of a bunch stranded or a concentric-stranded member or members, as a central core, around which are laid one or more helical layers of such members.

Unidirectional conductor - conductor conducted with a central core surrounded by more than one layer of helically laid wires, all layers having a common direction of lay, with increase in length of lay for each successive layer.

Unilay conductor - conductor constructed with a central core surrounded by more than one layer of helically laid wires, all layers having a common length and direction of lay.

Conductor - a wire or combination of wires not insulated from one another, suitable for carrying an electric current.

Conductor core - the centre strand or member about which one or more layers of wires or members are laid helically to form a concentric-lay.

Continuous cast drawing stock - the as-rolled section, normally round, produced by a continuous casting and rolling process.

Core - see conductor core.

Cored, annular, conductor - a conductor in which one or more layers of wires are laid helically around a central core of metallic or nonmetallic material. The core is used as a mandrel for the application of subsequent layers of wire to maintain consistent spacing of these members around the conductor axis.

Direction of lay - the lateral direction, designated as left-hand or right-hand, in which the wires of a member or units of a conductor run over the top of the member or conductor as they recede from an observed looking along the axis the member or conductor.

Drawing stock - the as-rolled section, normally round, made from any of a variety of manufacturing processes, intended as feed stock for subsequent drawing operations.

Electric-butt, cold-upset weld - a weld between two prepared ends of adjacent lengths of work-hardenable material that is pressed together in a resistance welding apparatus which melts the abutting ends to unite them and form the weld. In turn, the resulting weld zone is forced out in the form of flash by a cold-upsetting operation which, through coldworking, restores the material substantially to its original tensile strength.

Equilay conductor - see concentric-lay conductor.

Galvanized steel wire - steel wire coated with zinc.

Half-hard wire - as applied to aluminum, wire that has been processed so as to produce a strength approximately midway between that of soft wire and that of hard-drawn wire.

Hard-drawn wire - as applied to aluminum and copper, wire that has been cold drawn to final size so as to approach the maximum tensile strength obtainable.

Hot-rolled drawing stock - the as-rolled section, normally round, produced by not rolling in a rod mill from a billet or wire bar.

Intermediate temper - as applied to aluminum, any temper between soft and hard drawn.

Joint - that portion of the conductor where the ends of two wires, rods, or groups of wires are joined by brazing, soldering, welding or by mechanical means.

Lay, n^3 - one turn of the helix of a wire or member of a standard conductor. See also direction of lay and length of lay.

Lay, v - to arrange the wires of members of a conductor either by twisting them or by forming them into one or more layers helically applied.

Lay, factor - the ratio of the length of lay to the external diameter of the corresponding layer of wires or members in the stranded conductor.

Length of lay - the axial length of one turn of the helix of a wire or member.

Linear density - mass per unit length.

Liquor-finished wire - wire, usually of ferrous material, drawn through a wet solution of metallic salts, that is tin or copper, to facilitate drawing and to enhance the appearance and surface characteristics of the finished wire, and not to provide the properties of a coated wire.

Medium-hard drawn wire - as applied to copper wire, having tensile strength less than the minimum for hard-drawn wire, but greater than the maximum of soft wire.

Member - a group of wires stranded together for combination with other stranded groups into a multiple membered conductor.

Messenger wire - a metallic supporting member either solid or stranded which may also perform the function of a conductor.

Mil - a unit of length equal to $1/_{1000}$ of an inch (0.254 mm).

Nominal, adj - name or identifying value of a measurable

property by which a conductor or component or property of a conductor is identified, and to which tolerances are applied.

Parallel-core conductor - see concentric-lay conductor.

Percent conductivity - the ratio of the resistively of the International Annealed Copper Standard (IACS) at 20°C to the resistivitiy of a material at 20°C, expressed in percent. Results are calculated on a weight basis or volume basis and so specified.

Plain conductor - a conductor made up of one or more plain wires of the same metal.

Plain wire - wire consisting of one metal only.

Rated strength - the strength in tension of a stranded conductor calculated in accordance with specification requirements.

Resistance[3] - the scaler property of an electric circuit or of any body that may be used as part of an electric circuit which determines for a given current the rate at which electric energy is converted into heat or radiant energy and which has a value such that the product of the resistance and the square of the current gives the rate of conversion of energy.

In a d-c circuit:

$P = I^2R$

where:

P = power, W,

I = current, A, and

R = resistance, Ohm.

Resistivity[4] - the electrical resistance of a body of unit length, and unit cross-sectional area or unit weight.

Rope-lay conductor - see concentric-lay conductor.

Self-damping conductor - a conductor with internal vibration damping properties which will protect itself from damaging strains caused by aeolian vibration.

Single input wire construction - a stranded conductor design which varies the number of wires within a range of conductor sizes in order to permit that range of conductor sized to be constructed from wires of a single diameter.

Soft wire - wire that has been drawn or rolled to final size and then heated to remove the effects of cold working.

Solid conductor - a conductor consisting of one wire.

Splice - see joint.

Stiffness (as applied to copper) - the property of a conductor that causes it to resist permanent deformation by bending.

Strain hardening[5] - an increase in hardness and strength caused by plastic deformation at temperatures lower than the recrystallization range.

Strand, n[3] - one of the wires of any stranded conductor.

Stranded conductor - a conductor composed of a group of wires, usually twisted, or of any combination of such groups of wires.

Stranding factor - the ratio of the mass or electrical resistance of a unit length of stranded conductor to that of a solid conductor of the same cross-sectional area. The stranding factor *m* for the completed stranded conductor is the numerical average of the stranding factors for each of the individual wires in the conductor, including the straight core wire, if any (for which the stranding factor is unity). The stranding factor (m_{ind}) for any given wire in a concentric-lay-stranded conductor is:

$$m_{ind} = \sqrt{1 + (9.8696/n^2)}$$

Where:

$$n = \frac{\text{length of lay}}{\text{diameter of helical path of the wire}}$$

Tensile strength - the maximum load per unit of original cross-sectional area that a conductor attains when tested in tension to rupture.

Three-quarter-hard wire - as applied to aluminum, wire that has been processed to produce a strength approximately midway between that of half-hard wire and that of hard-drawn wire.

Tinned wire - see coated wire.

Trapezoidal wire - a wire with a keystone-shaped (wedge) cross section with two circular parallel sides.

Trolley wire - a round or spaded, solid bare, hard conductor ordinarily used to supply current to motors through travelling current collectors.

Unidirectional conductor - see **concentric-lay conductor.**

Volume resistivity - the resistance in ohms of a body of unit length and unit cross-sectional area.

Weight resistivity - the resistance in ohms at a specified temperature of a body of uniform cross section and unit weight and unit length.

Welding - joining the ends of two wires, rods, metal whose length is great in comparison with the major axis of its cross section, or groups of wires (I) by fusing, using the application of heat or pressure or both by means of a flame torch, electric arc, or electric current or (2) by cold pressure.

Wire3 - a rod or filament of drawn or rolled metal whose length is great in comparison with the major axis of its cross section.

WIRE GAUGES

Gauge				Diameter		Sectional area			Aluminum wire weight
B.W.G.	A.W.G.	S.W.G.	mm.G.	mil	mm	CM	in^2	mm^2	kg/km
5/0	—	7/0	—	500	12.700	250,000	0.1964	126.7	342.1
—	—	—	12	472.4	12.000	223,162	0.1753	113.1	305.4
—	—	6/0	—	464	11.786	215,296	0.1691	109.1	294.6
—	4/0	—	—	460	11.684	211,600	0.1662	107.2	289.4
4/0	—	—	—	454	11.532	206,100	0.1619	104.4	281.9
—	—	5/0	—	432	10.973	186,624	0.1466	94.56	255.3
3/0	—	—	—	425	10.795	180,600	0.1419	91.52	247.1
—	3/0	—	—	409.6	10.404	167,772	0.1318	85.03	229.6
—	—	4/0	—	400	10.160	160,000	0.1257	81.07	218.9
—	—	—	10	393.7	10.000	155,000	0.1217	78.54	212.1
2/0	—	—	—	380	9.652	144,400	0.1134	73.17	197.6
—	—	3/0	—	372	9.449	138,384	0.1087	70.12	189.3
—	2/0	—	—	364.8	9.266	138,079	0.1045	67.42	182.0
—	—	—	9	354.3	9.000	125,528	0.09859	63.62	171.8
—	—	2/0	—	348	8.839	121,104	0.09512	61.36	165.7
0	—	—	—	340	8.636	115,600	0.09079	58.58	158.2
—	0	—	—	324.9	8.250	105,560	0.08291	53.49	144.4
—	—	0	—	324	8.230	104,976	0.08245	53.19	134.6
—	—	—	8	315	8.000	99,225	0.07793	50.27	135.7
1	—	1	—	300	7.620	90,000	0.07069	45.60	123.1
—	1	—	—	289.3	7.348	83,694	0.06573	42.41	114.5
2	—	—	—	284	7.214	80,660	0.06335	40.87	110.3
—	—	2	—	276	7.010	76,176	0.05983	38.60	104.2
—	—	—	7	275.6	7.000	75,955	0.05966	38.48	103.9
3	—	—	—	259	6.579	67,080	0.05269	33.99	91.77
—	2	—	—	257.6	6.544	66,358	0.05212	33.63	90.80
—	—	—	6.5	255.9	6.500	65,485	0.05143	33.18	89.59
—	—	3	—	252	6.401	63,504	0.04988	32.18	86.89
4	—	—	—	238	6.045	56,640	0.04449	28.70	77.49
—	—	—	6.0	236.2	6.000	55,590	0.04382	28.27	76.33
—	—	4	—	232	5.893	53,824	0.04227	27.27	73.63
—	3	—	—	229.4	5.827	52,624	0.04133	26.66	71.98
5	—	—	—	220	5.588	48,400	0.03801	24.52	66.20
—	—	—	5.5	216.5	5.500	46,872	0.03681	23.72	64.04
—	—	5	—	212	5.385	44,944	0.03530	22.77	61.48
—	4	—	—	204.3	5.189	41,738	0.03278	21.15	57.11
6	—	—	—	203	5.156	14,210	0.03237	20.88	56.38
—	—	—	5.0	196.9	5.000	38,770	0.03045	19.63	53.00
—	—	6	—	192	4.877	36,864	0.02895	18.68	50.30
—	5	—	—	161.9	4.621	33,088	0.02599	16.77	45.28
7	—	—	—	180	4.572	32,400	0.02545	16.42	44.33
—	—	—	4.5	177.2	4.500	31,400	0.02466	15.90	42.93

WIRE GAUGES

Gauge				Diameter		Sectional area			Aluminum wire weight
B.W.G.	A.W.G.	S.W.G.	mm.G.	mil	mm	CM	in^2	mm^2	kg/km
—	—	7	—	176	4.470	30,976	0.02433	15.70	42.39
8	—	—	—	165	4.191	27,220	0.02138	13.80	37.26
—	6	—	—	162	4.115	26,244	0.02061	13.30	35.91
—	—	8	—	160	4.064	25,600	0.02011	12.97	35.02
—	—	—	4.0	157.5	4.000	24,806	0.01948	12.57	33.94
9	—	—	—	148	3.759	21,900	0.01720	11.10	29.97
—	7	—	—	144.3	3.665	20,822	0.01635	10.55	28.49
—	—	9	—	144	3.658	20,736	0.01629	10.52	28.40
—	—	—	3.5	137.8	3.500	18,989	0.01491	9.621	25.98
10	—	—	—	134	3.404	17,960	0.01410	9.098	24.57
—	8	—	—	128.5	3.264	16,512	0.01297	8.368	22.59
—	—	10	—	128	3.251	16,384	0.01287	8.302	22.42
—	—	—	3.2	126	3.200	15,876	0.01247	8.042	21.71
11	—	—	—	120	3.048	14,400	0.01131	7.297	19.70
—	—	11	—	116	2.946	13,456	0.01057	6.818	18.41
—	9	—	—	114.4	2.906	13,087	0.01028	6.632	17.91
—	—	—	2.9	114.2	2.900	13,042	0.01024	6.605	17.83
12	—	—	—	109	2.769	11,880	0.008331	6.020	16.25
—	—	12	—	104	2.642	10,816	0.008495	5.481	14.80
—	—	—	2.6	102.4	2.600	10,486	0.008246	5.309	14.33
—	10	—	—	101.9	2.588	10,384	0.008156	5.262	14.21
13	—	—	—	95	2.413	9,025	0.007088	4.573	12.35
—	—	13	—	92	2.337	8,464	0.006648	4.289	11.58
—	11	—	—	90.74	2.305	8,234	0.006467	4.172	11.26
—	—	—	2.3	90.55	2.300	8,199	0.006439	4.155	11.22
14	—	—	—	83	2.108	6,889	0.005411	3.491	9.426
—	12	—	—	80.61	2.053	6,530	0.005129	3.309	8.934
—	—	14	—	80	2.032	6,400	0.005027	3.243	8.756
—	—	—	2.0	78.74	2.000	6,200	0.004869	3.142	8.483
15	—	15	—	72	1.829	5,184	0.004072	2.672	7.093
—	13	—	—	71.76	1.828	5,178	0.004067	2.624	7.085
—	—	—	1.8	70.87	1.800	5,023	0.003945	2.545	6.872
16	—	—	—	65	1.651	4,225	0.003318	2.141	5.781
—	14	—	—	64.08	1.628	4,106	0.003225	2.081	5.619
—	—	16	—	64	1.626	4,096	0.003217	2.075	5.603
—	—	—	1.6	62.99	1.600	3,968	0.003116	2.011	5.430
17	—	—	—	58	1.473	3,364	0.002642	1.705	4.604
—	15	—	—	57.07	1.450	3,257	0.002558	1.650	4.455
—	—	17	—	56	1.422	3,136	0.002463	1.589	4.290
—	—	—	1.4	55.12	1.400	3,038	0.002386	1.539	4.155
—	16	—	—	50.82	1.291	2,563	0.002029	1.309	3.534
18	—	—	—	49	1.245	2,401	0.001886	1.217	3.286
—	—	18	—	48	1.219	2,304	0.001810	1.167	3.151
—	—	—	1.2	47.24	1.200	2,232	0.001753	1.131	3.054
—	17	—	—	45.26	1.150	2,048	0.001608	1.037	2.800

CONVERSION TABLES

English and Metric Weights and Measures

MULTIPLY			BY	TO OBTAIN
LENGTH — English	:	Mils	.001	inches
	:	Mils	.0254	millimeters
	:	Inches	1,000.00	mils
	:	Inches	25.40	millimeters
	:	Inches	2.54	Centimetres
:	:	Feet	30.48	Centimeters
:	:	Feet	.3048	meters
:	:	Feet (Thousands of)	.3048	kilometers
	:	Yards	.9144	meters
.	:	Miles	1.6093	kilometers
LENGTH — Metric	:	Millimeters	39.37	mils
.	:	Millimeters	.03937	inches
.	:	Centimeters	.3937	inches
.	:	Centimeters	.032808	feet
.	:	Meters	39.37	inches
.	:	Meters	3.2808	feet
	:	Metres	1.0936	yards
	:	Kilometers	3,208.83	feet
.	:	Kilometers	.62137	miles
AREA — English	:	Square mils	1.2732	circular mils
.	:	Square mils	.000001	square inches
.	:	Circular mils	.7854	square mils
.	:	Circular mils	.0000007854	square inches
.	:	Circular mils	.0005067	square millimeters
.	:	Square inches	1,000,000.	square mils
.	:	Square inches	1, 273, 240.	circular mils
.	:	Square inches	645.16	square millimeters
.	:	Square inches	6.4516	square centimeters
.	:	Square feet	.09290	square meters
	:	Square yards	.8361	square metrers
AREA — Metric	:	Square millimeters	1,973.52	circular mils
.	:	Square millimeters	.00155	square inches
.	:	Square centimeters	.155	square inches
.	:	Square meters	10.7638	square feet
	:	Square meters	1.19599	square yards
VOLUME — English	:	Cubic inches	16.38716	cubic centimeters
.	:	Cubic feet	.028317	cubic meters
.	:	Quarts (Liquid U.S.)	.9463	litres
:	:	Gallons (U.S.)	3.7854	litres
VOLUME — Metric	:	Cubic centimeters	.06102	cubic inches
	:	Cubic meters	35.3145	cubic feet
.	:	Litres	1.05668	quarts (Liquid U.S.)
	:	Litres	.26417	U.S. Gallons

CONVERSION TABLES

English and Metric Weights and Measures

MULTIPLY			BY	TO OBTAIN
WEIGHT — English	:	Ounces	28.3495	grams
	:	Pounds (Av.)	453.59	grams
	:	Pounds (Av.)	.45359	kilograms
	:	Tons (short)	907.19	kilograms
	:	Tons (long)	1,016.05	kilograms
WEIGHT — Metric	:	Grams	.03527	ounces
	:	Grams	.002205	pounds
	:	Kilograms	35.274	ounces
	:	Kilograms	2.2046	pounds
	:	Kilograms	.001102	tons (short)
	:	Kilograms	.0009842	tons (long)
MISCELLANEOUS — English	:	Pounds per 1000 feet	1.48816	kilograms per kilometer
	:	Pounds per mile	.28185	kilograms per kilometer
	:	Pounds per square inch	.0007031	kilograms per sq. millimeter
	:	Pounds per square inch	.07031	kilograms per sq. centimeter
	:	Pounds per cubic inch	27.68	grams per cubic centimeter
	:	Feet per second	18.288	meters per minute
	:	Feet per second	1.09728	kilometers per hour
	:	Miles per hour	1.60935	kilometers per hour
	:	Ohms per 1000 feet	3.28083	ohms per kilometer
	:	Ohms per mile	.62137	ohms per kilometer
	:	Decibels per 1000 feet	3.28083	decibels per kilometers
	:	Decibels per mile	.62137	decibels per kilometer
	:	Decibels	8.686	nepers
MISCELLANEOUS — Metric	:	Kilograms per kilometer	.67197	pounds per 1000 ft.
	:	Kilograms per kilometer	3.54795	pounds per mile
	:	Kilograms per square millimeter	1,422.34	pound per square inch
	:	Kilograms per square centimeters	14.2234	pounds per square inch
	:	Grams per cubic centimeter	.03613	pounds per cubic inch
	:	Meters per minute	.05468	feet per second
	:	Kilometers per hour	.91134	feet per second
	:	Kilometers per hour	.62137	miles per hour
	:	Ohms per kilometer	.3048	ohms per 1000 feet
	:	Ohms per kilometer	1.6093	ohms per mile
	:	Decibels per kilometer	.3048	decibels per 1000 feet
	:	Decibels per kilometer	1.6093	decibels per mile
	:	Nepers	.1153	decibels
TEMPERATURE	° Fahrenheit		5/9 (°F. -32)	° Centigrade
	° Centigrade		9/5 °C. +32	° Fahrenhit

MEMO

MEMO

OUR VALUED CUSTOMERS - DOMESTIC

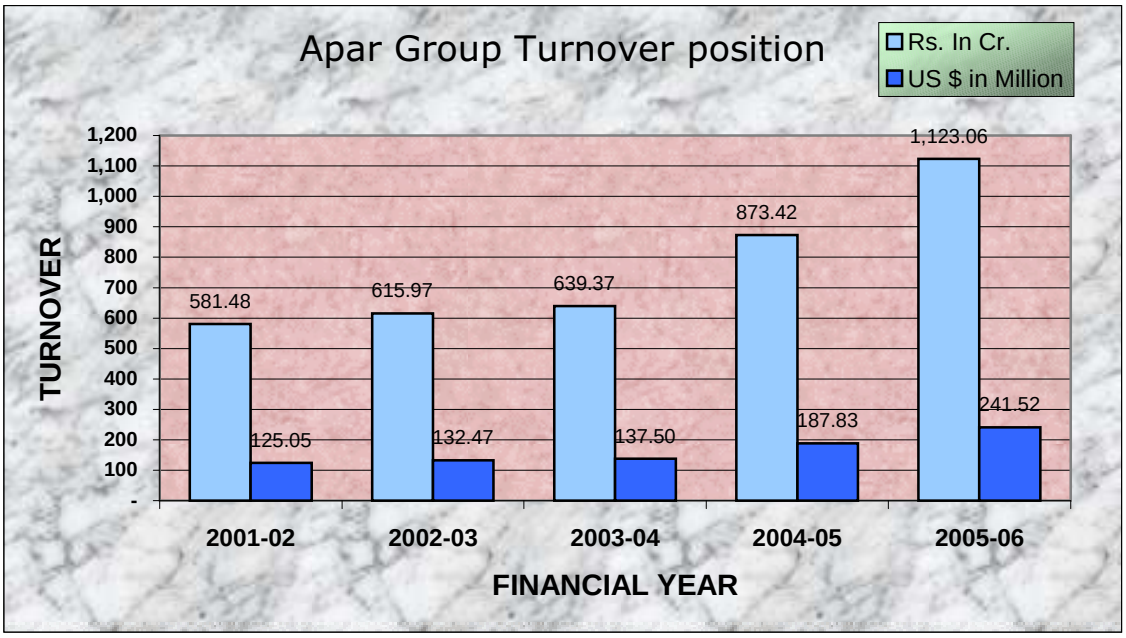
Sr. No.	NATIONAL CUSTOMERS
1	POWER GRID COPORATION OF INDIA LIMITED
2	NATIONAL THERMAL POWER CORPORATION
3	KEC INTERNATIONAL LIMITED
4	RPG TRANSMISSION LIMITED
5	SIEMENS LIMITED
6	KALPTARU POWER TRANSMISSION LIMITED
7	TATA POWER & PROJECTS LIMITED
8	LARSEN & TOUBRO LIMITED
9	JYOTI STRUCTRUES LIMITED
10	GRID CORPORATION OF ORISSA
11	APTRANSCO, ANDHRA PRADESH
12	CROMPTON GREAVES LIMITED
13	JAI PRAKASH INDUSTRIES
14	IRCON INTERNATIONAL LIMITED
15	ABB LIMITED, INDIA
16	SUZLON INFRASTRUCTURE SERVICES LIMTED
17	ADANI POWER PVT. LIMITED
18	GODREJ & BOYCE MANUFACTURING Co. LIMITED
19	A2Z MANINTANCE & ENGINEERING SEVICES PVT. LIMITED.
20	AREVA T & D (INDIA) LIMITED
21	ASSOCIATED TRANSRAIL STRUCTURES LIMITED
22	ALL STATE ELECTRICITY BOARD IN INDIA

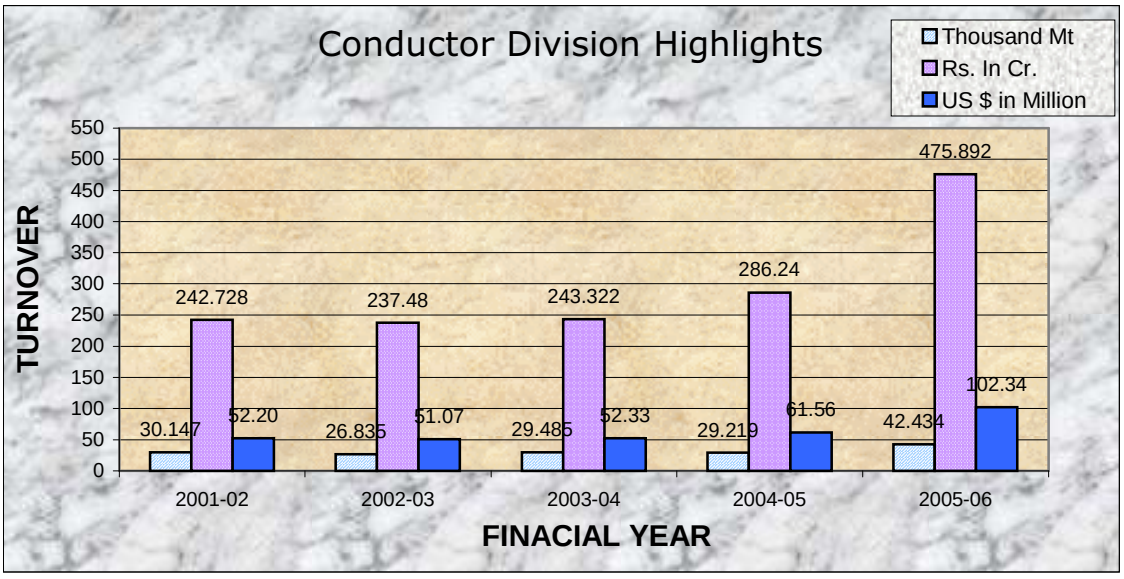
OUR VALUED CUSTOMERS - EXPORT

Sr. No.	DIRECT CUSTOMERS
1	SONELGAZ, ALGERIA
2	GENERAL ELECTRIC COMPANY OF LIBYA (GECOL), LIBYA
3	NAMPOWER, NAMIBIA
4	ETHIOPIAN ELECTRIC POWER CORPORATION (EEPCo), ETHIOPIA.
5	KENYA POWER AND LIGHTING COMPANY LTD. (KPLC), KENYA
6	STEG" (Tunisian Company of Electricity and Gas), TUNISIA
7	ESKOM, SOUTH AFRICA
8	BOTSWANA POWER CORPORATION, BOSTWANA
9	POWER HOLDING COMPANY OF NIGERIA, NIGERIA
10	NEPAL ELECTRICITY AUTHORITY, NEPAL
11	KAZAKHSTAN ELECTRICITY GRID OPERATING Co. (KEGOC), KAZAKHSTAN
12	REB & POWER GRID CORPORATION OF BANGALDESH, BANGLADESH
13	MINISTRY OF ENERGY & WATER (MEW), AFGHANISTAN
14	CEYLON ELECTRICITY BOARD (CEB), SRILANKA
15	NATIONAL POWER CORPORATION (NPC), PHILIPPINE
16	IRAN POWER, IRAN
17	IRAQ ELECTRICITY AUTHORITY, IRAQ
18	MOTARA Co., MOZAMBIQUE

Sr. No.	TURNKEY CONTRACTORS - EXPORT
1	IBERDROLA, S.A.BILBAO, SPAIN
2	ELECNOR, SPAIN
3	ISOLUX INGENIERIA, S.A, SPAIN
4	ABB LTD. (WORLD WIDE)
5	SAE Sadelmi S.p.A.. ITALY
6	ENERGOINVEST, BOSNIA HERZEGOVINA
7	ALSTOM (WORLD WIDE)
8	COBRA, SAPIN
9	INABENSA, SPAIN
10	DALEKOVOD, CROATIA
11	SAG, GERMANY
12	LTL ENERGY (PVT) LTD., SRILANKA
13	NORLAC, FRANCE
14	PRIORITY WIRE & CABLE, U.S.A.
15	BALFOUR BETTY, UK
16	MELBYE, NORWAY.
17	AQUICK INTERNATIONAL, SOUTH AFRICA
18	STCK, BURKINA FASO
19	ALHARAM, YAMAN
20	IGUNYA POWER, SOUTH AFRICA
21	SAEX, SPAIN
22	MAGE INC., TURKEY
23	TRANS AFRICA PROJECTS, SOUTH AFRICA
24	I N E O (Transdeco GtmH), France/South Africa
25	EQUIPTEC, S.A. Panama, U.S.A.
26	AVON INTERNATIONAL, U.S.A.

Business Growth











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CLASSIFICATION



GUPTA POWER

Making life better on Earth

RHINO WIRES & CABLES

High Temperature Low Sag Conductors

(Rhino HVCRC, Rhino STACIR, Rhino ACSS, Rhino TACSR)

COMPANY PROFILE

CLASSIFICATION



50 years of excellence

GUPTA POWER

Making life better on Earth

Over 5 decades, Gupta Power has been continuously working to support the customers to provide cost effective energy efficient solutions.

A special dedicated R&D team is working to develop various new products to enhance the power transmission and distribution networks to address the global power demand.

Gupta Power has state-of-the-art manufacturing facilities to make its new products. It also has highly qualified and experienced professionals that provides end to end solutions for T&D sector to minimize the CAPEX and OPEX.

Conductor Product Range

Gupta Power is a significant contributor to the global power sector through indigenous manufacturing of a complete range of Rhino overhead conductors at Distribution voltage level from 11Kv to 33 Kv, High Voltage level from 66 Kv to 220 Kv, and Extra/Ultra High Voltage level from 400 Kv to 1200 Kv.

Rhino AAC All Aluminium Conductor
Rhino ACSR/GS Aluminium Conductor (Galvanized) Steel Reinforced
Rhino ACSR/AW Aluminium Conductor (Aluminium Clad) Steel Reinforced
Rhino AAAC All Aluminium Alloy Conductor
Rhino AACSR Aluminium Alloy Conductor Steel Reinforced
Rhino ACAR-Aluminium Conductor Alloy Reinforced
Rhino Low Resistance/High Ampacity Conductor
Rhino High Temperature Low Sag Conductor (Rhino HVCRC, Rhino STACIR, Rhino ACSS, Rhino TACSR)

GUPTA POWER
Making life better on Earth

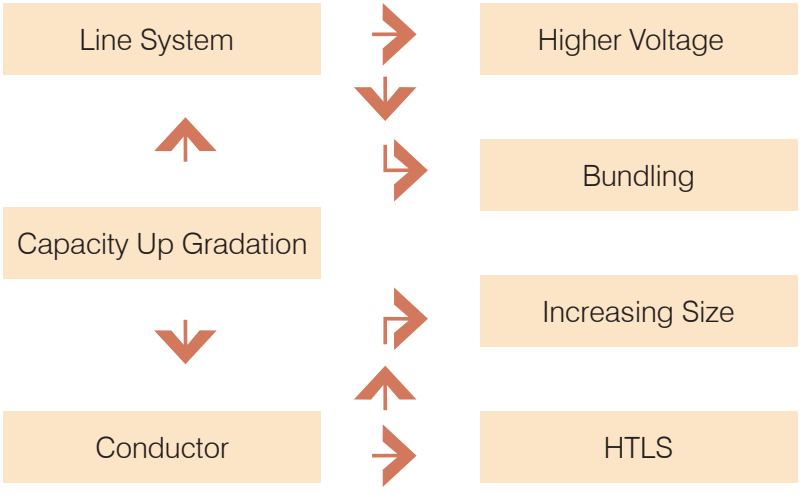
Product Research & Development

Our Focus :

We have a qualified and experienced team for Research and Product Development to focus on developing new technology and new energy efficient products to meet the global Power Demand

New Product Development	Hi-Temperature Conductors, Special Alloy conductors
Technology Adoption	New material development and adoption
In Process Efficiency Improvement	Continual Improvement on Process to attain world class Quality
T&D Solution	End to End T&D solutions to our customers for optimizing the project cost

Capacity Up gradation



Gupta Power signs a manufacture and supply agreement with Mercury Cable and Energy

Gupta Power Infrastructure Limited, a leading manufacturer of all types of cables and conductors in India has signed a deal with USA based Mercury Cable & Energy, an ace developer of High Voltage Composite Reinforced Conductors (HVCRC) with a worldwide presence. According to the agreement, Gupta Power will have exclusive right to manufacture and supply Mercury's HVCRC product line in India and based on mutual consent, across the world, thus providing the best solution to acute power crisis.

The agreement was signed by the Director of Gupta Power Mr. Abhishek Gupta & Mr. Ron Morris, CEO of Mercury Cable & Energy on 7th July 2012 in the Company's Corporate Office at Bhubaneswar, India.

Gupta Power will manufacture HVCRC conductors and sell them in the Indian market under its brand name "Rhino HVCRC CONDUCTOR". Rhino HVCRC is the modern and ultimate smart conductor available in India offering unmatched efficiency over the conventional ACSR & AAA Conductors with innumerable advantages for construction smart grid supporting the concept of Green Power.

The Rhino HVCRC conductors will surely revolutionize the construction of transmission line providing the easiest solution to acute power crisis for Indian Power Utilities. The "Rhino - High Ampacity Low Sag HVCRC CONDUCTOR" as a replacement of conventional variant can be strung on the existing towers, thereby completely avoiding much difficult Right of Way problem.

"We are pleased to begin our relationship with Gupta Power", said Mr. Ron Morris. "Gupta Power is an ideal fit for the introduction of Mercury's HVCRC products into India." This will be heralded as starting of a new era in the company's 50th year of excellence in this field, said a spokesperson of the company.

Rhino-HVCRC

Smart Conductor For Smart Grid











Rhino-HVCRC Conductors

The new Rhino-HVCRC is a light weight and having more strength with very low or negligible linear co-efficient of expansion than any other ACSR or AAAC conductors. This conductor is superior to other conventional conductors by the following points:

- Doubles the current in comparison to ACSR
- Substantially reduces high temperature sag
- Low CAPEX cost
- Increase capacity of existing line structures through retrofitting (i.e., improves their efficiency, and extends their life span).
- Eliminates bi-metallic solutions
- Significantly reduces line losses compared to same diameter conventional and composite conductors at equal operating temperatures.

Application:

The Rhino-HVCRC can be used for the following purposes:

- Uprating of any Transmission or distribution overhead line
- Reconductoring of existing line without any tower modification
- New Lines

Standard:

IEC standard, ASTM standard and Gupta Power Specification.

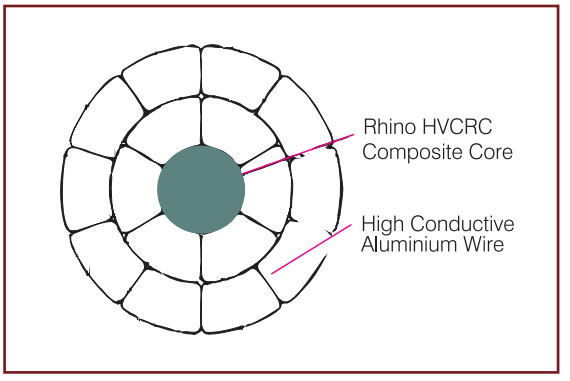
Construction of the Conductor:

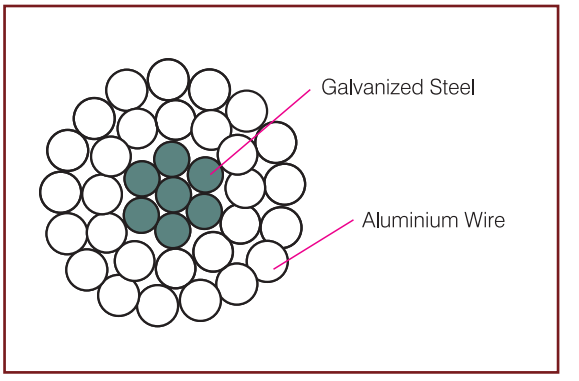
Outer Conductive Wire: Annealed Aluminium wire in Trapezoidal shape so as to provide more Aluminium in comparison to any round wire conductor of same outer diameter.

Inner Core: Carbon Composite core named as Rhino HVCRC*.
(*Rhino HVCRC is a patented product of Mercury Cable & Energy, USA.)









Special Features:

- Double Current Carrying Capacity compared to ACSR
- Low sag
- Lower weight and more strength compared to ACSR

Advantages:

For Uprating Lines:

- Double Ampacity
- No modification / reinforcement of towers
- Cost effective

For Reconductoring:

- Double Ampacity
- No modification / reinforcement of towers
- Cost effective

For New Lines:

- Lesser tower heights
- Number of Towers can be minimized

General Comparison for 132 Kv:

Conductor	Rhino-HVCRC	ACSR Panther
Outer Diameter, mm	21.78	21
Weight, kg/km	928	974
Current Carrying Capacity, A	1050	345
Sag, m	5.3	6.4

Rhino High Temperature Low Sag Conductors [HTLS]

To address the global demand for Power, launches the Rhino brand of High Temperature Low Sag Conductors to meet the global power demand.

Rhino STACIR



New aluminium alloy having high thermal resistance can withstand 210°C without significant loss in strength throughout the life time. The core of low linear expansion Invar is used to address the sag.

- Rhino STACIR has the advantage of double Ampacity than a similarly sized ACSR conductor
- No modification or reinforcement required for the towers
- Invar core is having low thermal Co-efficient of expansion which minimize/equal the sag similar to that of ACSR Conductors

Application

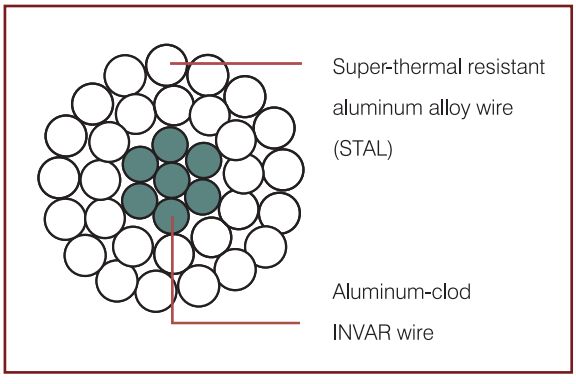
Rhino STACIR/AW is used to up-rate the existing Rhino mission line by simply replacing the existing conductor without tower modification.

Standard

IEC, ASTM and Gupta Power Specification.

Construction of the Conductor

Outer Conductive wire: Super thermal aluminium alloy wire which can continuously operate up to 210°C.
Inner Core wire: Aluminium Clad Invar wire (Invar is a metal which is having 36% Ni in Steel)



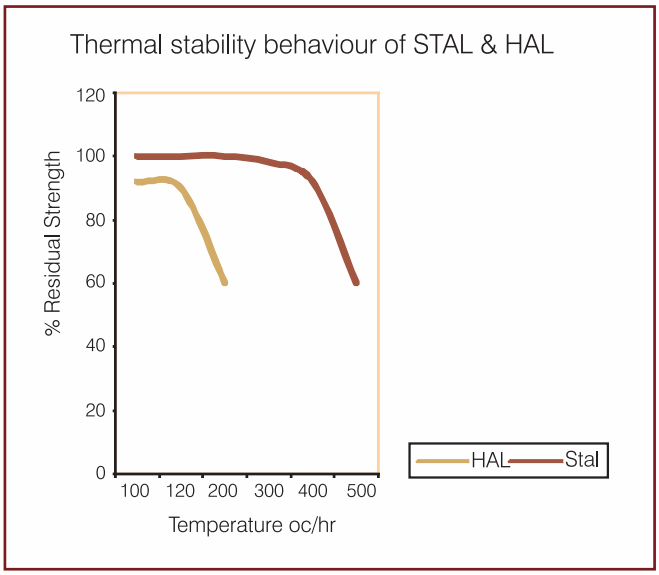
Feature

- Double Amapacity compared to ACSR
- Low Sag
- High Corrosion resistance

Super Thermal Aluminium Alloy

The thermal resistance of aluminium can be improved by adding Zirconium so as to keep the strength even at high temperatures. The super thermal resistant alloy can operate up to 210°C with specified strength loss. The Super thermal resistant alloy has similar mechanical and electrical properties like EC 1350.

Material	Tensile Strength Mpa	% IACS Conductivity	% Elongation	Operating Temperature in °C
EC 1350	160	61	1.2	90
STAL	162	60	1.2	210



Invar Core Wire

The Aluminium Clad invar wire has lower linear co-efficient of expansion than the galvanized steel wire.

Material	UTS Mpa	Linear Co-efficient of Expansion / 0C	Modulus of Elasticity Mpa
Galvanized Steel wire	1226	$11.5*10^{-6}$	196000
Aluminium Clad Invar wire	1200	$3.7*10^{-6}$	152000

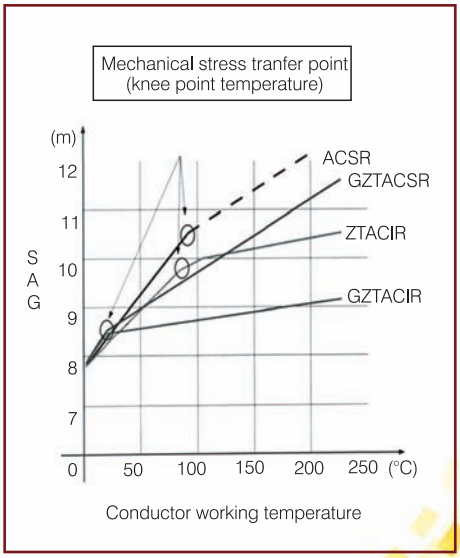
Advantage

For Uprating Lines

- Double Ampacity
- No modification/Reinforcement of Towers
- Cost effective

For New Lines

- Lesser Tower height
- Number of towers can be minimized



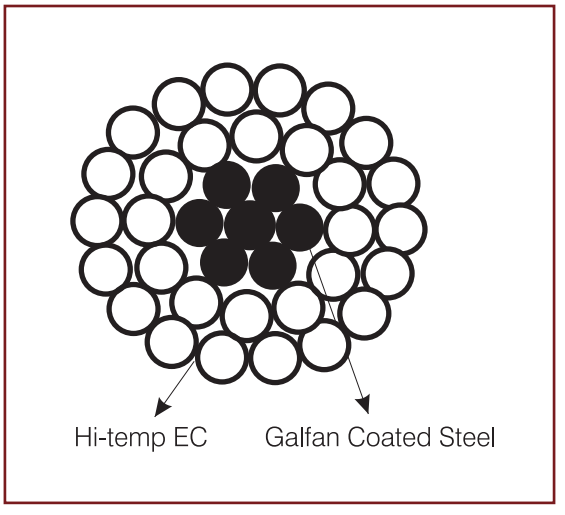
Rhino Aluminium Conductor Steel Supported (ACSS)

Introduction:

Rhino Aluminium Conductor Steel Supported (ACSS) has unique capabilities for high operating temperature and Better Aeolian vibration resistance. Rhino ACSS is a composite Aluminium steel conductor that looks just like conventional ACSR conductor. The difference is in the aluminium temper. The aluminium used in Rhino ACSS is fully annealed wire (O) where as the aluminium used in ACSR is fully work hardened (H19).

Rhino ACSS conductor meets the requirement of ASTM B856.

Construction of the conductor



Performance Advantage

1. Rhino ACSS can operate continuously at very high temperature without any determinant to mechanical properties
2. The final Sag tension properties is not affected by long term creep of aluminium
3. Rhino ACSS has a high capability for damping mechanical oscillation, such as those associated with Aeolian vibration
4. Rhino ACSS aluminium wire having high conductivity of about 63% IACS where as the ACSR aluminium wire having the conductivity of only 61% IACS

Rhino ACSS Aluminium Wires Hi-temp EC

All of the above performance advantages derive from the fact that Rhino ACSS aluminium wires are annealed and have very low yield strength. Because of this low yield strength, inelastic elongation of the aluminium occurs quite rapidly when tension is applied to Rhino ACSS conductor and thereby forcing most of the load to steel core. More importantly these aluminium wires have higher ductility and higher conductivity than the conventional ACSR.

Steel Core in Rhino ACSS

Steel core wire shall be Zinc 5% Aluminium Mischmetal alloy (Galfan) coated steel confirming to ASTM B 802 and B803.

High Temperature Characteristic

As ACSS Hi-temp EC wires are fully annealed and there is no possibility of further annealing by high temperature in services. So there will not be any strength loss in the aluminium in the high temperature application.
The only temperature limitation is that which can cause damage to the coating of the steel core. Gupta Power offers galfan coated steel wire the coating will not damage up to continuous operation of 250°C.

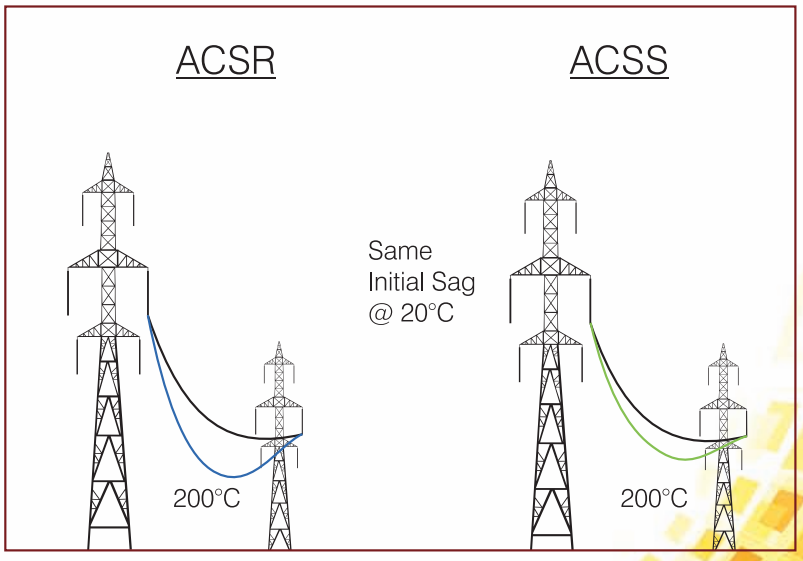
Self Damping Capability

Conventional types of conductors inherently have some degree of capability for damping mechanical oscillation such as those associated with aeoliation vibration. The most generally accepted theory holds that this self damping capability derives primarily from the generation of heat by interstand friction as the wires slip, however, a force is required to overcome the static state frictional coupling between them. Because operating stresses in the aluminium wires of Rhino ACSS are much lower than in ACSR, there is less static state frictional coupling between wires in successive layers. As a result aluminium wires in Rhino ACSS are much more free to move relative to the wires of the other layers when the conductor is flexed.

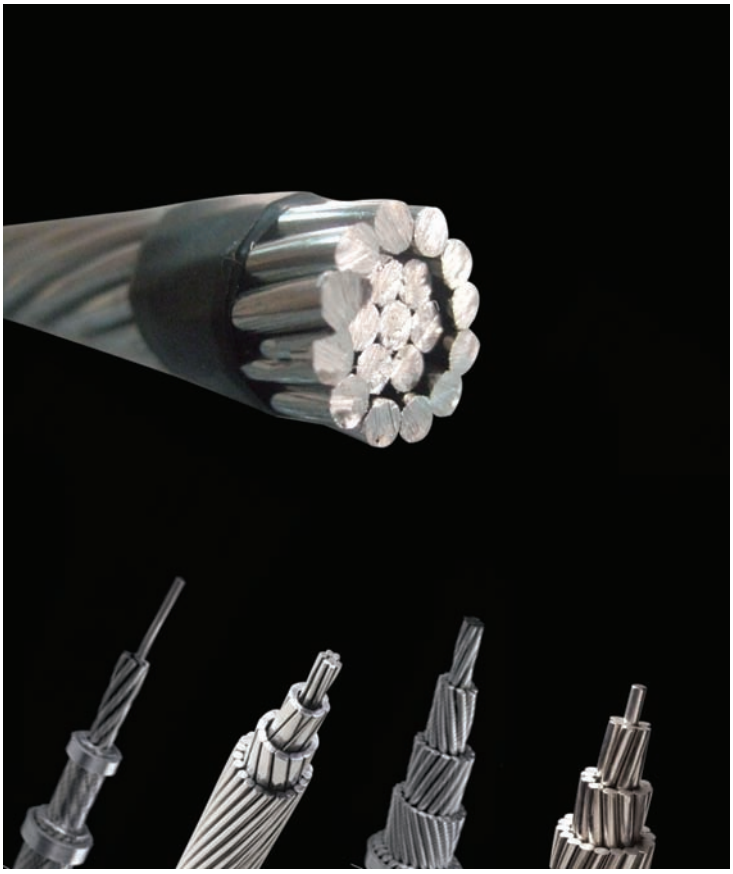
Long Term Creep

In service, all the tension in Rhino ACSS will be carried by steel core, Because of this long time creep of aluminium is of no concern and does not affect the final sag.

Long time creep rate of steel wires throughout the operating stress and temperature is very low and it will not have major effect on final sag.



Rhino TACSR



New aluminium alloy having high thermal resistance can withstand heat upto150°C without significant loss in strength throughout its life time. This conductor is similar to an ACSR conductor. Only the conductive layer is replaced with Thermal alloy to avoid the hard drawn aluminium's loss of strength at 150°C.

- Rhino TACSR has 1.6 times higher ampacity than a similarly sized ACSR conductor
- No need for modification or reinforced required for the towers
- Steel core either aluminium clad or galvanized (After knee point Linear coefficient is 11.5 X 10–6/°C)

Application

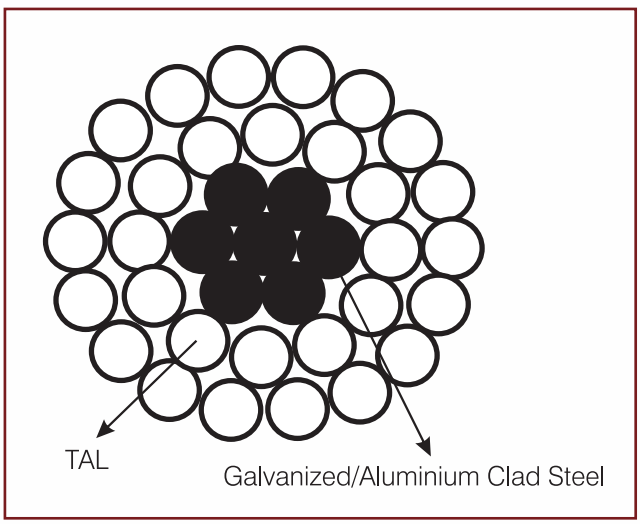
Rhino TACSR is used to up-rate the existing Rhino mission line (X 1.6) by simply replacing the existing the conductor without tower modification.

Standard

IEC, ASTM and Gupta Power Specification.

Construction of the conductor

Outer Conductive wire: Thermal aluminium alloy wire which can continuously operate up to 150°C.
Inner Core wire: Aluminium Clad/Galvanized steel wire.



Thermal Aluminium Alloy

The thermal resistance of aluminium can be improved by adding Zirconium so as to keep the strength even at high temperature. The thermal resistance alloy can operate up to 150°C with specified strength loss.

The Super thermal resistance alloy has similar mechanical and electrical properties like EC 1350.

Material	Tensile Strength Mpa	% IACS Conductivity	% Elongation	Operating Temperature °C
EC 1350	160	60	1.2	90
TAL	162	61	1.2	150

Core Wire

The Aluminium Clad / Galvanized steel wire is similar to an ACSR conductor. Aluminium clad steel minimizes the power loss.

Advantage

For Uprating Lines

- 1.6 times higher Ampacity than ACSR
- No modification/Reinforcement of Towers
- Cost effective

For New Lines

- Lesser Tower height
- Number of Towers can be minimized

The Works

Factory snaps shots of Gupta Power spread over different units : Khurda in Odisha, Kashipur in Uttarakhand and Gummidipoondi in Tamil Nadu.











RHINO WIRES & CABLES

Study request for the Overhead Conductor Solutions

Date:

Utility Name :	
Contact Person:	
Tel :	
Fax :	
Email :	

Electrical Parameters

Parameter	Enter Values
Required Power to be transmitted (MVA or MW)*	
Maximum Ambient Temperature (°C)*	
Maximum Conductor Temperature (if any requirement) (°C)*	
Network Frequency (Hz)*	
Solar Radiation admitted (W/m^2)*	
Solar Absorption Coefficient *	

Mechanical Parameters

Parameter	Enter Values
Maximum Wind Speed (m/s)*	
Ambient Temperature (°C)*	
Snow/Ice Maximum thickness (mm)*	
Maximum and Minimum Span Length (m)*	
Maximum Sag allowance (m)*	

*: Mandatory fields

Send it to: R&D Department, Gupta Power Infrastructure Ltd., Cuttack Road, Bhubaneswar 751006, Odisha
email: ad@guptapower.com



GUPTA POWER

Making life better on Earth

RHINO WIRES & CABLES

High Temperature Low Sag Conductors

(Rhino HVCRC, Rhino STACIR, Rhino ACSS, Rhino TACSR)

COMPANY PROFILE

CLASSIFICATION

RHINO
WIRES & CABLES

Product Range



Cables



Conductors



Aluminium and Alloy Wire Rods



EPC

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Web: www.guptapower.com

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Email: mumbai@guptapower.com

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www.ieema.org

CLASSIFICATION



ISO 9001 | ISO 14001
OHSAS 18001
BUREAU VERITAS
Certification

HINDUSTHAN URBAN INFRASTRUCTURE LIMITED

Formerly HINDUSTHAN VIDYUTPRODUCTS LIMITED
(An enterprise of THE HINDUSTHAN GROUP)

CONDUCTORS



Global Presence









HINDUSTHAN URBAN INFRASTRUCTURE LIMITED

Formerly HINDUSTHAN VIDYUTPRODUCTS LIMITED
(An enterprise of THE HINDUSTHAN GROUP)

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www.thehindusthangroup.co.in

Bangalore • Bhubaneswar • Chennai • Faridabad • Guwahati • Gwalior • Mumbai

COMPANY PROFILE | CLASSIFICATION

About The Group

Contributing to the development of the Indian economy for more than 6 decades, we are proud to be part of The Hindusthan Group, a multi - discipline, multi - location, well diversified industrial conglomerate involved in core sector areas like Engineering, Electricals, Chemicals, Agro Based products, Renewable Energy & Education.

Energy Transmission Division

- We take this opportunity to introduce ourselves as one of India's leading manufacturer of T&D Overhead Conductors (AAC, AAAC, ACAR, ACSR, ACSR/AS, AACSR and all type of "High Temperature Low Sag" Conductors).
- We are driven by our vision of "being a leader in energy transmission solutions with the best in class technology & quality".

Our Company (formerly known as Hindusthan Vidyut Products Limited) has a long and impressive track record of over 54 years catering to the Power Generation, Transmission and Distribution Sector Industry in India & Abroad.





Manufacturing Locations

Faridabad (near Delhi)	-	Overhead Conductor
Gwalior (Central India)	-	Overhead Conductor
Guwahati (East India)	-	Overhead Conductor
Bhubaneswar (East India)	-	Overhead Conductor, special emphasis on HTLS Conductors. Plant commissioning in Q3 FY14-15.

All our manufacturing plants are equipped with state of the art manufacturing & in-house testing facilities, being operated by well trained and committed resources with emphasis on Quality & Timely Delivery.



Product Range

We manufacture a wide range of Overhead Conductors as per customer requirements in line with various National / International Specifications like IEC, BS, DIN, ASTM, CS, NEMA etc

- AAC, AAAC, ACSR, ACSR/AS, ACAR & AACSR Overhead Conductors up to 800 KV Lines.
- High conductivity Aluminium Alloy ConductorsAL-59 & 1120.
- High Temperature Low Sag Conductors such as TACSR/AW, STACIR/AW, ACSS/TW, GTACSR (Gap Type), Composite Carbon Core etc.

Production Capacity

- AAC, AAAC, ACSR, ACSR/AS, ACAR, AACSR, AL-59,1120 a HTLS Conductors: 100000 M.T.

Management System Certifications

Our continuous and systematic efforts to achieve high standards of quality and management system have already been recognized with the award of - .

- ISO 9001:2008
- ISO 14001:2004 &
- BS OHSAS 18001:2007 Certificate by BVQI U.K., the International Accrediting Agency.

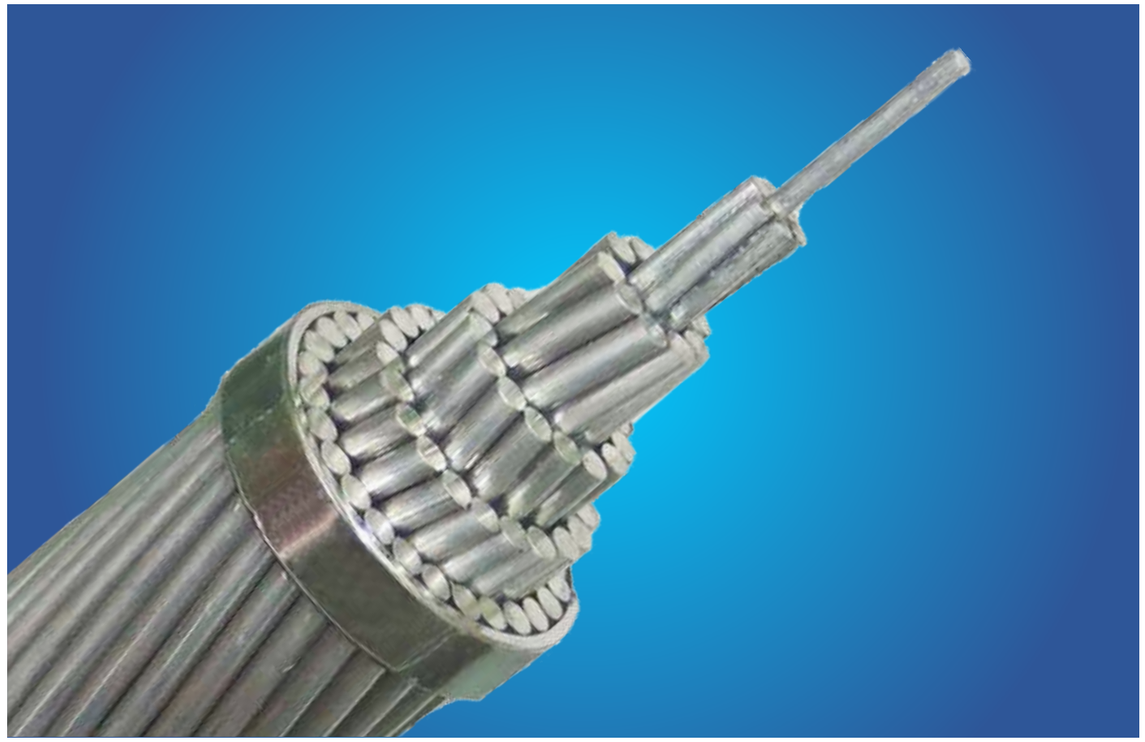
BIS mark

All our products carry the BIS (Bureau of Indian Standard) mark.

Test & Quality Assurance

We assure Quality at every stage of the process to ensure that only high quality products are produced and delivered. The raw materials are procured from reputed vendors across the globe. All incoming raw material passes through defined inspection procedure.
Our Conductors have been successfully Type Tested in International Laboratories likeCESI- Italy, EDF-France, NEFTA- South Africa and Hydro Quebec-Canada Apart from the above, our Conductors are regularly Type Tested in India as per relevant standards as prescribed by customers at Independent Test Houses such as CPRI - Bengaluru a Bhopal, ERDA-Vadodara, Tag Corporation - Chennai, NTH - Delhi,
NABL approved laboratories etc.





HTLS
(High Temperature Low Sag Conductors)

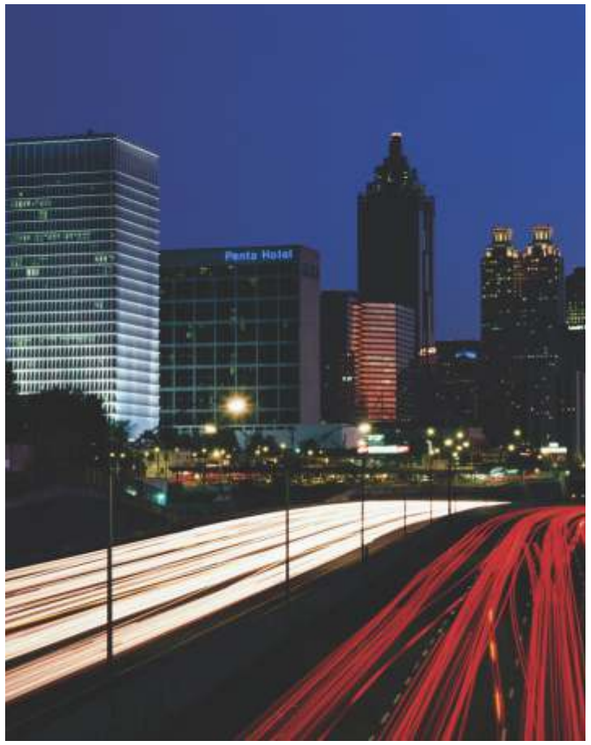
With the increasing requirements of Power transfer due to increase in infrastructure and Right of way issues, HTLS Conductors are emerging out as next generation conductors. HVPL has included these conductors in their portfolios. These conductors are required for following applications

For Reconductoring

- Doubling current carrying and power transfer capacity.
- Existing towers- No modification

For new lines

- Increase in current carrying capacity.
- Improvement in corrosion resistance values
- Faster project execution
- Overall reduction in per unit transmission cost.
- Additional capacity availability for future demand.



Performance Summary

We have supplied Overhead Conductors across the length and breadth of the country to various Transcoms and Discoms against various orders from reputed customers like Power Grid, National Thermal Power Corporation, Tata Hydro Electric Company, Bharat Heavy Electricals, Damodar Valley Corporation, Orissa Power Generation Corporation, etc and all the State Electricity Boards for their various Power Projects. We have also executed a large number of orders against World Bank / ADB / IBRD / IDA funded contracts to various customers in India against stiff Global competition.

We have also created a strong reputation in overseas markets with export of our products to countries like Afghanistan, Bangladesh, Bhutan, Cyprus, United Arab Emirates, Germany, Ghana, Iran, Italy, Kenya, Libya, Mauritius, Mozambique, Nepal, Nigeria, Philippines, Sri Lanka, Sudan, Sultanate of Oman, Surinam, Sweden, Tajikistan, Tanzania, Trinidad & Tobago, Uganda, Vietnam, Yemen, Yugoslavia, Zambia, Zimbabwe etc. In recognition of our performance we have been honoured by Export Promotion Council a number of times for Export excellence. We have been recognized as an Export House by Joint Director General of Foreign Trade.

In the last few years, we have been concentrating mainly on the manufacture of specialized multi strand bigger size Conductors for EHV transmission lines. We are the first in India to supply ACSR Bersimis conductor to Power Grid for 500 KV Kishenpur- Moga transmission line. Apart from the past track record, we are currently supplying Conductors for 765 / 800 KV transmission lines.
The Company has achieved a turnover of Approx US$ 120 Million during the Fiscal year 2013-14.
We have successfully produced and type tested different variants of High Tension Low Sag (HTLS) Conductors. We are supported by International technology partners in HTLS Conductors and Turnkey Solutions tailor-made to specific customer requirements.



CONSTRUCTIONAL FEATURES FOR OVERHEAD CONDUCTORS

AAC (AUAIuminum Conductors)

Conductor shall be all aluminium stranded circular (as per IEC 61089) or any other International Specification such as BS, ASTM, DIN, Canadian, GOST & Swedish Specification etc.

ACSR (Aluminum Conductor Steel Reinforced)

Conductor shall be aluminium stranded circular with steel reinforced (as per IEC 61089) or any other International Specification, such as BS, ASTM, DIN, Canadian, GOST & Swedish Specification etc.

AAAC (AUAIuminum Alloy Conductors)

Conductor shall be all aluminium magnesium silicon alloy stranded circular (as per IEC 61089) or any other International Specification, such as BS, ASTM, DIN, Canadian, GOST & Swedish Specification etc.

AL- 59 Conductors

Aluminium Magnesium Silicon Alloy with minimum 59% conductivity. As compared to ACSR conductor of equivalent diameter or weight is having higher current carrying capacity.

AACSR (Aluminum alloy Conductor Steel Reinforced)

Conductor shall be aluminium magnesium silicon alloy stranded circular with steel reinforced (as per IEC 61089) or any other International Specification, such as BS, ASTM, DIN, Canadian, GOST & Swedish Specification, etc.

HTLS (HIGH TEMPERATURE LOW SAG CONDUCTOR)

ACSS: Aluminium Conductor Steel Supported (ACSS, ACSS/TW)

Fully annealed Aluminium (1350-0) wire round / trapezoidal shape around Aluminium Clad or Zn-5% Aluminium Mischmetal Alloy (Galfan) coated Extra High strength Steel core wire stranded conductors. Suitable for high temperature operation (more than 200°C), having excellent Conductivity-63% IACS, Corrosion resistance & self¬damping with Low Sag.

Gap Type Conductor (GTACSR/ GZTACSR)

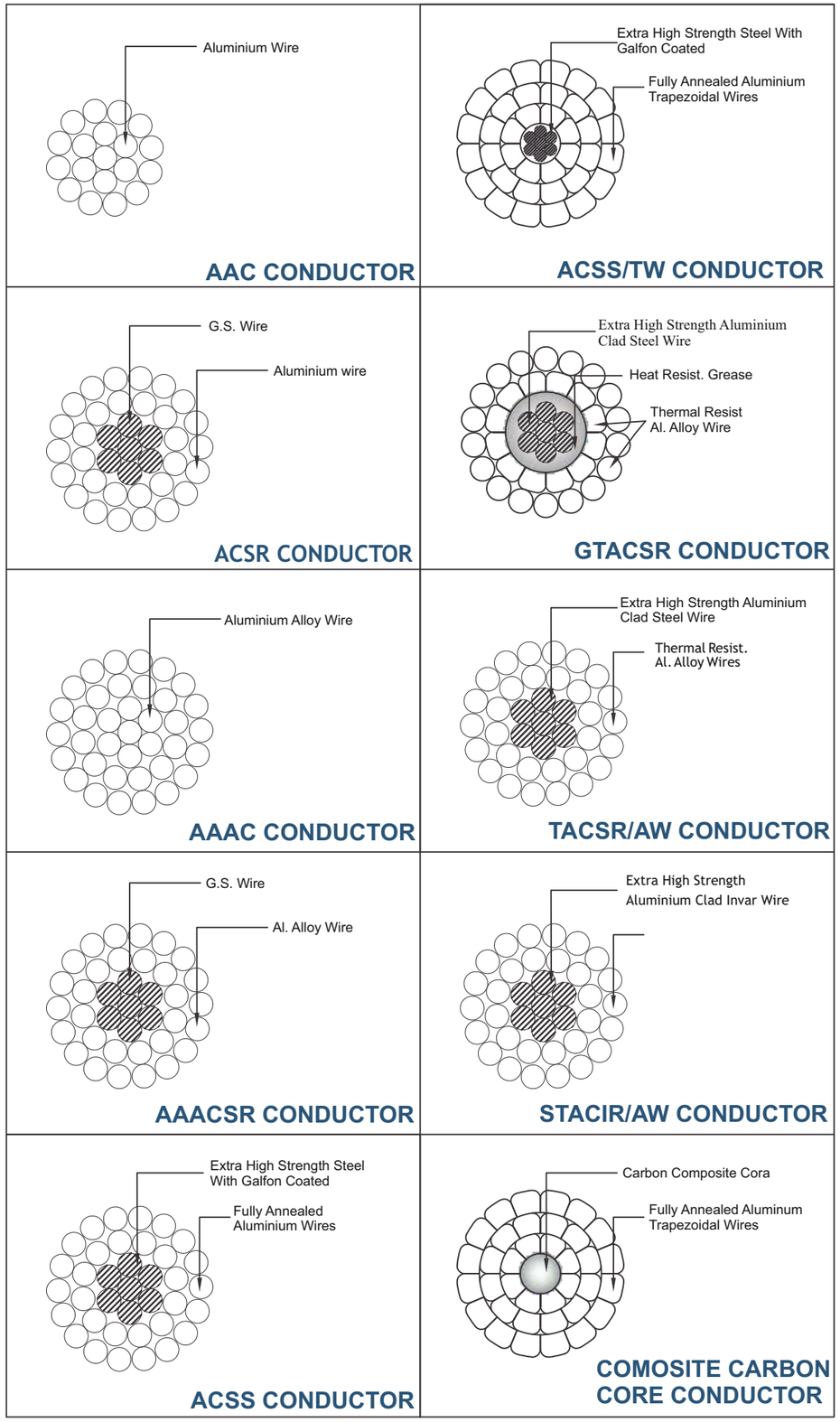
The inner Thermal Resistant Aluminium alloy wire layer is constructed with trapezoidal wires, creating a gap, filled with high temperature resistant grease around Aluminium Clad Extra High Strength Steel Core. Outer Thermal Aluminium Alloy layers could be round or trapezoidal shaped wire.

High Temperature Thermal Resistant Alloy Conductor (TACSR/AW, ZTACSR/AW)

Round/Trapezoidal shaped Thermal Aluminium Alloy wire stranded over Aluminum Clad Extra High Strength Steel wire Core suitable for high temperature operation.

Super Thermal Aluminium Alloy Conductor Aluminium Clad Invar Reinforced (TACIR, STACIR)

Round / Trapezoidal shaped super thermal aluminium alloy wire stranded over Aluminium Clad INVAR alloy wire. Invar alloy contents approx. 36% of nickel and having very low coefficient of thermal expansion.



ALL ALUMINIUM CONDUCTORS (AAC) AS PER IS-398-1: 1996

Code Word	Nominal Aluminium . Area Sq. mm	Stranding & wire dia No./mm	Sectional Area Sq. mm	Approx. Overall Diameter mm	Approx. Weight Kg/Km	Calculated Resistance at 20°C (Max.) Ohm/Km	Approx. Calculated breaking load KN
Gnat	25	7/2.21	26.85	6.63	74	1.096	4.52
Ant	50	7/3.10	52.83	9.30	145	0.5525	8.25
Wasp	100	7/4.39	106.00	13.17	290	0.2752	15.96
Spl. Conductor	150	19/3.18	150.90	15.90	415	0.1942	23.28
Spider	240	19/3.99	237.60	19.95	654	0.1235	35.74
Butterfly	300	19/4.65	322.70	23.25	888	0.09107	48.74

ALL ALUMINIUM CONDUCTORS (AAC) AS PER BRITISH SPECIFICATION BS-215-I-1970

Code Word	Conductor Size Sq. mm	Stranding & wire dia No./mm	Sectional Area Sq. mm	Overall Diameter mm	Approx. Weight Kg/Km	Ultimate Strength Kg	Approx. Resistance at 20°C (Max.) Ohm/Km
Midge	22	7/2.06	23.33	6.18	64	407	1.227
Gnat	25	7/2.21	26.85	6.63	74	468	1.066
Ant	50	7/3.10	52.83	9.30	145	844	0.5419
Fly	60	7/3.40	63.55	10.20	174	1010	0.4505
Wasp	100	7/4.39	106.00	13.17	290	1632	0.2702
Hornet	150	19/3.25	157.60	16.25	434	2620	0.1825
Chafer	200	19/3.78	213.20	18.90	587	3300	0.1349
Cockroach	250	19/4.22	265.70	21.10	731	4120	0.1083
Butterfly	300	19/4.65	322.70	23.25	888	4976	0.08916
Centipede	400	37/3.78	415.20	26.46	1145	6430	0.06944
TARANTULA	795	37/5.23	794.80	36.60	2191	12014	0.03628
BULL	865	61/4.25	864.92	38.25	2400	14169	0.03339

ALL ALUMINIUM CONDUCTORS (AAC) AS PER BRITISH SPECIFICATION BS-215-1-1970

Code Word	Conductor Size Sq. mm	Stranding & wire dia No./mm	Sectional Area Sq. mm	Overall Diameter mm	Approx. Weight Kg/Km	Ultimate Strength Kg	Approx. Resistance at 20°C (Max.) Ohm/Km
Pansy	(1)	7/2.78	42.39	8.32	116.8	746	0.6752
Poppy	(1/10)	7/3.12	53.48	9.40	147.4	900	0.5351
Aster	(2/0)	7/3.50	67.42	10.51	185.8	1140	0.4245
Lily	(3)	7/2.202	26.66	6.606	73.5	515	1.076
Oxlip	(4/0)	7/4.42	107.2	13.30	295.6	1840	0.2671
Tulip	336400	19/3.38	170.5	16.91	470.0	2890	0.1690
Hyacinth	500000	37/2.95	253.1	20.70	698.5	4140	0.1138
Orchid	636000	37/3.33	322.2	23.31	888.4	5250	0.0896
Lilac	795000	61/2.90	403.2	26.11	1112	6510	0.0719
Jessamine	1750000	61/4.30	886.9	38.73	2446	13500	0.0326
Cowslip	2000000	91/3.76	1013	41.40	2793	15600	0.0284

ALL ALUMINIUM CONDUCTORS (AAC) AS PER GERMAN SPECIFICATION DIN 48 201 TEIL 5/1981

Nominal Aluminium . Area Sq. mm	Stranding & wire dia No./mm	Approx. Overall Diameter mm	Sectional Area Sq. mm	Approx. Weight Kg/Km	Approx. Calculated breaking load KN	Calculated Resistance at 20°C (Max.) Ohm/Km
16	7/1.70	5.10	15.89	43	2.84	1.8017
25	7/2.10	6.30	24.25	66	4.17	1.1806
35	7/2.50	7.50	34.36	94	5.78	0.8332
50	7/3.00	9.00	49.48	135	7.94	0.5786
50	19/1.80	9.00	48.35	133	8.44	0.5948
70	19/2.10	10.50	65.81	181	11.32	0.4370
95	19/2.50	12.50	93.27	256	15.67	0.3084
120	19/2.80	14.00	117.00	322	18.77	0.2459
150	37/2.25	15.80	147.11	406	25.29	0.1960
185	37/2.50	17.50	181.62	500	30.54	0.1588
240	61/2.25	20.30	242.54	670	39.40	0.11920
300	61/2.50	22.50	299.43	827	47.69	0.09651
400	61/2.89	26.00	400.14	1104	60.86	0.07222
500	61/3.23	29.10	499.83	1379	74.67	0.05782
625	91/2.96	32.60	626.20	1732	95.24	0.04625
800	91/3.35	36.90	802.09	2218	118.39	0.03611
1000	91/3.74	41.10	999.71	2767	145.75	0.02897

ALL ALUMINIUM CONDUCTORS (AAC)
AS PER CANADIAN SPECIFICATION CSAC-49/1965

Nominal Aluminium . Area Sq. mm	Stranding & wire dia No./mm	Approx. Overall Diameter mm	Sectional Area Sq. mm	Approx. Weight Kg/Km	Approx. Calculated breaking load KN	Calculated Resistance at 20°C (Max.) Ohm/Km
ROSE	7/1.96	5.89	21.16	58	4.07	1.351
LILY	7/2.20	6.61	26.65	73	5.05	1.072
IRIS	7/2.47	7.42	33.61	92	6.23	0.8497
PANSY	7/2.78	8.33	42.39	116	7.60	0.6739
POPPY	7/3.12	9.36	53.48	146	9.22	0.5341
ASTER	7/3.50	10.51	67.42	184	11.62	0.4236
PHLOX	7/3.93	11.80	85.03	232	14.07	0.3360
OXLIP	7/4.42	13.25	107.23	293	17.75	0.2664
DAISY	7/4.96	14.90	135.16	369	22.36	0.2113
VALERIAN	19/2.91	14.57	126.71	348	22.26	0.2274
LAUREL	19/3.01	15.05	135.16	372	23.78	0.2129
PEONY	19/3.19	15.97	152.00	417	26.19	0.1890
TULIP	19/3.38	16.91	170.45	467	29.38	0.1638
DAFFODIL	19/3.45	17.24	177.35	488	30.56	0.1624
CANNA	19/3.67	18.36	201.42	554	34.04	0.1427
GOLDENTUFT	19/3.91	19.55	228.00	626	37.72	0.1263
COSMOS	19/4.02	20.12	241.68	664	40.02	0.1188
ZINNIA	19/4.12	20.60	253.35	695	41.93	0.1132
DAHLIA	19/4.35	21.73	282.00	774	46.69	0.1018
MEADOWSWEET	37/3.23	22.63	304.00	838	52.43	0.0948
ORCHID	37/3.33	23.31	322.26	888	55.57	0.0896
HEUCHERA	37/3.37	23.56	329.35	908	56.79	0.0876
VERBENA	37/3.49	24.45	354.71	978	61.16	0.0814
VIOLET	37/3.53	24.74	362.58	1000	62.54	0.0797
PETUNIA	37/3.62	25.32	380.00	1048	64.20	0.0758
ARBUTUS	37/3.72	26.06	402.84	1112	68.08	0.0715
ANEMONE	37/3.90	27.33	443.10	1222	73.32	0.0653
COCKSCOMB	37/3.96	27.73	456.06	1257	75.48	0.0633
MAGNOLIA	37/4.08	28.55	483.42	1333	80.00	0.0597
HAWKWEED	37/4.18	29.23	506.71	1396	83.87	0.0568
BLUEBELL	37/4.24	29.72	523.68	1445	86.68	0.0551
MARIGOLD	61/3.43	30.89	563.93	1559	97.22	0.0512
HAWTHORN	61/3.55	31.95	604.26	1670	104.13	0.0479
NACISSUS	61/3.67	33.02	644.51	1781	108.79	0.0450
COLUMBINE	61/3.78	34.01	684.84	1893	115.71	0.0423
CARNATION	61/3.89	35.03	725.10	2004	119.92	0.0400
GLADIOLUS	61/4.00	35.99	765.35	2116	126.59	0.0377
COREOPSIS	61/4.10	36.91	805.68	2226	133.26	0.0358

ALUMINIUM CONDUCTORS STEEL REINFORCED (ACSR)
AS PER IS-398-II: 1996 a IS-398-V: 1992

Code Word	Nominal Aluminium . Area Sq. mm	Stranding & wire dia No./mm Alum.	Steel	Sectional Area Sq. mm	Total Sectional Sq. mm	Approx. Overall mm	Approx. Weight Kg/Km Total	Alum.	Steel	Calculated at 20°C (Max.) Ohm/Km	Approx. Calculated breaking load KN
Mole	10	6/1.50	1/1.50	10.60	12.37	4.50	43	29	14	2.780	3.97
Spl.	18	6/1.96	1/1.96	18.10	21.12	5.88	73	50	23	1.618	6.74
Squirrel	20	6/2.11	1/2.11	20.98	24.48	6.33	85	58	27	1.394	7.61
Weasel	30	6/2.59	1/2.59	31.61	36.88	7.77	128	87	41	0.9289	11.12
Rabbit	50	6/3.35	1/3.35	52.88	61.70	10.05	214	145	69	0.5524	18.25
Raccoon	80	6/4.09	1/4.09	78.83	91.97	12.27	319	217	102	0.3712	26.91
Dog	100	6/4.72	7/1.52	105.00	118.50	14.15	394	288	106	0.2792	32.41
Wolf	150	30/2.59	7/2.59	158.10	194.90	18.13	726	438	288	0.1871	67.34
Panther	200	30/3.00	7/3.00	212.10	261.50	21.00	974	587	387	0.1390	89.67
Kundah	400	42/3.50	7/1.96	404.10	425.20	26.88	1281	1120	161	0.07311	88.79
Zebra	420	54/3.18	7/3.18	428.90	484.50	28.62	1621	1187	434	0.06868	130.32
Moose	520	54/4.13	7/3.53	528.50	597.00	31.77	1998	1465	539	0.05595	159.60
Markulla	560	42/4.13	7/2.30	562.70	591.70	31.68	1781	1559	228	0.05231	120.16
Bersimis	690	42/4.57	7/2.54	688.90	724.40	35.04	2187	1907	280	0.04242	146.87

ALUMINIUM CONDUCTORS STEEL REINFORCED (ACSR)
AS PER BRITISH SPECIFICATION BS-215-II-1970

ACSR Code World	Conductorl Size Sq. mm	Stranding & wire dia No./mm Alum.	Steel	Calculated Sectional Area Sq.mm Alum.	ACSR	Overall Diameter mm ACSR	Approx. Weight. kg/km ACSR Alum.	Steel	Ultimate Strength Kg	Calculated Resistance at 20°C (Max.) Ohm/Km
Gopher	25	6/2.36	1/2.36	26.24	30.62	7.08	106	72	34	980	1.093
Weasel	30	6/2.59	1/2.59	31.61	36.88	7.77	128	87	41	1170	0.9077
Fox	35	6/2.79	1/2.79	36.68	42.80	8.37	148	101	47	1340	0.7822
Ferret	40	6/3.00	1/3.00	42.41	49.48	9.00	172	117	55	1550	0.6766
Rabbit	50	6/3.35	1/3.35	52.88	61.70	10.05	214	145	69	1870	0.5426
Mink	60	6/3.66	1/3.66	63.17	72.64	10.98	255	173	82	2220	0.4546
Horse	70	12/2.79	7/2.79	73.37	116.20	13.95	538	203	335	6240	0.3936
Dog	100	6/4.72	7/1.57	105.00	118.50	14.15	394	288	106	3330	0.2733
Coyote	130	26/2.54	7/1.91	131.70	151.80	15.89	521	364	157	4730	0.2191
Wolf	150	30/2.59	7/2.59	158.10	194.90	18.13	726	437	289	7060	0.1828
Lynx	175	30/2.79	7/2.79	183.40	226.20	19.53	842	507	335	8140	0.1576
Panther	200	30/3.00	7/3.00	212.10	261.50	21.00	974	586	388	9430	0.1363
Jaguar	200	18/3.86	1/3.86	210.60	222.30	19.30	671	580	91	4750	0.1367
Goat	320	30/3.71	7/3.71	324.30	400.00	25.97	1489	896	593	13850	0.08912
Bison	380	54/3.00	7/3.00	381.70	431.20	27.00	1443	1055	888	12330	0.07574
Zebra	400	54/3.18	7/3.18	428.90	484.50	28.62	1622	1186	436	13450	0.06740
Deer	425	30/4.27	7/4.27	429.60	529.80	29.89	1973	1187	786	16210	0.06727
Moose	525	54/3.53	7/3.53	528.50	597.00	31.71	1998	1461	537	16420	0.05470

ALUMINIUM CONDUCTORS STEEL REINFORCED (ACSR)
AS PER GERMAN SPECIFICATION DIN 48.204/1974

Nominal Size. Sq. mm	Stranding & wire dia No./mm Alum.	Steel	Approx. Overall Diameter mm	Sectional Area Sq. mm Alu.	St.	Total Sectional Area Sq. mm	Approx. Weight Kg/Km ACSR	Alum.	Steel	Approx. Calculated breaking load KN	Calculated Resistance at 20°C (Max.) Ohm/Km
16/2.5	6/1.80	1/1.80	5.40	15.30	2.55	17.85	42	20	62	5.83	1.8750
25/4.0	6/2.25	1/2.25	6.80	23.80	4.00	27.80	65	32	97	9.02	1.2060
35/6.0	6/2.70	1/2.70	8.10	34.30	5.70	40.00	94	46	140	12.41	0.8365
44/32	14/2.0	7/2.40	11.20	44.00	31.70	75.70	122	250	372	44.14	0.6570
50/8	6/3.20	1/3.20	9.60	48.30	8.00	56.30	132	64	196	16.77	0.5941
50/30	12/2.3	7/2.33	11.65	51.20	29.80	81.00	141	237	378	42.96	0.5642
70/12	26/1.5	7/1.44	11.70	69.90	11.40	81.30	193	91	284	26.29	0.4130
95/15	26/2.5	7/1.67	13.60	94.40	15.30	109.70	260	123	383	35.07	0.3058
95/55	12/3.0	7/3.20	16.00	96.50	56.30	152.80	266	446	712	77.84	0.2992
105/75	14/3.0	19/2.5	17.50	105.70	75.50	181.50	292	599	891	106.38	0.2735
120/20	26/2.4	7/1.90	15.50	121.60	19.80	141.40	336	158	494	4.78	0.2374
120/70	12/3.0	7/3.60	18.00	122.00	71.30	193.30	337	564	901	98.10	0.2367
125/30	30/2.3	7/2.33	16.10	127.90	29.80	157.70	353	238	591	56.50	0.2259
150/25	26/2.0	7/2.10	17.10	148.90	24.20	173.10	411	194	605	54.20	0.1939
170/40	30/2.0	7/2.70	18.90	71.80	40.10	211.90	475	319	794	75.29	0.1682
185/30	26/3.0	7/2.33	19.00	183.80	29.80	213.60	507	239	746	64.94	0.1571
210/35	26/3.0	7/2.49	20.30	209.10	34.10	243.20	577	273	850	73.47	0.1380
210/50	30/3.0	7/3.00	21.00	212.10	49.50	261.60	587	94	981	92.11	1.1362
230/30	24/3.0	7/2.33	21.00	230.90	29.80	260.70	638	239	877	7.16	0.1249
240/40	26/3.5	7/2.68	21.90	243.00	39.50	282.50	671	316	987	84.75	0.1188
265/35	24/3.4	7/2.49	22.40	263.7	34.1	297.8	728	274	1002	81.47	0.10940
300/50	26/3.6	7/3.00	24.50	304.3	49.5	353.8	840	396	1236	104.96	0.09486
305/40	54/2.8	7/2.68	24.10	304.6	39.5	344.1	843	317	1160	97.51	0.09490
340/30	48/3.0	7/2.33	25.00	339.3	29.8	369.1	938	242	1180	91.13	0.08508
380/50	54/3.0	7/3.00	27.00	382.0	49.5	431.5	1056	397	1453	120.70	0.07568
385/35	48/3.0	7/2.49	26.70	386.0	34.1	420.1	1067	277	1344	102.80	0.07479
435/55	54/3.0	7/3.20	28.80	434.3	56.3	490.6	1203	450	1653	133.80	0.06686
450/40	48/3.5	7/2.68	28.70	448.7	39.5	488.2	1241	320	1561	118.45	0.06434
490/65	54/3.0	7/3.40	30.60	490.3	63.6	553.9	1356	510	1866	150.19	0.05896
495/35	45/3.4	7/2.49	29.90	494.1	34.1	528.2	1369	277	1646	119.50	0.05846
510/45	48/3.8	7/2.87	30.70	510.2	45.3	555.5	1413	365	1778	134.00	0.05661
550/70	4/3.0	7/3.60	32.40	550.0	71.3	621.3	1520	572	2092	167.35	0.05256
560/50	48/3.6	7/3.00	32.20	561.7	49.5	611.2	1553	401	1954	146.12	0.05140
570/40	45/4.2	7/2.68	32.20	571.2	39.5	610.7	1571	317	1888	133.61	0.05057
650/45	45/4.0	7/2.87	34.00	653.5	45.3	698.8	1806	365	2171	152.54	0.04420
680/85	54/4.0	19/2.0	36.00	678.6	86.0	764.6	1868	702	2570	202.33	0.04259
1045/45	72/4.0	7/2.87	43.00	1045.6	45.3	1090.9	2893	358	3251	213.46	0.02765

ALUMINIUM CONDUCTORS STEEL REINFORCED (ACSR)
AS PER CANADIAN SPEIFICATION CSAC-49/1965

Code Name	Stranding & wire dia No./mm Alum.	Steel	Approx. Overall Diameter mm	Sectional Area Sq. mm Alu.	St.	Total Sectional Area Sq. mm	Approx. Weight Kg/Km ACSR	Alu.	Steel	Approx. Calculated breaking load KN	Calculated Resistance at 20°C (Max.) Ohm/Km
WREN	6/1.33	1/1.33	3.99	8.39	1.42	9.81	23	11	34	3.33	3.4226
WRABLER	6/1.50	1/1.50	4.50	10.59	1.77	12.36	29	14	43	4.16	2.7139
TURKEY	6/1.68	1/1.68	5.04	13.29	2.19	15.48	37	17	54	5.19	2.1535
THRUSH	6/1.89	1/1.89	5.67	16.77	2.77	19.54	46	22	68	6.47	1.7077
SWAN	6/2.12	1/2.12	6.36	21.16	3.55	24.71	58	27	85	8.14	1.3537
SWALLOW	6/2.38	1/2.38	7.14	26.65	4.45	31.09	73	35	108	10.05	1.0738
SPARROW	6/2.67	1/2.67	8.01	33.61	5.61	39.22	92	44	136	12.44	0.8504
ROBIN	6/3.00	1/3.00	9.00	42.39	7.10	49.49	116	55	171	15.54	0.6752
RAVEN	6/3.37	1/3.37	10.11	53.48	8.90	62.38	146	69	215	19.03	0.5251
QUAIL	6/3.78	1/3.78	11.34	67.42	11.23	78.65	185	88	273	23.78	0.4245
PIGEON	6/4.25	1/4.25	12.75	85.03	14.19	99.22	233	110	343	29.72	0.3366
PENGUIN	6/4.77	1/4.77	14.31	107.23	17.87	125.10	294	139	433	37.47	0.2671
OWL	6/5.36	7/1.79	16.09	135.16	17.55	152.71	371	137	508	42.47	0.2119
WAXWING	18/3.9	1/3.09	15.45	135.16	7.48	142.54	372	58	430	31.49	0.2126
PARTRIDGE	26/2.7	7/2.00	16.28	135.16	22.00	157.16	374	171	545	50.03	0.2136
PHOEBE	18/3.8	1/3.28	16.40	152.00	8.45	160.45	418	65	483	35.51	0.1893
OSTRICH	26/2.3	7/2.12	17.28	152.00	24.71	176.71	420	193	613	56.21	0.1900
PIPER	30/2.4	7/2.54	17.78	152.00	35.48	187.48	420	277	697	68.67	0.1903
MERLIN	18/3.7	1/3.47	17.35	170.45	9.48	179.93	469	74	54	339.82	0.1686
LINNET	26/2.9	7/2.25	18.31	170.45	27.81	198.26	470	217	687	62.54	0.1696
IBIS	26/3.4	7/2.44	19.88	201.42	32.77	234.19	557	256	813	72.00	0.1434
LARK	30/2.2	7/2.92	20.44	201.42	46.97	248.39	557	366	923	88.87	0.1437
PELICAN	18/4.4	1/4.14	20.70	241.68	13.42	255.10	665	104	769	54.78	0.1191
HAWK	26/3.4	7/2.67	21.77	241.68	39.42	281.10	667	308	975	86.52	0.1194
HEN	30/3.0	7/3.20	22.40	241.68	56.39	298.07	688	440	1128	103.88	0.1198
HERON	30/3.8	7/3.28	22.96	253.35	59.10	312.45	701	461	1162	108.79	0.1142
SAPSUCHER	22/4.4	7/2.24	22.88	282.00	27.68	309.68	777	216	993	79.11	0.1024
DOVE	26/3.2	7/2.89	23.55	282.00	45.94	327.94	778	359	1137	99.91	0.1024
EAGLE	30/3.6	7/3.46	24.22	282.00	65.81	347.81	780	513	1293	121.25	0.1027
DUCK	54/2.9	7/2.69	24.21	306.58	39.81	346.39	848	311	1159	100.11	0.0945
GROSBEAK	26/3.7	7/3.09	25.15	322.26	52.45	374.71	890	409	1299	111.24	0.0896
EGRET	30/3.0	19/2.2	25.90	322.26	73.55	395.81	891	576	1467	140.57	0.0896
GOOSE	54/2.6	7/2.76	24.84	322.26	41.74	364.00	891	326	1217	105.26	0.0899
GULL	54/2.2	7/2.82	25.38	337.74	43.81	381.55	935	342	277	109.23	0.0856
STARLING	26/4.1	7/3.28	26.68	362.58	59.03	421.61	1002	460	1462	125.02	0.0797
REDWING	30/3.2	19/2.5	27.43	362.58	82.58	445.16	1002	646	1648	153.96	0.0797
CROW	54/2.2	7/2.92	26.28	362.58	46.97	409.55	1003	366	1369	117.22	0.0797
DRAKE	26/4.4	7/3.45	28.11	402.84	65.61	468.45	1112	512	1624	139.05	0.0715
MALLARD	30/4.4	19/2.8	28.96	402.84	91.87	494.71	1113	719	1832	171.08	0.0719
CONDOR	54/3.8	7/3.08	27.72	402.84	52.19	455.03	1113	408	1521	127.03	0.0719
CRANE	54/3.3	7/3.23	29.07	443.10	57.48	500.58	1226	448	1674	139.69	0.0653
CANARY	54/3.8	7/3.28	29.52	456.06	59.10	515.16	1262	462	1724	143.71	0.0633
CARDINAL	54/3.8	7/3.38	30.42	483.42	62.65	546.07	1338	488	1826	152.39	0.0597
CURLEW	54/3.1	7/3.51	31.59	523.68	67.87	591.55	1448	530	1978	165.29	0.0551
FINCH	54/3.5	19/2.9	32.85	563.93	71.55	636.48	1561	560	2121	178.88	0.0512
GRACKEE	54/3.7	19/2.7	33.97	604.26	76.58	680.84	1671	600	2271	191.78	0.0479
PHEASANT	54/3.0	19/2.4	35.10	644.51	81.68	726.19	1783	538	2421	199.33	0.0449
MARTIN	54/4.2	19/2.1	36.17	684.84	86.71	771.55	1894	679	2573	211.79	0.0432
PLOVER	54/4.4	19/2.8	37.24	725.10	91.87	816.97	2006	719	2725	224.25	0.0400
PARROT	54/4.5	19/2.5	38.25	765.35	96.84	862.19	2118	759	2877	237.15	0.0377
FALCON	54/4.6	19/2.2	39.26	805.68	102.13	907.81	2229	799	3028	249.61	0.0358

ALUMINIUM CONDUCTORS STEEL REINFORCED (ACSR)
AS PER ASTM B - 232 - 1992

ACSR Code Word	Conductorl Size Sq. mm	Stranding & wire dia No./mm Alum.	Steel	Calculated Sectional Area Sq.mm Alum.	ACSR	Overall Diameter mm ACSR	Approx. Weight. Kg/Km ACSR	Alum.	Steel	Ultimate Strength Kg	Calculated Resistance at 20°C (Max.) Ohm/Km
Sparrow	(2)	6/2.67	1/2.67	33.61	39.22	8.01	136.0	92	44	1295	0.853
Swallow	(3)	6/2.38	1/2.38	26.65	31.10	7.14	108	73	35	1040	1.076
Raven	(1/0)	6/3.37	1/3.37	53.48	62.38	10.11	216	147	69	1990	0.5364
Penguin	(4/0)	6/4.77	1/4.77	107.23	125.10	14.31	433	294	139	3800	0.2676
Merlin	336400	18/3.47	1/3.47	170.45	179.90	17.36	544	470	74	3930	0.1692
Lbis	397500	26/3.14	7/2.44	201.40	234.00	19.88	814	558	256	7380	0.1438
Pelican	477000	18/4.14	1/4.14	241.68	255.10	20.70	771	666	105	5350	0.1193
Hawk	477000	26/3.43	7/2.67	241.70	280.80	21.78	976	90	307	8880	0.1194
Grosbeak	636000	26/3.97	7/3.08	322.26	374.78	25.15	1303	893	400	11500	0.08989
Drake	795000	26/4.44	7/3.45	402.80	466.84	28.11	1628	1116	512	14300	0.07192
Coot	795000	36/3.77	1/3.77	402.80	414.00	26.42	1197	1110	87	7610	0.07134
Mallard	795000	30/4.14	19/2.48	402.84	494.71	8.96	1839	1119	719	17450	0.07208
Rail	954000	45/3.70	7/2.47	483.42	516.84	29.61	1600	1339	260	12020	0.05994
Cardinal	954000	54/3.38	7/3.38	483.42	546.07	30.42	1829	1339	490	5500	0.05994
Curlow	1033500	54/3.52	7/3.52	523.68	591.55	31.68	1981	1451	530	16700	0.05531
Falcon	1590000	54/4.36	19/2.62	805.80	908.12	39.26	3042	2243	799	25000	0.03612

ALL ALUMINIUM ALLOY CONDUCTOR (AAAC)
AS PER IS: 398-IV - 1994

Actual Area Sq. mm	Standing and Wire Dia Nos./mm	Approx. overall dia mm	Approx. Kg/Km	Calculated Resistance Breaking Load Ohm/Km	Approx. Calculated at 20°C (Max.) KN
15	3/2.50	5.39	40.15	2.3040	4.33
22	7/2.00	6.00	60.15	1.5410	6.45
34	7/2.50	7.50	94.00	0.9900	10.11
55	7/3.15	9.45	149.20	0.6210	16.03
80	7/3.81	11.43	18.26	0.4250	23.41
100	7/4.26	12.78	272.86	0.3390	29.26
125	19/2.89	14.45	342.51	0.2736	36.64
148	19/3.15	15.75	406.91	0.2290	43.50
173	19/3.40	17.00	474.02	0.1969	50.54
200	19/3.66	18.30	549.40	0.1710	58.66
232	19/3.94	19.70	636.67	0.1471	68.05
288	37/3.15	22.05	794.05	0.1182	84.71
346	37/3.45	24.15	952.56	0.0984	101.58
400	37/3.71	25.97	1101.63	0.0829	117.40
465	37/4.00	28.00	1280.50	0.0734	136.38
525	61/3.31	29.79	1448.39	0.0651	146.03
570	61/3.45	31.05	1573.71	0.0598	158.66
604	61/3.55	31.95	1666.00	0.0568	167.99
642	61/3.66	32.94	1771.36	0.0534	178.43
695	61/3.81	34.29	1919.13	0.0492	193.25
767	61/4.00	36.00	2115.54	0.0446	213.01

ALL ALUMINIUM ALLOY CONDUCTOR (AAAC)
AS PER BRITISH SPECIFICATION BS: 3242 - 1970

Code Word	Nominal Aluminium Area Sq. mm	Stranding & wire dia No./mm	Sectional Area Sq. mm	Overall Diameter mm	Approx. Weight Kg/Km	Calculated Breaking Load Kg	Calculated Resistance at 20°C (Max.) Ohm/Km
Almond	25	7/2.34	30.10	7.02	82	8.44	1.094
Cedar	30	7/2.54	35.50	7.62	97	9.94	0.9281
Fir	40	7/2.95	47.84	8.85	131	13.40	0.6880
Hazel	50	7/3.30	59.90	9.90	164	16.80	0.5498
Oak	100	7/4.65	118.9	13.95	325	33.30	0.2769
Ash	150	19/3.48	180.7	17.40	497	50.77	0.1830
Elm	175	19/3.76	211.0	18.80	580	59.10	0.1568
Upas	300	37/3.53	362.1	24.71	997	101.50	0.09155

ALL ALUMINIUM ALLOY CONDUCTOR (AAAC)
AS PER ASTM B - 399 - 1992

Conductor	Stranding & wire dia No./mm	Sectional Area Sq. mm	Approx. Overall Diameter mm	Approx. Mass Kg/Km	Calculated Resistance at 20°C (Max.) Ohm/Km	Rated Strength KN	Class
MCM 30.58	7/1.68	15.52	5.04	43	2.163	4.85	
MCM 48.69	7/2.12	24.71	6.36	68	1.356	7.75	A
MCM 77.47	7/2.67	39.19	8.01	108	0.8540	12.31	A
MCM 123.30	7/3.37	62.44	10.11	172	0.5371	19.62	AA, A
MCM 155.40	7/3.78	78.55	11.34	217	0.4259	23.70	AA, A
MCM 195.7	7/4.25	99.30	12.75	274	0.3376	29.9	AA, A
MCM 246.9	7/4.77	125.10	14.31	345	0.2677	37.7	A
MCM 312.8	19/3.26	158.59	14.30	437	0.2113	47.2	A
MCM 394.5	19/3.66	199.90	18.30	551	0.1677	57.1	AA, A
MCM 465.0	19/3.98	236.38	19.90	650	0.1421	67.3	AA
MCM 559.5	19/4.36	283.67	21.80	781	0.1181	80.9	AA
MCM 652.5	19/4.71	331.05	23.55	911	0.1014	94.4	AA
MCM 740.8	37/3.59	374.53	25.13	1034	0.0892	107	AA
MCM 927.2	7/4.02	469.62	28.14	1295	0.0712	134	AA
MCM 1077.4	61/3.38	545.90	30.42	1495	0.0613	156	AA
MCM 1164.1	61/3.51	590.30	31.59	1617	0.0568	169	AA
MCM 1259.6	61/3.65	638.20	32.85	1748	0.0526	182	AA
MCM 1348.8	61/3.78	683.40	4.02	1872	0.0490	195	AA
MCM 1439.2	61/3.90	729.20	35.10	1997	0.0461	208	AA

ALL ALUMINIUM ALLOY CONDUCTOR (AAAC)
AS PER GERMAN SPECIFICATION DIN 48 201 TEIL 6/1981

Nominal Aluminium Sq. mm	Stranding & wire dia No./mm	Approx. Overall Diameter mm	Sectional Area Sq. mm	Approx. Weight Kg/Km	Approx. Calculated breaking load KN	Calculated Resistance at 20°C (Max.) Ohm/Km
16	7/1.70	5.10	15.89	43	4.44	2.0910
25	7/2.10	6.30	24.25	66	6.77	1.3720
35	7/2.50	7.50	34.36	94	9.60	0.9670
50	7/3.00	9.00	49.48	135	13.82	0.6716
50	19/1.80	9.00	48.35	133	13.50	0.6893
70	19/2.10	10.50	65.81	181	18.38	0.5079
95	19/2.50	12.50	93.27	256	26.05	0.3580
120	19/2.80	14.00	117.00	322	32.68	0.2853
150	37/2.25	15.80	147.11	406	41.09	0.2278
185	37/2.50	17.50	181.62	500	50.73	0.1842
240	61/2.25	20.30	242.54	670	67.74	0.1385
300	61/2.50	22.50	299.43	827	83.63	0.1119
400	61/2.89	26.00	400.14	1104	111.76	0.08407
500	61/3.23	29.10	499.83	1379	139.60	0.06713
625	91/2.96	32.60	626.20	1732	174.90	0.05375
800	91/3.35	36.90	802.09	2218	224.02	0.04197
1000	91/3.74	41.10	999.71	2767	279.22	0.03360

BUREAU VERITAS Certification

HINDUSTHAN URBAN INFRASTRUCTURE LIMITED

(An enterprise of THE HINDUSTHAN GROUP)

Kanchenjunga, (7th Floor) 18, Barakhamba Road,
New Delhi -110001 (INDIA)

This is a multi-site certificate, additional site details are listed in the appendix to this certificate

Bureau Veritas Certification certify that the Management System of the above organization has been audited and found to be in accordance with the requirements of the management system standard detailed below

Standards

ISO 9001:2008, ISO 14001:2004 & BS OHSAS 18001:2007

Scope of certification

SALES & MARKETING OF:

- **LT PVC & XLPE POWER AND CONTROL CABLES UPTO AND INCLUDING 6.6 KV GRADE**
- **HT XLPE POWER CABLES UPTO AND INCLUDING 66 KV GRADE**
- **AERIAL BUNCHED CABLES UPTO AND INCLUDING 33 KV GRADE**
- **OVERHEAD CONDUCTORS AAC, AAAC, ACSR, AACSR, AL-59 AND HTLS UPTO 800 KV LINES**

Certification cycle start date: **11 February 2014**
Subject to the continued satisfactory operation of the organization's Management System, this certificate expires on: **10 February 2017**
Original Certification Date: **01 September 1994**
Certificate No. IND14.506U/Q/E/HS Version:1 Revision date: **11 February 2014**

Certification Authority
RAMESH KOREGAVA
General Manager

UKAS MANAGEMENT SYSTEMS 008

Certification body address: Brandon House, 180 Borough High Street, London Se1 Se1 1LB United Kingdom

Local office: "Marwah Centre" 6th floor, Krishanlal Marwah Marg, Opp: Ansa Inds. Estate, Off : Saki Vihar Road, Andheri East, MUMBAI 400 072, India

Further clarifications regarding the scope of this certificate and the applicability of the management system requirements may be obtained by consulting the organization.
To check this certificate validity please call +91 22 66956300

BUREAU VERITAS Certification

Appendix to the certification

HINDUSTHAN URBAN INFRASTRUCTURE LIMITED
(An enterprise of THE HINDUSTHAN GROUP)

Standards

ISO 9001:2008, ISO 14001:2004 & BS OHSAS 18001:2007

Scope of certification

Site	Address	Scope
SITE1	12/1; MILE STONE; DELHI-MATHURA ROAD, 121 003, FARIDABAD, INDIA	DESIGN, MANUFACTURE AND DESPATCH OF: • LT PVC & XLPE POWER AND CONTROL CABLES UPTO AND INCLUDING 6.6 KV GRADE • HT XLPE POWER CABLES UPTO AND INCLUDING 66 KV GRADE • AERIAL BUNCHED CABLES UPTO AND INCLUDING 33KV GRADE • OVERHEAD CONDUCTORS AAC, AAAC, ACSR, AACSR, AL-59 AND HTLS UPTO 800 KV LINES
SITE2	INDUSTRIAL AREA, PO-BIRLA NAGAR, GWALIOR-474 004 (MP), INDIA	MANUFACTURE AND DESPATCH OF: • OVERHEAD CONDUCTORS AAC, AAAC, ACSR, AACSR, AL-59 AND HTLS UPTO 800 KV LINES
SITE3	1C, BRAHMAPUTRA INDUSTRIAL PARK, VILL. SILA, SINDURI GHOPA, NORTH GUWAHATI-781031 DIST. KAMRUP (ASSAM), INDIA.	MANUFACTURE AND DESPATCH OF: • OVERHEAD CONDUCTORS AAC, AAAC, ACSR, AACSR, AL-59 AND HTLS UPTO 800 KV LINES

Certificate No. IND14.506U/Q/E/HS **Version:1** **Revision date: 11 February 2014**

Certification Authority
RAMESH KOREGAVA
General Manager

UKAS MANAGEMENT SYSTEMS 008

Certification body address: Brandon House, 180 Borough High Street, London Se1 Se1 1LB United Kingdom

Local office: "Marwah Centre" 6th floor, Krishanlal Marwah Marg, Opp: Ansa Inds. Estate, Off : Saki Vihar Road, Andheri East, MUMBAI 400 072, India

Further clarifications regarding the scope of this certificate and the applicability of the management system requirements may be obtained by consulting the organization.
To check this certificate validity please call +91 22 66956300



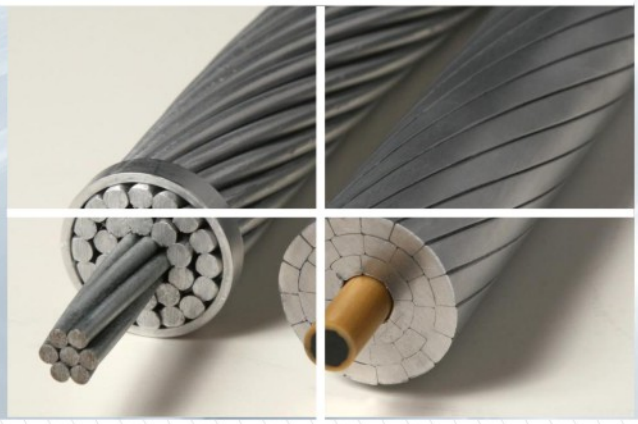




www.ieema.org

CLASSIFICATION





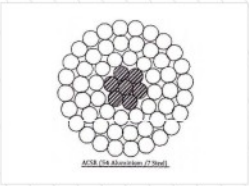
JSK Industries Pvt. Ltd.

ISO 9001:2008 Company & Export "Trading House" Status Holder

CONDUCTORS

ACSR - Aluminum Conductor, Steel Reinforced

ACSR 61 Strand (54 Al / 7 St) Conductors



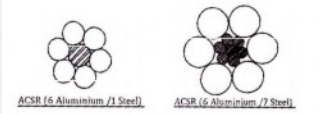
Conductor	Number of Wires			Dia			Cross Sectional Area			Linear Weight	Breaking Load / RTS	DC Resistance
	Al	Steel	Cond	Al	Steel	Cond	Al	Steel	Cond	Kg/Km	KN	ohm/km
ZEBRA	54	7	61	3.18	3.18	28.62	428.9	55.6	484.5	1621	132.32	0.06868
MOOSE	54	7	61	3.53	3.53	31.77	528.5	68.5	597	2004	161.2	0.05552
BERSIMIS	42	7	49	4.57	2.54	35.04	688.9	35.5	724.4	2187	146.87	0.04242

ACSR 37 Strand (30 Al / 7 St) Conductors



Conductor	Number of Wires			Dia			Cross Sectional Area			Linear Weight	Breaking Load / RTS	DC Resistance
	Al	Steel	Cond	Al	Steel	Cond	Al	Steel	Cond	Kg/Km	KN	ohm/km
WOLF	30	7	37	2.59	2.59	18.13	158.1	36.8	194.9	726	67.34	0.1871
PANTHER	30	7	37	3	3	21	212.1	49.4	261.5	974	89.67	0.139

ACSR 7 Strand (6 Al / 1 St) & 13 Strand (6 Al/7 St) Conductors



Conductor	Number of Wires			Dia			Cross Sectional Area			Linear Weight	Breaking Load / RTS	DC Resistance
	Al	Steel	Cond	Al	Steel	Cond	Al	Steel	Cond	Kg/Km	KN	ohm/km
SQUIRREL	6	1	7	2.11	2.11	6.33	20.98	3.5	24.48	85	7.61	1.394
WEASEL	6	1	7	2.59	2.59	7.77	31.61	5.27	36.88	128	11.12	0.9289
RABBIT	6	1	7	3.35	3.35	10.05	52.88	8.82	61.7	214	18.25	0.5524
RACCOON	6	1	7	4.09	4.09	12.27	78.83	13.14	91.97	319	26.91	0.3712
DOG	6	7	13	4.72	1.57	14.15	105	13.5	118.5	394	32.41	0.2792

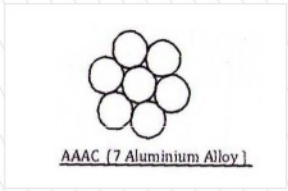
COMPANY PROFILE
CLASSIFICATION

JSK Industries Pvt. Ltd.

ISO 9001:2008 Company & Export "Trading House"Status Holder

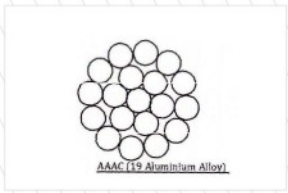
AAAC - All Aluminum Alloy Conductor. Bare

AAAC 7 Strand Conductors



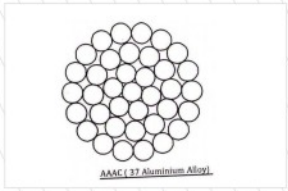
Conductor	Number of Wires	Dia		Cross Sectional Area	Linear Weight	Breaking Load / RTS	DC Resistance
-	-	Wire	Cond	Cond	Cond	KN	ohm/km
SQUIRREL	7	2.00	6.00	22	60	6.45	1.541
WEASEL	7	2.50	7.50	34	94	10.11	0.99
RABBIT	7	3.15	9.45	55	149	16.03	0.621
RACOON	7	3.81	11.43	80	218	23.41	0.425
DOG	7	4.26	12.78	100	273	29.26	0.339

AAAC 19 Strand Conductors



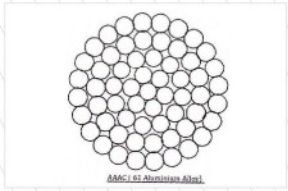
Conductor	Number of Wires	Dia		Cross Sectional Area	Linear Weight	Breaking Load / RTS	DC Resistance
-	-	Wire	Cond	Cond	Cond	KN	ohm/km
DOG-UP	19	2.89	14.45	125	343	36.64	0.2735
COYOTE	19	3.15	15.75	148	407	43.50	0.2290
WOLF	19	3.40	17.00	173	474	50.54	0.1969
WOLF-UP	19	3.66	18.3	200	549	58.66	0.1710
PANTHER	19	3.94	19.7	232	637	68.05	0.1471

AAAC 37 Strand Conductors



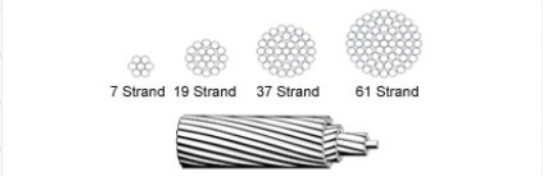
Conductor	Number of Wires	Dia		Cross Sectional Area	Linear Weight	Breaking Load / RTS	DC Resistance
-	-	Wire	Cond	Cond	Cond	KN	ohm/km
PANTHER-UP1	37	3.15	22.05	288	794	84.71	0.1182
PANTHER-UP2	37	3.45	24.15	346	952	101.58	0.0984
KUNDAH	37	3.71	25.97	400	1102	117.4	0.0829
ZEBRA	37	4.00	28.00	465	1281	136.38	0.0734

AAAC 61 Strand Conductors



Conductor	Number of Wires	Dia		Cross Sectional Area	Linear Weight	Breaking Load / RTS	DC Resistance
-	-	Wire	Cond	Cond	Cond	KN	ohm/km
ZEBRA-UP	61	3.31	29.79	525	1448	146.03	0.0651
MOOSE	61	3.45	31.05	570	1574	158.66	0.0598
MORKULLA	61	3.55	31.95	604	1666	167.99	0.0568
MOOSE UP	61	3.66	32.94	642	1771	178.43	0.0534
MORKULLA - UP	61	3.81	34.29	695	1919	193.25	0.0492

AAC - All Aluminum Conductor. Bare



Applications

These Conductors are used primarily for overhead transmission and primary and secondary distribution, where Ampacity must be maintained and a lighter conductor (compared to ACSR) is desired, when conductor strength is not a critical factor. Classes B and C are used primarily as bus, apparatus connectors and jumpers, where additional flexibility is required.

Specifications

JSK's AAC bare conductors meet International Standard including ASTM, BS, DIN, IEC, NFC etc.

COMPANY PROFILE
CLASSIFICATION

AL - 59 Conductor

AL 59- 37 Strand Conductors



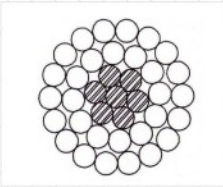
Conductor	Number of Wires	Dia		Cross Sectional Area	Linear Weight	Breaking Load / RTS	DC Resistance
-	-	Wire	Cond	Cond	Kg/Km	KN	ohm/km
AL 59 Panther	37	3.37	23.59	330	910	82.5	0.1061

AL 59- 61 Strand Conductors



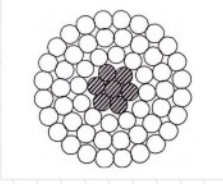
Conductor	Number of Wires	Dia		Cross Sectional Area	Linear Weight	Breaking Load / RTS	DC Resistance
-	-	Wire	Cond	Cond	Kg/Km	KN	ohm/km
AL 59 Zebra	61	3.18	28.62	490	1336	121.02	0.0625
AL 59 Moose	61	3.5	31.5	590	1618	141.12	0.0507
AL 59 Bersimis	61	4.02	36.18	774	2140	178	0.0384

HTLS



HTLS- 37 Strand (30 Al/ 7 St.) Conductors

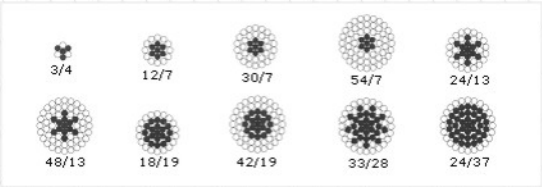
Conductor	Number of Wires			Dia			Cross Sectional Area			Linear Weight	Breaking Load / RTS	DC Resistance
-	Al	Steel	Cond	Al	Steel	Cond	Al	Steel	Cond	Kg/Km	KN	ohm/km
HTLS Panther	30	7	37	3.00	3.00	21.00	7.161	7.161	200	974	105.3	0.141



HTLS- 61 Strand (54 Al/ 7 St.) Conductors

Conductor	Number of Wires			Dia			Cross Sectional Area			Linear Weight	Breaking Load / RTS	DC Resistance
-	Al	Steel	Cond	Al	Steel	Cond	Al	Steel	Cond	Kg/Km	KN	ohm/km
HTLS Zebra	54	7	61	3.18	3.18	28.62	7.945	7.945	420	1621	145	0.0697
HTLS Moose	54	7	61	3.53	3.53	31.77	9.79	9.79	520	2001	177	0.05651

ACAR - Aluminum Conductor Alloy Reinforced



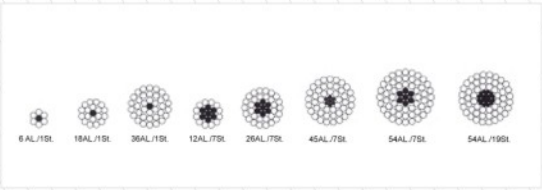
Applications

Used as bare overhead transmission cable and as primary and secondary distribution cable. A good strength-to-weight ratio makes ACAR applicable where both ampacity and strength are prime considerations in line design. For equal weight ACAR offers higher strength and ampacity than ACSR.

Specifications

JSK's ACAR bare conductors meet International Standard including ASTM, BS, DIN, IEC, NFC etc

AACSR - Aluminum Alloy Conductor, Steel Reinforced



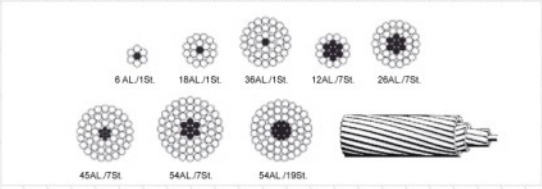
Applications

Used as bare overhead transmission cable and as primary and secondary distribution cable. AACSR offers optimal strength for line design. Variable steel core stranding enables desired strength to be achieved without sacrificing Ampacity.

Specifications

JSK's bare AACSR conductors meet International Standard including ASTM, BS, DIN, IEC, NFC etc

ACSR / AW - Aluminum-Clad Steel Reinforced. Bare



Applications

Used as bare overhead transmission and as primary and secondary distribution cable. ACSR/AW offers strength characteristics similar to ACSR, along with slightly greater Ampacity and resistance to corrosion due to aluminum-cladding ofthe steel core wires.

Specifications

JSK's bare ACSR/AW conductors meet International Standard including ASTM, BS, DIN, IEC, NFC etc

ACSR - Black Conductor



Applications

Changing to Black conductors has approved as an excellent technical and economical solution for revitalization of old overhead lines.

Specifications

JSK's bare ACSR Black conductors meet International Standard including ASTM, BS, DIN, IEC, NFC etc

JSK Industries Pvt. Ltd.

ISO 9001:2008 Company & Export "Trading House"Status Holder

Corporate Office:

9, A. K. Naik Marg, CST, Mumbai - 400 001, INDIA.Tel.: +91 - 22 - 6625 3700 Fax: +91 - 22 - 6655 0780

E-mail: jsk@jskindia.in Web: www.jskindia.in

Factory:

Survey No. 369/1/1/2, Behind Siyaram Silk Mills Ltd, Village Sayli, Silvassa - 396 230, U. T. of D. & N.H., INDIA.

Survey No. 126/1, Near Rakholi School, Rakholi, Silvassa - 396 240, U. T. of D. & N.H., INDIA.

COMPANY PROFILE

CLASSIFICATION







www.ieema.org

CLASSIFICATION

URS NABCB QM016
Certificate No. : 18629

NECCON POWER & INFRA LIMITED

(Formely : North Eastern Cables & Conductors (P) Ltd.)

416, (4TH FLOOR), CITY PLAZA, SPACE CINEMA COMPLEX, JAIPUR-302 016 INDIA. **TELEFAX :** 91-141-2281540 / 2281654
E-mail: neccon@sancharnet.in, necconjpr@yahoo.com **Website :** http://www.khetan-group.com

Ref: NECCON/INTRODUCTION/2013-14
M/s.

Sub: - **INTRODUCTION**

Dear Sir,

We introduce ourselves as one of the pioneer industrialist of India and serving the manufacturing and turnkey Power Sector Transmission line since last 40 years. We are dealing in following businesses under the name & style as "KHETANGROUP" comprising of following lines:-

1. **Neccon Power & Infra Ltd.**, -Manufacturer of AAC/ACSR/AAAC Conductors upto 765KV and Trunkey Transmission and Sub-station Projects(EPC) upto 400KV

2. **North Eastern Knowledge Foundation**: Established a University in the brand name of **KAZIRANGA UNIVERSITY** in NE region of India

3. **North Eastern Cables (P) Ltd.**, - Manufacturer of Power & Control Cables upto 1.1KV

4. **Khetan Electrical Industries** - LT & HT Hardware Line Materials upto 400KV Line

5. **Hightension Electricals** – Trading of Electricals Line Materials

6. **Managing Kothari Products Ltd.**, - "PAN PARAG" Unit at Jorhat (Assam) for manufacturing of Pan Masala, A Mouth Freshener.

7. **Managing Khushi Aromatics** - Associate unit of "PAN PARAG" Group for manufacturing of Perfume / Fragrances at Jorhat (Assam)

8. **Kreesna Industries (I) Pvt. Ltd.**, - On Contract Manufacturer of ITC Ltd. for Brand Cigarettes.

9. **Shyam Associate** – On Contract Manufacturer of ITC Ltd. for Brand Safety Matches.

Ours is a Industrial Units registered with Directorate of Industries, Govt. of Assam/Govt. of Rajasthan, India and also registered with M/s NSIC Ltd., India and by virtue of its performance, we have been awarded the prestigious **ISO-9001:2008 Quality System Certification Marks** by URS Certification Ltd., Bournemouth, UK.

Condt...

NECCON POWER & INFRA LIMITED JAIPUR

Certificate No. : 18629

NECCON POWER & INFRA LIMITED

(Formely : North Eastern Cables & Conductors (P) Ltd.)

416, (4TH FLOOR), CITY PLAZA, SPACE CINEMA COMPLEX, JAIPUR-302 016 INDIA. **TELEFAX** : 91-141-2281540 / 2281654
E-mail: neccon@sancharnet.in, necconjpr@yahoo.com **Website** : http://www.khetan-group.com

We take the liberty to state here that our units (conductor and cable) is registered and approved by the organization as per the Annexure enclosed.

In addition to the above, we are having full fledged testing laboratory at our works at **(1) Industrial Estate, Cinnamara, Jorhat-785 008 (2) Industrial Area, Sikar, & (3) Bapi Industrial Area, Dausa, Rajasthan** as per international standards.

GREAT ACHIEVEMENTS BY THE COMPANY:

Our organization has been conferred the following awards:

- **UDYOG RATTAN AWARD for contribution towards the industrial development of the country.**
- **EXCELLENCE AWARD for outstanding performance in productivity, Management, Quality and Innovation.**
- **BEST PRODUCTIVITY PERFORMANCE AWARD for the year 1995-96 by the National Productivity Council, Govt. of India.**
- **NATIONAL AWARD WINNER, Govt. of India for the year 2007-08**

We hope you would be considering our credentials favorably and offer us an opportunity to tie with your esteem Organization. Please feel free to contact us for any queries / clarification.

Thanking you and assuring of our best services at all the times.

Yours faithfully,
For Neccon Power & Infra Ltd.,

(P. K. Khetan)
Director

NECCON POWER & INFRA LIMITED JAIPUR

COMPANY PROFILE CLASSIFICATION

Certificate No. : 18629

NECCON POWER & INFRA LIMITED

(Formely : North Eastern Cables & Conductors (P) Ltd.)

416, (4TH FLOOR), CITY PLAZA, SPACE CINEMA COMPLEX, JAIPUR-302 016 INDIA. **TELEFAX** : 91-141-2281540 / 2281654
E-mail: neccon@sancharnet.in, necconjpr@yahoo.com **Website** : http://www.khetan-group.com

OFFICE & CONDUCTOR PLANT ADDRESS AND OTHER DETAILS:-

Correspondence Address:-

P. K. Khetan.
(Director)
Neccon Power & Infra Ltd.,
416, 4th floor, City Plaza, (Space Cinema Complex),
Banipark, Jaipur 302016 (INDIA)
Tele/Fax:- +91-141-2281540 Mobile:- +91-98290-62461
Email : necconjpr@yahoo.com
Web Site: www.khetan-group.com

Plants Address:-

North-West Region (India) : F-44 Industrial Area Sikar (Rajasthan) India
North-West Region (India) : Bapi Industrial Area, Bapi-Dausa (Rajasthan) India
North-Eastern Region (India): Industrial Estate, Cinnamara, Jorhat (Assam) India

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Import Export Code Registration No. (INDIA):- IEC Number:- 1497000629

Excise & Sales Tax Details:-

Plant Address	ECC Code	TIN No.	CST No.	Local ST No.
Sikar Plant	AABCN1603JXM001	08401851044	2441/00985	2441/00985
Dausa Plant	AABCN1603JEM003	08401851044	2441/00985	2441/00985
Jorhat Plant	AABCN1603JXM002	18030018704	JHT/CST/0065	JHT/AGST/192

URS NABCB QM016
Certificate No. : 18629

NECCON POWER & INFRA LIMITED

(Formely : North Eastern Cables & Conductors (P) Ltd.)

416, (4TH FLOOR), CITY PLAZA, SPACE CINEMA COMPLEX, JAIPUR-302 016 INDIA. **TELEFAX :** 91-141-2281540 / 2281654
E-mail: neccon@sancharnet.in, necconjpr@yahoo.com **Website :** http://www.khetan-group.com

LIST OF ORGANIZATION APPROVED WITH

NECCON

- Assam State Electricity Board.
- **Power Grid Corporation of India Ltd. India and aboard.**
- Meghalaya State Electricity Board.
- Electricity Department, Manipur
- Electricity Department, Tripura.
- Electricity Department, Arunachal Pradesh.
- Rajasthan State Electricity Board.
- Gujarat State Electricity Board.
- U. P. State Electricity Board.
- Maharastra Electricity Board.
- M. P. State Electricity Board.
- **Bhutan Power Corporation, Bhutan**
- Haryana Electricity Board.
- Punjab State Electricity Board
- Jharkhand State Electricity Board

NECAB

* Indian Oil Corporation Ltd., (AOD), Digboi
* Indian Oil Corporation Ltd., Guwahati Refinery, Guwahati
* Oil India Ltd., Duliajan / Guwahati / Kolkata
* Oil & Natural Gas Corporation Ltd., Sivasagar
* Bongaigaon Refinery & Petrochemicals Ltd., Bongaigaon,
* Assam Petrochemicals Ltd., Namrup
* Assam State Electricity Board, Assam
* North Eastern Electric Power Corporation Ltd., Shillong
* Hindustan Paper Corporation Ltd., Jagiroad
* Research Designs & Standards Organization, Lucknow.
* North-East Frontier Railway, Maligaon,
* Cement Corporation of India, Bokajan,
* Indian Institute of Technology, Guwahati
* Various Electricity Departments of North Eastern Region etc.
* Project & Development India Ltd., Jharkahand
* Kinetics Technology Industries, New Delhi

NECCON POWER & INFRA LIMITED JAIPUR







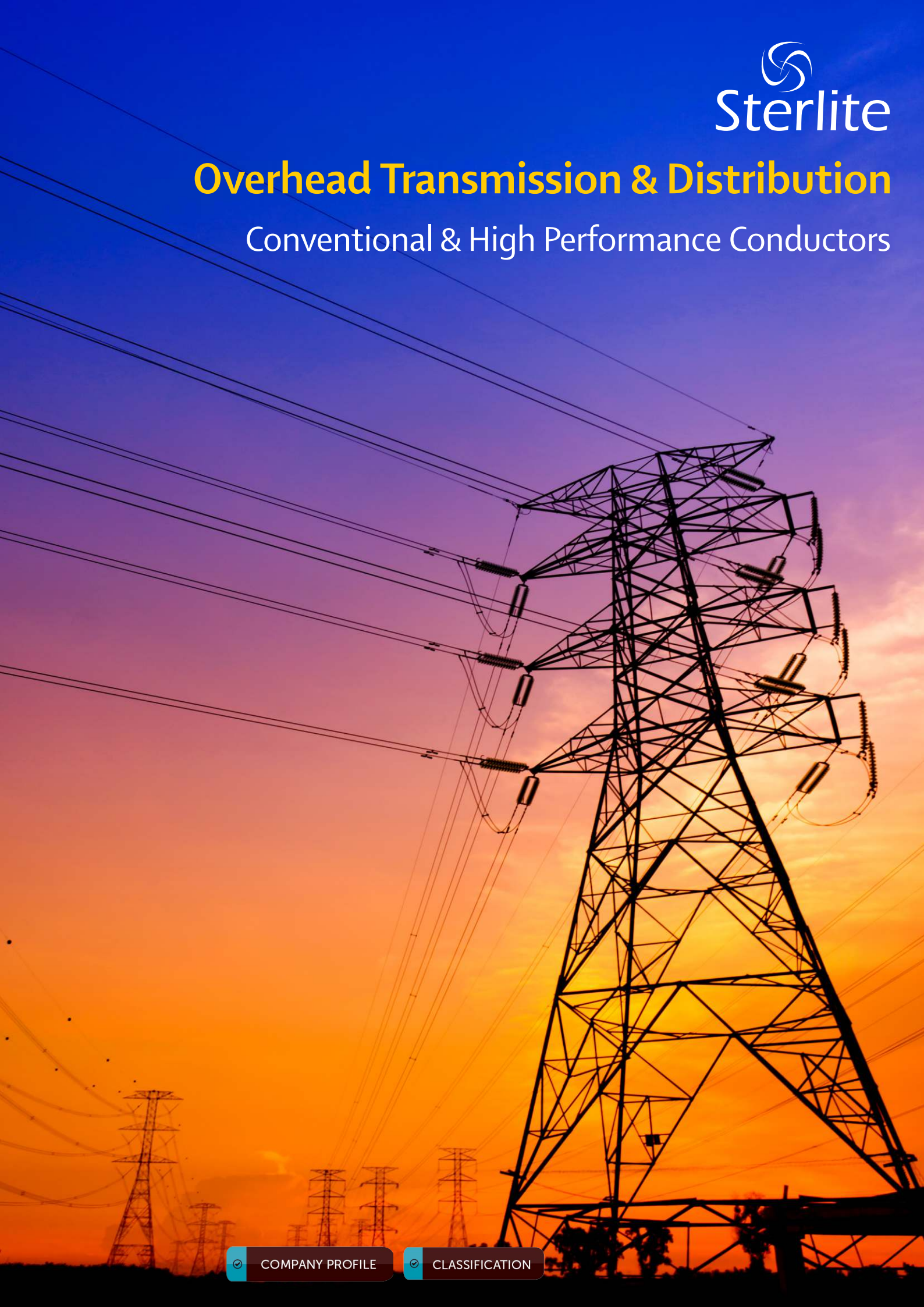
www.ieema.org

CLASSIFICATION

Sterlite

Overhead Transmission & Distribution

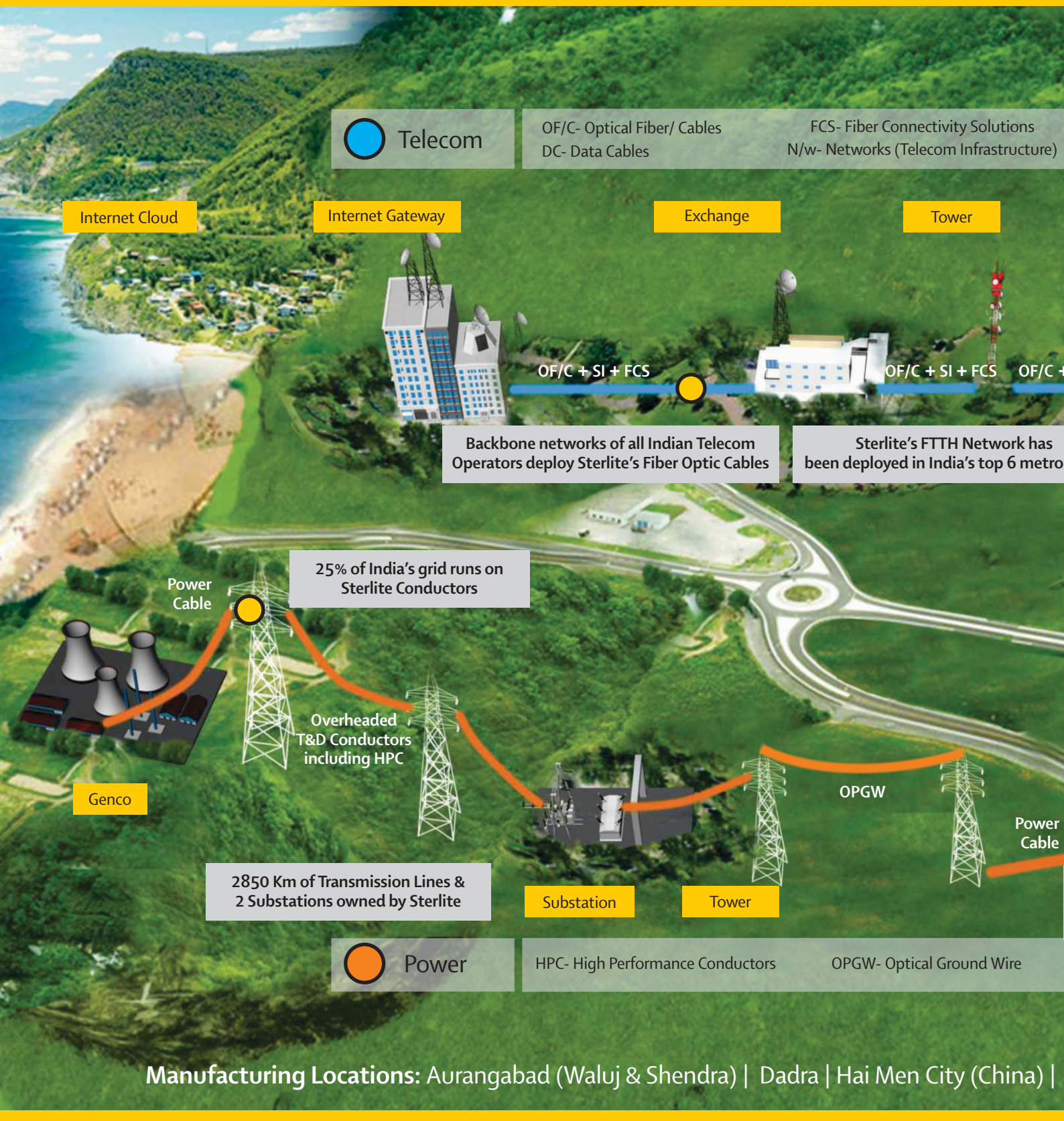
Conventional & High Performance Conductors



COMPANY PROFILE

CLASSIFICATION

Your Partners in High Speed Data and Ene

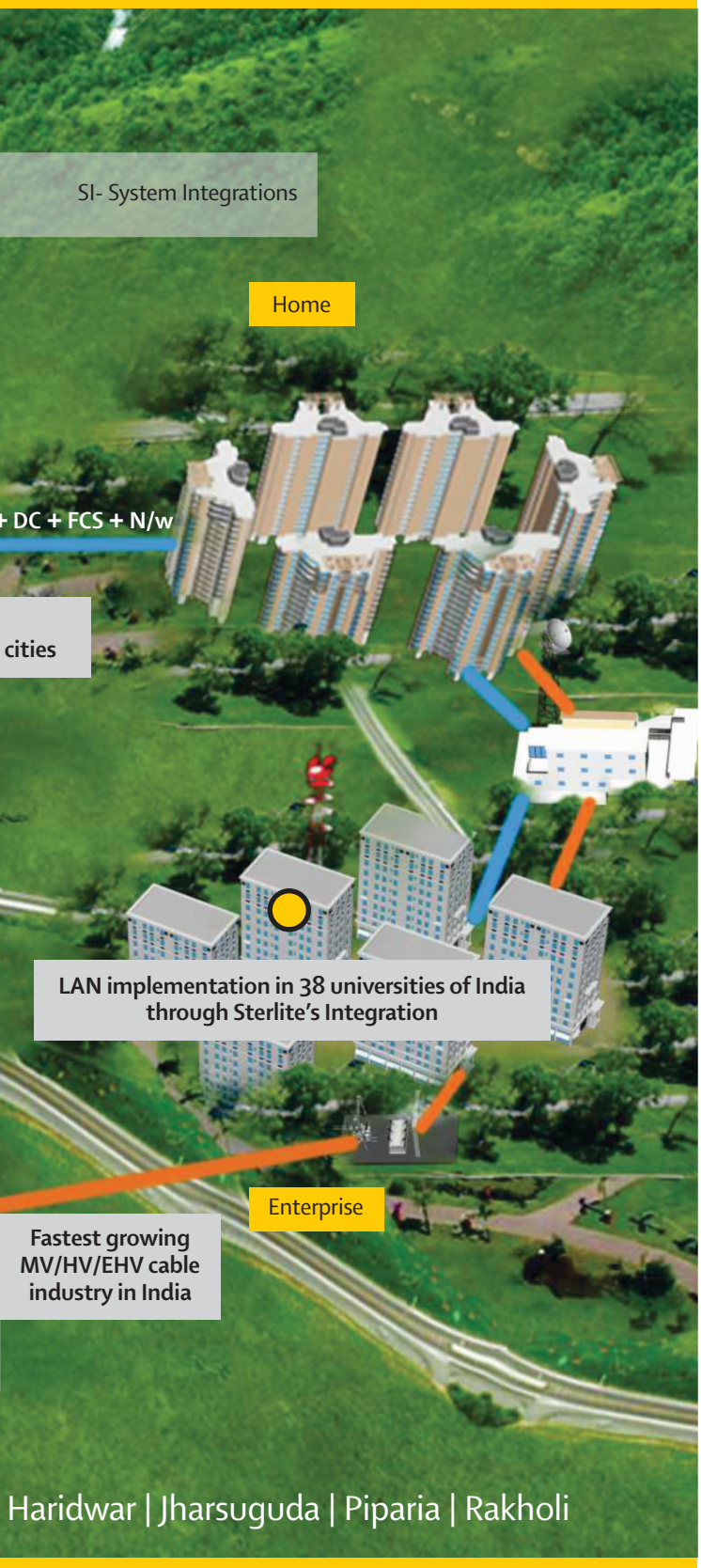


Manufacturing Locations: Aurangabad (Waluj & Shendra) | Dadra | Hai Men City (China) |

Connecting Every Home on the Planet

COMPANY PROFILE CLASSIFICATION

rgy Transmission



About Sterlite

Progress has been defined by a fundamental need for connectivity- connectivity between people, between places, of thoughts and of ideas. Power and Telecommunication are the two primary infrastructure platforms that have defined the progress of individuals, enterprises and nation.

Sterlite Technologies Limited facilitates progress across the planet, through connectivity- by making it faster, easier, and more cost-effective (for service providers) to build power and telecom networks. Sterlite does it through its suite of products, solutions and infrastructure.

Global Solutions

Sterlite Technologies Limited is a leader in providing transmission solutions for the power and telecom industry, globally. Equipped with a comprehensive portfolio that includes products such as overhead transmission & distribution conductors, high performance conductors, OPGW, power cables, optical fibers, telecommunication cables, solutions for system integration, fiber connectivity and building power & telecom infrastructure, Sterlite's vision is to "Connect every home on the planet". We are committed to providing the lowest per unit cost of energy transmission over the life cycle.

Positioned strongly in high growth geographies and high growth industries, we are recognized as one of the most cost-effective manufacturers in the world. This gives us a competitive edge to effectively address sales in our chosen focus markets. We have also invested in several projects for backward integration of our manufacturing processes as well as forward integration of our technology solutions.

Today, Sterlite is the only company offering products for ultra high voltage power transmission and extra high speed data transmission. Our products are suitable for use in Power, Telecom, Defense, Aviation, Oil & Gas and Transportation sectors. Sterlite is also executing multi-million dollar power transmission system projects, pan-India and has been awarded three projects for building transmission lines and substations in India, as a developer, on a build-own-operate-maintain (BOOM) basis.

We share a common lineage with Vedanta Resources Plc., a globally diversified natural resources group.



Sterlite's conductors used in the

first 500kV transmission line to connect Sweden & Finland

COMPANY PROFILE

CLASSIFICATION



Overhead Transmission & Distribution Conventional Conductors

Sterlite provides power transmission & distribution companies a holistic one-stop window for assessment, development & implementation of solutions for their power transmission & distribution (T&D) networks. Supported by a fully integrated manufacturing facility that converts ingots to bare overhead conductors, Sterlite's range of standard and custom-designed power solutions deliver superior performance in transmission and performance reliability.

Our offerings include:

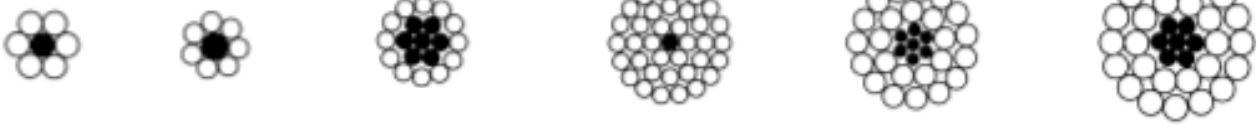
- STER-ACSR™
- STER-ACSR™/AS or /AW
- STER-AAC™
- STER-AAAC™
- STER-ACAR™

COMPANY PROFILE

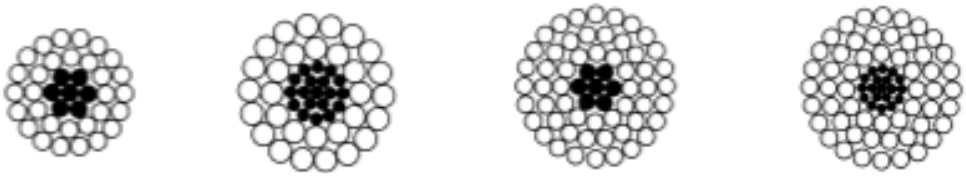
CLASSIFICATION

Overhead T&D Conventional Conductors

STER-ACSR™ & STER-ACSR-AW



6/1 7/1 12/7 36/1 24/7 26/7



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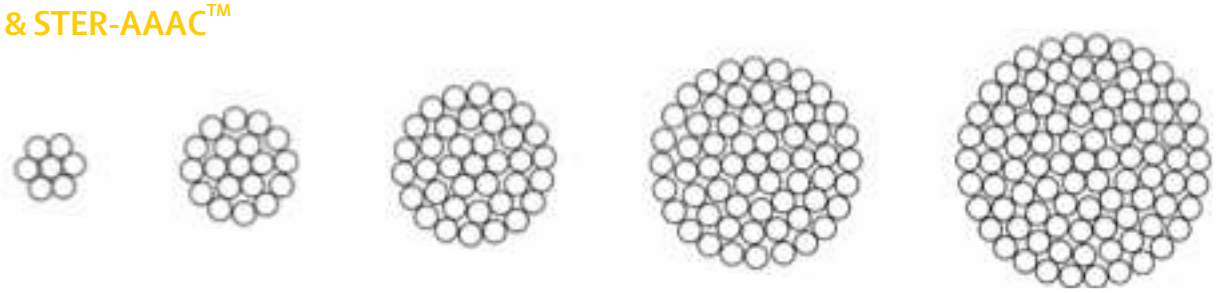
STER-AAC™ & STER-AAAC™



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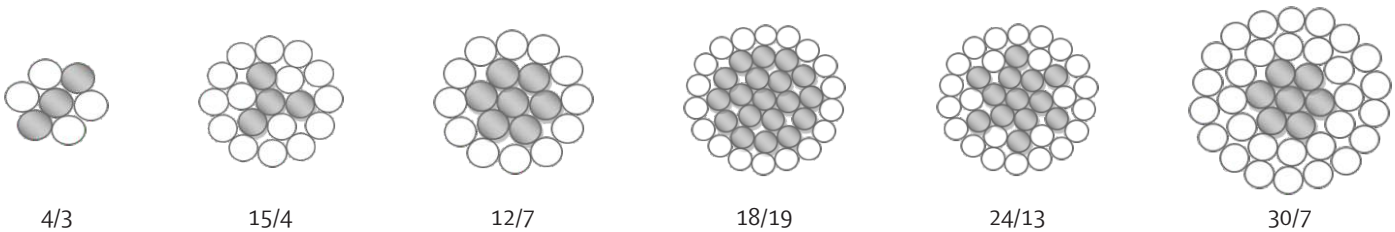
STER-ACAR™



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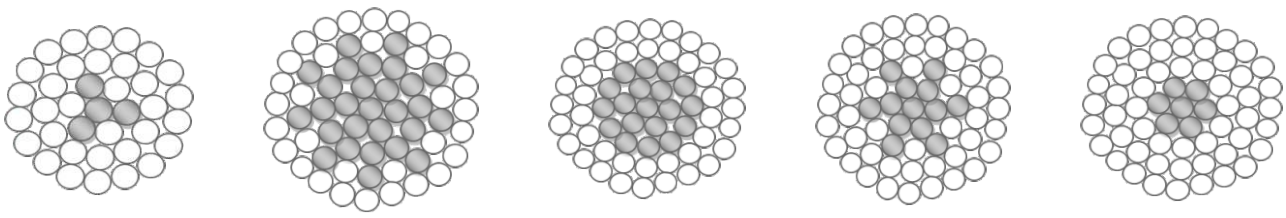


33/4 33/28 42/19 48/13 54/7

STER-ACSR™

Aluminium Conductors Steel Reinforced (ACSR), also known as Bare aluminium conductors, are one of the most widely used conductors for transmission. The conductor consists of a one or more layers of aluminium wires stranded over a high strength steel core. The core can be single or multiple strands depending on the application or requirement. There can be various stranding combinations of Al and steel wires giving flexibility to obtain the suitable current carrying capacity and mechanical strength based on the application.

Advantages

Its low weight combined with its high tensile strength allow larger span runs. Electrical losses by corona effect are greatly reduced, due to the larger diameter size of this design. Economical transmission and distribution of electrical energy can be achieved by ACSR, at very high voltages and distances.

Applications

Overhead T&D lines- MV, HV & EHV (11 kv to 800 Kv Lines).

Manufacturing Capability

Sr. No.	Description	Range	
1	Conductor Area	10.6 mm^2 to 1393 mm^2	0.0164 in^2 to 2.1592 in^2
2	Conductor Construction	6Al/1Steel to 84Al/19Steel	
3	Conductivity of Aluminum	61%	

Physical Properties

At a temperature of 20°C (68°F), the density of hard-drawn aluminum has been taken as 2.703 g/cm^3 (168.74 lb/cf) and for steel wire 7.78 g/cm^3 (485.69 lb/cf)

Sr. No.	Conductor Construction	Modulus of elasticity*		Linear Coefficient*	
		Mpa	ksi	°C	°F
1	6Al/1Steel	81000	11748	19.2	10.7
2	6Al/7Steel	75000	10878	19.8	11.0
3	12Al/7Steel	107000	15519	15.3	8.5
4	18Al/1Steel	66000	9572	21.2	11.8
5	24Al/7Steel	74000	10733	19.4	10.8
6	26Al/7Steel	77000	11168	18.9	10.5
7	30Al/7Steel	82000	11893	17.8	9.9
8	26Al/19Steel	76000	11023	19.0	10.5
9	30Al/19Steel	81000	11748	17.9	9.9
10	42Al/7Steel	60000	8702	21.2	11.8
11	45Al/7Steel	61000	8847	20.9	11.6
12	48Al/7Steel	62000	8992	20.5	11.4
13	54Al/7Steel	70000	10153	19.3	10.7
14	54Al/19steel	68000	9863	19.4	10.8
15	84Al/7steel	65000	9427	20.1	11.1

Sr. No.	Description	Range	
1	Permissible Temp in continuous operation	85°C	185°F
2	Temp in a short circuit (duration up to 5 s)	200°C	392°F

COMPANY PROFILE CLASSIFICATION

Standards –

IEC, BS, ASTM, CAN-CSA, DIN, IS, AS and relevant National and International standards.

STER-ACSR™/AS or STER-ACSR™/AW

Aluminium Conductors, Aluminium Clad Steel Reinforced (ACSR/AS or ACSR/AW) are concentrically stranded conductors with one or more layers of hard drawn 1350-H19 aluminum wires on Aluminium Clad steel wire core. The core can be single wire or stranded depending on the size.

Advantages

A higher UTS can be achieved by increasing core and higher current carrying capacity by increasing Al content. The mechanical properties of ACSR/AS conductors are similar to ACSR conductors but offers improved ampacity and resistance to corrosion because of the presence of aluminum clad steel wires in the core. These conductors are better replacement for ACSR conductors where corrosive conditions.

Applications

High voltage overhead transmission & distribution lines , & coastal regions.

Manufacturing Capability

Sr. No.	Description	Range	
1	Conductor Area	10.6 mm^2 to 1393 mm^2	0.0164 in^2 to 2.1592 in^2
2	Conductor Construction	6Al/1ACS to 84Al/19ACS	
3	Conductivity of Aluminum	61%	
4	Conductivity of ACS Wire	20.3%	

Physical Properties

At a temperature of 20° C (68°F), the density of hard-drawn aluminum has been taken as 2.703 g/cm^3 (168.74 lb/cf) and aluminum clad steel wires 6.59 g/cm^3 (411.40 lb/cf)

Sr. No.	Conductor Construction	Modulus of elasticity*		Linear Coefficient*	
		Mpa	ksi	°C	°F
1	6Al/1ACS	74000	10733	19.3	10.7
2	26Al/7ACS	71000	10298	19.1	10.6
3	30Al/7ACS	74000	10733	18.0	10.0
4	54Al/7ACS	65000	9427	19.5	10.8

Sr. No.	Description	Range	
1	Permissible Temp in continuous operation	75°C	167°F
2	Temp in a short circuit (duration up to 5 s)	200°C	392°F

Standards –

IEC, BS, ASTM, CAN-CSA, DIN, IS, AS and relevant National and International standards.

STER-AAC™

AAC conductor is also known as aluminum stranded conductor. These conductors consist of several layers of aluminium wires stranded concentrically. AAC are manufactured from electrolytically refined aluminum, with a minimum purity of 99.7%

Advantages

All Aluminum Conductor (AAC) have high ratio of electrical conductivity to weight, high flexibility and low UTS. Also the aluminium has low levels of brittleness.

Applications

All Aluminum Conductor (AAC) are used in low voltage overhead lines in urban areas and in high voltage substation conductoring. Also, used in very cold areas due to low brittleness of aluminum in the MV lines.

Manufacturing Capability

Sr. No.	Description	Range	
1	Conductor Area	10.6 mm^2 to 1095 mm^2	0.0164 in^2 to 1.6973 in^2
2	Conductor Construction	7Al to 91Al	
3	Conductivity	61%	

Physical Properties

At a temperature of 20° C (68°F), the density of hard-drawn aluminum has been taken as 2.703 g/cm^3 (168.74 lb/cf)

Sr. No.	Conductor Construction	Modulus of elasticity*		Linear Coefficient*	
		Mpa	ksi	°C	°F
1	7 Strands	60000	8702	23.0	12.8
2	19 Strands	57000	8267	23.0	12.8
3	37 Strands	57000	8267	23.0	12.8
4	91 Strands	55000	7977	23.0	12.8

Sr. No.	Description	Range	
1	Permissible Temp in continuous operation	75°C	167°F
2	Temp in a short circuit (duration up to 5 s)	200°C	392°F

Standards –

IEC, BS, ASTM, CAN-CSA, DIN, IS, AS and relevant National and International standards.

STER-AAAC™

AAAC (All Aluminium Alloy Conductors)- Several layers of aluminium alloy (generally Al-Mg-Si) stranded in concentric layers. Designed using a highstrength aluminum alloy to achieve a high strength-to-weight ratio; affords better sag characteristics

Advantages

AAAC has good corrosion resistance, however due to the absence of steel, the resistance of AAAC is lower as compared to ACSR. AAAC can carry atleast 15-20% extra current as compared to ACSR of equal size. Also, it has higher life span of 60 years as compared to ACSR which has around 30 years life span. The surface hardness of AAAC is 80 BHN as compared to 35 BHN of ACSR. This reduces the damage to surface during handling and therefore leading to lesser corona losses and ratio interference at EHV. AAAC can be operated with stable temp 85° C against ACSR conductors which are stable upto 75° C. Since AAAC has higher strength to weight ratio, span can be increased from 2 to 15% resulting in overall reduction of cost in towers supports and other accessories in transmission line system.

Applications

All Aluminum Alloy Conductors (AAAC) are extensively used for primary and secondary transmission in bare overhead distribution and transmission lines (11 kv to 800 Kv Lines) & HV substations. Also, usable in highly polluted industrial areas and coastal regions due to corrosion resistance.

Manufacturing Capability

Sr. No.	Description	Range	
1	Conductor Area	10.6 mm^2 to 1095 mm^2	0.0164 in^2 to 1.6973 in^2
2	Conductor Construction	7Al Alloy to 91Al Alloy	
3	Conductivity	52.5% to 53%	

Physical Properties

At a temperature of 20° C (68°F), the density of hard-drawn aluminum has been taken as 2.70 g/cm^3(168.74 lb/cf).

Sr. No.	Conductor Construction	Modulus of elasticity*		Linear Coefficient*	
		Mpa	ksi	°C	°F
1	7 Strands	62000	8992	23.0	12.8
2	19 Strands	60000	8702	23.0	12.8
3	37 Strands	57000	8267	23.0	12.8
4	61 Strands	55000	7977	23.0	12.8

Sr. No.	Description	Range	
1	Permissible Temp in continuous operation	85°C	185°F
2	Temp in a short circuit (duration up to 5 s)	200°C	392°F

Standards –

IEC, BS, ASTM, CAN-CSA, DIN, IS, AS and relevant National and International standards.

STER-ACAR™

Aluminium Conductor Alloy Reinforced (ACAR) is formed by concentrically stranded wires of Aluminium 1350 on high strength Aluminium -Magnesium -Silicon (AlMgSi) alloy core. The number of wires of Aluminum1350 & AlMgSi alloy depends on the cable design. Though the general design comprises a stranded core of AlMgSi alloy strand, in certain cable constructions, the wires of AlMgSi alloy strands can be distributed in layers throughout the Aluminium 1350 strands.

Advantages

ACAR has better mechanical and electrical properties as compared to an equivalent ACSR, AAC or AAAC. A very good balance between the mechanical and electrical properties therefore makes ACAR the best choice where the ampacity, strength and light weight are the main consideration of the line design. For equal weight ACAR offers higher strength and ampacity than ACSR. A higher U.T.S. can be obtained, by increasing aluminium alloy content, and a higher current carrying capacity by increasing aluminium content.

Applications

Aluminum Conductors Alloy Reinforced (ACAR) are extensively used for overhead distribution and transmission lines.

Manufacturing Capability

Sr. No.	Description	Range	
1	Conductor Area	10.6 mm^2 to 1520 mm^2	0.0164 in^2 to 2.356 in^2
2	Conductor Construction	4Al/3Al Alloy to 72Al/19Al Alloy	
3	Conductivity of Aluminum	61%	
4	Conductivity of Al Alloy	52.5% to 53%	

Physical Properties

At a temperature of 20° C (68°F), the density of hard-drawn aluminum has been taken as 2.703 g/cm^3 (168.74 lb/cf) and aluminum alloy wires 2.70 g/cm^3 (168.56 lb/cf)

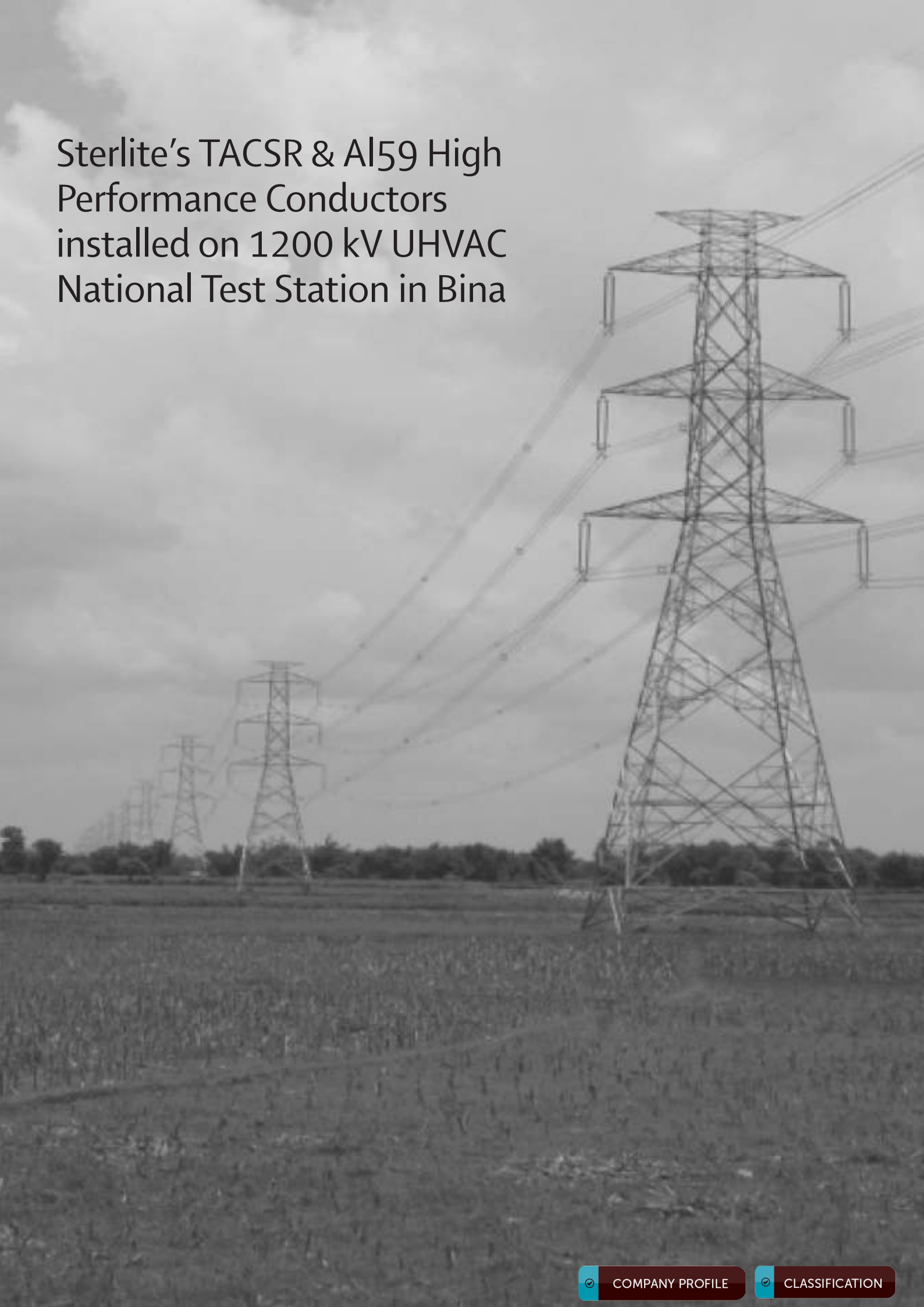
Sr. No.	Conductor Construction	Modulus of elasticity*		Linear Coefficient*	
		Mpa	ksi	°C	°F
1	7 Strands	62000	8992	23.0	12.8
2	19 Strands	60000	8702	23.0	12.8
3	37 Strands	57000	8267	23.0	12.8
4	61 Strands	55000	7977	23.0	12.8

Sr. No.	Description	Range	
1	Permissible Temp in continuous operation	85°C	185°F
2	Temp in a short circuit (duration up to 5 s)	200°C	392°F

Standards –

IEC, BS, ASTM, CAN-CSA, DIN, IS, AS and relevant National and International standards.

Sterlite's TACSR & Al59 High Performance Conductors installed on 1200 kV UHVAC National Test Station in Bina



COMPANY PROFILE

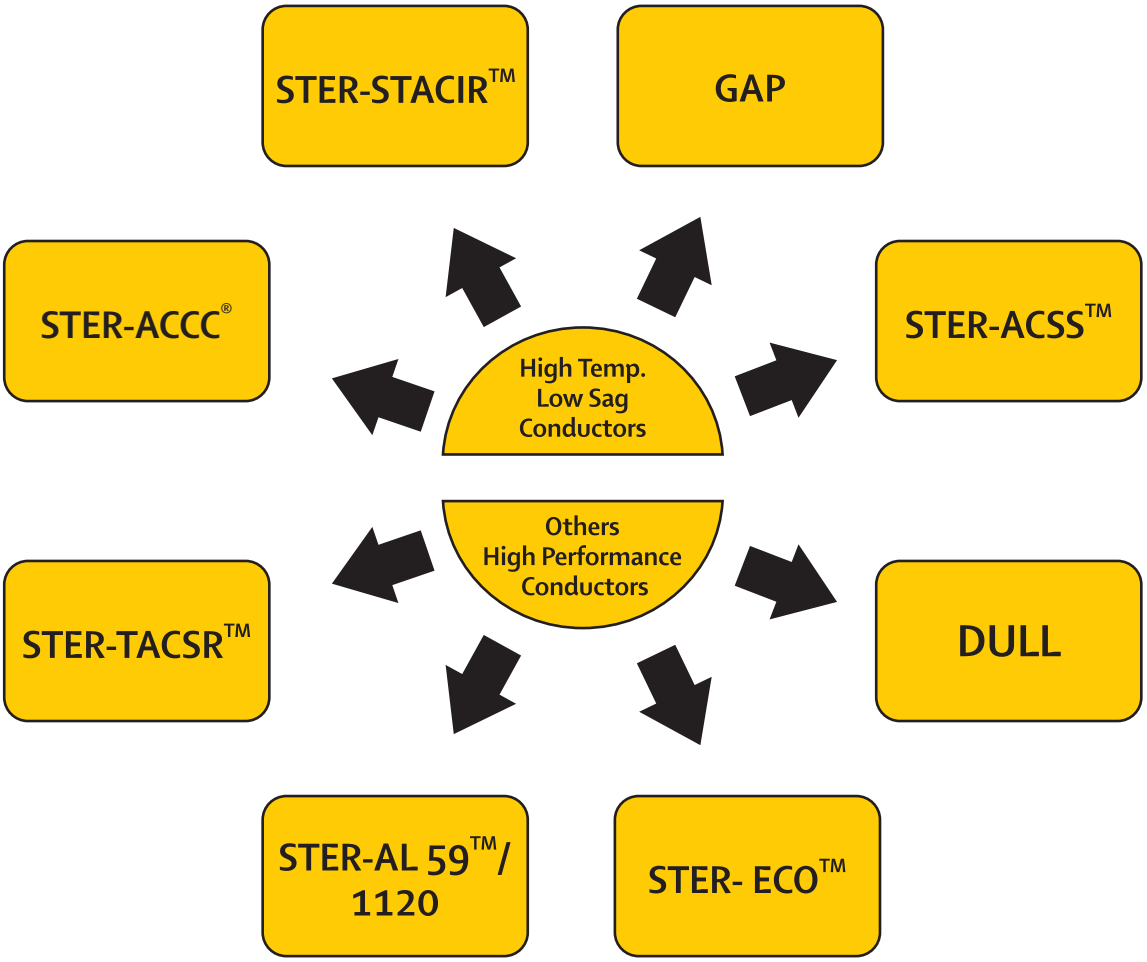
CLASSIFICATION

High Performance Conductors

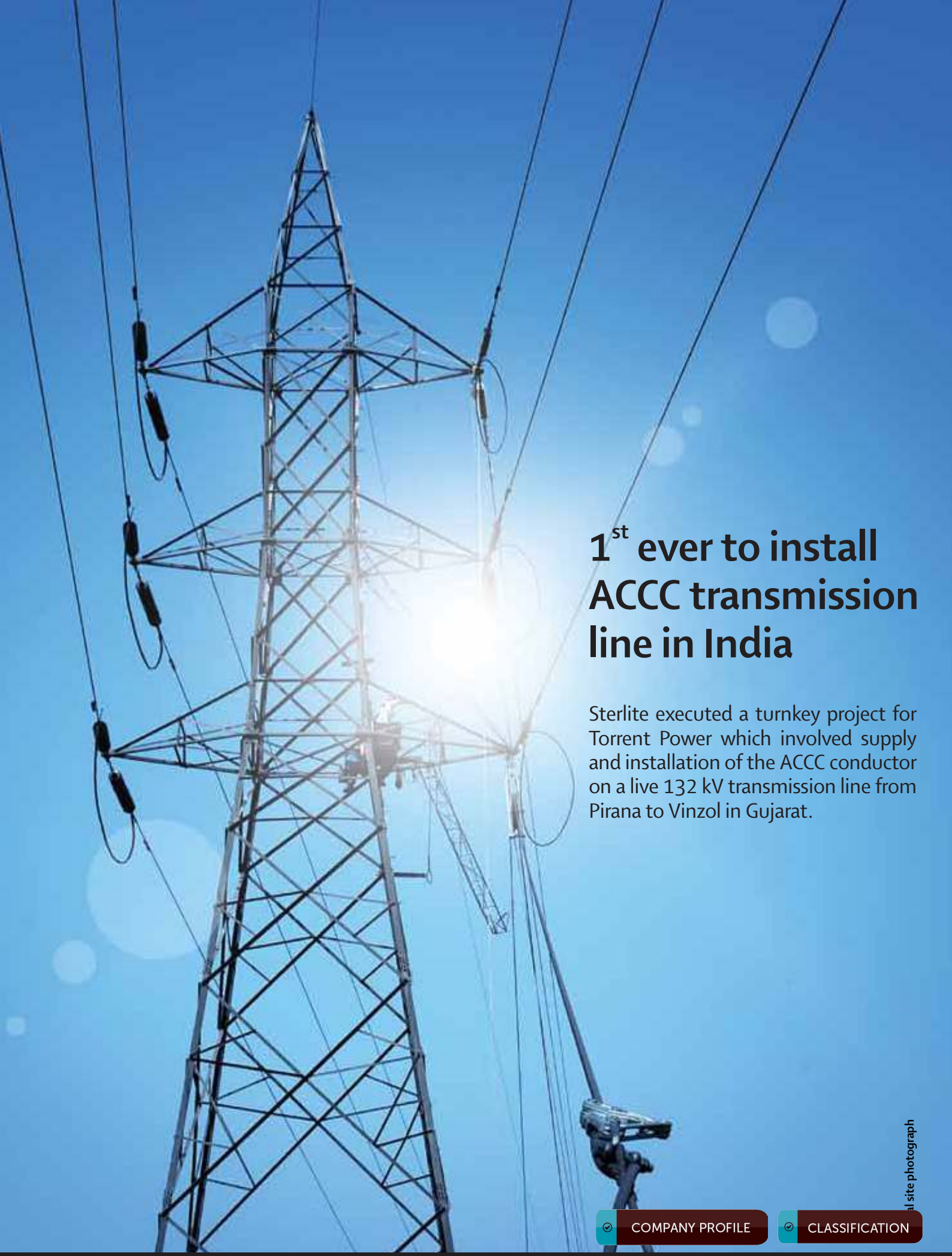
Development of efficient power transmission is the need of the hour, aimed to alleviate the burgeoning demands from today's power utility system.

If the challenge is to transmit more power over existing lines, high ampacity conductors that are manufactured from a range of speciality materials, offer the most optimal means to increase line capacity at a relatively low cost.

A range of speciality alloys offer superior thermal resistance that improves the efficiency in high current transmission.



As these new generation conductors enhance the current carrying capacity, they are favourable for use in re-conductoring as well as new lines. This provides the user high corridor intensity and reduces congestion in existing lines.



1st ever to install ACCC transmission line in India

Sterlite executed a turnkey project for Torrent Power which involved supply and installation of the ACCC conductor on a live 132 kV transmission line from Pirana to Vinzol in Gujarat.

COMPANY PROFILE

CLASSIFICATION

Live Stringing on 132 kV transmission line from Pirana to Vinzol in Gujarat | Double the original capacity | Eco-friendly Reduced Loss in Transmission | Effortless Integration | Compliant with Design Standards | Improved Efficiency

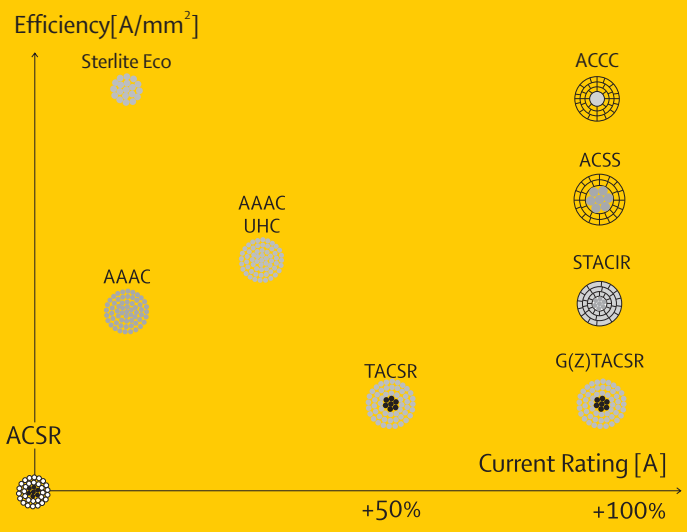
Benefits in Performance & Cost

Re-conductoring

- Enhanced current carrying capacity for the same diameter/wieght.
- Minimum or no modification/ reinforcement to existing towers.

Green Solutions

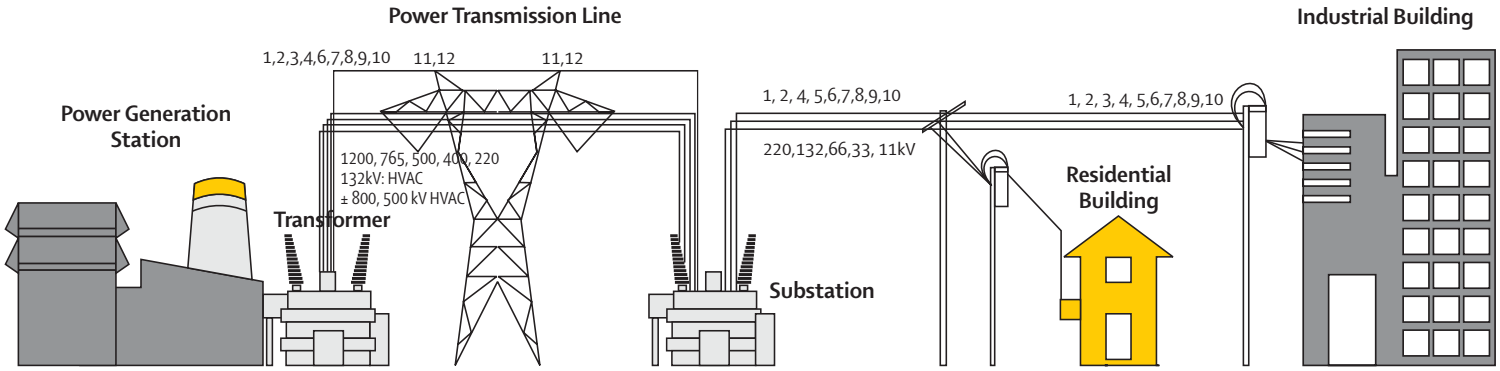
- Low losses leading to lower carbon emissions.
- Run at lower temperature for the same current.



Sterlite's High Performance conductors combined efficiency and increased current carrying capacity

New lines

- Enhanced current carrying capacity.
- Reduction in per unit transmission cost.
- Higher corrosion resistance.
- Shorter project duration.
- Additional Capacity of ~100% is reserved for the future demand



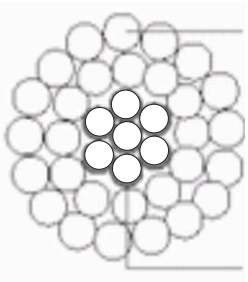
1. STER-AAAC™ Conductors
2. STER-ACSR™ Conductors
3. STER-AACSR™ Conductors
4. STER-ACAR™ Conductors
5. STER-AAC™ Conductors
6. STER-AL59™ Conductors
7. STER-ACSS™ Conductors
8. STER-TACSR™ Conductors
9. STER-STACIR™ Conductors
10. Special Alloy Conductors (1120, EHC, 6101, 6201)
11. OPGW Cables
12. OPGW Accessories
13. STER-ACCC® Conductors
14. STERLITE-ECO™ Conductors

COMPANY PROFILE CLASSIFICATION

STER-AL59™

These are homogenous alloy conductors belonging to Aluminium + Magnesium + Silica Alloy type. These conductors have a conductivity of 59% and hence have lesser DC resistance & higher current carrying capacity.





Application

Al59 alloy conductors are used in power transmission and distribution lines for a wide voltage range (low voltage to ultra high voltage). These conductors have higher current carrying capacity in lower losses due to lower DC resistance. Al59 conductors have high corrosion resistance, making them most suited for deployment in coastal regions.

Benefits

- 26% to 31% more current carrying capacity as that of ACSR of the same size, while maximum sag remains the same & working tension is lesser than that of ACSR.
- Resistivity is substantially lesser than that of ACSR/AAAC conductors, resulting in lower I^2R losses.
- Higher corrosion resistance than 6201 alloy series (AAAC).

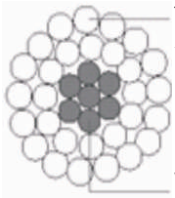
Technical Specifications

Properties	Al59 (ACSR Moose Equivalent)		Al59 (ACSR Zebra Equivalent)		Al59 (ACSR Panther Equivalent)	
Typical Factors	3.50 mm	0.1378 in	3.18 mm	0.1252 in	3.00 mm	0.1181 in
Reference Specifications	SS 4240814		SS 4240814		SS 4240814	
Total Cross Section Area	587.00 mm^2	0.9099 in^2	484.25 mm^2	0.7506 in^2	261.50 mm^2	0.4053 in^2
Conductive Wire	Al59		Al59		Al59	
Core Wire	Al59		Al59		Al59	
Conductor Diameter	31.50 mm	1.2402 in	28.62 mm	1.1268 in	21.00 mm	0.8268 in
Weight	1618 kg/gm	1087.2 lbs/mile	1336 kg/km	897.8 lbs/mile	720 kg/km	483.8 lbs/mile
Ultimate Tensile Strength	14350 kg	31636.3 lbs	12340 kg	27205.01 lbs	6661 kgf	14684.97 lbs
DC Resistance at 20°C Temperature	0.05 Ω/km	0.08 Ω/mile	0.06 Ω/km	0.10 Ω/mile	0.11 Ω/km	0.18 Ω/mile
Maximum Operating Temperature	95°C	203°F	95°C	203°F	95°C	203°F
Current Carrying Capacity at Maximum Operating Temperature	1094 Amp		958 Amp		654 Amp	

Assumptions: Ampacity is calculated based on, 45°C (113°F) ambient temperature, 0.6 m/s wind velocity, 0.5 as coefficient of solar absorption, 0.6 as coefficient of emmisivity and 1200Wt/sqm coefficient for solar radiation, at sea level.

STER-TACSR™

Sterlite® Thermal-resistant Aluminum-alloy Conductor, Steel Reinforced (TACSR) conductors are high ampacity conductors, wherein the inner core is composed of galvanized steel and the outer layers are composed of thermal-resistant aluminum-alloy.





Application

TACSR conductors are recommended for new lines for high power transfer requirement.

Benefits

New Aluminium alloys having high thermal resistance can carry 50% to 60% more current as that of ACSR of the same size; while maximum sag & maximum working tension remains almost same as that of ACSR.

- Can carry 50% to 60% more current as that of ACSR of the same size.
- Higher capacity new lines can be built to deal with future demands

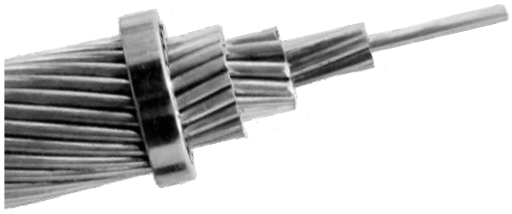
Technical Specifications

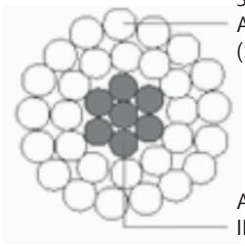
Properties	TACSR (ACSR Moose Equivalent)		TACSR (ACSR Zebra Equivalent)		TACSR (ACSR Panther Equivalent)	
Typical Factors	3.53 mm	0.1378 in	3.18 mm	0.1252 in	3.00 mm	0.1181 in
Reference Specifications	IEC 62004		IEC 62004		IEC 62004	
Total Cross Section Area	596.99 mm^2	0.9253 in^2	484.25 mm^2	0.7506 in^2	261.50 mm^2	0.4054 in^2
Conductive Wire	Al Zr AT1		Al Zr AT1		Al Zr AT1	
Core Wire	Galvanized Steel		Galvanized Steel		Galvanized Steel	
Conductor Diameter	31.77 mm	1.2508 in	28.62 mm	1.1268 in	21.00 mm	0.8268 in
Weight	2004 kg/gm	1346.6 lbs/mile	1621 kg/km	1089.3 lbs/mile	972 kg/km	653.2 lbs/mile
Ultimate Tensile Strength	16438 kg	36239.54 lbs	14407 kg	31761.96 lbs	10119 kg	22308.55 lbs
DC Resistance at 20°C Temperature	0.06 Ω/km	0.09 Ω/mile	0.07 Ω/km	0.11 Ω/mile	0.14 Ω/km	0.22 Ω/mile
Maximum Operating Temperature	150°C	302°F	150°C	302°F	150°C	302°F
Current Carrying Capacity at Maximum Operating Temperature	1509 Amp		1302 Amp		831 Amp	

Assumptions: Ampacity is calculated based on, 45°C (113°F) ambient temperature, 0.6 m/s wind velocity, 0.5 as coefficient of solar absorption, 0.6 as coefficient of emmisivity and 1200Wt/sqm coefficient for solar radiation, at sea level.

STER-STACIR™

Sterlite® Super Thermal Alloy Conductor Invar Reinforced (STACIR) conductor has outer layers composed of Super Thermal Aluminum (STAL) alloy wires that can operate up to 210°C (410°F). The inner core is composed of aluminum clad INVAR wires. INVAR is a metal alloy with 36% Ni in steel.





Application

STACIR/AW conductors are suited for re-conductoring applications. The capacity of the existing transmission line can be enhanced by simply replacing the existing conductor without any modifications to the tower.

Benefits

- Can carry 100% more current as that of ACSR of the same size, while maximum sag and maximum working tension remain the same as that of ACSR.
- For uprating transmission and distribution lines, no modification or reinforcement is required to the existing towers.

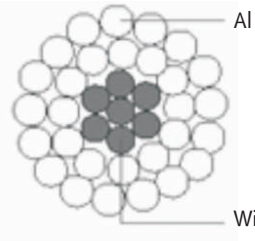
Technical Specifications

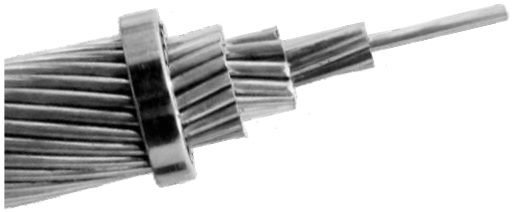
Properties	STACIR (ACSR Moose Equivalent)		STACIR (ACSR Zebra Equivalent)		STACIR (ACSR Panther Equivalent)	
Typical Factors	3.53 mm	0.1390 in	3.18 mm	0.1252 in	3.00 mm	0.1181 in
Reference Specifications	IEC 62004		IEC 62004		IEC 62004	
Total Cross Section Area	597.00 mm^2	0.9254 in^2	484.50 mm^2	0.751 in^2	261.50 mm^2	0.4054 in^2
Conductive Wire	Al Zr AT3		Al Zr AT3		Al Zr AT1	
Core Wire	Aluminum Clad Invar		Aluminum Clad Invar		Aluminum Clad Invar	
Conductor Diameter	31.77 mm	1.2508 in	28.62 mm	1.1268 in	21.00 mm	0.8268 in
Weight	1993 kg/gm	1339.2 lbs/mile	1582 kg/km	1063.1 lbs/mile	939 kg/km	631.0 lbs/mile
Ultimate Tensile Strength	14641 kg	32277.84 lbs	11968 kg	26384.89 lbs	8436 kg	18598.17 lbs
DC Resistance at 20°C Temperature	0.06 Ω/km	0.09 Ω/mile	0.07 Ω/km	0.11 Ω/mile	0.13 Ω/km	0.21 Ω/mile
Maximum Operating Temperature	210°C	410°F	210°C	410°F	210°C	410°F
Current Carrying Capacity at Maximum Operating Temperature	1871 Amp		1626 Amp		1040 Amp	

Assumptions: Ampacity is calculated based on, 45°C (113°F) ambient temperature, 0.6 m/s wind velocity, 0.5 as coefficient of solar absorption, 0.6 as coefficient of emmisivity and 1200Wt/sqm coefficient for solar radiation, at sea level.

STER-ACSS™

Sterlite® Aluminum Conductor Steel Supported (ACSS) conductor is a composite concentric lay-stranded conductor consisting of a stranded steel central core with one or more layers of 1350-0 (High Temperature) aluminum wires.





Application

ACSS conductors can be designed as a low loss solution, as part of efficient transmission networks. These conductors are suitable for lines that transmit very high or fluctuating loads.

Benefits

- Improved self-damping characteristics and high degree of resistance to vibration fatigue.
- Can operate continuously at high temperatures up to 250°C (482°F) with appropriate steel core coating vs. 100°C (212°F) for standard ACSR, hence carrying twice as much as current compared to ACSR conductor.
- No creep.
- Less susceptible to Aeolian vibration fatigue due to the very low mechanical load on the annealed aluminum wire.
- Requires conventional installation techniques.
- Allows for lower overall transmission cost.

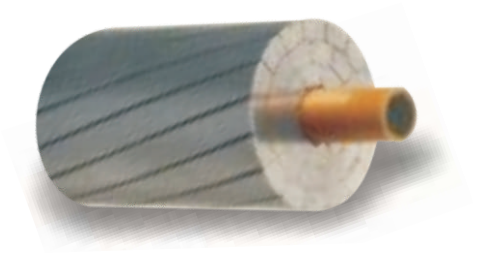
Technical Specifications

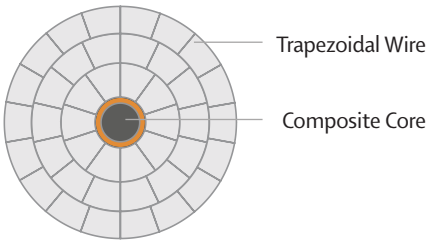
Properties	ACSS Curlew		ACSS Drake		ACSS Hawk	
Typical Factors	3.51 mm	0.1383 in	4.44 mm/3.45 mm	0.1749 in/ 0.136 in	3.51 mm/2.67 mm	0.1383 in/ 0.1051 in
Reference Specifications	ASTM B856		ASTM B856		ASTM B856	
Total Cross Section Area	591.00 mm^2	0.9161 in^2	468.50 mm^2	0.7262 in^2	281.00 mm^2	0.4356 in^2
Conductive Wire	Al1350-O (Fully Annealed Al wires)		Al1350-O (Fully Annealed Al wires)		Al1350-O (Fully Annealed Al wires)	
Core Wire	Mischmetal Alloy Coated Steel		Mischmetal Alloy Coated Steel		Mischmetal Alloy Coated Steel	
Conductor Diameter	31.62 mm	1.2449 in	28.13 mm	1.1075 in	21.77 mm	0.8571 in
Weight	1981 kg/km	1331.2 lbs/mile	1629 kg/km	1094.6 lbs/mile	976 kg/km	655.8 lbs/mile
Ultimate Tensile Strength	13807 kg	30439.19 lbs	12742 kg	28091.27 lbs	7779 kg	17149.74 lbs
DC Resistance at 20°C Temperature	0.05 Ω/km	0.09 Ω/mile	0.07 Ω/km	0.11 Ω/mile	0.12 Ω/km	0.19 Ω/mile
Maximum Operating Temperature	210°C	410°F	210°C	410°F	210°C	410°F
Current Carrying Capacity at Maximum Operating Temperature	1854 Amp		1564 Amp		1120 Amp	

Assumptions: Ampacity is calculated based on, 45°C (113°F) ambient temperature, 0.6 m/s wind velocity, 0.5 as coefficient of solar absorption, 0.6 as coefficient of emmisivity and 1200Wt/sqm coefficient for solar radiation, at sea level.

STER-ACCC®

Sterlite Aluminum Conductor Composite Core (ACCC) conductor consists of a hybrid carbon and glass fiber core which is wrapped with trapezoidal shaped aluminum strands. The high strength structural core carries most of the conductor's mechanical load, while the fully annealed aluminum strands carry all of the conductor's electrical current. ACCC conductor's composite core is much lighter and stronger than conventional or high-strength steel core.





Application

Ideal for Reconductoring

- Increase capacity while improving line clearance and losses.
- Reduce strain on structures increasing life.

Reduced Line Losses in New Lines:

- Under equal load conditions reduces line losses by 30 to 40 % compared to conductors of the same diameter and weight.
- 100% more capacity build towards future demand.

Benefits

- With 28% more annealed aluminum in a trapezoidal configuration the ACCC conductor of the same diameter as ACSR, can double the current (ampacity) rating; Higher operating efficiency reduces line losses and associated emissions by more the 35%, resulting in more power delivered and lower power generation costs.
- ACCC conductors use a patented carbon/glass/thermoset resin core that provides height strength and reduces height temperature sag.
- Can re-conductor existing pathways without structural modification and reduce capital expenses on new lines.
- Uses conventional installation methods, tools, and mostly conventional hardware- no special tools and limited special training.
- Resists environmental degradation– will not rust, corrode, or cause electrolysis with aluminum conductors and components.

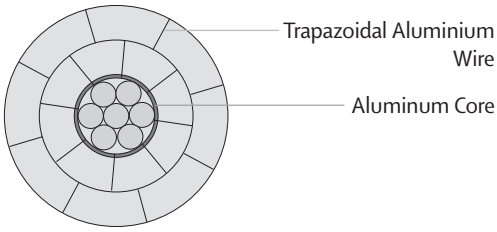
Technical Specifications

Properties	ACCC Helsinki		ACCC Lisbon		ACCC Copenhagen		ACCC Drake	
Typical Factors	5.97 mm	0.2355 in	7.11 mm	0.2799 in	5.97 mm	0.2350 in	9.53 mm	0.3752 in
Reference Specifications	ASTM B857, ASTM B609		ASTM B857, ASTM B609		ASTM B857, ASTM B609		ASTM B857, ASTM B609	
Total Cross Section Area	176.11 mm^2	0.2730 in^2	358.40 mm^2	0.5555 in^2	246.57 mm^2	0.3822 in^2	588.30 mm^2	0.9119 in^2
Conductive Wire	1350 0 temper Al		1350 0 temper Al		1350 0 temper Al		1350 0 temper Al	
Core Wire	Composite Core		Composite Core		Composite Core		Composite Core	
Conductor Diameter	15.65 mm	0.6161 in	21.78 mm	0.8575 in	18.30 mm	0.7205 in	28.14 mm	1.1079 in
Weight	455 kg/km	305.7 lbs/mile	957 kg/km	642.8 lbs/mile	657 kg/km	441.5 lbs/mile	1558 kg/km	1046.9 lbs/mile
Ultimate Tensile Strength	7036 kg	15511.71 lbs	10574 kg	23311.65 lbs	7443.9 kg	16410.97 lbs	18691 kg	41206.55 lbs
DC Resistance at 20°C Temperature	0.19 Ω/km	0.30 Ω/mile	0.09 Ω/km	0.14 Ω/mile	0.13 Ω/km	0.21 Ω/mile	0.06 Ω/km	0.09 Ω/mile
Maximum Operating Temperature	175°C	347°F	175°C	347°F	175°C	347°F	175°C	347°F
Current Carrying Capacity at Maximum Operating Temperature	710 Amp		1079 Amp		858 Amp		1484 Amp	

Assumptions: Ampacity is calculated based on, 45°C ambient temperature, 0.6 m/s wind velocity, 0.5 as coefficient of solar absorption, 0.6 as coefficient of emmisivity and 1200Wt/sqm coefficient for solar radiation, at sea level.

STER-ECO™

Eco Series conductors consist of trapezoidal shaped special aluminium alloy containing magnesium, silicon and copper stranded with round core. The trapezoidal shape provide compactness to the extent of 96%.





Application

Eco Seriess conductors are an innovative, efficient, low loss and most importantly an economical solution for re-conductoring power lines and constructing new lines. The higher efficiency of Eco Series Conductors enables significant savings when substituted in grid systems for normal ACSR or AAAC conductors. Also for delivery of same power to the customers, Eco Series Conductors enable power generators to reduce the amount of power they must generate and hence lesser emissions.

Benefits

- Upto 30% less I^2R losses for same sized conductor
- For same output runs cooler by 5-10°C(41-50°F), hence lower carbon emissions
- Contributing to greenhouse gases
- Can be deployed with existing structural designs

Technical Specifications

Properties	ECO Panther	
Typical Factors	2.37 mm	0.0933 in
Reference Specifications	SS42408013, 14	
Total Cross Section Area	314.11 mm^2	0.9161 in^2
Conductive Wire	Al59 wire	
Core Wire	Al59 wire	
Conductor Diameter	20.50 mm	0.8071 in
Weight	866 kg/km	581.9 lbs/mile
Ultimate Tensile Strength	7430 kg	16379.55 lbs
DC Resistance at 20°C Temperature	0.10 Ω/km	0.15 Ω/mile
Maximum Operating Temperature	95°C	203°F
Current Carrying Capacity at Maximum Operating Temperature	750 Amp	

Assumptions: Ampacity is calculated based on, 45°C ambient temperature, 0.6 m/s wind velocity, 0.5 as coefficient of solar absorption, 0.6 as coefficient of emmisivity and 1200Wt/sqm coefficient for solar radiation, at sea level.





Sterlite is among the largest fully integrated manufacturing facilities globally

Since the past decade, Sterlite has developed technical expertise in manufacture of bare overhead conductors and proven its capabilities in developing solutions that have been tested and certified by leading independent laboratories across the globe.

Fully Equipped Plants with International Standards

Three fully equipped plants to manufacture Overhead T&D conductors with International Standards.

In house Properzi Aluminium Rod rolling mills feed the manufacturing line for Transmission & Distribution conductors. The mills manufacture electrical grade Aluminium and Alloy Rods.

The plants have complete facilities for rod rolling, wire drawing, heat treatment and stranding to ensure precise tolerances to all inter national standards and stringent specifications.

A technology upgrade review is periodically undertaken to keep abreast with the latest manufacturing technology. There is a strong focus on research and development. In house domain expertise is used for customized solutions.

Quality

Our centralized quality control department comprises a team of experienced and quality engineers. At our fully equipped laboratories, we continuously monitor quality parameters at all stages: from raw material inflow, in process and final inspection.

In-house State of the art NABL accredited laboratories for Quality Control & Testing









Based on specific customer requirements, our Transmission & Distribution conductors are put through stringent type tests before dispatch. These tests include:

- Ultimate Tensile Strength
- Stress Strain
- Surface Condition
- DC Resistance
- Corona Inception and Extinction Voltage
- Radio Interface Voltage

Our Conductors conform to several international standards:

- European Norms (EN)
- Swedish Standards (SS)
- IEC
- American Standards (ASTM)
- Indian Standards (IS)
- Australian Standards (AS)
- Canadian Standards (CSA)

Our Solutions have been tested & certified by various renowned laboratories across the globe such as ERDA (India), CPRI (India), Kinectrics (Canada), Veki VNL (Hungary), SAG FGH (Germany), EDF (France), NETFA (South Africa), SABS (South Africa), CSERI (China), Tag Corporation (India), NABL (India).

Packaging



The packing of the conductor is an integral part of the manufacturing process, and the kind of package must be predetermined before production can begin.

Unless otherwise specified or agreed with in case of order, all type of conductors shall be shipped on Sterlite standard steel reels having dimensions that can be provided on enquiry.

Sterlite standard reels shall have enough condition to stand against the ordinary handling in transportation and shipping and be found ready and handy enough at the time of installation in site. The reels will be stenciled legibly with following information; serial/drum number, size and kind of conductor, length of conductor, and any other identification marks specified on the order by the purchaser.

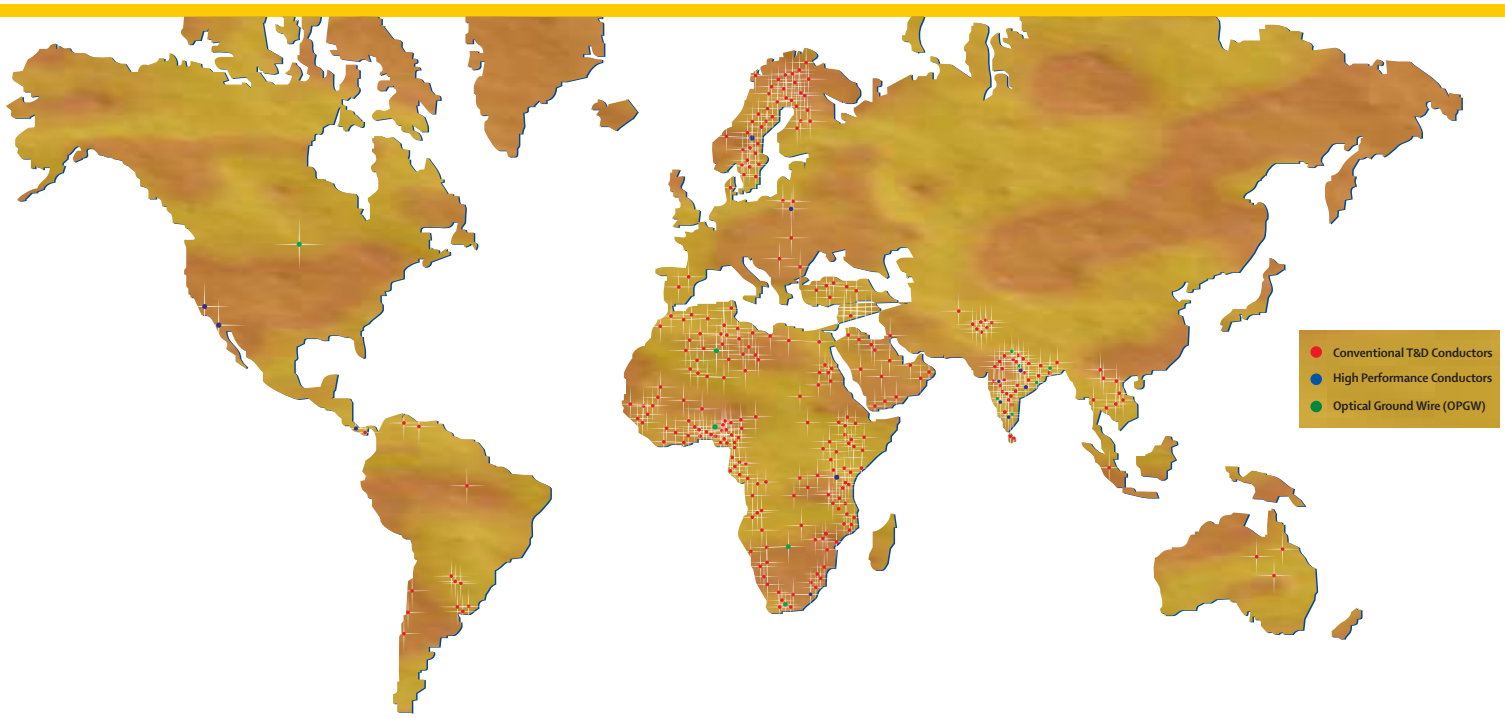
Outer Protection

Outer layer of conductor shall be protected with Thick PE sheet and solid PP sheet in place of wooden lagging. Inner surface of flange and barrel shall be protected with PPE Solid Sheet. The Drums shall be painted with one primer coat and then synthetic enamel.

Features and Benefits

- Optimum mechanical protection without breaking/ splintering like wooden batten
- Impact and puncture resistant (second layer solid sheet)
- Environmental resistance– long lifetime, unaffected by climate change or UV exposure, unlike wood, zero risk of deterioration and fungus
- Nail free- no risk of nail damage to conductor
- Reusable- can be dismantled and reused as and when required
- Can be stored as long as possible

Global Footprints



Power transmission & distribution solutions proven in global networks

Sterlite ® has been instrumental for the supply of technologically advanced power solutions to leading incumbents over 65 countries.

Sterlite's conductors have been deployed extensively across India. Our solutions are being used by:

- PGCIL- one of the world's largest transmission utilities.
- Major Transcos like MSETCL, UPPTCL, AP Transco, KPTCL, RRVPNL, MPPTCL, TANtransco, etc.
- IPPs like BALCO, Jindal, Adani, Reliance as well Renewable Energy providers like Suzlon

Globally, our high performance conductors have been installed in the T&D networks of the following geographies:

- Latin America
- USA
- Europe
- Africa
- India



The Sterlite Advantage

Global experience

- Expert in providing customized solutions to business challenges in the transmission industry, worldwide
- Significant supply record
- In India, 25% of the national grid runs on Sterlite's conductors

Building Infrastructure

On BOOM Basis,

- 2850 Kms of transmission lines & 2 substations across India
- Over 3000 Kms of OPGW Live line being developed by MTCIL, 1st of its kind Joint Venture with state owned utility of Maharashtra, India
- Fiber brought to over 1 million homes in top 6 Metro cities of India

End-to-end project implementation

Sterlite ensures complete control over the value chain and delivers end-to-end project management services.

Sterlite's project management suite:



Qualified and experience talent pool

Sterlite has a qualified talent pool, experienced in network design, project management, network implementation and network maintenance.

Credible partners

Sterlite has partnered with reputed project management companies and Original Equipment Manufacturers (OEMs), to ensure that the delivery of the project is streamlined.

Solution development for newer applications

Sterlite continues to enhance its portfolio taking into account the bandwidth need evolving from client applications.

Fully integrated Company

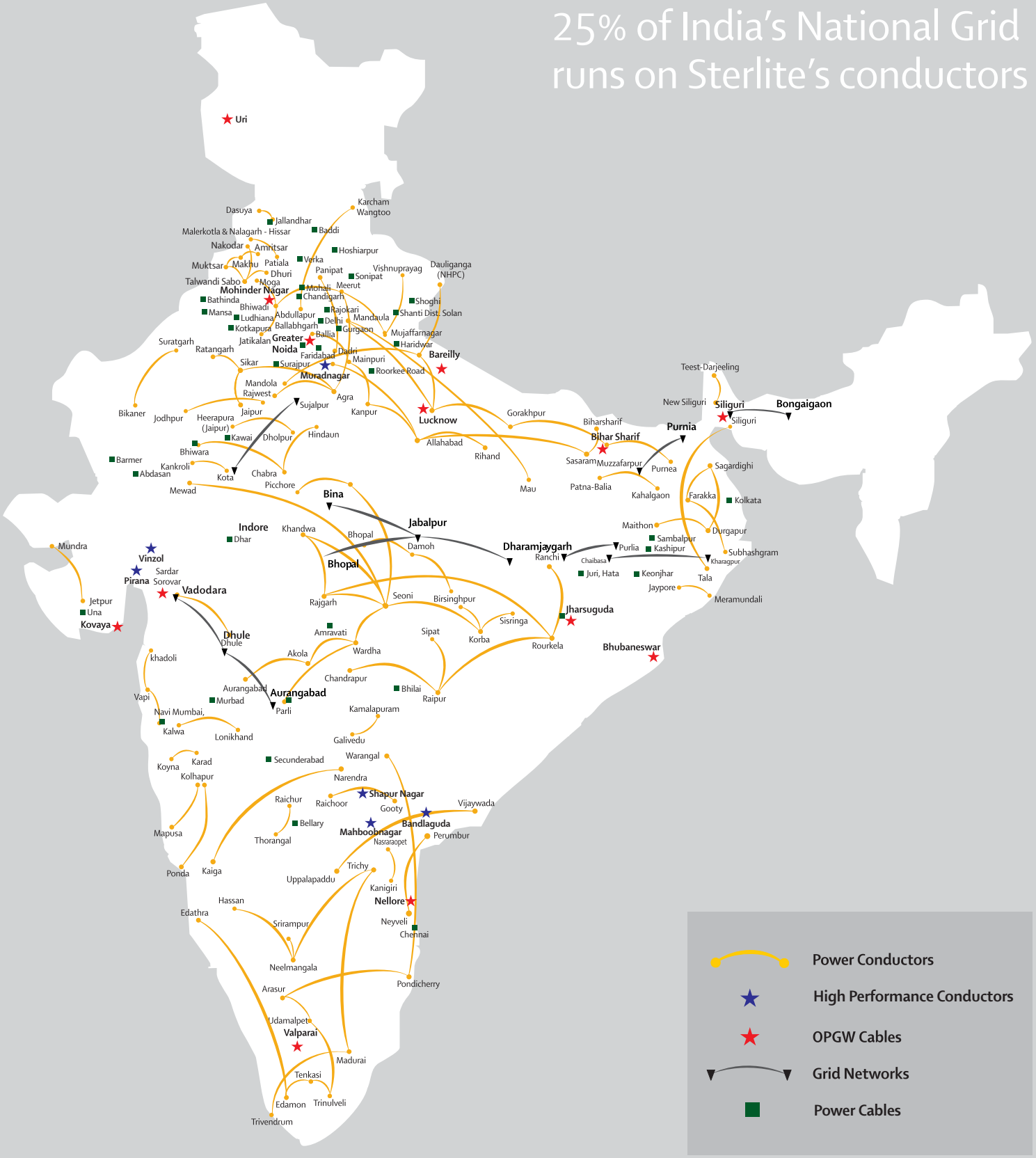
Backward integration of manufacturing processes and forward integration of our technology solutions

Local support

With offices in 10 countries, Sterlite always has a relationship manager who is a mere phone call away, to understand your growth aspirations and to explore areas where value can be added to your business.

Partnering India's growth in Power sector

25% of India's National Grid runs on Sterlite's conductors



We make it easier, faster and more cost effective to build infrastructure for power transmission and distribution.

COMPANY PROFILE

CLASSIFICATION

Power Business

Sterlite provides power transmission & distribution companies a holistic one stop window for assessment, development & implementation of solutions for their power transmission & distribution(T&D) networks.

T&D Network Assessments
- Assessment of existing & potential power demand
- Technical Analysis
- Assessment of suitable solution options

Development
- T&D Solution Development
- T&D Solution Testing

Implementation
- T&D Solution Manufacture
- Inventory Management & Supply
- Technical Support and Service

Sterlite's portfolio also includes:

OPGW

Since the past two decades, Sterlite has developed technical expertise in fibre optic cables and proven its capabilities in the manufacture of energy efficient bare overhead transmission & distribution conductors. Sterlite has integrated these strengths in its comprehensive OPGW solution, becoming the first fully integrated manufacturer of OPGW cables in India.

Hardware & Accessories

Compatible accessories like dead ends, suspension sets, joints/joint boxes, vibration dampers and all necessary fittings , for a whole range of OPGW & HPC offerings , are provided as part of Sterlite's solution.

Power Cables

Sterlite's single integrated Power Cables facility at Haridwar, manufactures and supplies MV, HV and EHV cables. The plants have complete facilities for sheathing, rod rolling, wire drawing, heat treatment and stranding to ensure precise tolerance to all international standards and stringent specification 6.6 to 220 kV.

Power Infrastructure

Sterlite has been awarded five projects for building power transmission systems (line and substations) in India, as a developer, on a Build-Own-Operate-Maintain (BOOM) basis. For these projects, Sterlite undertakes designing, financing, construction, and maintenance of the transmission systems for concession periods ranging from 25 to 30 years.

These transmission lines would help facilitate power evacuation and would be used for SEBs, Power Gencos for which Sterlite would earn a fixed transmission tariff.

Key Highlights:
- Total value: Approx US $ 1014 Mn
- Approx 2850 Km of transmission lines + 2 substations
- India's first 765 kV D/C transmission line

Sterlite's Power Infrastructure portfolio of the five projects would evacuate and transmit power through a network of 2850 km of transmission lines and 2 substations in the Indian states of Maharashtra, Gujarat, Madhya Pradesh, Chattisgarh, West Bengal, Bihar, Assam and Rajasthan.

These EHV projects represent significant advancements in the field of power transmission. These projects would enhance the overall grid capacity significantly and substantially reduce transmission power losses, thus assisting the economic development of the nation.

"Enabling lowest cost of Energy Transmission over the life cycle"

For product details/ query, contact nearest Sales representative or write to us at *communications@sterlite.com*

Certificates



CERTIFICATE OF REGISTRATION

This is to certify that:

Sterlite Technologies Limited

(Transmission Business Division)

Survey 99/2/22, Rakholi, Silvassa 396230 INDIA

operates a

ENVIRONMENTAL MANAGEMENT SYSTEM

which complies with the requirements of

AS/NZS ISO 14001:2004

for the following scope

The manufacture and supply of aluminium and aluminium alloy bare overhead conductors with or without galvanized/aluminised steel reinforcements, ACAR, for power transmission and distribution lines, aluminium and aluminium wire and wire rods.

Certificate No: CEM21196

Issued: 2 July 2012
Expires: 13 July 2015

Originally Certified: 14 July 2009
Current Certification: 29 June 2012

William Smith
Certification Manager

Duncan Lilley
Global Head – Assurance Services

ISO 14001

WWW.JAS-ANZ.ORG/REGISTER

Registered by:
SAI Global Certification Services Pty Ltd (ACN 108 716 669) 286 Sussex Street Sydney NSW 2000 Australia with SAI Global Limited 11/12 Swastik Disa Business Park behind Vadhani Estate L.B.S Marg Ghatkopar (W) Mumbai 400086 India ("SAI Global") and subject to the SAI Global Terms and Conditions for Certification. While all due care and skill was exercised in carrying out this assessment, SAI Global accepts responsibility only for proven negligence. This certificate remains the property of SAI Global and must be returned to SAI Global upon its request. To verify that this certificate is current please refer to SAI Global On-Line Certification register at http://www.saiglobal.com

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CERTIFICATE OF REGISTRATION

This is to certify that:

Sterlite Technologies Ltd

(Transmission Business Division)

Survey 99/2/22, Rakholi, Silvassa 396230 INDIA

operates a

OCCUPATIONAL HEALTH & SAFETY MANAGEMENT SYSTEM

which complies with the requirements of

OHSAS 18001:2007

for the following scope

The manufacture and supply of aluminium and aluminium alloy bare overhead conductors with or without galvanized/aluminised steel reinforcements, ACAR, for power transmission and distribution lines, aluminium and aluminium wire and wire rods.

Certificate No: OHS20818

Issued: 2 July 2012
Expires: 13 July 2015

Originally Certified: 14 July 2009
Current Certification: 29 June 2012

William Smith
Certification Manager

Duncan Lilley
Global Head – Assurance Services

OHSAS 18001

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Registered by:
SAI Global Certification Services Pty Ltd (ACN 108 716 669) 286 Sussex Street Sydney NSW 2000 Australia with SAI Global Limited 11/12 Swastik Disa Business Park behind Vadhani Estate L.B.S Marg Ghatkopar (W) Mumbai 400086 India ("SAI Global") and subject to the SAI Global Terms and Conditions for Certification. While all due care and skill was exercised in carrying out this assessment, SAI Global accepts responsibility only for proven negligence. This certificate remains the property of SAI Global and must be returned to SAI Global upon its request. To verify that this certificate is current please refer to SAI Global On-Line Certification register at http://www.saiglobal.com

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CERTIFICATE OF REGISTRATION

This is to certify that:

Sterlite Technologies Limited

(Transmission Business Division)

Survey 99/2/22 Rakholi SILVASSA 396230 INDIA

operates a

QUALITY MANAGEMENT SYSTEM

which complies with the requirements of

ISO 9001:2008

for the following scope

The registration covers the Quality Management System for the manufacture and supply of aluminum and aluminum alloy bare overhead conductors with or without galvanized / aluminised steel reinforcements, ACAR, for power transmission and distribution lines, aluminum and aluminum alloy wire and wire rods.

Certificate No: QEC12376

Issued: 9 June 2011
Expires: 17 June 2014

Originally Certified: 18 June 2002
Current Certification: 9 June 2011

Alex Ezrakhovich
General Manager – Certification Services

Duncan Lilley
Global Head – Assurance Services

ISO 9001

WWW.JAS-ANZ.ORG/REGISTER

Registered by:
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SABS

Permit to Apply Certification Mark

Subject to the provisions of the Standards Act, 2008 (Act 8 of 2008), the relevant regulations made thereunder and the permit conditions contained in the under mentioned schedules, this permit authorizes

STERLITE TECHNOLOGIES LTD
SILVASSA - DADRA NAGAR HAVELI, INDIA

to apply the certification mark

SABS APPROVED

in respect of the mark specification:

SANS 182-2:2008
TO: CONDUCTORS FOR OVERHEAD ELECTRICAL TRANSMISSION LINES
PART 2: STRANDED ALUMINIUM CONDUCTORS

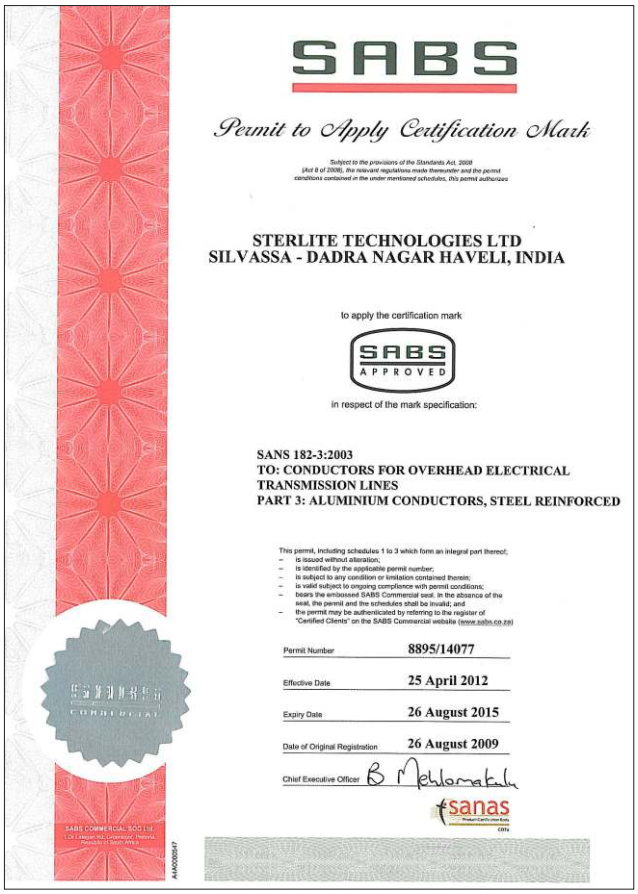
This permit, including schedules 1 to 3 which form an integral part thereof;
- is issued without alteration;
- is identified by the applicable permit number;
- is subject to any condition or limitation contained therein;
- is valid subject to ongoing compliance with permit conditions;
- bears the embossed SABS Commercial seal. In the absence of the seal, the permit and the schedules shall be invalid; and
- the permit may be authenticated by referring to the register of "Certified Clients" on the SABS Commercial website (www.sabs.co.za)

Permit Number	8895/15389
Effective Date	25 April 2012
Expiry Date	25 April 2015
Date of Original Registration	25 April 2012

Chief Executive Officer

sanas

Certificates



SABS

Permit to Apply Certification Mark

Subject to the provisions of the Standards Act, 2008 (Act 8 of 2008), the relevant regulations made thereunder and the permit conditions contained in the under mentioned schedules, this permit authorizes

STERLITE TECHNOLOGIES LTD
SILVASSA - DADRA NAGAR HAVELI, INDIA

to apply the certification mark

SABS APPROVED

in respect of the mark specification:

SANS 182-3:2003
TO: CONDUCTORS FOR OVERHEAD ELECTRICAL TRANSMISSION LINES
PART 3: ALUMINIUM CONDUCTORS, STEEL REINFORCED

This permit, including schedules 1 to 3 which form an integral part thereof;
- is issued without alteration;
- is identified by the applicable permit number;
- is subject to any condition or limitation contained therein;
- is valid subject to ongoing compliance with permit conditions;
- bears the embossed SABS Commercial seal. In the absence of the seal, the permit and the schedules shall be invalid; and
- the permit may be authenticated by referring to the register of "Certified Clients" on the SABS Commercial website (www.sabs.co.za)

Permit Number	8895/14077
Effective Date	25 April 2012
Expiry Date	26 August 2015
Date of Original Registration	26 August 2009
Chief Executive Officer	

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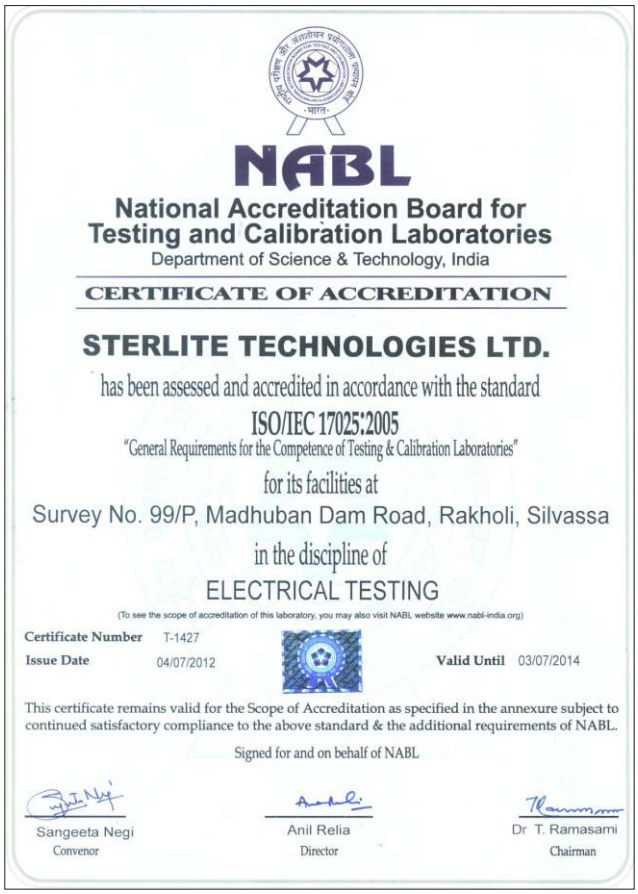


NABL

National Accreditation Board for Testing and Calibration Laboratories
Department of Science & Technology, India

CERTIFICATE OF ACCREDITATION

STERLITE TECHNOLOGIES LTD.

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2005

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

Survey No. 99/P, Madhuban Dam Road, Rakholi, Silvassa

in the discipline of

ELECTRICAL TESTING

(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Certificate Number T-1427
Issue Date 04/07/2012
Valid Until 03/07/2014

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the additional requirements of NABL.

Signed for and on behalf of NABL

Sangeeta Negi, Convenor | Anil Relia, Director | Dr T. Ramasami, Chairman



NABL

National Accreditation Board for Testing and Calibration Laboratories
Department of Science & Technology, India

CERTIFICATE OF ACCREDITATION

STERLITE TECHNOLOGIES LTD.

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2005

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

Survey No. 99/P, Madhuban Dam Road, Rakholi, Silvassa

in the discipline of

CHEMICAL TESTING

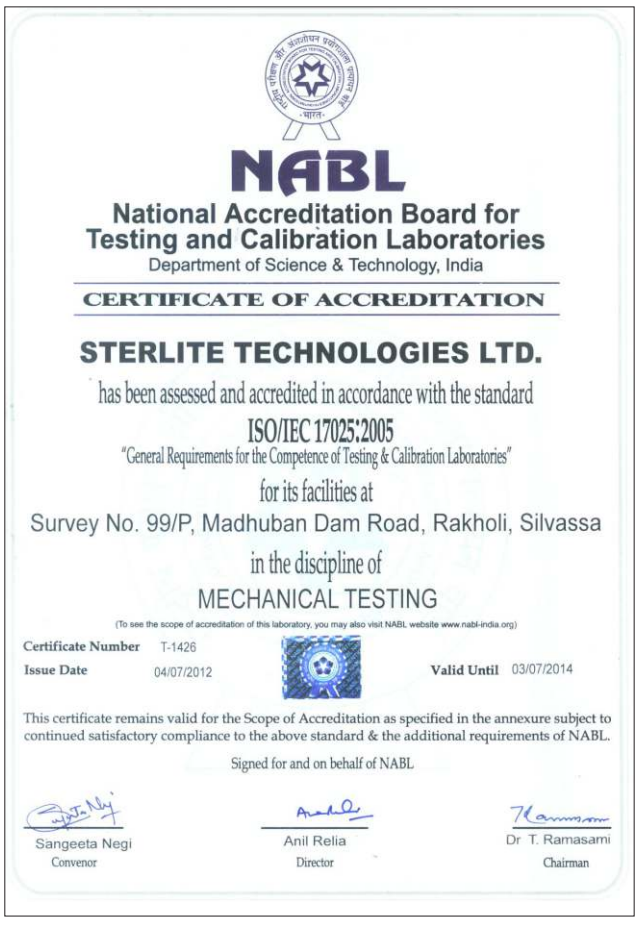
(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Certificate Number T-1425
Issue Date 04/07/2012
Valid Until 03/07/2014

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the additional requirements of NABL.

Signed for and on behalf of NABL

Sangeeta Negi, Convenor | Anil Relia, Director | Dr T. Ramasami, Chairman



NABL

National Accreditation Board for Testing and Calibration Laboratories
Department of Science & Technology, India

CERTIFICATE OF ACCREDITATION

STERLITE TECHNOLOGIES LTD.

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2005

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

Survey No. 99/P, Madhuban Dam Road, Rakholi, Silvassa

in the discipline of

MECHANICAL TESTING

(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Certificate Number T-1426
Issue Date 04/07/2012
Valid Until 03/07/2014

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the additional requirements of NABL.

Signed for and on behalf of NABL

Sangeeta Negi, Convenor | Anil Relia, Director | Dr T. Ramasami, Chairman

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Sterlite



Connecting

every home on the planet

We make it easier, faster and more cost-effective for service providers to build Power & Telecom infrastructure

STL/CONDUCTORS/Dec 2013

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communications@sterlite.com

COMPANY PROFILE

CLASSIFICATION



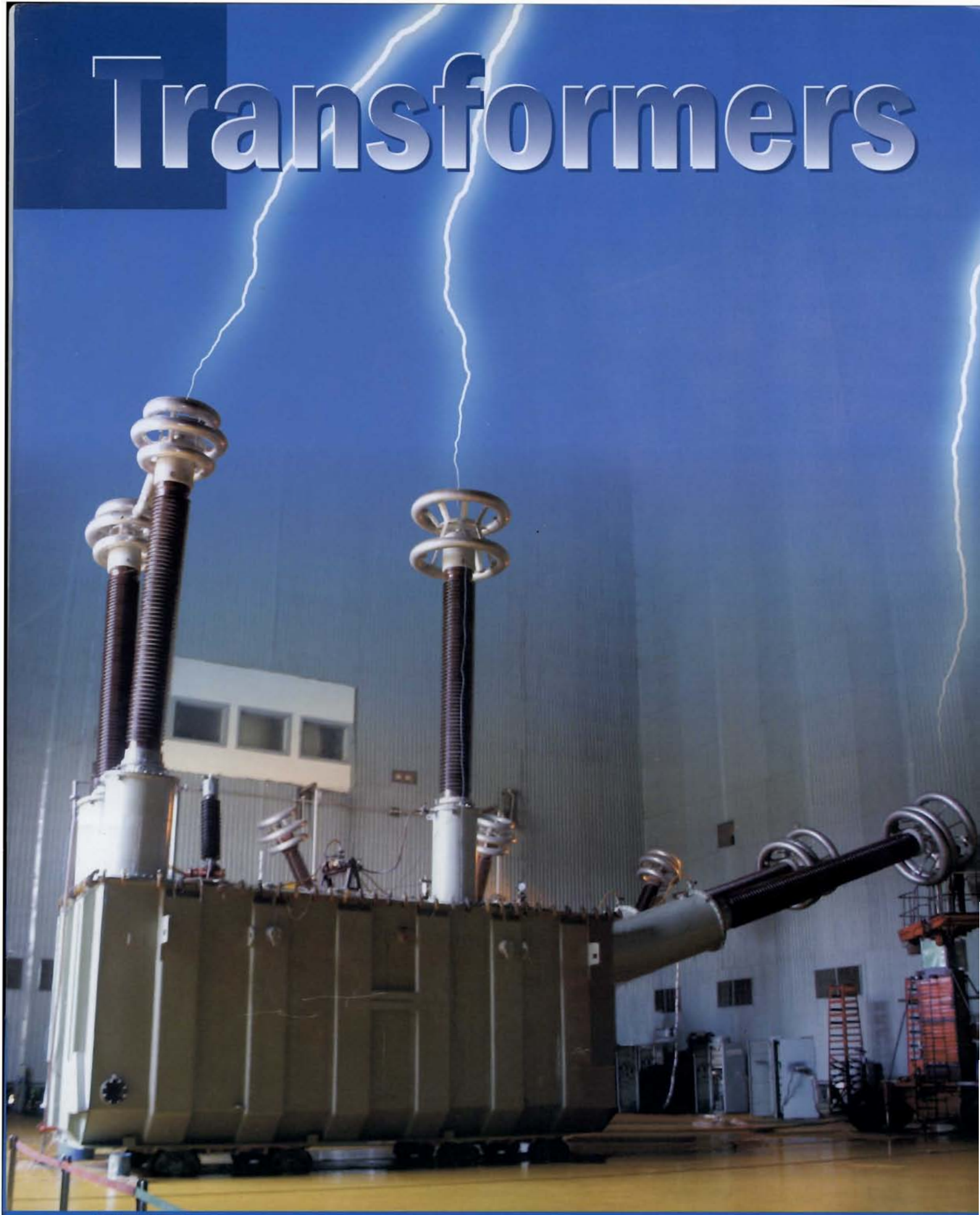




www.ieema.org

CLASSIFICATION

Transformers



Bharat Heavy Electricals Limited
Bhopal (India)

COMPANY PROFILE

CLASSIFICATION

POWER TRANSFORMER

The BHEL Bhopal plant is having ISO-9001:2000 and ISO-14001:1996 accreditation.

The range of BHEL power transformers covers the whole field from low voltage medium power transformers to extra large power transformers of 1500 MVA bank in 765 KV class and HVDC Convertor Transformers of 1500 MVA bank in ±500 KV DC. Product range also includes shunt reactor upto 150 MVAR 3 Phase in 400 KV class and 330 MVAr bank in 765 KV class This brochure generally serves to illustrate the broad principles and manufacturing process involved.

In general, the main parts of a transformer - core, coils and tank are made separately. The core and coils are then assembled, and the assembly is placed in the tank. Depending on customer's requirement, an on-load tap changer or an off-circuit tap changer is fitted at this stage. The finished transformer is then ready for processing and testing, prior to despatch.



180 MVA 275/132/11kV 3-Phase Auto transformer at Skudai S/stn , Malaysia

बी एच ई एल
BHEL

TRANSFORMERS SALES DIVISION

CORE

BHEL make transformers have core-type configuration. Core is built up from cold rolled grain oriented silicon alloy sheet steel of the best magnetic properties. CNC machine is used for slitting, cropping / mitring operations with perfect control on burr level. A computer programme determines number of steps, position of oil ducts and sizes of laminations for optimum cross sections of core and yokes. In order to achieve a further reduction of Iron loss, laminations are mitred and core bolts for clamping are kept to a minimum. Bolts in core legs are completely eliminated by using resin bonded glass tape for binding or by using skin stressed cylinder.

Magnetic circuits are generally of 3 limb construction (for single phase transformers, only centre limb is provided with windings and the outer limbs provide return path for main flux). To facilitate transportation, the overall height of very large 3 phase transformers is reduced by using narrower horizontal yokes, and adding 2 vertical return limbs, thus making a 5 limb construction.

The vertical limbs are interleaved into the top and bottom yokes, and the laminations are so clamped together as to ensure freedom from vibration, and a minimum of magnetostriction noise.



Core of 315 MVA 400 kV Auto transformer



The top and bottom yokes are held securely together by welded steel end frames, provided with flanges to support the windings. The vertical limbs are securely held together by core clamping plates, which are fastened to the top and bottom end frames. This offers satisfactory arrangement for lifting the core separately or together with the winding. The windings are kept under pressure with the help of separate adjusting screws or dash pots mounted on the top end frame. In case of EHV transformers, the bottom yokes are clamped by means of screw jacks against a form fit bottom tank.

Core is assembled in horizontal position, Final lifting is done with the help of a cradle to avoid any undue strain during lifting. Cross section of core is a stepwise assembly to give a circular shape by achieving better space factor utilization. Ducts are provided through core to allow oil circulation, thus ensuring efficient cooling.

All structural steel work associated with the core is shot blasted to remove scale, and then coated with oil-proof varnish.



Three phase five limbed core

WINDING

Transformer winding is cylindrical and arranged concentrically. This design offers substantial advantages like:

- Simplicity & elimination of weak insulation points by means of symmetrical layout.
- Great mechanical resistance to short circuit stresses.
- Free oil flow through cooling channels.
- The rating and connection of the winding largely determine the choice of the type of winding. The following 4 types of windings are generally used :
- Helical winding
- Spiral winding
- Continuous disc section winding
- Interleaved disc winding

HELICAL WINDING :

This is generally used for low voltage windings and consists of a number of parallel conductors simultaneously wound on an insulating cylinder of high mechanical strength. Where current is very high, the conductors are transposed to ensure equal current distribution in all strands, thereby reducing stray copper losses to a minimum. To provide adequate cooling, axial and radial ducts are provided by spacer blocks.

SPIRAL WINDING :

The spiral windings are generally used for voltages upto 33 KV. These are essentially same as helical windings, except that turns are not separated by radial spacing blocks.



Winding in Air-Conditioned room

CONTINUOUS DISC SECTION WINDING :



For voltages between 33 KV and 132 KV, the winding is generally split into a number of separate coils, in order to limit the voltage per coil.

These coils are made up of one or several flat conductors wound in spiral form. These are stacked one above the other and connected in series by cross overs made alternately on their inner and outer sides, so that the windings are continuous without any joints between coils.

Such a winding is made in the simplest form, proportioning the insulation at each point to suit the power frequency and surge voltage stresses. For system voltages above 66 KV, stress rings are usually incorporated to modify the stresses at the ends of the winding.

To ensure adequate cooling, oil ducts are provided by vertical pressboards spacing strips and horizontal radial spacing blocks between sections.

INTERLEAVED DISC WINDING :

For EHV windings this type of winding is commonly used. By properly interleaving the turns within a pair of discs, the series capacitance of winding can be increased many times. This results in nearly uniform voltage distribution under impulse conditions. Cross overs are made at the inside of the disc pair and joints are made near the outside. More often partially interleaved disc coil is used where only a part winding is interleaved and balance portion is continuous disc construction.

SHORT CIRCUIT RESISTANCE :

Circular coil offers the greatest resistance to the radial component of electromagnetic forces, since this is the shape which any coil will tend to assume under short circuit stresses.

The longitudinal stresses are reduced by proper balancing of primary and secondary ampere-turns, along the coil. In particular, the voltage adjustment taps are distributed so as to keep imbalance of ampere-turns to the minimum.

Where large range of tappings are required, these are generally arranged in a separate coil which is spread over the whole length of the coil stack, in order to preserve magnetic balance between the windings as far as practicable, and to minimise axial stresses under fault conditions.

All insulation is shrunk during manufacture to virtually preclude any shrinkage in service, which might result in looseness and movement of the windings under short circuit.



Vertical winding machine in Air-Conditioned room

CORE AND COIL ASSEMBLY

At this stage of manufacture , the core and coils are brought together and assembled. The insulation system is so designed that the terminal major insulation and internal coil insulation are properly co-ordinated to minimise the effects of any surge voltages. Immediately after core and coil assembly, preliminary ratio and resistance tests are carried out before doing further work on the transformers.

Experimental investigations are sometimes carried out to determine the magnitude and nature of the impulse stresses, which are not distributed linearly along the legs as they are under power frequency conditions. The voltages that would be appearing between the various parts of a winding under surge conditions are found out at this stage by means of recurrent surge oscilloscope.







Core and Coil Assembly

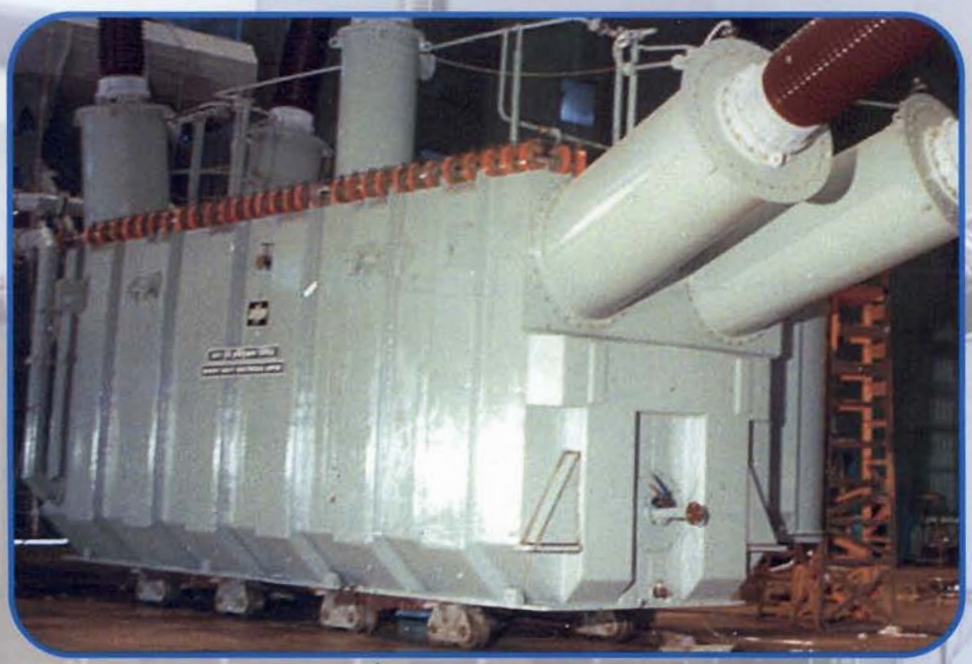
TANK

Tanks are fabricated from mild steel plates, electrically welded and are shot-blasted, inside as well as outside to remove any scales before painting. The inner surface is coated with suitable oil resistant paint whereas the outer surface is painted with high quality anticorrosive paint system comprising of 4 coats.

Tanks are designed and tested to withstand appropriate vacuum and pressure. For special designs, the mechanical stresses are analysed by Finite Element method. The weldings are checked by ultrasonic / dye penetration method for any defects.

The tank fabrication shop is fully equipped to make tanks of any shape and of the largest sizes, including bell type construction. This construction allows easier access to core and winding for maintenance purposes.

The flanges are designed so as to provide adequate gasket seating for prevention of leakages. Suitable locking arrangements are provided inside the tank so as to prevent movement of core and winding in transit.



315 MVA HVDC Convertor Transformer Tank

COOLING SYSTEM

NATURAL AND AIR BLAST COOLING:

Detachable radiators are used to provide adequate cooling surface mounted directly on the tank side or built up in one or two banks placed adjacent to the transformer and connected to it by pipe work. The radiator element is made from specially treated sheet steel plates. Two rolled and pressed plates are welded together along the outer edges and along the troughs between flutes. A number of such elements are welded into a mild steel header.

For increased cooling, fans are provided beneath the radiators. The fans are operated automatically when winding reaches a preset temperature by means of mercury switch contacts provided in the winding temperature indicator.

WATER COOLING :

The water cooler is usually of condenser type. Top oil is pumped around a set of tubes through which cooling water circulates. This type of cooling reduces the space requirement considerably, and is recommended specially for generator transformers where plenty of cooling water is available. To prevent any possible leakage of water into the transformer oil, oil pressure is always maintained higher than the circulating water pressure.

FORCED OIL COOLING :

Hot oil from the top of the tank is pumped into a compact cooler with built-in fans, and returned to the tank at the bottom. Alternatively a pump can be introduced to force the oil circulation between the top and bottom main radiator headers (where radiators are mounted in a separate bank).



Separately mounted radiator cooling tank

PROCESSING

The quality of a transformer, and consequently its performance and life, depends essentially on the factory processing, which is carried out at various stages of manufacture.

All the coils are preshrunk before assembly. After the coils are assembled on the core, the whole assembly is heated in an oven for extraction of moisture, and also the coils are reduced to proper dimensions.

After final assembly, the core and coils are kept in their own tank, and the whole unit is placed in a vacuum chamber for final drying. The chamber is heated up to about 100° C and a vacuum of very high degree is maintained during dry-out. Sometimes vacuum drying is done by drawing vacuum in its own tank and keeping the whole transformer inside an oven.

Besides this conventional method of drying, most modern Vapour Phase Drying method is used alternatively.

Much importance is attached to proper dry-out, as otherwise coils would become loose in service and may get distorted under short circuit conditions.

The oil is treated separately in the filtering and degerating plant, and is kept constantly under vacuum at a temperature of 80° C, so that moisture-free degassed oil is always available. Ten thousand gallons of oil can be treated in the plant at a time. Oil is tested for electrical strength, and moisture content before the same is let into the transformer. The oil impregnation of winding insulation is also done under high vacuum conditions. The dryness of insulation is measured in terms of insulation resistance.

ACCESSORIES

OIL CONSERVATOR :

All power transformers are invariably provided with an expansion vessel called Conservator. This is to take care of the changes in oil volume due to change in ambient temperature, or as a consequence of changes in load on the transformer. The oil level in conservator thus rises or falls, resulting in a phenomenon called 'Breathing'.

The conservator is fitted with an oil preservation system called 'Aircell', which is a bag made of nitrile rubber and it floats on the oil surface inside the conservator. The aircell inflates or deflates as the oil level in the conservator falls or rises.

The above system prevents direct contact of transformer oil with atmospheric air and retards oxidation and sludging, thereby greatly reducing the oil deterioration / maintenance problems at site. Maintenance of the system is also negligible, since once in operation it generally needs no attention other than routine visual inspection.

OIL LEVEL GUAGE :

A magnetic oil level guage is fitted to indicate oil level in the conservator, float of which is always beneath the aircell. This guage is also provided with a switch which gives alarm when oil level falls below the minimum oil level or when air cell is damaged and sinks.

BREATHER :

A breather is connected to the aircell and is used to dry the air that enters in the aircell when the transformer breathes. The breather contains an absorbent material like Silicagel for absorbing the moisture present in the atmospheric air. Air entering the breather is first drawn through an oil seal at the bottom, and passes upwards through the silicagel crystals to the connecting pipe at the top of aircell.

During the upwards passage of air, any moisture present is absorbed by the dry silicagel. The oil seal at the bottom ensures that the gel absorbs moisture only when the transformer is breathing in.

TEMPERATURE INDICATORS :

Each transformer is provided with dial type thermometers for oil and winding temperature indication. The bulb is placed in an oil filled pocket screwed into the transformer tank cover. The pocket or the bellow for winding temperature indicator has a heating coil around it, temperature indicator pocket/bellow.

which is fed by a CT provided on one of the transformer line terminals. As such any changes in the load reflect in the heating of the winding temperature indicator pocket/bellow.

The expansion of the liquid in the bulb is transmitted throgh a capillary tube to an indicating instrument. The dial type thermometer is also provided with mercury switches for alarm and trip circuit operations in the event of excessive temperature rise and also for operation of cooling fans and oil pump motors at certain preset temperatures. A potentiometer device can also be provided for remote temperature indication.

BUCHHOLZ RELAY :

The oil and gas actuated relay (Buchholz) serves as a protection against any loss of oil, discharge inside the tank and interturn short circuit and insulation defects. Indications for the above faults are available from this relay even when the fault current is too small to operate the overcurrent and earth fault relays. This device is usually mounted in the connecting pipe between the highest point in the transformer and the oil conservator. The device accommodates two floats, of which the upper float is actuated by a build-up of gas and the lower float by a sudden oil surge. The contacts for the first float normally give an alarm signal and those of the second, cause tripping. Gas sample can be collected from the upper part of the device, and analysis of the gas gives an indication as to the nature of fault.

MARSHALLING BOX :

A weather proof marshalling box is fitted on the side of the transformer tank or mounted separately. This accommodates the oil and winding temperature indicators, starters etc for various fan and pump motors, and terminal connectors from various alarm and trip circuits provided in the transformer. A heater is provided inside the marshalling box to avoid any condensation.

PRESSURE RELIEF VALVE :

This is a spring loaded safety valve mounted on the tank cover for protection of transformers in case of sudden over pressure. Valve diaphragm is sealed against gaskets by springs. Valve operation is effected when pressure inside the tank exceeds opening pressure established by springs. The transformer pressure is then rapidly reduced to normal value and spring returns the diaphragm to closed position.

BUSHINGS :

Oil filled porcelain bushings are used for taking out the terminals for voltages up to a level of 33 KV. The bushing consists of a conductor within a porcelain jacket.

For 52 KV and above, condenser type bushings are used. The active part of these bushings consists of Oil impregnated paper (OIP) condenser core manufactured from superior grade craft paper wound on Aluminium tube. This bushing is voltage graded by suitably interposed Aluminium foils forming condenser layers. Thus the electrical stresses are controlled throughout the thickness and along the surface avoiding highly stress concentrations.

The condenser core is assembled with a mounting flange and porcelain insulators at both outdoor and oil immersed end. The wound core is vacuum dried and impregnated with high grade degassed and dehydrated transformer oil. A prismatic or magnetic oil level guage is provided to indicate the level of oil in the bushing.

A self earthed test tap arrangement is provided on the flange which is used for measurement of Tan delta and Capacitance of the bushing. Creepage distance suitable for highly polluted atmosphere is also provided.



420 KV OIP Bushing

BHEL range of inhouse manufacture of bushings covers the complete requirement upto 400 KV class and caters to requirement of both, in-house manufactured transformers as well as for other transformer manufacturers.

Depending on specific requirement of customer, Oil filled / Air / Compound filled cable boxes are also manufactured.

TAP CHANGERS :

The Tap Changers are used to vary the ratio of oil-immersed transformers under load.

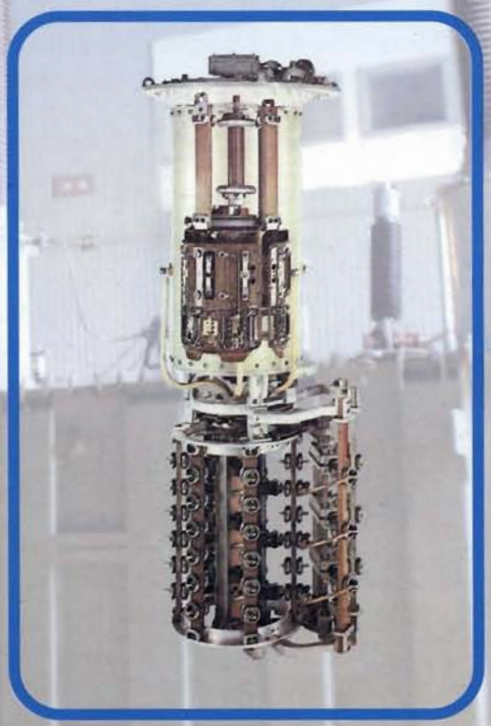
The M-type tap changer comprise a diverter switch and a tap selector in a single column design. The V-type tap changer works as a selector switch combining the features of a diverter switch and a tap selector.

Few important features of M-type tap changer are :

- High speed transition resistor type diverter switch with arc extinction at the first current zero.
- Three pole design for neutral application at 350 A, 500 A and 600 A ratings for three phase Y-connected windings.
- Three pole fully insulated design at 350 A, 500 A and 600 A ratings for three phase Delta or Auto connected windings.
- Single pole designs at 350 A, 500 A, 600 A, 800 A, 1200 A, 1500 A and 1800 A ratings for Auto connected or Single phase transformers.
- Available with ±9, ±11, ±13, ±15, ±17 steps.
- Rapid tap change operation, low thermal stresses on the transition resistors.
- Tap selector gear with steady torque during the tap chan ger operation.
- Long contact life.
- Diverter switch contacts easy to replace.

Few important features of V-type tap changers are :

- High speed transition resistor type diverter switch with arc extinction at the first current zero.
- Three pole design for neutral application at 200 A, 350 A and 500 A ratings for three phase Y-connected windings.
- Three pole fully insulated design at 200 A, 350A and 500 A ratings for three phase Delta or Auto connected windings.
- Single pole designs at 200A, 350 A and 700 A ratings for Single phase transformers.
- ratings for Single phase transformers.
- Available upto ±13 steps.
- Long contact life.
- The technical data of tap changer type M and V have been verified by type tests according to IEC recommendations Publ. 214 (1976).



•BHEL range of in house manufacture of tap changer covers the complete requirement upto 400 KV class transformers and caters to requirement of both, in-house manufactured transformers as well as for other transformer manufacturers.



CONTROL EQUIPMENT :

The tap changer can be provided with local electrical, remote electrical independent, and remote electrical non-automatic/ automatic parallel operation. Outdoor weather- proof kiosk for mounting of local electrical control equipment and indoor control cubicle for the mounting of the remote control equipment can also be supplied.

TESTING

Testing facility at BHEL works is well established for conducting routine as well as type tests as per International or Indian Standards. The tests on transformer can in general be divided briefly into following categories :

- Tests requiring sine wave voltage at variable frequencies :

No-load loss test and over-potential tests (with partial discharge measurement) fall in this category. These tests require a large sine wave generator. A short time rated 4 MVA generator having a continuous rating of 2 MVA, with a frequency variation from 25 to 180 Hertz has been installed for this purpose.

It may be mentioned here, specially with regard to iron loss test, that application of sine wave voltage is absolutely important to get a form factor as close as possible to 1.11, so that application of correction factor is avoided as far as possible.



Inside UHV test lab

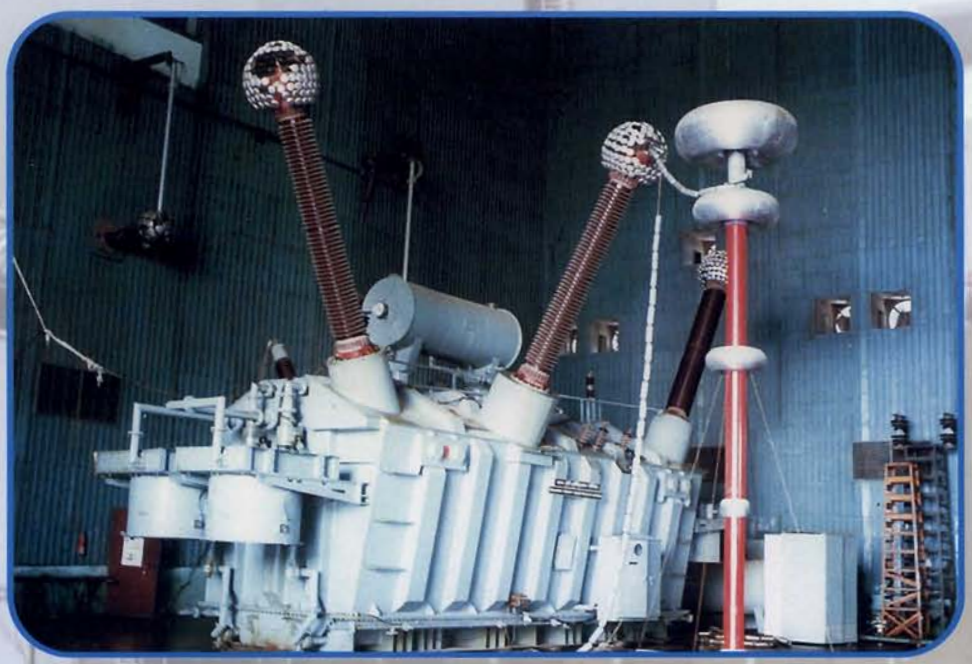
- Tests requiring power frequency voltage at full power for a transformer under test :

Load loss test, impedance voltage measurement test and temperature rise test fall in this category. For these tests, a large power output at varying voltage is necessary, to enable feed full copper and iron losses at the impedance voltage of the transformer under test. A 40 MVA motor generator set and a matching transformer have been installed for this purpose, which can give full output at voltages from 6 to 37 KV, thus enabling testing of even large transformers at full load.

- Tests requiring Impulse voltage such as Lightening and Switching.
- Special tests such as RIV, Noise level, Vibration test, Stress measurement etc.



Inside UHV test lab



In house manufactured 160 MVA 66/650 kV 3 Phase testing transformer

MANUFACTURING FACILITIES

SALIENT FEATURES



- Slitting line for CRGO steel (width of roll 1100 mm).
- Hydraulic & Pneumatic Cropping line (Lamination size 750 mm).
- CNC Cropping line (Lamination size - 1050mm).
- 200 T Core building platform.
- 20 T Vertical winding machine.
- 16 T Horizontal winding machine.
- High frequency brazing machine.
- 300 T Hydraulic press.
- 400 KW Vapour phase processing plant.
- 8000 LPH Oil Filteration plant.
- 250 T Crane lifting capacity.
- Railway wagons of 92T, 150T, 180T and 250 T capacity.
- Inhouse manufacturing & testing facility for Bushings, Tap changers, Radiators, OFAF Coolers, OFWF Coolers, Control panels, Machine shop, Insulation Shop.

TESTING FACILITIES

SALIENT FEATURES

In order to meet the country's demand of a testing facility at par with international standards, we have established an Ultra High Voltage (UHV) laboratory, which is having Certificate of Accreditation as per ISO/IEC 17025:1999 standards from National Accreditation Board for Testing and Calibration Laboratories (N.A.B.L), Department of Science & Technology, India. Testing of transformers of rating 315 MVA 3-phase ; 200 MVA 1-phase in 400 KV class, Shunt reactors of rating 80 MVAR 3-phase in 400 KV class, ±500 KV DC 1-phase Converter transformers, 800 KV Bushings and CVT have been satisfactorily established.

This UHV lab is having internal clear dimensions of 67 M (L) x 35 M (W) x 35 M (H) and is one of the largest screened laboratories in the world, attached to a transformer manufacturing plant.

The major test equipments / facilities in our UHV laboratory are :

- 4.0 Million-volt, 400 KW Impulse Generator.
- 500 Kilo-volt, 15 KW Impulse Generator.
- 3.6 Million-volt, 400 pF Impulse Voltage divider.
- 3.0 Million-volt Multiple Chopping gap.

- 1500 KVA, 1500 KV Cascade Connected testing transformer.
- 160 MVA, 66/650 KV 3-phase Testing Transformer.
- 3x13.33 MVA, 11/90 KV, 1-phase Transformers.
- 3x3.33 KVAr, 11 KV, 1-phase Reactors.
- 100 MVAr, 13-156 KV 3-phase Capacitor bank.
- 1.2 Million-volt, 30 mA DC voltage generator.
- 40 MVA, 0-11 KV, 50 Hz, 3-phase MG set.
- 9 MVA, 0-11 KV, 50-200 Hz, 3-phase MG set.
- 7 MVA, 0-11 KV, 50 HZ, 3-phase MG set.
- 2 MVA, 0-11 KV, 30-180 Hz, 3-phase MG set.
- Partial Discharge detector and RIV meter.
- 2.5M dia x 3.6M high Oil tank for Dielectric and Thermal Stability tests on Bushings.
- 800 KV, 71.5 pF SF6 filled standard capacitor.
- Frequency Response Analyser equipment.



Core Coil Assembly



400 kV Bushsing under test

TRANSFORMERS SALES DIVISION

MAJOR LANDMARKS / INHOUSE R&D PROJECTS

- Complete range of products are type tested as per IS/IEC.
- 2 nos. 200 MVA, 1-phase, 400 KV Generator Transformer tested for Short Circuit at KEMA-Netherlands for M/s NTPC, India in 2002.
- 186.2 MVA, 3-phase, 220 KV Generator Transformer tested for Short Circuit at KEMA-Netherlands for M/s NTPC, India in 2000..
- 167 MVA, 1-phase, 400 KV Auto Transformer tested for Short Circuit at KEMA-Netherlands for M/s NTPC, India in 2002.
- 102 MVA, 1-phase, 400 KV Generator Transformer tested for Short Circuit at KEMA-Netherlands for M/s NJPC, India in 1999.



70 MVA Single phase generator transformer on short circuit test barge at KEMA.

- 100 MVA, 3-phase, 400 KV Tie Transformer tested for Short Circuit at KEMA-Netherlands for M/s NTPC, India in 2003.
- 70 MVA, 1-phase, 400 KV Generator Transformer tested for Short Circuit at KEMA-Netherlands for M/s THPA, Bhutan in 2003.
- 50 MVA, 3-phase, 400 KV Station Transformer tested for Short Circuit at KEMA-Netherlands for M/s NTPC, India in 2000.
- Other Transformers of rating 80 MVA, 63 MVA, 45 MVA, 40 MVA, 25 MVA tested for Short Circuit at CPRI-Bangalore & Bhopal for M/s NTPC, MSEB.



186.2 MVA Three phase Transformer n Short Circuit Test barge at KEMA, Netherlands



50 MVAR, 400kV 3- phase Controlled Shunt Reactor



315 MVA 1-phase HVDC Converter Transformer

- 50 MVAR, 3-phase, 400 KV Controlled Shunt Reactor developed inhouse and installed at 400 KV Itarsi s/stn of M/s PGCIL, India in 2001.
- 2 MVA, 3-phase, 33 KV Phase Shifting Transformer developed inhouse and installed at BHEL R&D complex at Hyderabad, India in 2002.
- 160 MVA, 3-phase, 66/650 KV OFAF cooled testing transformer developed inhouse and installed in BHEL-Bhopal UHV lab since 1987.
- On-load tap changer type tested at CESI-Italy and KEMA-Netherlands.
- 800 KV, 1250 Ampere Bushing and 800 KV, 3000 pF CVT developed and tested inhouse.
- Export to more than 20 countries including Europe and Middle east.
- Inhouse development of computer software to analyse behaviour of transformer under Short Circuit conditions, distribution of voltage under Lightening/Switching impulse conditions etc.



315 MVA, 400 KV Generator Transformer loaded on road-trailer



View of Ultra High Voltage Test Lab

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Piplani, Bhopal (462 022)

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Siri Fort, Asiad,
New Delhi - 110 049



POWER OR SYSTEM TRANSFORMER

TRANSFORMER COMMERCIAL DEPARTMENT

BHARAT HEAVY ELECRICALS LIMITED - JHANSI

COMPANY PROFILE

CLASSIFICATION



COIL WINDING OF TRANSFORMER

TRANSFORMER COMMERCIAL DEPARTMENT

BHARAT HEAVY ELECRICALS LIMITED - JHANSI

COMPANY PROFILE | CLASSIFICATION



CORE COIL ASSEMBLY

TRANSFORMER COMMERCIAL DEPARTMENT

BHARAT HEAVY ELECRICALS LIMITED - JHANSI

COMPANY PROFILE CLASSIFICATION

POWER TRANSFORMERS – AN INTRODUCTION

The range of BHEL Power Transformers covers the whole field from low voltage medium power transformers to extra large power transformers of 600 MVA Bank in 400 KV class. Although it is not possible to describe, in detail, the manufacture of every type, the process through which a typical power transformer passes is described in the following pages, and this brochure generally serves to illustrate the broad principles and manufacturing process involved.

In general, the main parts of a transformer- core, coils and tank are made separately. The core and coils are then assembled and the assembly placed in the tank. Depending on customer's requirement, an on-load tap changer is filled at this stage, and the finished transformer is then ready for testing prior to dispatch.

CORE

BHEL make transformers have core-type configuration. Core is built up from cold rolled grain-oriented silicon alloy steel sheet of the best magnetic properties. CNC machine is used for slitting, cropping/mitering operations with perfect control on burrs. A computer programmed determines number of steps, position of oil ducts and sizes of laminations for optimum cross sections of core and yokes. In order to achieve a further reduction of iron loss, laminations are mitered and core bolts for clamping are kept to a minimum. Bolts in core legs are completely eliminated by using resin bonded glass tape for binding, or by using skin stressed cylinder.

Magnetic circuits are generally of 3-limb construction (for single phase transformers, only center limb is provided with windings and the outer limbs provide return path for main flux) To facilitate transportation. The overall height of very large 3 phase transformers is reduced by using narrower horizontal yokes, and adding 2 vertical return limbs, thus making a five limb construction.

The vertical limbs are interleaved into the top and bottom yokes, and the laminations are so clamped together as to ensure freedom from vibration, and a minimum of magnetic hum to restrict noise level.

The top and bottom yokes are held securely together by welded steel and frames, provided with flanges to support the windings. The vertical limbs are securely held together by core clamping plates, which are fastened to the top

and bottom end frames. This offers satisfactorily arrangement for lifting the core separately or together with the winding.

The windings are kept under pressure with the help of separate adjusting screws or dashpots mounted on the top end frames. In case of EHV transformers the bottom yokes are clamped by means of screw jacks against a form fit bottom tank.

Core is assembled in horizontal position. Final lifting is done with the help of a cradle to avoid any undue strain during lifting. Cross section of core is a step-wise assembly to give a circular shape. Ducts are provided through core to allow oil circulation, thus ensuring efficient cooling.

All structural steel work associated with the core is shot blasted to remove scale, and then coated with oil-proof varnish.

COIL WINDINGS

Transformer winding is cylindrical and is arranged concentrically. This design offers substantial advantages:

- **Simplicity and elimination of weak insulation points by means of a Symmetrical layout.**
- **Great mechanical resistance to short circuit stresses.**
- **Free oil flow through cooling channels.**

The choice of the type of windings is largely determined by the rating and connection of the winding. The following 5 types of windings are generally used:

- **Helical winding.**
- **Spiral winding.**
- **Continuous disc section winding.**
- **Shielded layer winding.**
- **Interleaved disc winding.**

HELICAL WINDING:

This is generally used for low voltage windings and consists of a number of parallel conductors simultaneously wound on an insulating cylinder of high mechanical strength.

Where current is very high, the conductor are transposed to ensure equal current distribution in all strands, thereby reducing stray copper losses to a

minimum. To provide adequate cooling axial and radial ducts are provided by spacer blocks.

SPIRAL WINDING:

The spiral windings are generally used for voltages up to 33 KV. These are essentially same as helical windings except that turns are not separated by radial spacing blocks.

CONTINUOUS DISC SECTION WINDING:

For voltages between 33 KV and 132 KV, the winding is generally split into a number of separate coils, in order to limit the voltage per coil.

These coils are made up of one or several flat conductors wound in spiral form. These are stacked on above the other and connected in series by crossover made alternately on their inner and outer sides, so that the windings are continuous without any joints between coils.

Such a winding is made in the simplest form, proportioning the insulation at each point to suit the power frequency and surge voltage stresses. For system voltages above 66 KV, stress rings are usually incorporated to modify the stresses at the ends of the winding.

To ensure adequate cooling, oil ducts are provided by vertical pressboard spacing strips and horizontal radial spacing blocks between sections.

SHIELDED LAYER WINDINGS:

For voltages greater than 132 KV with system neutral solidly earthed, the shielded layer winding frequently offers many advantages.

This type of winding consists essentially of a number of concentric spiral coils diminishing in length as the diameter increases. All these layers are connected in series, one end of the outermost coil being the line terminal.

The coils are separated by oil ducts and unbounded paper cylinders. During winding, the latter are arranged to extend well beyond the turns of the coil and afterwards these extensions are 'petalled' and bent over at right-angles to form insulating flanges between succeeding coils.

At the same time, these flanges provide an insulation system to ground which increases progressively from the neutral up to a maximum for the line-end coil.

Outside this latter coil is arranged an electrostatic shield, connected to the line terminal. The coils and shield are so dimensioned that they form a number of substantially equal capacitances in series, thus ensuring relatively

uniform distribution through the windings of surge voltages as well as power frequency voltages.

INTERLEAVED DISC WINDING:

For EHV windings this type of winding is commonly used. By properly interleaving the turns within a pair of discs, the series capacitance of winding can be increased many times. This results in nearly uniform voltage distribution under impulse conditions. Cross-over are made at the inside of the disc pair and joints are made near the outside. More often partially interleaved disc. Coil is used where only a part winding is interleaved and balance portion is continuous disc construction.

SHORT CIRCUIT RESISTANCE:

Circular coil offers the greatest resistance to the radial component of electromagnetic forces, since this is the shape which any coil will tend to assume under short circuit stresses.

The longitudinal stresses are reduced by proper balancing of primary and secondary ampere-turns, along the coil. In particular, the voltage adjustment taps are distributed so as to keep imbalance of ampere-turns to the minimum.

Where large range of tapings are required, these are generally arranged in a separate coil which is spread over the whole length of the coil stack, in order to preserve magnetic balance between the windings as far as practicable, and to minimize axial stresses under fault conditions.

All insulation is shrunk during manufacture to virtually preclude any shrinkage in service, which might result in looseness and movement of the windings under short circuit.

Final clamping of the winding, by means of the adjusting screw/ dashpots, is carried out before the transformer leaves the factory.

CORE AND CORE ASSEMBLY

All this stage of manufacture, the core and coils are brought together and assembled. The insulation system is to design that the terminal major insulation and internal coil insulation are properly coordinated to minimize the effects of any surge voltages.

Immediately after core and coil assembly, preliminary ratio and resistance tests are carried out before doing further work on the transformers.

COMPANY PROFILE CLASSIFICATION

Experimental investigations are sometimes carried out to determine the magnitude and nature of the impulse stresses, which are not distributed linearly along the legs as they are under power frequency conditions. The voltages that would be appearing between the various parts of a winding under surge conditions are found out at this stage by means of recurrent surge oscilloscope.

TANK

Tanks are fabricated from mild steel plates, electrically welded and are shot-blasted, inside as well as outside to remove any scales before painting. The inner surface is coated with suitable electrical resistant paint whereas the outside is painted with high quality anticorrosive paint systems comprising 4 coats.

Tanks are designed to withstand appropriate vacuum and pressure and are also tested for these. For special designs, the mechanical stresses are analyzed by Finite Element method. The weldings are checked by ultrasonic /dye penetration method for any defects.

The tank fabrication shop is fully equipped to make tanks of any shape and of the largest sizes, including bell type construction. This construction allows easier access to core and winding for maintenance purposes.

The flanges are designed so as to provide adequate gasket seating for prevention of leakages. Welded cover on top is preferred.

Suitable anchoring arrangements are provided inside the tank so as to prevent movement of core and winding in transit.

COOLING SYSTEM

NATURAL AND AIR BLAST COOLING:

Detachable radiators are generally used to provide adequate cooling surface. They may be mounted directly on the tank side or built up in one or two banks placed adjacent to the transformer and connected to it by pipe work, depending on size of transformer and available space at site.

The radiators element is made from specially treated sheet steel plates. Two rolled and pressed plates are welded together along the outer edges and along the troughs between flutes. A nipple is welded at each and of the element. A

number of such elements are welded into a mild steel header. Completed radiator is tested at a hydraulic pressure of 0.70 kg. Per sq. cm.

The radiator units are connected to the transformer tank (or to the common headers when radiators are mounted in separate banks) through isolating valves.

For increased cooling, fans are provided beneath the radiators. The fans are operated automatically when winding reaches a preset temperature by means of mercury switch contacts provided in the winding temperature indicator.

WATER COOLING:

The water-cooling is usually of condenser type. Top oil is pumped around a set of tubes through which cooling water circulations. This type of cooling reduces the space requirement considerably, and is recommended specially for generator transformers where plenty of cooling water is available.

The cooler is tested at a specific pressure to check leakage of water into the oil. Further, to prevent any possible leakages of water into the transformer oil, oil pressure is always maintained higher than the circulating water pressure. A differential pressure gauge is provided to keep a check on this.

FORCED OIL COOLING:

Hot oil from the top of the tank is pumped into a compact cooler with built-in fans, and returned to the tank at the bottom. Alternatively a pump can be introduced to force the oil circulation between the top and bottom main radiator headers (where radiators are mounted in a separate bank). The choice depends on available space. The second arrangement would need more space, but will have the advantage of a high output available in the event of pump or fan failure. In the latter case, the pump motor and fan motor are arranged to operate automatically when winding reaches a preset temperature, by means of mercury contacts provided in the winding temperature indicator.

PROCESSING

The quality of a transformer, and consequently its performance and life, depends essentially on the factory processing, which is carried out at various stages of manufacture.

All the coils are preshrunk assembly. After the coils are assembled on the core, the whole assembly is heated in an over for extraction of moisture, and also the coils are reduced to proper dimensions.

After final assembly, the core and coils are kept in their own tank, and the whole unit is placed in a vacuum chamber for final drying. The chamber is heated up to about 100 degree C and a vacuum of very high degree is maintained during dry-out. Some times vacuum drying is done by drying vacuum in its own tank and keeping the whole transformer inside on oven.

Besides this conventional method of drying most modern Vapour phase Drying method is used alternatively.

Much importance is attached to proper dry-out, as otherwise coils would become loose in service and may get distorted under short circuit conditions.

The oil is treated separately in the filtering and degerating plant, and is kept constantly under vacuum at a temperature of 80 degree C, so that moisture-free degassed oil is always available. Ten thousand gallons of oil can be treated in the plant at a time. Oil is tested for electrical strength, and moisture content before the same is let into the transformer. The oil impregnation of winding insulation is also done under high vacuum conditions. The dryness of insulation is measured in terms of insulation resistance.

ACCESSORIES

1. OIL CONSERVATOR:

Transformer oil, when in use, must maintain its properties over many years to ensure a long life for the transformers. The oil must thus be prevented from absorbing moisture, as it would otherwise loose good insulating properties. For this reason, all transformers are provided with oil conservator which in fact serves a dual role. Firstly, a space of 1/13 of the oil volume of the transformer is provided, in which the oil can expand under the influence of temperature changes in surrounding atmosphere and due to changes in the loading conditions. Secondly, the oil surface which comes into contact with the air in the conservator is appreciably less than the oil surface in the tank.

2. OIL LEVEL GAUGE:

The oil level in the conservator is indicated by an instrument normally placed on one end. The dial of the indicator is calibrated to give the level of oil as a fraction of conservator capacity. A mercury switch is provided in indicating instrument, so that when the oil level falls

below a specific level an alarm is sounded. The instrument is of float type, and the movement of the float is transmitted to the pointer either mechanically or by means of a magnet.

3. BREATHER:

A breather is used to dry the air that enters a transformer, as the volume of oil decreases because of fall in temperature. Air entering the breather is first drawn through an oil seal at the bottom, and passes upwards through the silica gel crystals to the connecting pipe at the top. During the upward passage of air, any moisture present is absorbed by the dry silica gel. The oil seal at the bottom ensures that the gel absorbs moisture only when the transformer is breathing in. Other advanced method of breathing e.g. thermosyphon system, Atmoseal bag system etc. are also in vogue.

4. TEMPERATURE INDICATORS:

Each transformer is provided with dial type thermometers for oil and winding temperature indication. The bulb is placed in an oil-filled pocket screwed into the transformer tank cover. The pocket or the bellow for winding temperature indicator has a heating coil around it, which is fed by a CT provided on one of the transformer line terminals. As such any changes in the load reflect in the heating of the winding temperature indicator pocket/bellow.

The expansion of the liquid in the bulb is transmitted through a capillary tube to an indicating instrument. The dial type thermometer is also provided with mercury switches for alarm and trip circuit operations in the event of excessive temperature rise and also for operation of cooling fans and oil pump motors at certain preset temperatures.

A potentiometer device can also be provided for remote temperature Indication.

5. BUCHHOLZ GAS PROTECTOR:

The oil and gas actuated relay (Buchholz) serves as a protection against any loss of oil, discharge inside the tank and interturn short circuit and insulation defects. Indicators for the above faults are available from this relay even when the fault current is too small to operate the over current and earth fault relays. This device is usually mounted in the connecting pipe between the highest point on the transformer and the oil conservator. The device accommodates two floats, of which the upper float is actuated by a build-up of gas and the lower float by sudden oil surge. The contacts for the first float normally give an alarm signal and those of the second cause tripping.

Gas sample can be collected from the upper part of the device, and analysis of the gas gives an indication as to the nature of fault.

6. MARSHALLING BOX:

A weather-proof marshalling box is fitted on the side of the transformer tank or mounted separately. This accommodates the oil and winding temperature indicators, starters etc. for various fan and pump motors, and terminal connections from various alarm and trip circuits provided in the transformer. A heater is provided inside the marshalling box to avoid any condensation.

7. RELIEF VENT:

A relief vent is mounted on the tank cover or on one side of the tank to protect against high-pressure build-up inside the oil tank. This consists of a vertical pipe work closed by a diaphragm made of thin Bakelite sheet. The diaphragm bursts in the event of pressure build-up inside the tank. A diverter plate is used at the bottom, to ensure that the gases liberated inside the transformer in the event of a fault, do not collect inside the vent. A by pass is provided to allow the oil to enter the vent and equalize the pressure on each side of the diverter plate. Spring loaded pressure relief valves with trip contacts can alternatively be provided.

8. BUSHINGS:

Oil-filled porcelain bushings are used for taking out the terminals for voltages up to a level of 33 KV. The bushing consists of a conductor within a porcelain jacket. For 66 KV and above, condenser type bushing are used. In general, the bushings consist of a central metallic conductor tube enclosed by wound oil impregnated paper body with aluminum foils in between the layers for field control. The innermost aluminum layer is connected to the conducting tube and the outermost to the fixing flange. A porcelain jacket is provided on the condenser bushing. The space between the paper body and porcelain jacket is filled with insulating oil, with an air space below the protective hood of the bushing which is sufficient for expansion of oil. A sight glass is provided to indicate the top oil level. Alternatively, magnetic oil level indicator is provided.

TAP CHANGERS

On- load tap changers for use with power transformers could be in their own tank or suitable for housing in the same tank along with transformer.

On-load tap changers of three-phase unit in their own tank are generally available for smaller transformers for system voltages up to 66 KV.

On-load tap changers suitable for mounting in the same tank along with the transformer are available in three-phase unit for neutral end connection and in single-phase unit for connection in the middle of the winding. The design of the on-load tap changer is based on modular construction and can be used at the neutral end of windings up to 400 KV system or at the line end of winding up to 220 KV system.

IMPORTANT FEATURES OF THE OLTC:

1. **The tap changer is of resistor transition type, and this ensures minimum arcing at the diverter switches.**

2. **The contact bounce at the diverter switches is eliminated.**

3. **Reliability of operation is ensured by the type of mechanism used, and by provision of a special follow-up device.**

3. **The tap changer is to design that once a tap changer has been initiated, it is impossible for the operator to interrupt. The diverter switches are actuated by the energy stored in a number of lightly stressed springs in parallel, if the supply to the motor drive fails during the stressing of the springs the diverter switches will not be operated and the tap changer will remain on the original tap. Once the springs have reached the point at which they give up their energy, the diverter switches will be operated irrespective of the failure of the supply.**

5. **The selector switch in the multi-compartment units is so arranged that it does not break any current.**

6. **The main current is never interrupted during a tap change.**

7. **The diverter switch is very rapid in operation as this is operated from the stored energy of a spring.**

8. **The ohmic values of the transition resistors are chosen to reduce the voltage variation during a tap change to a minimum.**

9. **The diverter switch for the multi-compartment unit is enclosed in a separate tank for easy inspection and changing of oil.**

CONTROL EQUIPMENT:

The tap changer can be provided with local electrical, remote electrical independent, and remote electrical non-automatic/automatic parallel operation.

Outdoor weather-proof kiosk for mounting of local electrical control equipment and indoor control cubicle for the mounting of the remote control equipment can also be supplied.

TESTING

Testing facility at BHEL works is well established for conducting routine as well as type tests as per International or Indian Standards. The tests on transformer can in general be divided briefly into two categories:

1. **TESTS REQUIRING SINE WAVE VOLTAGE AT VARIOUS FREQUNCIES:**

   Iron loss test and over-potential tests fall in this category. These tests require a large sine wave generator. A short time rated 4 MVA generator having a continuous rating of 2 MVA, with a frequency variation from 25 to 180 Hertz has been installed for this purpose.

   It may be mentioned here, specially with regard to iron loss test, that application of sine wave voltage is absolutely important to get a form factor as close as possible to 1.11, so that application of correction factor is avoided as far as possible.

2. **TESTS REQUIRING POWER FREQUENCY VOLTAGE TO FULL POWER FOR A TRANSFORMER UNDER TEST.**

   Copper loss test, impedance voltage measurement test and temperature rise test fall in this category. For these tests, large power output of varying voltage is necessary, to enable feed full copper and iron losses at the impedance voltage of the transformer under test. A 40 MVA motor generator set and a matching transformer have been installed for this purpose, which can give full output at voltage from 6 to 37 KV, thus enabling testing of even large transformers at full load.

   In order to meet the country's demand of a testing facility at par with International standards we have established on Ultra High

Voltage Laboratory, which is one of the five such Labs in the world for the benefit of the users.

THE MAJOR TEST EQUIPMENT IN UHV LABORATORY ARE:

- ✓ **4000 KV, 400 kJ Impulse Generator and associated equipment.**
- ✓ **1500 KVA, 1500 KV cascade connected testing Transformers.**
- ✓ **500 V, 15 kJ Impulse Generator.**
- ✓ **750 KV, Wall Bushing.**
- ✓ **3.33 MVAr, 11 KV Reactor.**
- ✓ **60 MVAr, 156 KV three-phase Capacitor Bank.**
- ✓ **Partial Discharge Detector and RIV meter.**
- ✓ **9 MVA 200 Hz 3 phase generator for partial discharge test.**
- ✓ **A 2.5 M dia x 3.6 M high oil tank for dielectric and thermal Stability tests on bushings.**
- ✓ **Various measuring and recording instruments.**
- ✓ **160 MVA, 66/650 KV 3 phase testing transformers.**

THE DIFFERENT TESTS WHICH CAN BE CARRIED OUT IN THE UHV LABORATORY ON DIFFERENT HIGH VOLTAGE EQUIPMENT ARE :

- ➢ **Lightning & Switching Impulses.**
- ➢ **Power frequency dielectric test.**
- ➢ **Partial Discharge and RIV measurement.**
- ➢ **Artificial rain test and artificial pollution tests.**
- ➢ **All routine tests and type tests as per IES/IS.**
- ➢ **Thermal stability test on bushing besides other routine and type tests.**



IMPULSE GENERATOR AT BHEL JHANSI

TRANSFORMER COMMERCIAL DEPARTMENT

BHARAT HEAVY ELECRICALS LIMITED - JHANSI

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VAPOUR PHASE PLANT AT BHEL JHANSI

TRANSFORMER COMMERCIAL DEPARTMENT

BHARAT HEAVY ELECRICALS LIMITED - JHANSI

COMPANY PROFILE CLASSIFICATION



For further details and enquiry, Please contact:
Transformer Commercial department,
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Siemens Transformers Worldwide

Today, Siemens is a world leader in the manufacturing of Transformers. Our Transformers are employed in vital places throughout the world's power grids ensuring reliable, safe and uninterrupted electricity flow. Siemens Transformer group represents a unique worldwide sales & service network in more than 190 countries. Also our 21 manufacturing units spread across the globe add to the great reputation that these transformers enjoy with customers the world over.

This is not surprising because, each of these Transformers is a result of the integrated know-how acquired from AEG, Trafo-Union & VA-tech – including its brand names ELIN, EBG, Peebles, Ferranti-Packard and Stem. With over 100 years of expertise and technical knowhow, Siemens is known for its outstanding quality and reliability.

Siemens offers the entire range of Transformers from Generation to HVDC Transmission to Distribution Transformers. We are also pioneers in the manufacture of special application Transformers like Furnace Duty, Rectifier Transformers, Traction Transformers, Phase Shifters, Shunt Reactors, GEAFOL Cast-resin Transformers and other special duty Transformers.

Siemens Transformers, a name associated with highest quality and reliability standards is a pioneer in Transformer technology and has built many of the large Transformer units up-to 1200kV voltage class and up-to 1500 MVA 3-phase power ratings. Very naturally, some of the world's most renowned and accepted Transformer specialists in engineering and quality standards are part of our team at Siemens.



The Milestones

1890 Transformer factory established in Nuremberg

1912 First 100 kV Three-phase Transformer manufactured in Nuremberg

1918 Highest rated power 60 MVA, 110/25 kV

1923 First Three-phase Transformer with five limb core

1929 First 220 kV mains voltage, 60 MVA Transformer introduced

1932 First Phase-shifting Transformer

1933 First Rectifier Transformers upto 12 MVA

1952 300 MVA, 220 kV Booster Transformer

1957 The first 400 kV, 660 MVA Three-phase bank made

1965 First GEAFOL Cast-resin Transformer

1968 The first 800 kV Transformers and reactors

1969 Supply of first Three-phase 400 kV Generator Transformer

1972 Successful testing of HVDC Transformer

1972 Prototype of 1200 kV Inter-connecting Transformer

1982 250 MVAr, 420 kV Shunt Reactor, the largest in the world at that time

1984 The first 1100 MVA, 420 kV Generator Transformer

2003 First 30-MVA GEAFOL Cast-resin Transformer

2005 "Whispering Transformer" – extremely quiet 420 MVA, 345 kV autotransformer with a sound level of only 57 dB (A)

2008 World's first 800 kV HVDC Transformer successfully tested

2012 UHVDC mock-up 1.100 kV DC successfully tested

2014 Worlds largest natural ester transformer 420 kV / 300 MVA energized



Transformer Facility in India

The Transformer factory established in 2006 in India is the most modern, well equipped unit of the Siemens Transformer family. It has an installed capacity of over 18,000 MVA annually.

This state-of-the-art manufacturing facility at Kalwa near Mumbai caters to the power requirements of the country and abroad with the capability to manufacture the biggest ever ratings of Transformers & reactors.

Our Transformer factory in India produces Power Transformers, Generator Transformers and System/Grid/Network Transformers. This facility in India also offers Transformers with niche technology like HVDC, SVC and shunt reactors. Our Transformer factory also manufactures traction Transformers suitable for railway locomotives and Electrical Multiple Units (EMU). It has the infrastructure, manufacturing and testing facilities available to meet the largest voltage requirement of the country upto 1200 kV.

In order to make this possible, modern technology related to all aspects of design & manufacturing is transferred through the centre of competence in Nuremberg, Germany. That is why, the products manufactured by us in India are at par with those made in Europe, USA and other parts of the world.

At Siemens India we also make sure all the best practices established in Siemens Transformer factories the world over are applied in this factory. Each product is tailor-made according to the specific requirements of the client with the help of sophisticated design software and stringent quality norms. Best practice sharing across all the Siemens units globally forms the basis of selecting the tools and software used during engineering and in different aspects of manufacturing & testing.

The core workforce, including shop floor technicians have been trained at various Siemens plants. What's more, all the factory processes are dutifully followed and quality is built at every stage of production. Careful attention to even minute details ensures high performance, reliability and efficiency of the product at site.

The Milestones

2006 Transformer factory established in India.

2007 First transformer rolled out of factory of 100 MVA, 220 kV class.

2008 First order for 400 kV Auto & Generator transformer.

2009 First 400 kV transformer successfully commissioned.

First order for HVDC transformer of +500 kV.

2011 500 kV HVDC transformer successfully commissioned.

First traction transformer successfully commissioned.

2012 First 400 kV shunt reactor successfully commissioned.

2013 Order for largest single phase 315 MVA 400 kV Generator Transformer.

2014 First 500 MVA 765 kV Auto transformer commissioned successfully.

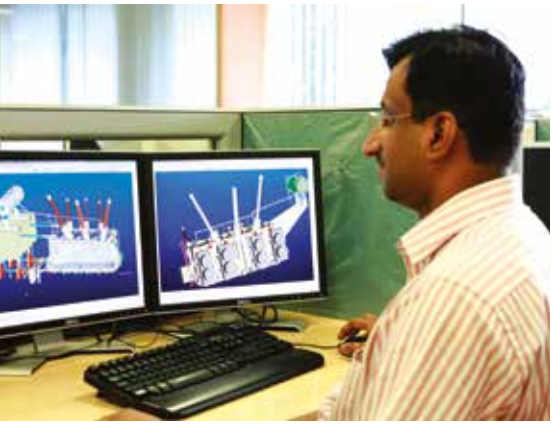
First 333 MVA, 1200 kV 1-ph Transformer sucessfully supplied.

525kV shunt reactors under manufacturing.





Engineering



Our customized designs with the most modern design tools come from a common pool of 21 factories spread worldwide. It adopts best practice sharing and ensures Transformers which are low loss, have low noise levels and the highest short circuit withstanding capability with low partial discharge.

This ensures long life expectancy and the lowest life cycle cost.

Know-how, R&D back-up and precision design tools are the key to these best designs. Detailed engineering for the determination of electrical strength, thermal strength, mechanical strength and long term stability is made with Siemens advanced software tools.

Manufacturing



Winding

In a dust-free, and a positive pressure environment, windings are made on horizontal and vertical winding machines. The insulated conductors are wound in layers under constant set pressure and tension on horizontal machines. This sustains axial and radial forces during operation and makes the winding intact. This unique method followed by Siemens ensures tightened winding and gives high short circuit strength.

The windings are designed with adequate axial and radial cooling ducts to reduce hotspots based on detailed calculations on globally common design software.

Paper or non paper insulated CTC's are used as per design requirement which reduce stray losses in the windings. The use of transposed conductors ensures the lowest losses due to few brazed joints.



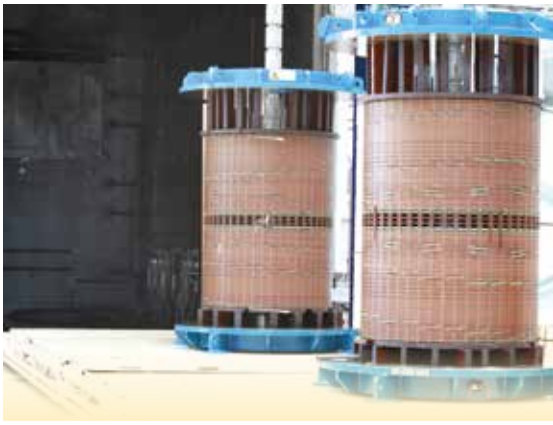


Conditioning of windings

In special vapour phase drying ovens, individual coils are kept under a constant pre-set pressure. After evacuating the drying chamber, the liquid vapour and heating cycle together ensure complete extraction of moisture and cleanliness of windings followed by oil impregnation under vacuum.

Stabilization of winding height is better controlled by vapour phase drying under pressure. Due to this, the windings acquire a high degree of stability which ensures high short circuit withstand capacity and a very long service-life in the most demanding of conditions.

This unique technology improves the stability of windings, reduces springback and ensures a robust Transformer design.



Core Stacking

Transformers built here are of core type and are built on one of the largest core tables in India. This large table is designed for a jerk free lift and is capable of building cores both with the 3-limb and 5-limb designs.

Step-lap stacking method is followed in this factory that has low no-load loss and low noise emission benefits.

The core is made upright with the help of a single capacity large crane and taken to pre-assembly bay with the help of air cushions for a jerk-free movement.

Siemens reactors are made with gapped core design. Unlike many other competitors we have in-house core cutting facility for the core packets.

Due to inhouse cutting facility, we achieve better accuracy in dimensional tolerances and finish. We have fully automatic machine and user friendly interface.

Due to above measures and advantages, Siemens reactors offer very Low noise & Vibration values affirming the quality of the product.









Core-Coil Assembly

Pre-assembly is carried out in a large, dust-free and humidity controlled environment to minimize ingress of moisture during assembly. This also enhances the life of the Transformer.

Special care is taken to avoid sharp edges in the vicinity of windings and live parts and all hardware is covered to keep partial discharge to the minimum. The fitting of the tap changer for facilitating voltage variation and the arrangement of leads is done at this stage.



Tanking & Final Assembly

The core and coil assembly dried under vacuum in a separate vapour phase drying plant with the highest state of dryness is inserted in the tank. Accessories like bushings, radiators, motor drive unit, control cabinets, monitoring devices, etc are mounted on the tank. The Transformer is then evacuated, filled with Transformer oil and made completely ready for the final testing.

Special air transporters minimize the crane handling of the windings and active parts, facilitating the smooth and jerk free movement of the assemblies, sub-assemblies and the complete Transformer within the factory. This ensures a high stability in all the parts inside.





Testing

Our electro-magnetically and acoustically shielded high voltage test laboratory is a Faraday's Cage and is one of the largest in India.

It is capable of testing Power Transformers of the highest voltage class, which includes up to 1200 kV, HVDC, SVC Transformers and Shunt Reactors. It is capable of conducting all relevant routine, type and special tests in accordance with national and international standards namely IS 2026, IEC 60076 and ANSI. Needless to say, this state-of-the-art laboratory is equipped with the most modern instruments to deliver the most accurate results possible.

This HV test lab is also equipped with a highly sophisticated oil testing laboratory for the analysis of Transformer oil.

All Siemens Transformers are subjected to stringent tests before they leave the factory to ensure their reliability in field performance.





NABL accredited Oil Testing Lab

We have established a separate oil test laboratory which is NABL accredited according to ISO/IEC 17025: 2005 vide Certificate No. T-1832 and is equipped with the most modern and advanced test facilities.

In general, transformer oil as per IS/IEC standards of various grades can be tested in this lab.

This lab caters to the oil testing requirements of not only our works but also provides testing facility for various other customers/end users/maintenance agencies across India.

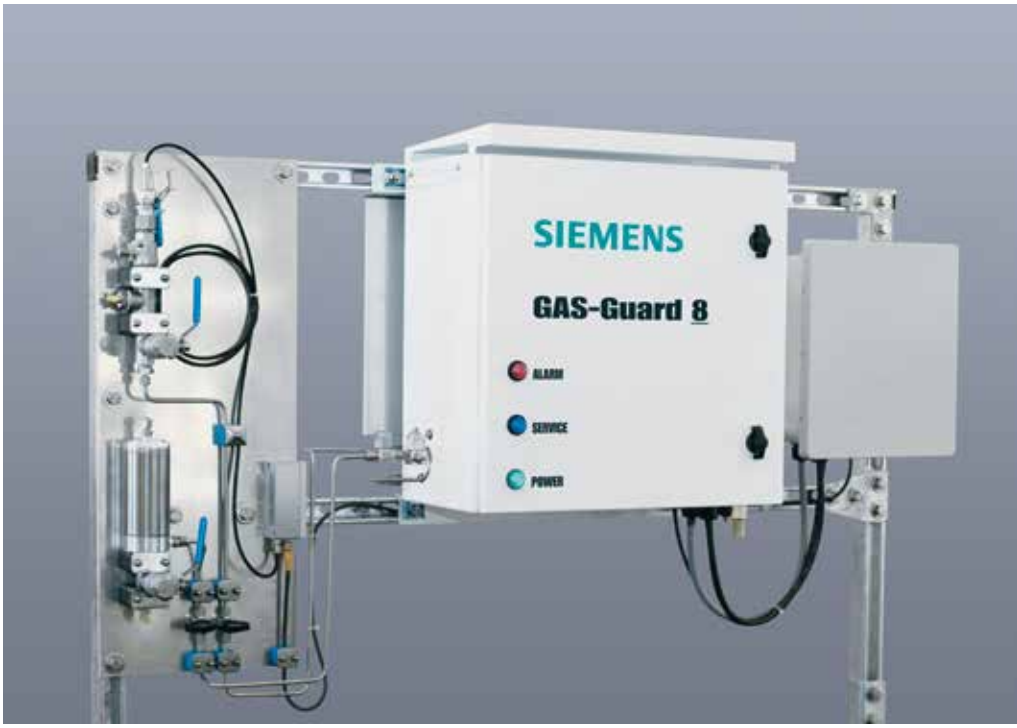
The testing facilities such as DGA, Tan Delta, Resistivity, Inter Facial Tension & Flash Point are all automated to provide extremely accurate and reliable results.

The list of tests that can be conducted are as follows:

- Appearance
- Electric Strength (Oil BDV)
- Water Content (PPM)
- Dielectric Dissipation Factor (Tan Delta)
- Specific Resistance (Resistivity)
- Dissolved Gas Analysis (DGA)
- Inter Facial Tension (IFT)
- Flash Point
- Pour Point
- Density
- Viscosity
- Neutralization Value







TLM -Transformer Lifecycle Management

It is crucial for the Transformers to provide trouble free supply of power with no interruptions. They are frequently in use for decades at a time and thus are subject to effects of aging and wear.

Hence it becomes imperative to plan maintenance expenditures in a targeted way, avoid unforeseeable outages and reduce planned downtimes.

How we can achieve this is through Transformer Lifecycle Management (TLM) – the service concept of Siemens for all transformers in the network, regardless of age or manufacturer. TLM allows you to act promptly and responsibly to preserve the value of your transformers in the most effective way and at low cost.

TLM broadly caters to services pertaining to the areas of Erection and Commissioning, Condition Assessment and Diagnostics, Online Monitoring, Maintenance and Lifecycle Extension, Repair and Retrofit, Consulting and Expertise, and Spare part supply.

Some key features include a well equipped High Voltage lab and a NABL accredited oil testing facility. An indigenously manufactured online dehydration system by the name of SITRAM Dry, to enhance the life of a transformer completes the portfolio.

Siemens' experience through the years in manufacturing of transformers ensures to provide these services to the customers at the highest level of quality and technical know how.

Key products and services:

Condition assessment and diagnostics: Facility and equipments for testing of transformers, and trained personnel for diagnosis and fault detection. Also, an NABL accredited oil test lab to conduct oil analysis is a key feature of TLM.



Monitoring: Online DGA measurement and Integrated condition monitoring systems showing all key parameters of one or more transformers as a consolidated solution.

Consulting and Training: Expert solutions on maintenance of transformers, and training modules at Transformer Works.

Maintenance and Lifecycle extension: Online dehydration system (SITRAM Dry) indigenously manufactured and supplied to enhance life of transformer of all ratings.

Spares: Supply of necessary spares and accessories

Repair: Repair, refurbishment and overhauling of Transformers and solutions provided to improve losses and better the efficiency of existing transformers of all makes.

Erection and commissioning: ETC services provided to ensure highest quality of operation of transformer at site.


HAEFELY
HAEFELY





HVDC Transformers:

Siemens had supplied and commissioned its state of the art HVDC transformers, 498MVA, 500kV the largest in its class in India from its Navi Mumbai works.

These transformers form a part of the largest HVDC transmission system built by Adani Power Ltd. This HVDC transmission line will transmit power more efficiently from Mundra (Gujarat) to Mohindergarh (Haryana) covering a distance of approximately 1000 kms.

765 kV Transformers:

Siemens India has also rolled 765kV, 500MVA class auto transformers from their Navi Mumbai plant.

The above symbol of excellence were commissioined in March'2014 at Powergrid (PGCIL) Kurnool substation under transmissioin system associated with Krishnapatnam UMPP.

Siemens factory in India is also executing supply orders of HVDC transformers for customers outside India.

1200 kV Transformers:

Siemens has successfully manufactured, tested and supplied its first 1200kV transformer to PGCIL Bina from its Navi Mumbai works.

333.33MVA, 1200kV single phase auto transformer rating was supplied for a development project initiated by Powergrid (PGCIL) and is one of the largest voltage rating manufactured in India.



Quality Management System (QMS)

With an ISO 9001:2008 certification, our QMS ensures quality at each stage, right from order acquisition to installation of every Transformer on the customer's premises.

This eco-friendly plant has also acquired ISO 14001:2004 for Environmental Management and OHSAS 18001:2007 for Occupational Health and Safety.

Under the supervision of global experts, it is ensured that the practices followed in all the Transformer factories worldwide are observed here, in order to achieve a high degree of quality in our unique technology.

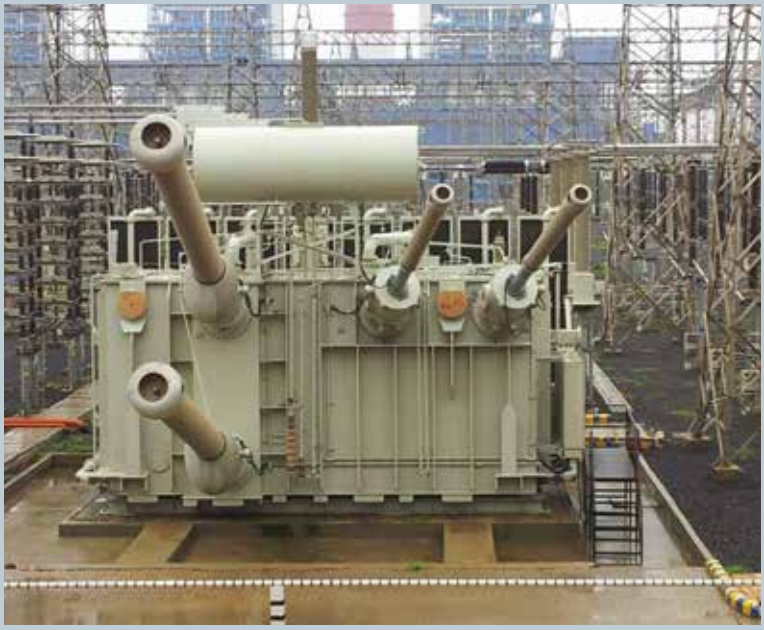












Installation at Site

The Transformers are delivered in pre-wired condition to save the customers the hassles of cable-matching, connection etc. and save on installation time at site.

Our highly skilled and dedicated installation team is committed to delivering consistent and high quality service.

Siemens strives for the highest standards in quality, reliability and technology.

Siemens Transformers

Transforming commitment into comprehensive service.

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TLM – Transformer Works
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EM-TR-001

The information in this document contains general descriptions of the technical options available, which do not always have to be present in individual cases. The required features should therefore be specified in each individual case at the time of closing the contract.

www.siemens.co.in

COMPANY PROFILE CLASSIFICATION







www.ieema.org

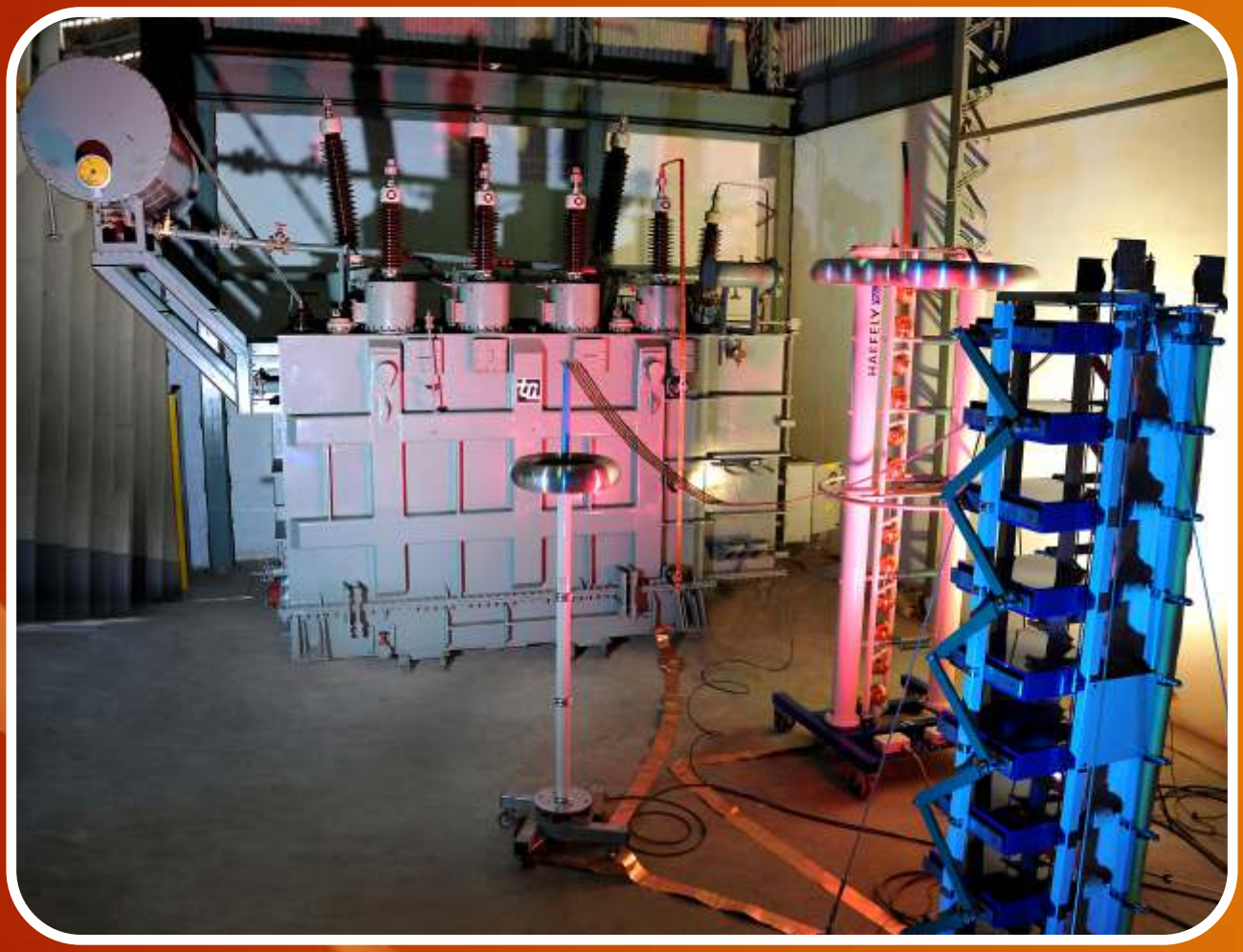
CLASSIFICATION

Energising India since 1969...

TECHNICAL ASSOCIATES LIMITED

An ISO 9001 : 2008 Company

Power Transformers up to 200 MVA, 220 KV



WE TRANSFORM THE NATION'S POWER

COMPANY PROFILE

CLASSIFICATION

INTRODUCTION

- Technical Associates Ltd. **(TAL)** is one of the **Top Ten manufacturers** of Power Transformers in India.
- Manufacturing Capacity: 11,000 MVA p.a.
- Range: Single phase / Three phase transformers up to 200 MVA, 220 KV:
  - Generator Transformers
  - Station Transformers
  - Auto Transformers
  - System Transformers
  - Railway Traction Transformers
- Additional infrastructure available to manufacture 765 KV Class transformers.
- More than 400 Power Transformers already delivered & successfully commissioned for various customers in India.
- All delivered transformers successfully type tested from accredited 3rd party test houses (as per IEC 60076 and IS 2026).
- In-house design team of highly experienced engineers uses CAD techniques for development and continuous improvement of reliable, cost-effective transformers in conformance with IS, IEC or ANSI standards.
- Designs for Power Transformer take care of Electro-magnetic, Electro-mechanical & Thermal aspects based on individual customer needs. Software based design techniques ensure structural strength, short circuit withstand capacity, lighting impulse withstand capacity, short duration overload, noise disturbances and vibration. Special software is used for optimization of material cost and labour.
- Sophisticated and calibrated testing equipments for in-house Routine and Type Tests.
- Strict Quality control for incoming stock, process monitoring and finished products using SQC techniques.
- Installation, commissioning and repairing of Power and Distribution Transformers by trained and experienced engineers backed by timely supply of spares.



Design using CAD

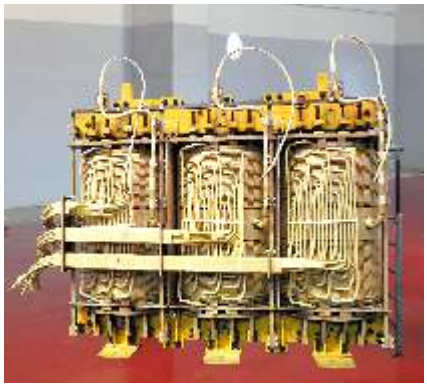


Power Transformer Bay



Front view of EHV Sitarganj Transformer Plant

MANUFACTURING PROCESS AND INFRASTRUCTURE



Core-Coil Assembly



Horizontal Winding Machine



Core Building

- Lucknow works for Power Transformers (2,000 MVA p.a.) with 5000 sq.m of covered sheds.
- Sitarganj works for EHV, Power Transformers (9,000 MVA p.a.) with 23000 sq.m of covered sheds.
- Manufacturing activities certified by BSI, UK as complying to ISO 9001:2008 standards.
- In-house facilities for Core slitting, cutting & annealing, Conductor manufacturing & paper covering, Tank fabrication, Oil storage and filtration, Insulation processing using latest machineries for QC and JIT approach.
- Sophisticated manufacturing, process & handling equipments such as Vapour Phase Drying Plant, Winding Machines with Variable Frequency Drives, etc. ensure product reliability.
- Excellent material handling facilities such as EOT Cranes up to 300 MT, Air Castors and innovative plant layouts for easy and fast movement of components.



160 MVA, 220 KV Auto Transformer with online Nitrogen Fire Protection System manufactured by TAL in RRVPNL Grid



Vapour phase drying oven (VPD)



Autoclave with vacuum capacity up to 1.0 Torr

TESTING

- Documented in-process checks ensure low lead times and process reliability.
- Fully computerized automatic testing facilities for all routine tests as per IS, IEC, ANSI.
- Tests on each Power Transformer include:
  - Turns ratio check
  - Polarity check
  - No load current and loss measurement
  - Percentage impedance and load loss measurement
  - Induced over voltage test, separate source voltage withstand test
  - Insulation resistance measurement
  - Winding resistance measurement
  - Pressure test for detection of oil leakage
- Impulse testing facilities from Haefely (Switzerland) (1600 KVp, 160 KJ & 99 KVp, 45 KJ) installed up-gradeable for testing of 400 KV transformers.
- SFRA test facility
- In-house Temperature rise test plant.
- PD measurement facility.
- DGA for Oil analysis.
- Short-circuit test at Independent accredited Laboratories as per customers' requirement.



Computerized Test Bench



Impulse Testing Lab



Impulse Testing Facility



Transformers under test

QUALITY



TAL Quality Policy

We, at Technical Associates Ltd., are committed to achieve total satisfaction of our customers by:

- Effectively implementing and continually improving the Quality System.
- Delivering on time, products conforming to agreed specifications at competitive prices.
- Collectively and individually striving to do things right - the first time and every time - both in personal life as well as at the workplace.
- Continuous upgradation of technology and active involvement of all employees and associates in productivity improvement.

SERVICES



- TAL also undertakes installation and commissioning of Power Transformers of its own make on customer request for the same.
- TAL service team consists of experienced Engineers having expertise of installation, commissioning and repairing. We also offer comprehensive maintenance of all TAL installations. Our service is backed by supply of spares and components in shortest time as per customer needs.
- TAL also undertakes specialized service activities which include: Repair of Power Transformers up to 400 KV and Turnkey Execution of Power Projects.

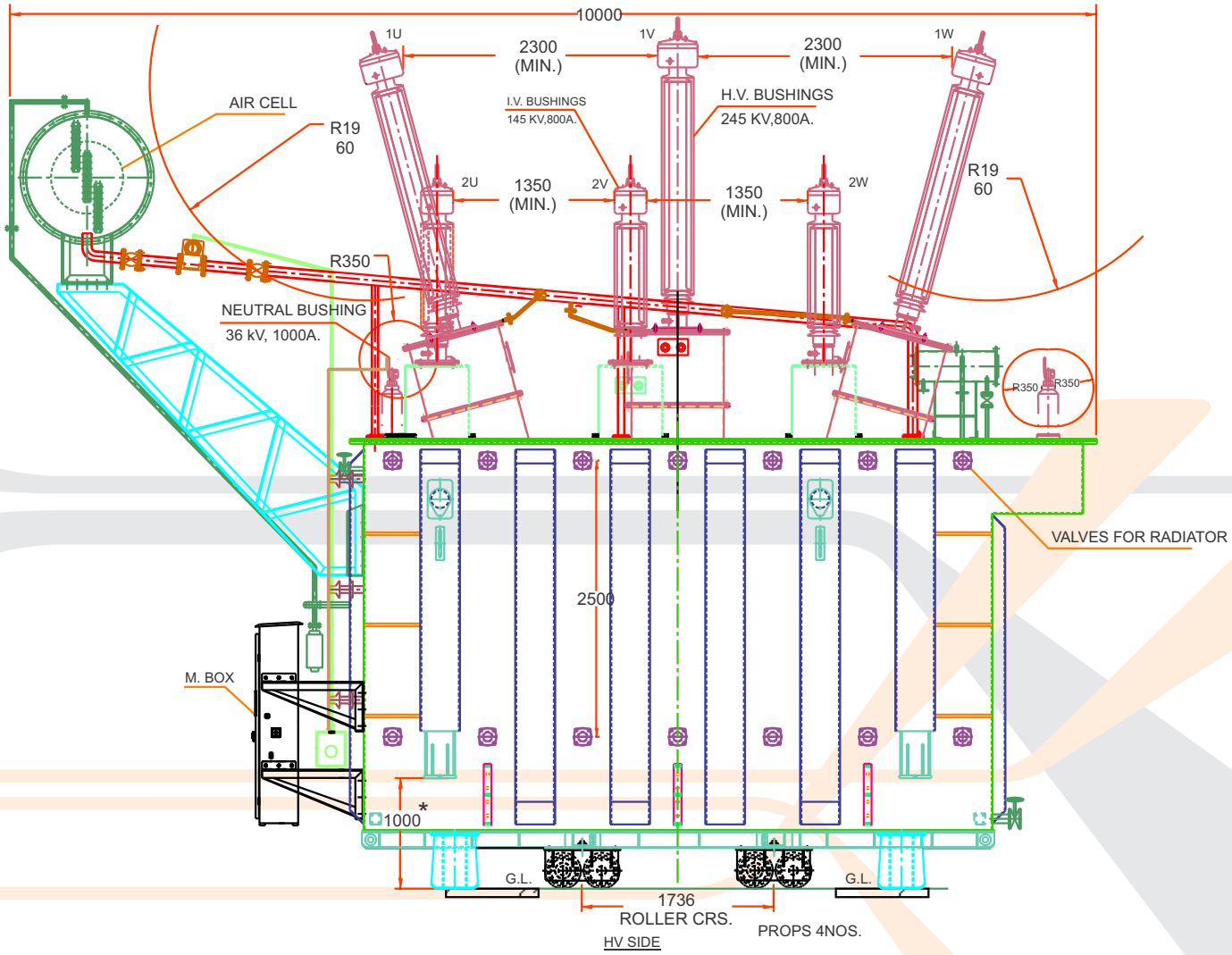
TYPICAL PARAMETERS OF POWER TRANSFORMERS

33 KV Power Transformers								
Sl. No.	Rating	Voltage Class	% Z	No Load Loss (KW)	Load Loss (KW)	Dimension (mm)		
						Length	Breadth	Height
1	8 MVA	33/11 KV	8.35%	7.00	48.00	3100	2200	2800
2	10 MVA	33/11 KV	8.35%	10.00	53.00	4800	3600	3500
66 KV Power Transformers								
Sl. No.	Rating	Voltage Class	% Z	No Load Loss (KW)	Load Loss (KW)	Dimension (mm)		
						Length	Breadth	Height
1	12.5 MVA	66/11 KV	10.00%	11.30	39.55	5460	4150	4200
2	12.5/16 MVA	66/11 KV	10.00%	11.00	55.00	5600	4200	4500
3	20 MVA	66/11 KV	10.00%	14.00	48.00	5600	3900	4800
4	25/31.5 MVA	66/11 KV	10.00%	15.00	76.50	5900	4200	4800
132 KV Power Transformers								
Sl. No.	Rating	Voltage Class	% Z	No Load Loss (KW)	Load Loss (KW)	Dimension (mm)		
						Length	Breadth	Height
1	10/16 MVA	132/11 KV	10.00%	10.00	62.59	5460	4150	4300
2	12.5 MVA	132/11 KV	12.50%	11.20	39.00	6300	3900	5200
3	20 MVA	132/11 KV	12.50%	14.50	48.00	5800	2500	3400
4	20/25 MVA	132/33 KV	10.00%	14.00	69.00	6300	5000	5000
5	40 MVA	132/33 KV	12.50%	17.00	185.00	6600	5620	5600
6	50 MVA	132-110/33 KV	10.00%	25.00	110.00	7500	5100	6000
220 KV Power Transformers								
Sl. No.	Rating	Voltage Class	% Z	No Load Loss (KW)	Load Loss (KW)	Dimension (mm)		
						Length	Breadth	Height
1	100/75 MVA	220/132/11 KV	12.00%	24.50	168.50	10000	4800	7840
2	160 MVA	220/132/11 KV	12.50%	31.00	172.50	12000	6000	8000

Note : The above figures are indicative only.
Customised transformers in Intermediate sizes can be built as per specification with ON LOAD / OFF LOAD tap changer.

OUTLINE GENERAL ARRANGEMENT OF

100/75 MVA, 220/132/11 KV, 3ϕ, 50 Hz. (AUTO TRANSFORMER)



FM 561794
An ISO 9001:2008 Company

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COMPANY PROFILE
CLASSIFICATION

Energising India since 1969...

TECHNICAL ASSOCIATES LIMITED

An ISO 9001 : 2008 Company

Distribution & Small Power Transformers



WE TRANSFORM THE NATION'S POWER

COMPANY PROFILE

CLASSIFICATION

INTRODUCTION



3 ϕ Distribution Transformers (100 KVA, 11 KV)



3 ϕ Distribution Transformers (11 KV)

- Technical Associates Ltd. (TAL) is one of oldest and preferred manufacturers of Distribution Transformers (DTs) in India: Manufacturing DTs for more than 42 years.
- One of the **Top Ten manufacturers** of DTs.
- Manufacturing Capacity: 4,000 MVA p.a., or almost 6000 DTs per month.
- Range:
  - Stacked Core & Wound Core 1 ϕ Oil Filled DTs in 11, 22 & 33 KV Class from 5 KVA upwards.
  - 3, 4 & 5 Star Rated DTs in conformance with BEE's Energy Labeling programme.
  - 3 ϕ Oil Filled DTs in 11, 22 & 33 KV Class up to 6.3 MVA.
  - Special purpose transformers for industries/commercial requirements.
- More than 5,00,000 DTs already delivered & successfully commissioned for various customers in India.
- All delivered transformers successfully type tested from accredited 3rd party test houses (as per IEC 60076 and IS 2026).
- In-house design team of highly experienced engineers uses CAD techniques for development and continuous improvement of reliable, cost-effective transformers in conformance with IS, IEC or ANSI standards.
- Sophisticated and calibrated testing equipments for in-house Routine and Type Tests.
- Strict Quality control for incoming stock, process monitoring and finished products using SQC techniques.
- Installation & commissioning of Power and Distribution Transformers by trained and experienced engineers backed by timely supply of spares.



Impulse Testing Facility



3 ϕ Distribution Transformer (33 KV)

PRODUCT RANGE



1ϕ Wound Core Distribution Transformer (11 KV)



1ϕ Stacked Core Distribution Transformer (11 KV)



5 MVA, 33/11 KV Small Power Transformer



Distribution Transformer Assembly Line

Single Phase Wound Core Transformer: Voltage class 6 KV, 11KV

- TAL manufactures single phase wound core transformers from 5 KVA to 100 KVA up to 11 KV voltage class.
- Circular cores are formed from prime grade CRGO steel for ensuring low loss. Annealing of the formed cores under inert atmosphere ensures stress relieving thereby retaining the original characteristic of electrical steel.
- Progressively wound LV and HV windings bring reliability in terms of short circuit withstand ability of the Transformer whereas proper drying and choice of right grade of insulation ensure the capacity to withstand the specified impulse level.

Three Phase stacked Core Distribution & Small Power Transformers: Voltage class – 6 KV, 11KV, 22 KV, 33 KV

- TAL manufactures three phase stacked core distribution transformers starting from 10 KVA up to 1000 KVA in 6 KV or 11 KV voltage class
- Small Power Transformers that are typically used in the distribution system are also manufactured up to 6.3 MVA in 11 or 33 KV voltage class
- Conventional stacked core Transformers are made from Prime grade CRGO steel and using electrolytic grade copper or Aluminium as per customers' requirement.
- TAL uses step-lap or mitered joint laminations with low burr, made from prime CRGO sheets, to reduce no-load loss and noise level. HV and LV coils are prepared in dust free environments and are subjected to regular in process check.
- Designing of HV coils is focused on ensuring effective uniform distribution of voltage to take care of impulse and transients while



Corrugated Transformers



3.15 MVA, 33/11 KV Transformer



10 MVA, 33/11 KV Transformer

compression of coils for proper geometrical shape to take care of axial forces during short circuit condition.

- The Core-Coil Assembly (also known as the active part) is processed under controlled conditions in air drying and vacuum ovens to ensure removal of moisture while preventing insulation damage on account of excessive heating. This increases the service live of these transformers to a great effect.
- Excellent infrastructure, including facilities available for backward integration like in-house Core slitting, conductor manufacturing, Tank fabrication ensure quality control at every step. Input stocks as well as finished Transformers are subjected to quality checks as per organization's quality policy.

Customisation Options:

Customers also have the option of being able to customize their Distribution Transformers with multiple options as given below:

1. Mounting arrangements: (a) Wheels, (b) Side/Bottom mounted.
2. Tank types: (a)Conventional (Bolted), (b)Sealed, (c) Corrugated.
3. Radiators: (a) Conventional, (b) Flange bolted/ Welded.
4. Surface Treatment options: (a) Painted with finishes for different atmospheric conditions, (b) Powder Coated, (c) Galvanized.
5. Connections: (a) Bushings, (b) Cable Boxes.
6. On Load/ Off Circuit Tap Changers.
7. Anti Theft features for preventing theft of Transformer Oil.

MANUFACTURING PROCESS AND INFRASTRUCTURE



Material handling capacity up to 300 MT

- In-house facilities for Core slitting, cutting & annealing, Conductor manufacturing & paper covering, Tank fabrication, Oil storage and filtration, Insulation processing using latest machineries for QC and JIT approach.
- Sophisticated manufacturing, process & handling equipments such as Vapour Phase Drying Plants, Winding Machines with Variable Frequency Drives, etc. ensure product reliability.
- Excellent material handling facilities such as EOT Cranes up to 300 MT, Air Castors and innovative plant layouts for easy and fast movement of components.



Core Building for Distribution Transformers



Paper Wrapping on Conductor



Finished Coils

TESTING



Computerized Test Bench

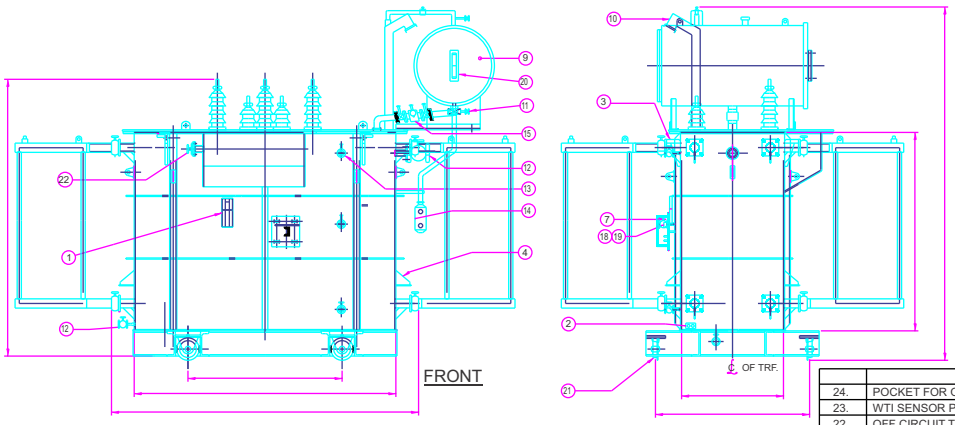
- Fully computerized automatic testing facilities for all routine tests as per IS, IEC, ANSI.
- Impulse testing facilities from Haefely (Switzerland) (1600 KVp, 160 KJ & 99 KVp, 45 KJ) installed upgradeable for testing of 400 KV transformers.
- In-house Temperature rise test facilities.
- PD measurement facility.
- DGA for Oil analysis.
- Short-circuit test at Independent accredited Laboratories as per customers' requirement.

TYPICAL PARAMETERS OF DISTRIBUTION TRANSFORMERS

Single Phase Distribution Transformers								
Sl. No.	Rating	Voltage Class	% Z	No Load Loss (Watt)	Load Loss (Watt)	Dimension (mm)		
						Length	Breadth	Height
1	5 KVA	11/0.250 KV	2.75%	22.5	120	515	350	880
2	10 KVA	11/0.250 KV	4.00%	50	210	785	665	655
3	16 KVA	11/0.250 KV	4.00%	75	250	850	770	695
Three Phase 11 KV Distribution Transformers								
Sl. No.	Rating	Voltage Class	% Z	No Load Loss (Watt)	Load Loss (Watt)	Dimension (mm)		
						Length	Breadth	Height
1	10 KVA	11/0.433 KV	4.00%	50	210	785	665	655
2	16 KVA	11/0.433 KV	4.50%	80	475	900	980	881
3	25 KVA	11/0.433 KV	4.50%	85	685	880	660	1310
4	40 KVA	11/0.433 KV	4.50%	140	950	950	900	1180
5	63 KVA	11/0.433 KV	4.50%	155	1235	1005	830	1485
6	100 KVA	11/0.433 KV	4.50%	260	1760	1050	1010	1425
7	200 KVA	11/0.433 KV	4.50%	400	3135	1350	1250	1700
8	315 KVA	11/0.433 KV	5.00%	800	4600	1260	1150	1700
9	500 KVA	11/0.433 KV	4.50%	850	6140	1800	1725	1780
10	630 KVA	11/0.433 KV	4.75%	1000	7000	1300	1850	2100
11	750 KVA	11/0.433 KV	5.00%	1500	9000	1875	1375	1950
12	1000 KVA	11/0.433 KV	5.00%	1200	8000	1700	1540	2257
Three Phase 33 KV Small Power Transformers								
Sl. No.	Rating	Voltage Class	% Z	No Load Loss (KW)	Load Loss (KW)	Dimension (mm)		
						Length	Breadth	Height
1	3.15 MVA	33/11 KV	6.25%	3.0	16	2450	5000	5000
2	5 MVA	33/11 KV	7.15%	5.0	31	3000	2300	3000
3	6.3 MVA	33/11 KV	7.15%	7.5	43	3000	3400	3250

Note : The above figures are indicative only.
Customised transformers in Intermediate sizes can be built as per specification with ON LOAD / OFF LOAD tap changers.

Typical OGA of 33/11 kV, 3 ϕ, 5 MVA, Small Power Transformer

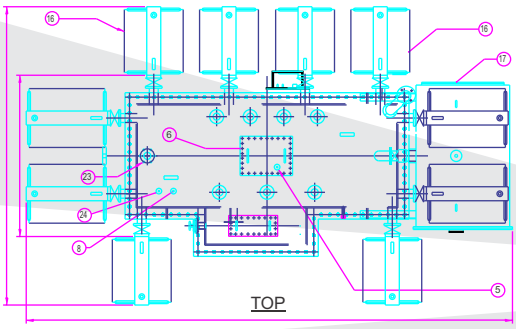


	WEIGHTS (APPROX.)		
1.	WT. OF CORE & WDG.	kg	6100
2.	TANK & FITTINGS	kg	3000
3.	WT. OF OIL	kg	2100
4.	VOLUME OF OIL	Ltr	2600
5.	WT. OF TRANSFORMER	kg	11200

DIMENSIONS			
	L	W	H
TANK	1920	755	1610
OVER ALL	2430 (L')	1265 (W')	2450 (H')

TANK SIDE THICKNESS= 6MM

TANK TOP & BOTTOM THICKNESS= 10MM

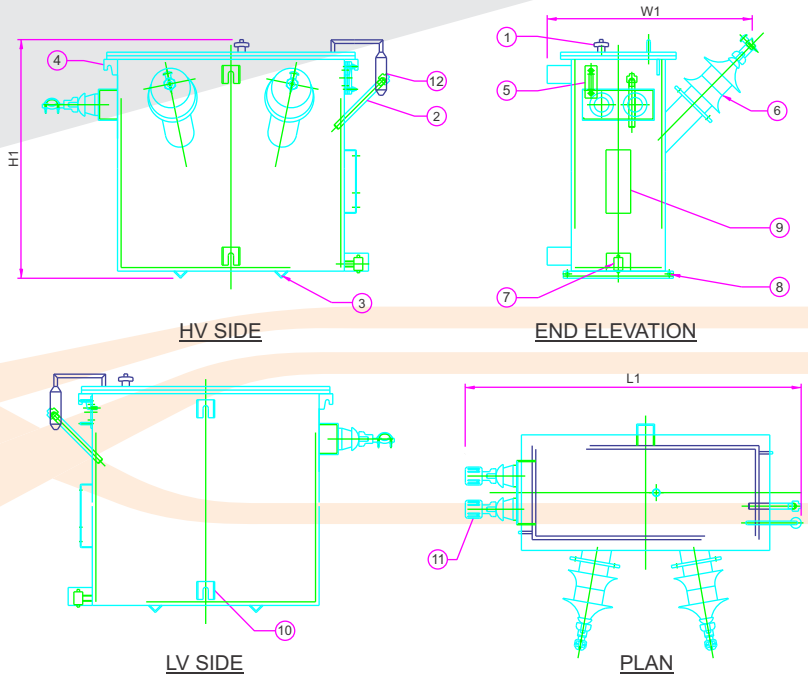


NOTES :-

1. OVERALL WEIGHT AND DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCE - ± 5
2. LOCATION OF FITTINGS CAN BE CHANGED AT THE TIME OF MANUFACTURE.
3. ALL DIMENSION ARE IN MM.
4. FINISH PAINT: AS PER ISS:5,SHADE NO. 631

S.NO.	DESCRIPTION	QTY.
24.	POCKET FOR OIL TEMPERATURE INDICATOR	1
23.	WTI SENSOR POCKET	1
22.	OFF CIRCUIT TAP SWITCH +3 TO -9 @3	1
21.	BIDIRECTIONAL ROLLERS	4
20.	OIL LEVEL GUAGE (-5, 30 & 100 °C)	1
19.	DIAL TYPE WINDING TEMPERATURE INDICATOR	1
18.	DIAL TYPE OIL TEMPERATURE INDICATOR	1
17.	MAGNETIC TYPE OIL GUAGE	1
16.	RADIATORS WITH VALVES (1500x300x20 FINS)	10
15.	BUCHHOLZ RELAY	1
14.	DEHYDRATING BREATHER	1
13.	OIL SAMPLING VALVES (15mm) TOP / MIDDLE / BOTTOM	3
12.	FILTER CUM DRAIN VALVE (TOP & BOTTOM)	2
11.	DRAIN VALVE WITH PLUG	1
10.	PRESSURE RELIEF DEVICE / EXPLOSION VENT.	1
9.	CONSERVATOR WITH FILLING HOLE	1
8.	THERMOMERTER POCKET	1
7.	MARSHALLING BOX	1
6.	INSPECTION COVER	1
5.	AIR RELEASE DEVICE	1
4.	JACKING LUGS	4
3.	LIFTING LUGS	4
2.	EARTHING TERMINALS	2
1.	RATING & TERMINAL MARKING PLATE	1

Typical OGA of 11 kV, 1 ϕ, 10 KVA, Distribution Transformer



DIMENSONS			
OVERALL	785(L1)	665 (W1)	655(H1)
TANK	454(L)	262 (W)	500 (H)

	APPROX. WEIGHTS		
1	WEIGHT OF CORE & WINDING	kg.	63
2	WEIGHT OF TANK & FITTINGS	kg.	45
3	WEIGHT OF OIL	kg.	29
4	TOTAL WEIGHT OF TRANSFORMER	kg.	137
5	VOLUME OF OIL LTR.	ltr.	36
12	SILICAGEL BREATHER 100 gm.		1
11	LV OUTDOOR BUSHING WITH TERMINALS		2
10	MOUNTING LUGS		2
9	NAME, RATING & DIAGRAM PLATE		1
8	EARTHING TERMINALS		2
7	DRAIN VALVE 20mm WITH GAURD		1
6	HV BUSHINGS WITH TERMINALS		2
5	PLAIN OIL LEVEL GAUGE		1
4	LIFTING LUGS		2
3	MS. ANGLE BASE 35x35x5		2
2	THERMOMETER POCKET		1
1	OIL FILLING HOLE WITH CAP		1
S. No.	DESCRIPTION		QTY.

COMPANY PROFILE

CLASSIFICATION

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An ISO 9001:2008 Company

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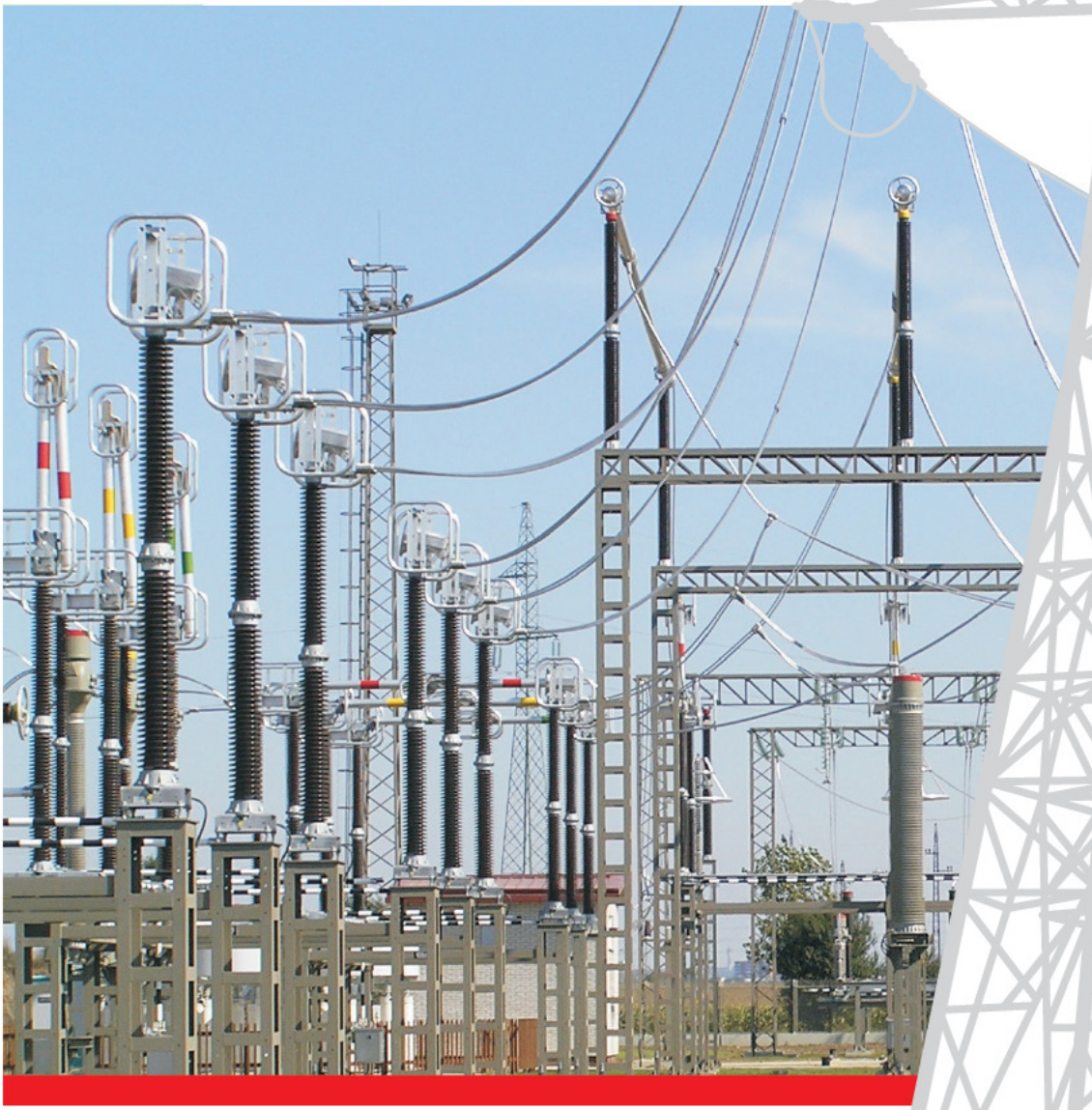
www.ieema.org

CLASSIFICATION

TOSHIBA

Leading Innovation

Toshiba Transmission & Distribution Systems (India) Pvt. Ltd.



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NABL

Certificate No.: T-3002

COMPANY PROFILE

CLASSIFICATION



Dr. Katsutoshi Toda
Chairman & Managing Director, TTDI

About Us

A GLOBAL SUPPLIER OF INTERGRATED SOLUTIONS

Toshiba Transmission & Distribution Systems group is a world leader in the supply of integrated solutions for energy Transmission & Distribution. Our systems effectively control Transmission & Distribution in order to deliver reliable electricity from Power Plants to Factories, Transportation Systems and even Our Homes.

Toshiba has developed its superior technology and has a history of high product quality in this market throughout the course of more than 100 years, manufacturing its first transformer in 1894 and its first switchgear in 1902. Our vast experience & continued expansion has allowed us to gain immense trust and appreciation from customers around the world. We strive to create products and services that enhance society and protect the environment. This is accomplished through a single component reducing environmental impact or a complete smart grid solution. Toshiba continues to serve the people and the planet that we call home.

Toshiba Corporation, Japan has acquired the businesses of Power Transformers, Distribution Transformers & Switchgear from Vijai Electricals Limited, Rudraram works, Hyderabad, Telangana State in December 2013 and thus formed, **Toshiba Transmission & Distribution Systems (India) Pvt. Ltd. (TTDI).**

TTDI will emerge as the global production hub of Toshiba Corporation to cater product & component requirements across the world.

Vision

To be the leading Global Transmission & Distribution Systems Company

Mission

To direct our efforts towards exceeding the expectations of our clients, partners and peers by striving:

- To continuously produce high quality products
- To provide reliable engineering solutions
- To meet customer satisfaction by understanding customer's requirements at all times
- To contribute to society

Committed to People, Committed to the Future

Commitment of the Toshiba Group

We, Toshiba Group of companies, based on our commitment to the society and the future, are determined to create a higher quality of life for the society, and to do our part to ensure that progress continues within the world community.

Commitment to People

We endeavour to serve the needs of the society, especially our customers, share holders and employees, by implementing forward-looking corporate strategies while carrying our responsible and responsive business activities. As a good corporate citizen, we actively contribute to further the goals of society.

Commitment to the Future

By continuously developing innovative technologies centering on the fields of Electronics and Energy, we strive to create products and services that enhance human life, which lead to a thriving healthy society. We constantly seek new approaches that helps realize the goals of the world community, including ways to improve the global environment.

1650 MVA, 765 kV Class Power Transformers



EHV & UHV Power Transformers



333 MVA,1200 kV Single Phase Auto Transformer

Power Transformers (Oil Filled) have a robust design and sturdy construction to competently handle short circuits.

Infrastructure

- Installed Capacity of 24 GVA per annum
- GEORG CNC Cut-to-Length Line for step lap cores
- Winding, Core Coil Assembly are carried out in dust proof clean room with temperature control
- CTC Conductor, Insulation, Tank & Radiators are manufactured In - House

Key Milestones

- Successfully supplied & commissioned 1 No. of 333 MVA, 1200 kV, 1 Ph, Auto Transformer with In-House development for 1200 kV Test Station at BINA, M/s. PGCIL during 2012-13
- Full scale dynamic Short Circuit Test carried out in 20 No's of Power Transformer, including 315 MVA, 400 kV Auto Transformer
- Supplied more than 60 No's of 400 kV class and above Transformers

Product Range

S.NO	DESCRIPTION	RATING	VOLTAGE CLASS	STANDARDS
1	Generator Transformer	Up to 1000 MVA	Up to 800 kV	ANSI, IS, BS, NEMA, IEC
2	Auto Transformer	Up to 1500 MVA	Up to 1200 kV	ANSI, IS, BS, NEMA, IEC
3	Two Winding Transformer	Up to 1000 MVA	Up to 800 kV	ANSI, IS, BS, NEMA, IEC
4	Medium Power Transformer	25 MVA to 60 MVA	60 kV to 245 kV	ANSI, IS, BS, NEMA, IEC
5	Traction Transformer	Up to 200 MVA	Up to 245 kV	ANSI, IS, BS, NEMA, IEC
6	Shunt Reactor	Up to 125 MVAR	Up to 800 kV	ANSI, IS, BS, NEMA, IEC

Applications

Industries, Power Generating Stations, Receiving Stations, Substations & Railways.

Small Power Transformers

(CRGO Silicon Steel)



Small Power Transformers (Oil Filled) have a robust design and sturdy construction to competently handle short circuits.

Technical Specification

Ratings	:	Single Phase Upto 3333 kVA Three Phase Upto 16000 kVA
Applicable Standards	:	IS,IEC,ANSI,JIS,DIN,BS,EN, etc.
Cooling	:	ONAN, ONAF
Insulating Fluid	:	Mineral Oil as per specification
Frequency	:	50 Hz, 60 Hz
Vector Group	:	As specified
Primary Voltage	:	Upto 66000 V
Secondary Voltage	:	33000 V, 11000 V, 6600 V, 3300 V (Other Voltages as required)
Winding Material	:	Copper
Tapping Range	:	Off circuit and On load tap changers as per customer specifications
Impedance	:	In line with applicable standards

Optional Fittings

- On load Tap Changer
- Condenser Type Bushings for Voltage Class of 33kV & 66kV
- RTCC Panel
- Winding Temperature Indicator
- Oil Temperature Indicator
- Terminal Connectors
- Magnetic Level Guage

Standard Fittings

- Primary Bushings
- Secondary Bushings
- Buchholz Relay
- Off circuit Tap Changer
- Pressure Relief Device/ Explosion vent
- Thermometer
- Silica Gel Breather
- Drain / Filter Values
- Oil Level Guage
- Rating and Diagram Plate
- Lifting Lugs
- Skid Base / Roller Arrangement

Applications

Industries, Power Stations, Receiving Stations & Substations, Railways and Ports.

Three Phase Distribution Transformers

(Amorphous Metal/CRGO Silicon Steel)



Corrugated Tank Distribution Transformers are compact in size and elegant in appearance. These Transformers are manufactured by using the highest quality materials, employing the most modern and reliable manufacturing practices.

These Transformers require little maintenance.

Advantages

- Compact in size: Transformers with Corrugated walls are smaller than transformers with radiators
- Improved Heat Dissipation
- Elegant appearance
- The fins have sufficient degree of elasticity to absorb the expansion in volume of the liquid, due to the heating of cooling medium, at the same time providing a large dissipating surface to cool the same cooling medium

Technical Specification

Ratings	:	CRGO : Upto 4000 kVA AMT : Upto 2500 kVA
Number of Phase	:	Three Phase
Applicable Standards	:	IS, CEA, IEC, ANSI, JIS, DIN, BS, EN, etc.
Cooling	:	ONAN
Insulating Fluid	:	Mineral Oil as per specification
Frequency	:	50 Hz, 60 Hz
Vector Group	:	As specified
Primary Voltage	:	Upto 33 kV
Secondary Voltage	:	415, 433 V (Other Voltages as required)
Winding Material	:	Copper / Aluminium
Tapping Range	:	+ 5% in steps of 2.5% (Other tappings as required)
Impedance	:	In line with applicable standards (or) As per customer requirement

Standard Fittings

- Prime Bushings
- Secondary Bushings
- Cable Terminations
- Oil Level Indicator
- Filling Device
- Earthing Terminal
- Rating and Diagram Plate
- Lifting Lugs
- Drain Plug

Optional Fittings

- HV / LV Cable Box
- Rollers (Uni-Directional / Bi-Directional)
- Drain valve
- Conservator and Silica gel Breather
- Pressure Relief Device
- Off Circuit Tap changer / OLTC

Completely Self-Protected Transformers

(Amorphous Metal/CRGO Silicon Steel)



Completely Self-Protected Transformers (CSP) offer a complete and safe solution against lightning, switch surges and severe overloads.

Technical Specification

Ratings	:	1 Phase :	CRGO : Upto 167 kVA
			AMT : Upto 167 kVA
		3 Phase :	CRGO : Upto 315 kVA
			AMT : Upto 315 kVA
Number of Phase	:	Single Phase and Three Phase	
Applicable Standards	:	IS, CEA, IEC, ANSI, JIS, BS, EN, etc.	
Cooling	:	ONAN	
Insulating Fluid	:	Mineral Oil as per specification	
Frequency	:	50 Hz, 60 Hz	
Vector Group	:	As specified	
Primary Voltage	:	Upto 11 kV	
Secondary Voltage	:	415, 433 V	
		(Other Voltages as required)	
Winding Material	:	Copper \ Aluminium	
Tapping Range :	:	+ 5% in steps of 2.5%	
		(Other tappings as required)	
Impedance	:	In line with applicable standards (or) As per customer requirement	

Features and Benefits

- Higher Transformers Availability : Available for a longer duration than conventional transformers. Internal breaker (Type CLR) is tripped by a standard Bi-Metallic thermal trip element, which integrates oil transformers and secondary current flow, allowing the transformers to continue to operate even under overload conditions, until the oil temperature makes coil damage imminent. Improvised CQR type breakers can also be provided which are furnished with instantaneous magnetic trip element in addition to the Bi-Metallic thermal trip element.
- More Reliable Service : CSP Transformers efficiently and effectively disconnect the load from the transformer under overload conditions. Moreover CSP components help in identifying locations where improvements in load management may be necessary.
- Lower System Cost : Considering the operating costs of energy supply and replacement cost of the transformers that have failed prematurely due to overload, CSP transformers would no doubt fair better than conventional ones.
- Easier and Simpler Installation: Involves only one piece of electrical equipment, The transformers and only one high voltage electrical connection to the distribution line.
- Safer operation

Standard Fittings

- Internal Low Voltage Circuit Breaker
- Internal High Voltage Protective Link
- Signal Light
- Operating Handle
- Lightning Arrester
- Rating and Diagram Plate
- Primary Bushings
- Secondary Bushings
- Oil Level Guage

Optional Fittings

- Terminal Connectors
- Pressure Relief Device / Explosion Vent
- Cable Box
- Rollers (Uni-Directional / Bi-Directional)
- Arcing Horns
- Free Breathing / Hermetically Sealed
- Cable Terminations

Elliptical Tank Three Phase Distribution Transformers

(Amorphous Metal/CRGO Silicon Steel)



Technical Specification

Ratings	:	CRGO: Upto 25 kVA AMT : Upto 25 kVA
Applicable Standards	:	IS, IEC, ANSI, JIS, BS, EN etc
Cooling	:	ONAN
Insulating Fluid	:	Mineral Oil as per Specification
Frequency	:	50 Hz, 60 Hz
Vector Group	:	As specified
Primary Voltage	:	Upto 11kV
Secondary Voltage	:	415 V, 433 V (Other Voltages as required)
Winding Material	:	Copper / Aluminium
Tapping Range	:	±5% in steps of 2.5% (Other tappings as required)
Impedance standards	:	In line with applicable standards

Features and Benefits

- Oil leakages will be reduced, due to less no. of welding joints
- Sealed type construction totally eliminates the contact of oil with outside atmosphere
- Stiffeners are not required due to its capability of withstanding the pressure
- Oil and MS required is less, hence the end cost will be reduced
- Easy to transport and handling during commissioning
- Compact size with Aesthetic look
- Self venting type top cover arrangement
- Good mechanical strength
- Top cover is fixed with welded clamping lugs to avoid theft

Standard Fittings

- Primary bushings
- Secondary bushings
- Completely Self Protection (CSP)
- Tank grounding provision
- Pole mounting bracket / Tank base channel
- Rating and diagram plate
- Lifting cum clamping lug

Optional Fittings

- Lightning Arrester
- LV cable Box
- Oil temperature indicator
- Pressure relief device
- Terminal connectors
- Tap changer
- Arcing horns

Single Phase Distribution Transformers

(Amorphous Metal/CRGO Silicon Steel)



Single Phase Oil Filled Distribution Transformers are designed to effectively improve the quality and reliability of the electrical distribution systems.

Features and Benefits

- Robust construction having excellent short circuit and thermal withstand capabilities.
- Proven technology, effectively improving the quality and reliability of the electrical distribution system.
- Ability to meet customized design and specification demands.
- Round Tank for aesthetic appearance.
- Powder Coated Tank Body - Excellent finish

Standard Fittings

- Pole Mounting Brackets
- Lifting Lugs
- Pressure Relief Device / Self Venting Top Cover
- Tank Grounding Provision
- Rating and Diagram Plate
- Primary Bushings
- Secondary Bushings
- Oil Level Guage

Technical Specification

Ratings	:	Upto 167 kVA
Applicable Standards	:	IS, IEC, ANSI, JIS etc
Cooling	:	ONAN
Insulating Fluid	:	Mineral Oil as per specification
Frequency	:	50 Hz, 60 Hz
Vector Group	:	As specified
Primary Voltage	:	Upto 33 kV Class
Secondary Voltage	:	120, 120/240, 210-105, 250, 240/480 V (Other Voltages as required)
Winding Material	:	Copper / Aluminium
Tapping Range	:	+ 5% in steps of 2.5% (Other tappings as required)
Impedance	:	In line with applicable standards (or) As per customer requirement

Optional Fittings

- Lightning Arrester / Arcing Horns
- High Voltage Neutral Bushing
- Terminal Connectors
- Tap Changer for External Operation
- Cable Terminations
- Complete Self Protection Feature

Dry Type Cast Resin Transformers



TTDI has been producing Dry Type Cast Resin Transformers for more than 15years.

Main Features & Benefits

- Resistant to short circuits (High Mechanical Strengths)
- Non-Flammable
- Resistant to Temperature Fluctuations
- Moisture Resistant since non Hygroscopic
- Space saving, permitting compact installation
- Practically to maintenance; Long and Trouble-Free Service
- Suitable for Hot and Humid environments
- Automatic temperature control and protection

Standard Fittings

- Lifting Eyes
- Tap Changer Links
- Rating and Diagram Plate
- High Voltage Bushings
- Low Voltage Bushings
- Thermal sensor like PT-100 for Indicator

Technical Specification

Ratings	:	Single Phase 25 kVA to 2667 kVA Three Phase 25 kVA to 8000 kVA
Applicable Standards	:	IS 11171, IEC 726, ANSI.C.12.01
Cooling	:	AN, ANAF
Frequency	:	50 Hz, 60 Hz
Vector Group	:	As specified
Primary Voltage	:	Upto 33 KV
Secondary Voltage	:	220/127, 480/277 V
		(Other Voltages as required)
Winding Material	:	Copper/ Aluminum
Tapping Range :	:	+ 5% in steps of 2.5% (Other tappings as required)
Impedance	:	In line with applicable standards

Applications

In service in diverse Industries, Electricity Boards, Nuclear / Thermal / Hydel Power Plants, Railway Traction, High-Rise Buildings, Hospitals, Subways, Underground Vaults, Tunnels, Schools, Steel Factories, Chemical Plants, etc. Where safety is of prime concern.

- Coils have smooth finish and are Robust in Construction.
- Toshiba successfully conducted Seismic Qualification test on Cast Resin Transformers supplied to Nuclear Power Installations in India, way back in 1994.

Optional Fittings

- Terminal Connectors
- Special Termination Arrangement
- Cable Box / Bus Duct
- Cooling Fan
- Rollers (Uni-Directional / Bi-Directional)
- Protection with Temperature Scanner
- Off Circuit Tap Changer

Pad Mounted Transformers

(Amorphous Metal/CRGO Silicon Steel)



Three Phase Pad Mounted Transformers are compact power centres for commercial or Industrial applications where safety, reliability and aesthetics are especially important. With proper design selection, they can be located near or inside the buildings for greater flexibility and savings.

Technical Specification

Ratings	:	Single Phase CRGO: Upto 1000 kVA AMT: Upto 167 kVA Three Phase CRGO: Upto 1000 kVA AMT: Upto 1000 kVA
Applicable Standards	:	ANSI
Insulating Fluid	:	Mineral Oil as per specification / FR3
Frequency	:	50 Hz, 60 Hz
Vector Group	:	As specified
Primary Voltage	:	Upto 25 kV
Secondary Voltage	:	415, 433 V (Other Voltages as required)
Winding Material	:	Copper / Aluminium
Tapping Range	:	+ 5% in steps of 2.5% (Other tappings as required)
Impedance	:	In line with applicable standards (or) As per customer requirement

Benefits

- Robust quality systems ensure implementation of the best design and manufacturing practices
- Flexibility in designing transformers to customer requirements (Optimum cost)
- Compliance to international standards like ANSI, IEEE, etc.

Standard Fittings

- Primary Bushings
- Secondary Bushings with terminal connectors
- Pressure Relief Device
- Oil Filling Plug
- Liquid Level Guage
- Drain Valve with sampler
- Hinged Cabinet Doors
- Sealed Tank Oil Preservation System
- Rating & Diagram Plate

Optional Fittings

- Current Limiting Fuses with Breaker for LV
- Bay-O- Net Fuses / Canister-HV
- Elbow Connectors - Load Break / Non Load Break Switch
- Dial Type Thermometer
- Tap Changer
- LV Distribution Panel

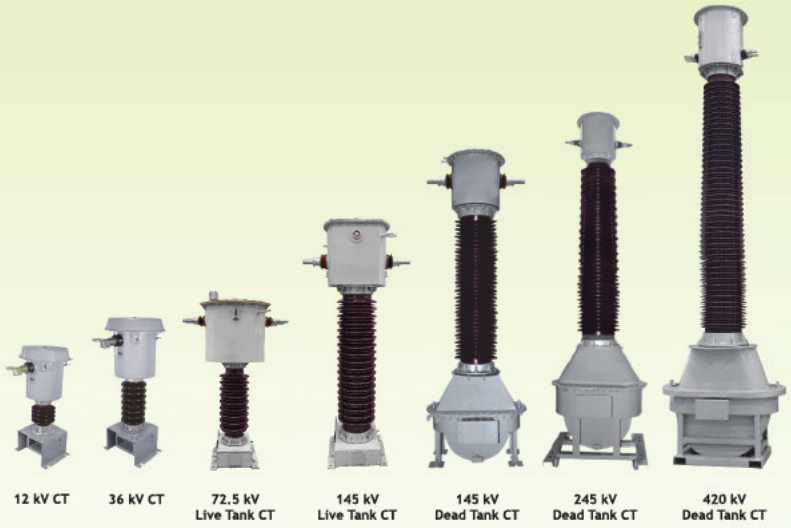
Applications

Industrial, Commercial, Institutional and Residential areas.

Indoor installations like Cellars, Malls, Complexes where safety is prime concern

Current Transformers (Oil Filled)

(12 kV to 420 kV)



Hermetically Sealed Current Transformers (Oil Filled) have a robust design with feasibility to achieve desired Accuracy Class & Output . Both live & dead tank designs available for Current Transformers. We can also supply Current Transformers with polymer insulators upon request

These products are being manufactured at TTDI Switchgear plant (Rudraram, Hyderabad), where TTDI is known for the quality & consistency.

Current Transformers

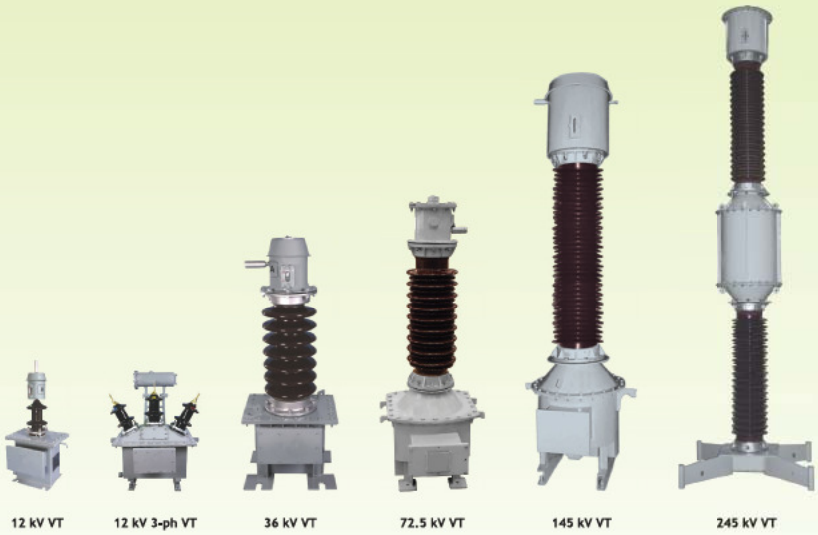
Types	DT/LT 12	DT/LT 36	LT 72.5	LT 145
Rated Voltage	11kV	33kV	66kV	132kV
Highest System Voltage	12kV	36kV	72.5kV	145kV
One minute power frequency voltage	28kV rms	70kV rms	140kV rms	275kV rms
Lightning impulse voltage	75kV Peak	170kV Peak	325kV Peak	650kV Peak
Rated frequency	50Hz	50Hz	50Hz	50Hz
Short time thermal current	25kA rms/3 Sec	25kA rms/3Sec	31.5kA rms/3Sec	40kA rms/3Sec
Dynamic withstand current	32.5kA Peak	62.5kA Peak	78.75kA Peak	100kA Peak
Total Creepage distance	*300	*900	*1813mm	*3625mm
Primary Current	Upto 2400A & higher currents can also be supplied on request	Upto 2400A & higher currents can also be supplied on request	Upto 2400A & higher currents can also be supplied on request	Upto 2400A & higher currents can also be supplied on request

Type	DT 145	DT 245	DT 420
Rated Voltage	132 kV	220 kV	400 kV
High System Voltage	145 kV	245 kV	420 kV
One minute power frequency voltage	275 kV rms	460 kV rms	630 kV rms
Lightning impulse voltage	650 kV peak	1050 kV peak	1425 kV peak
Rated frequency	50 Hz	50 Hz	50 Hz
Short time thermal current	31.5 kA rms / 3sec & 40 kA /1sec	40 kA rms / 1 sec	50 kA rms / 3 sec
Dynamic withstand current	78.75 kA peak /100 kA peak	100 kA peak	125 kA peak
Total creepage distance	*3625 mm	*6125 mm	*10500 mm
Primary current	Up to 2400 A & higher currents can also be supplied on request	Up to 2400 A & higher currents can also be supplied on request	Up to 2400 A & higher currents can also be supplied on request

* Other creepage can also be offered on specific request

Voltage Transformers (Oil Filled)

(12 kV to 245 kV)



Hermetically Sealed Electromagnetic Voltage Transformers (Oil Filled) have a robust design with feasibility to achieve desired Accuracy Class & Output. Our entire range of Voltage Transformers are designed and type tested as per relevant IS & IEC standards. We can also supply the Voltage Transformers with polymer insulators upon request.

These products are being manufactured at TTDI Switchgear plant (Rudraram, Hyderabad), where TTDI is known for the quality & consistency.

Voltage Transformers

Type	3 M 12/M 12	M 36	M 72.5	M 145	M 245
Rated Voltage	11kV	33kV	66 kV	132 kV	220 kV
Highest System Voltage	12kV	36kV	72.5 kV	145 kV	245 kV
One minute power frequency voltage	28 kV rms	70 kV rms	140 kV rms	275 kV rms	460 kV rms
Lightning impulse voltage	75 kV Peak	170 kV Peak	325 kV peak	650 kV peak	1050 kV peak
Rated frequency	50 Hz	50 Hz	50 Hz	50 Hz	50 Hz
Rated voltage factor	*1.2 Continuous &1.5 fo 30 sec	*1.2 Continuous &1.5 for 30 sec.	* 1.2 Continuous & 1.5 for 30 sec	* 1.2 Continuous & 1.5 for 30 sec	* 1.2 Continuous & 1.5 for 30 sec
Total Creepage distance	**300 mm	*900 mm	**1813 mm	** 3625 mm	** 6125 mm
Total simultaneous burden	As desired	As desired	As desired	As desired	As desired
No. of secondary windings & burden	As desired	As desired	As desired	As desired	As desired

* Voltage factor with 1.9 for 30 sec & 1.9 for 8 hrs can also be offered on request.

** Other Creepage distances can also be offered on specific request.

Indoor Vacuum Circuit Breaker (Type VVMS)

(12 kV)



12 kV Indoor VCB

Indoor Switchgear of (Type VVMS) employs proven vacuum interrupter technology with motor operated spring mechanism matching M2 class(10,000 operations), meeting the requirements of national and international specifications. Available with optional features like Bus connected VT, Feeder connected VT, Bus coupler arrangement, Busbar cable box, Rear extension chamber, Series Trip Coil, Two Trip Coils etc. as per customer requirement. Our Indoor Vacuum Circuit Breakers are designed and type tested conforming to relevant IS / IEC Standards.

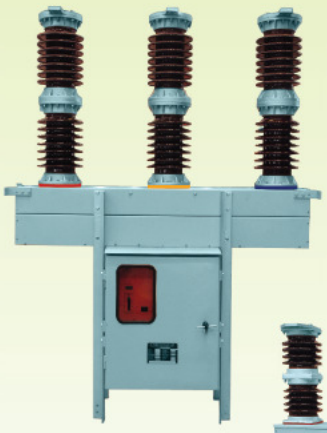
These products are being manufactured at TTDI Switchgear plant (Rudraram, Hyderabad), where TTDI is known for the quality & consistency.

Indoor Vacuum Circuit Breaker

Type	VVMS 12 / 1250
Rated Voltage	12 kV
Rated Current	Up to 1250 A
1 min. power frequency voltage	28 kV / 35 kV rms
Lightning impulse voltage	75 kV peak
Rated Short time withstand currnet	25 kA rms / 3 sec
Rated Short circuit making current	62.5 kA peak
Rated operating duty cycle	O-0.3 sec-CO-3 min-CO
Contact life	
• Mechanical	30,000 operations
• At normal rated current	20,000 operations
• At full short circuit current	100 operations

Outdoor Vacuum Circuit Breakers (Type VVPS & VVKS)

(12 kV & 36 kV)



36kV Outdoor
Vacuum Circuit Breaker



12kV Outdoor
Vacuum Circuit Breaker



12kV Outdoor
Vacuum Circuit Breaker Kiosk

Outdoor Switchgear of (Type VVPS & VVKS) employs proven vacuum interrupter technology with motor operated spring mechanism matching M2 class (10,000 operations), meeting the requirements of national and international specifications. Available with optional features like series Trip Coil, Two Trip Coils etc., as per customer requirement. Our Outdoor Vacuum Circuit Breakers are designed and type tested conforming to relevant IS / IEC Standards.

These products are being manufactured at TTDI Switchgear plant (Rudraram, Hyderabad), where TTDI is known for the quality & consistency.

Outdoor Vacuum Circuit Breakers

Type	VVPS 12 /1250	VVPS 36 /1600
Rated Voltage	12 kV	36 kV
Rated Current	Up to 1250 A	Up to 1600 A
1 min. power frequency voltage	28 / 35 kV rms	70 kV rms
Lightning impulse voltage	75 / 90 kV peak	170 kV peak
Rated Short time withstand current	20 / 25 kA rms / 3 sec	25 kA rms / 3 sec
Rated Short circuit making current	62.5 kA peak	62.5 kA peak
Rated operating duty cycle	O-0.3 sec-CO-3 min-CO	O-0.3 sec-CO-3 min-CO
Contact life		
• Mechanical	30,000 operations	30,000 operations
• At normal rated current	20,000 operations	20,000 operations
• At full short circuit current	100 operations	100 operations

Outdoor Vacuum Circuit Breaker Kiosk

Type	VVKS12 / 800
Rated Voltage	12 kV
1 min. power frequency voltage	28 / 35 kV rms
Lightning impulse voltage	75 kV peak
Rated Short time withstand current	25 kA rms / 3 sec
Rated Short circuit making current	62.5 kA peak
Rated operating duty cycle	O-0.3 sec-CO-3 min-CO
Contact life	
• Mechanical	30,000 operations
• At normal rated current	20,000 operations
• At full short circuit current	100 operations

Prefabricated Substation



Our Prefabricated Substations are factory assembled, fully tested and delivered as a complete solution to the customer, ready for service

The Compact Substation comprises of the following components:

- MV Switchgear (SF_6 Ring Main Unit)
- Hermetically sealed distribution Transformer
- LV Switchgear
- Enclosure
- Interconnections

Key Features

- Compact & robust construction
- Safe and reliable operation
- Weather and vermin proof
- Customized solution
- Tested for internal arc

Standards

The distribution transformer conforms to IEC 60076-1 or 600726-11

The MV switchgear and control gear conforms to IEC 62271-200 and IEC 60694

The LV switchgear and control gear conforms to IEC 60439-1

Ratings

MV Switchgear : 12/24/36 kV Ring Main Unit , Extensible or Non Extensible

Transformer : HV - 12/24/36kV, LV - 0.44kV , 1250kVA

LV Switchgear : As per the requirement

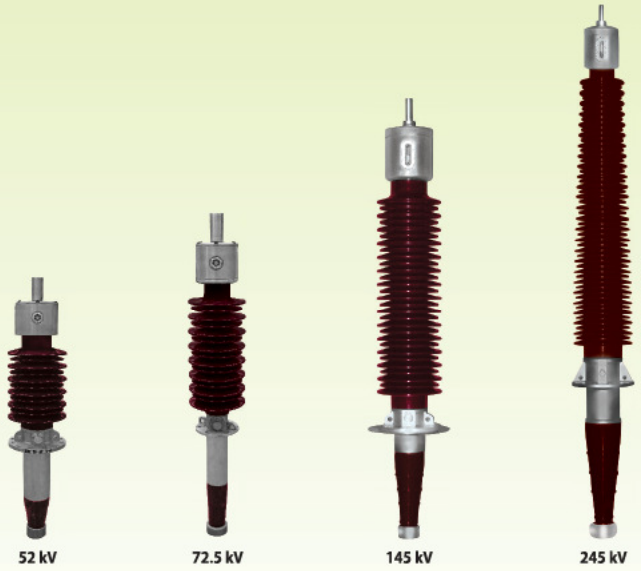
Applications

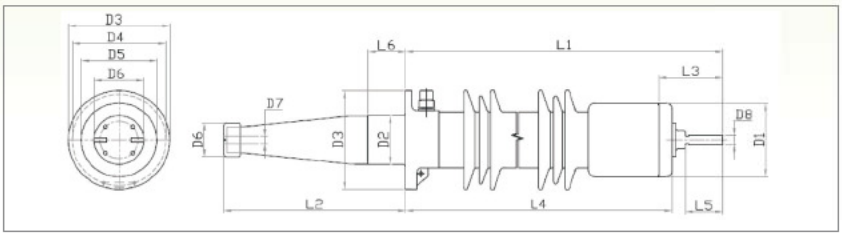
Prefabricated Substation Units, in Metallic Enclosure, are used in Electricity Cable Distribution Networks, in Urban or Rural Areas, Public or Industrial Areas, Building Sites, Mining, Irrigation in Agriculture etc.

In the recent years, Prefabricated Substation Units are being increasingly used in alternative energy production installations, such as those based on Solar Energy, Wind Power, Bio-Fuels, Biomass, Geothermal, Tidal Power and Wave Power.

Condenser Bushings (Oil Filled)

(52 kV to 245 kV)





Oil Impregnated Paper (OIP) Condenser Bushings are manufactured in the State of the Art Manufacturing facility equipped with facilities for insulation, winding,processing plants and electrostatically shielded test laboratory.

- Type tested fully conforming to IEC 60137-2008/IS:2099-1986/ IEC: 60507-1991
- Excellent partial discharge behavior up to highest system voltage
- Equipment with a test tap for connection of measuring bridge
- Superior performance under polluted conditions
- Anodized Al parts for corrosion resistance.

DIFFERENT TYPES OF OIP, OIL-AIR CONDENSER BUSHINGS

VOLTAGE RATING (kV)	52			72.5			145				245	
BIL (kvp)	250			325			650				1050	
CREEPAGE	1300			1810			3625				6125	
CURRENT RATING (A)	800	1250	3150	400	800	1250	800	1250	1600	2000	800	1250
TYPE OF LEAD	SS	SS	SS	SS	SS	SS	DL	DR	SS	SS	DL	DR
L1	875		950	1805			1805				2815	
L2±5 (FOR DIFFERENT VALUES OF L6 MIN)	450/650		475/675	495/695			600/800/1100				1130/1430	
L3 (MAX)	325			325			445				475	
L4 (MIN)	460			660			1250				2150	
L5 (MIN)	125			125			125				125	
L6 (MIN)	100/300			100/300			100/300/600				300/600	
D1 (MAX)	200		240	200			290				350	
D2 (MAX)	115		165	115			165				270	
D3 ± 2	225		335	225			335				450	
D4 ± 1	185		290	185			290				400	
D5 X N	15X6		15X12	15X6			15X12				20X12	
D6 (MAX)	115		115	115			165				270	
D7 (MIN)	-		-	-			38				48	
D8 + 0.2	30/60		30/60	30/60			30/60				30/60	

Note: 1) All Dimensions are in mm

2) Type of Lead : DL – DRAW LEAD, DR-DRAW ROD, SS-SOLID STEM

Vacuum Interrupter (Type GV)

(12kV to 36kV)



12 kV, 1250A VI | 12 kV, 2000A VI | 36 kV, 2000A VI

The "GV Series" Vacuum Interrupters (VIs) are designed to suit the requirements of the users for various applications. These VI designs are being manufactured in the state of art processing facility.

The manufacturing & testing facility at TTDI is comprising of world class brands of Vacuum Furnaces, Clean Room of 1000 / 100 class and other processing, testing equipments.

The VI specifications varies from rated voltage 690 V to 52 kV, rated normal current 400 A to 3150 A, Short Circuit breaking 4 kA to 44 kA. The application of VIs encompasses Conventional Circuit breakers, Vacuum Contactors, Auto Reclosers, RMUs etc.

USPs

- Mechanically Strong Construction
- Best performance & Higher reliability due to special design features
- Rated line to line voltage can be extended if required to the next standard rating
- Rated short circuit current can be extended if required to the next standard rating

Technical data for Vacuum Interrupter

Electrical Ratings (3 Phase Symmetrical Basis)	Unit	GV-001	GV-008	GV-009
Rated Maximum Line to Line Voltage	kV, r.m.s.	36	12	12
Rated Normal Current	A, r.m.s.	2000	2000	1250
Rated Frequency	Hz	50 / 60	50 / 60	50 / 60
Rated Power Frequency withstand Voltage : Air	kV, r.m.s.	70	36	36
Rated Impulse withstand Voltage : Air	kV, Peak	170	95	95
Rated short circuit current (3 Phase Symmetrical Basis)	kA, r.m.s.	26.3	26.3	20 / 26.3
Rated duration of Short time Current	Sec	3	3	3
Percentage D.C. component of Rated S.C. Breaking current	%	50	50	50
Rated short circuit making current	kA peak	67	67	67
Rated short time withstand current	kA, r.m.s.	26.3	26.3	20 / 26.3
Maximum contact Resistance at minimum closing force	micro ohms	50	30	30
Capacitor Switching capacity (Single Bank)	A, r.m.s.	400	400	400
Interrupter weight (Approx)	Kg	8	2.9	2.5
Moving Part Weight (Approx)	Kg	2.3	0.9	0.9
Contact force from atmospheric pressure	Kg	16.8	16.8	16.8
Requirements for usage				
Contact Stroke	mm	20 - 22	6 - 8	6 - 8
Opening Speed (average of 75 5 contact gap)	m / sec	1.4 - 1.6	1.0 - 1.3	1.0 - 1.3
Maximum over travel during opening	mm	3	2	2
Maximum rebound during opening	mm	2	1	1
Closing speed (average of last 30% contact gap)	m / sec	0.9 - 1.2	0.7 - 1.0	0.7 - 1.0
Maximum contact bounce duration (with max 2 bounces)	Sec	0.002	0.002	0.002
Added contact force for rated S.C making Current				
(Excl.contact force from atmp. pressure), at contact touch point	Kgf	227 - 249	227 - 249	227 - 249
Final Force	Kgf	230 - 280	230 - 280	230 - 280
Life expectancy				
Electrical life at rated normal current	Operations	20,000	30,000	30,000
Electrical life at rated short circuit current	Operations	100	100	100 / 35
Mechanical life	Operations	30,000	50,000	50,000
Contact Erosion limit	mm	3	3	3
Shelf Life	Years	20	20	20
Dimensions (D x H x h)	mm	142.5 x 300 x 240	114 x 221 x 159	91 x 221 x 159



420 kV, 63 kA Gas Insulated Switchgear



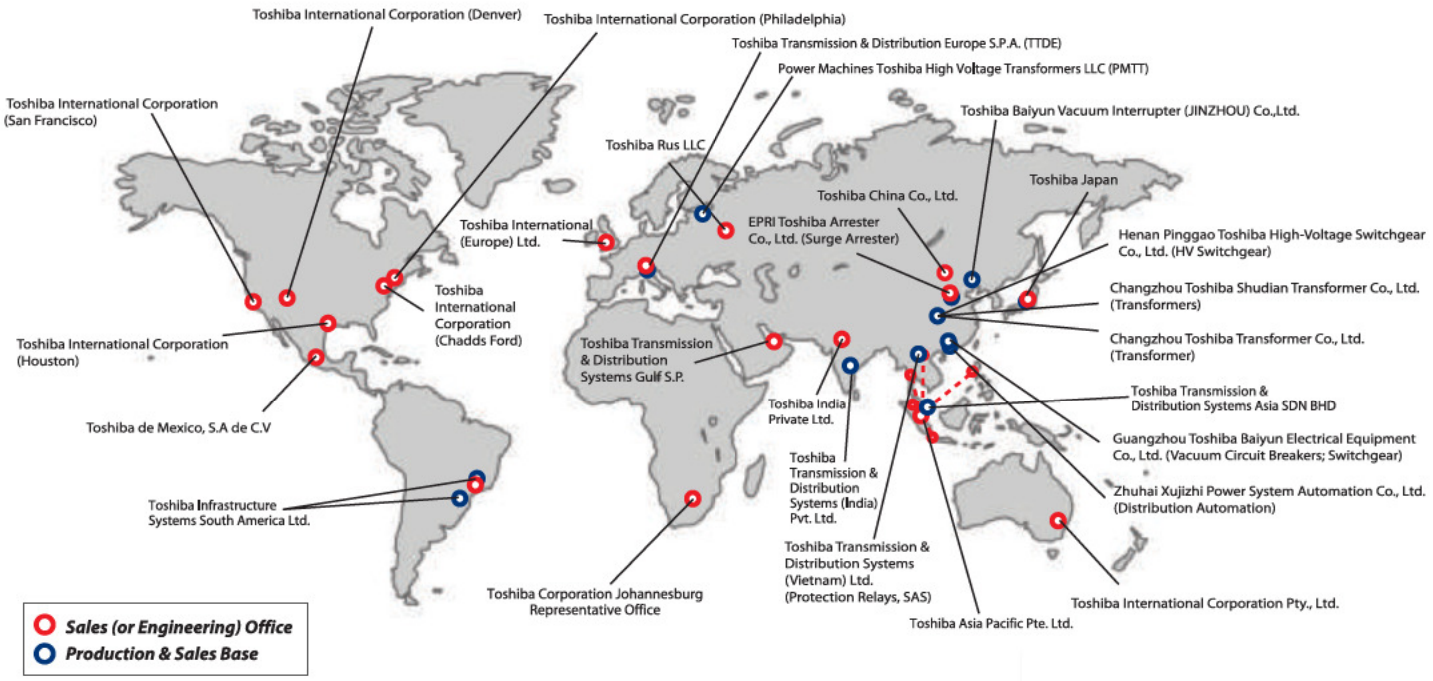
Up to 36 kV Solid Insulated Switchgear



COMPANY PROFILE

CLASSIFICATION

T&D GLOBAL OPERATIONS



Production base at Hyderabad, Telangana State, India.



EHV & UHV Power Transformers Plant



Switchgear Plant



Amorphous Core Transformers Plant



CRGO Core Transformers Plant

Contact us at:

Head Office & Works:

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www.ieema.org

CLASSIFICATION



THE **POWER** OF WE

transformers & rectifiers (india) ltd

ISO 9001:2008 | ISO 14001:2004 | BS OHSAS 18001:2007

COMPANY PROFILE

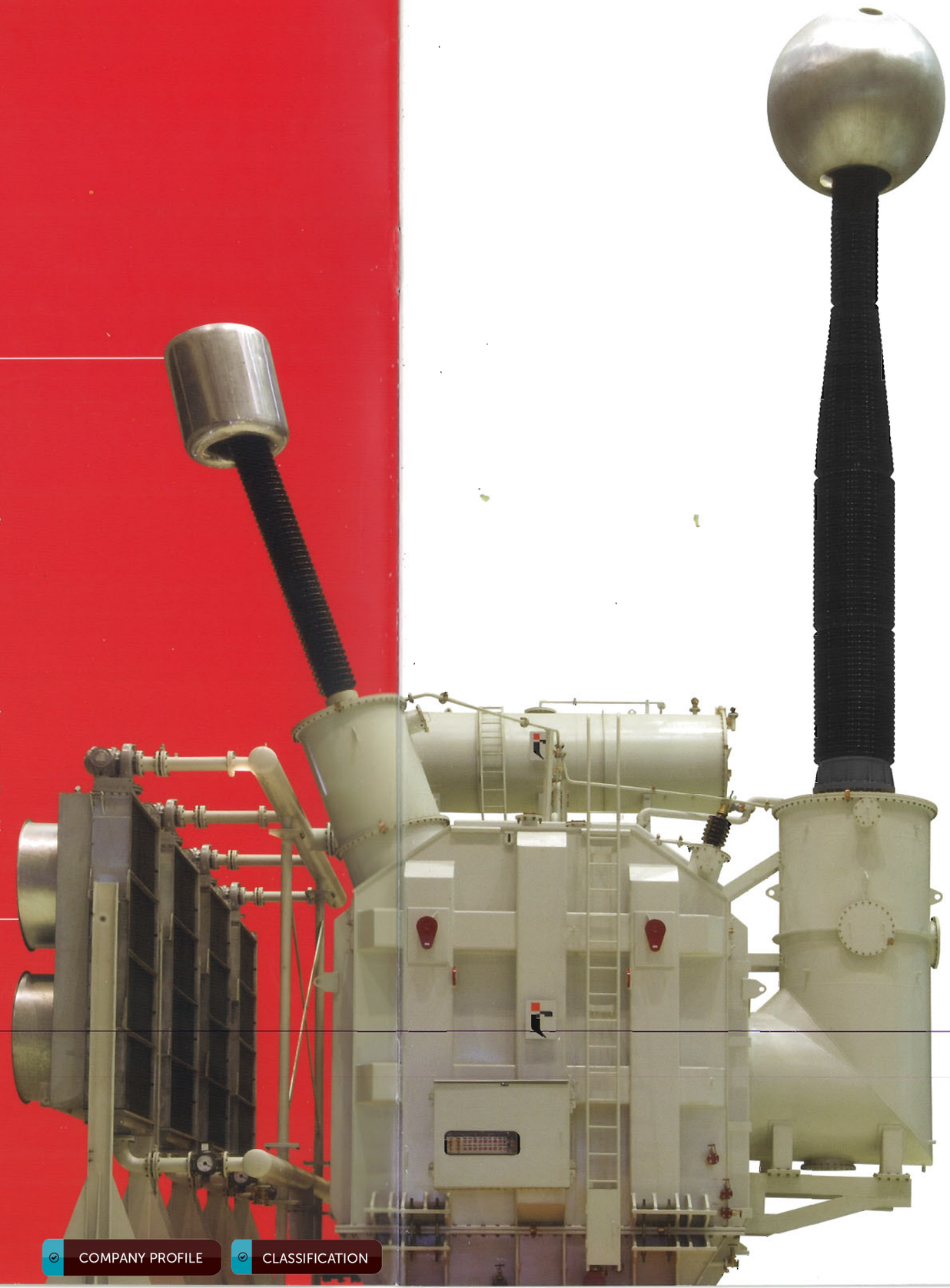
CLASSIFICATION

VISION

To consolidate our National and International presence as a leading manufacturer of Power, Furnace and Rectifier Transformers and maintain a leading position in the T & D industry.

MISSION

To emerge as a preferred solution provider for quality Transformers with a team of dedicated professionals and business associates who are ethical, value driven and create excellent customer relationships.



THE **POWER** OF WE

An initiative which was taken well over thirty years ago, inspired by self belief, driven by knowledge and empowered by a sustained vision stands truly endorsed today. Transformers & Rectifiers (India) Ltd. has positioned itself as one of the leading players in the T & D sector and functions with a fine sense of corporate values.

An innovative environment has helped to reengineer the way T & R approaches production, design, testing, quality and research while concurrently focusing on new geographies to make a global impact in an increasingly competitive T & D sector

In recent years, T & R has forged strong alliances to upgrade the core production values of the company. The Power Utilities sector which identifies key partners to facilitate the commissioning of Ultra Mega Power Plants, find us keeping pace with the stringent quality benchmarks demanded by them.

In an increasingly competitive economic ecosystem, T & R leverages its presence through the Power of WE - A collective vision which powers our goals.



MILESTONES

1981-1993

Manufactured Transformers upto 66 kV Class

Consolidated leadership in Furnace Transformers with a domestic market share of 80%

1994-2000

Inaugurated new state-of-the-art facility for manufacturing upto 245 kV Class Transformers

2001-2005

First 7.5 MVA Series Reactor supplied to Fluor Daniel, UK, installed in Kazakhstan with a short-circuit withstanding capacity of 105 kA

First 100 MVA, 220 kV Power Transformer

Received PGCIL approval

Single Order of 36 Transformers of 110 kV Class Delta Connected for TNEB.

Single Order of 10 Transformers of 220 kV Class for GETCO

Prestigious Orders from NTPC & PGCIL

2006-2011

Successfully went Public with an over-subscription of 92 times

Established a World-class Manufacturing Facility with a capacity of 16000 MVA

Winner of The Best Supplier Award from GETCO for three consecutive years

Honoured with 'Valued Customer Award' by Central Power Research Institute (CPRI)

Awarded 'Star Export House' certificate by Govt. of India

Successfully executed 315 MVA, 400 kV Class Power Transformer

Successfully executed 1200 kV Class Auto Transformer for PGCIL Pilot Project

Received order for 20 nos. 500 MVA, 765 kV Class, Auto Transformers

Executed more than 750 nos. Transformers of 132 kV Class and above

A SNAPSHOT

Our establishment dates back to 1981, as a private firm manufacturing Transformers in the small to medium range.

A strategic focus on manufacturing Furnace Transformers resulted in remarkable visbility for the company and a major share of this niche industry. In 1994, having upscaled to a closely held limited company, and harbouring an intent to diversify into the more challenging Power Transformer sector, a new production facility with 8000 MVA capacity was realised at Changodar, off Ahmedabad. Our new production facility in Moraiya ramped up our capability to manufacture Power and Distribution Transformers upto 1000 MVA in the 1200 kV Class and raising overall capacity upto 23200 MVA per annum. We are now a major supplier to utilities, multinationals, and are also empaneled with local and international consultants.

The Quality certifications of the company becomes an enabling facilitator in our sustained endeavour to mark our global presence. Our state of the art facilities spread over 68000 sq.mtrs houses manufacturing bays eases our effort to achieve these benchmarks and thereby realise international production standards. It also allows us to embed an enabling environment cued in to manufacture 1200 kV Transformers.

T & R currently exports to over twenty five countries including, Canada, United Kingdom and some leading Asian and African nations.

Our operations today, are driven by a team of management and technical professionals who bring years of experience in the design, development and production of a wide range of Transformers. The team is capable of delivering customised solutions and this has been instrumental in T & R occupying a niche position in the T & D industry.

WE

INFRASTRUCTURE



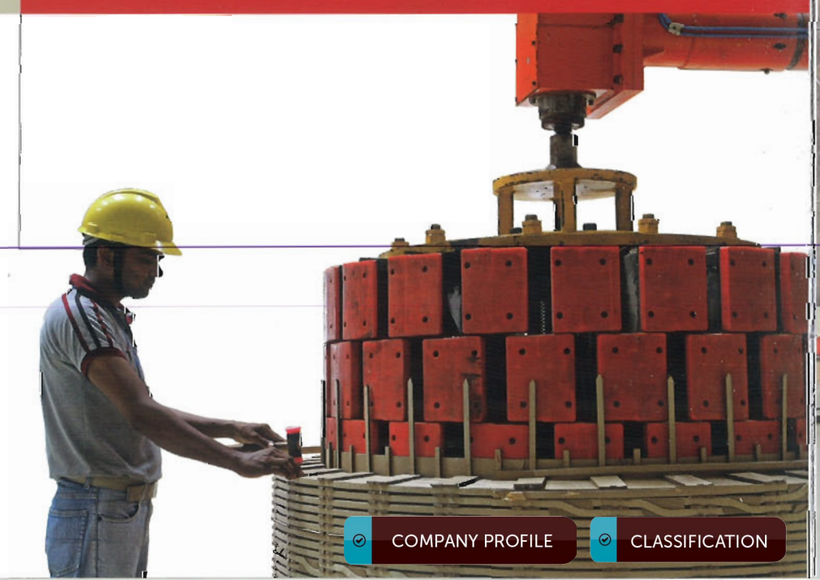


Currently, our facilities are located at Moraiya, Changodar & Odhav which are key industrial centres near Ahmedabad, Gujarat.

The Moraiya Facility - An impressivlely laid out production facility showcases international manufacturing standards, while augmenting our capability to manufacture 1200 kV Power Transformers in an environment which is highly automated, dust free and follows stringent testing and quality benchmarks.

The Changodar Facility - This unit functions as across an overall area of 25,000 sq.mtrs with a built up area of 6,500 sq.mtrs. It houses all the required facilities to design, manufacture and test transformers upto 160 MVA, 245 kV class.

The Odhav Facility - The first production facility, this unit is primarily engaged in the manufacture of Transformers of smaller ratings.





5 indigenously developed Vapour Phase Drying Chambers to process Transformers upto 1200 kV Class



WINDING

WE

The Winding shops are dust free chambers with the capability to ensure reduced axial stresses in Short Circuit conditions and also to withstand impulse and over-voltages.

For Power Transformers, both low voltage and high voltage windings are executed, providing for highest resistance against short circuit forces. It is ensured that proper tension is given on the winding for rigidness.

There are 10 variable speed winding machines in the shop.



Dust free chamber for Vertical Winding Machines



Dust free chamber for Horizontal Winding Machines



Vacuum Oven for Coil Pressing

Variable Speed Soft Start Vertical & Horizontal Winding Machines for Coils upto 3.5 mtrs & 25 tons

CORE & CORE COIL ASSEMBLY



Core Assembly Station

We use high quality material to ensure optimum losses and efficient working of the Transformer. The supporting structures and clamping devices of the core contribute to the compactness of the design and also ensure low sound levels.

The optimum design of Core-Coil Assembly is achieved by considering the required technical particulars including cooling, size compactness and tapping arrangement. All leads and conductors are rigidly supported by special frames.





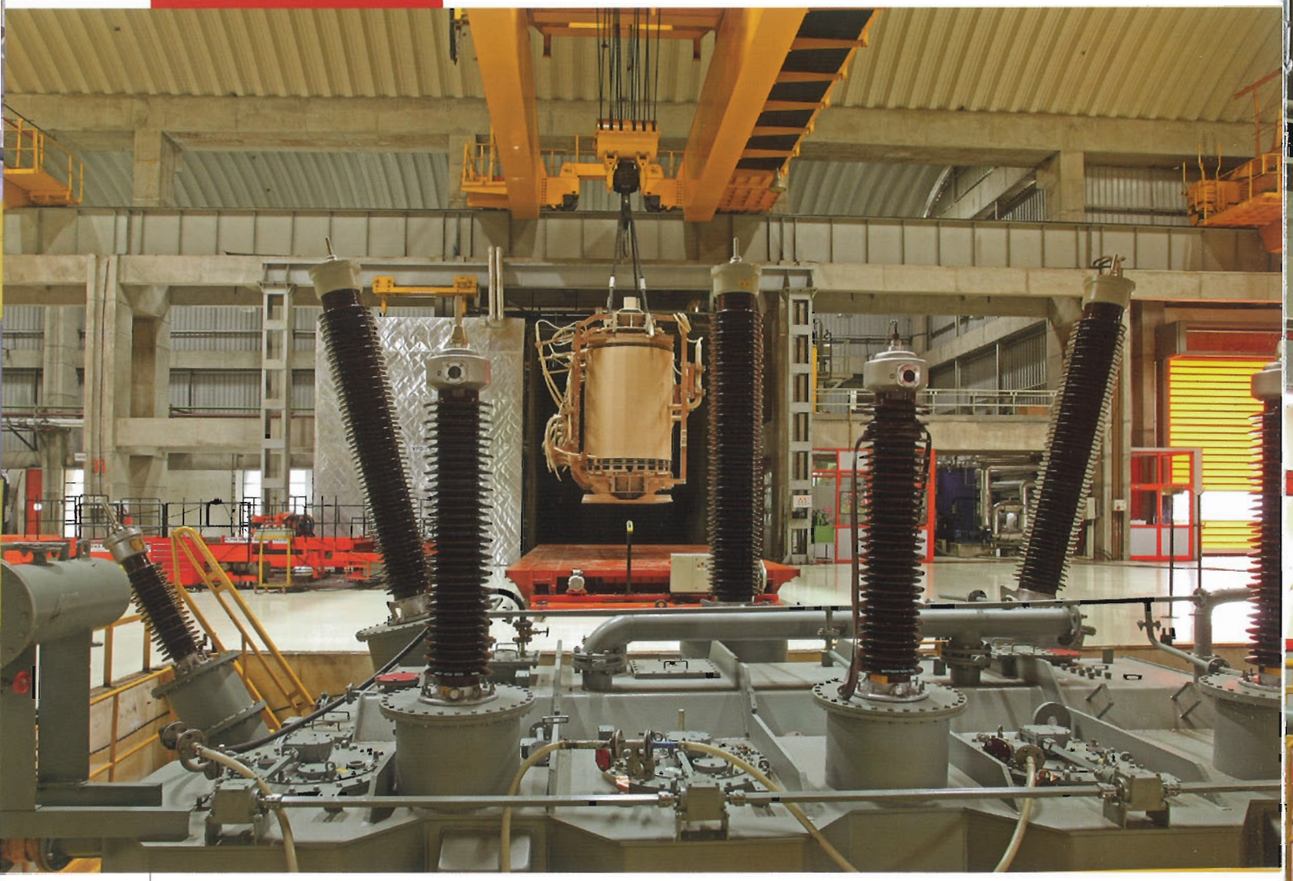


Dust free chamber for Core Coil Assembly

Assembly Facilities

- Core Assembly Comprises of 10 Turntables of varying capacities
- Mobile hydraulic power pack for coil pressing
- Isostatic presses for coil pressing and sizing
- Mobile Hydraulic power pack with multiple jacks to press all the coils simultaneously with control for individual phases

WE TANKING



Tanking Pit

On removing the Core-Coil Assembly from the heating oven, it is thoroughly cleaned by pressurised dry air and then placed into the tank and bolted up. All necessary accessories and fittings such as bushings, valves, oil level indicator, pressure relief device, temperature indicator, tap changer etc. are fitted on to the tank body. High quality filtered transformer oil is then filled in the tank to completely immerse the assembly. Finally, connections of primary and secondary to the terminal bushings are made.

Tanking Facilities

- State-of-art oil handling system
- Up to 250 ton crane capacity
- 300 ton air castor for movement





The process of manufacturing quality transformers is critically dependent on testing of raw materials, components and the final assembled product. We are equipped with state of the art testing facilities to perform all routine and special tests.

- Impulse generators of 1200 kVp & 2800 kVp for conducting Impulse Test of Transformers upto 1200 kV Class

Test Sources

- 3000 kW 50/60 Hz Generator
- 250 kV Transformer for High Voltage test
- 0-170 kV Source Transformer for losses measurement
- 1500 kW 200 Hz Generator
- 50 MVAr Capacitor Bank (provision to increase upto 100 MVAr)
- 800 kV Source Transformer

Testing Equipments

- 4000 Amps/170 kV Highly accurate loss measurement system (The most accurate system in the market today)
- Standard Capacitor 1000/√3 kV & Reactors loss measurement system
- Impulse voltage test system

  (2800 kVp 280 kJ Impulse Generator, 2800 kVp Damped capacitive impulse voltage divider. Controlled chopping gaps. Parallel resonant system, Glaninger circuit

TESTING

WE

DESIGN CAPABILITIES

In recent years, we have executed a number of challenging design assignments for speciality transformers. The design function is undertaken by a qualified and experienced team with proven capabilities to design a broad range of Transformers. The team uses advanced engineering software and initiates quick execution of complex designs.

SOFTWARE & DESIGN VALIDATION

- Impulse voltage distribution across windings
- Dielectric Strength of insulations
- Losses & temperature in tank, frames & other structures
- Hot spots
- Electric field distribution at the bottom of bushings
- Position of transposition in helical coils
- Short circuit withstand capacity & impedance

Some of the prestigious assignments executed by our design team include

- 30 MVA, 2-90 KV in steps of 2 kV, ABB
- 5.4 MVA, 11 KV/40 * 940 volts, IPR
- 15MVA, 11/300-400 volts for DC Arc Furnace
- 7.5 MVA Series Reactor with Short Circuit withstanding capacity of 105 kA (Peak)
- Executed prestigious project of 1200 kV Transformer
- Received order of 20 nos. 765 kV Transformers for PGCIL

WE

WE

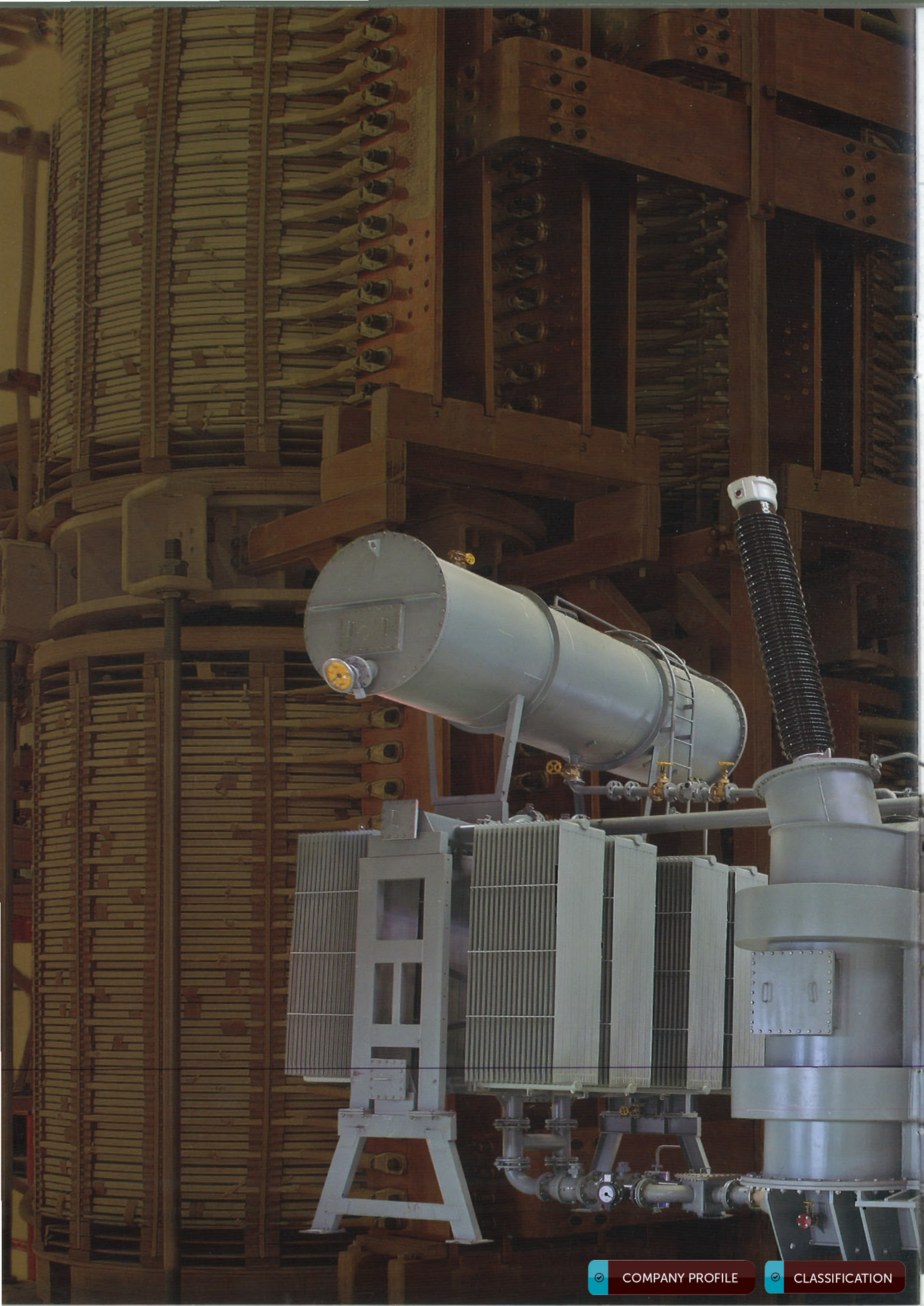
QUALITY

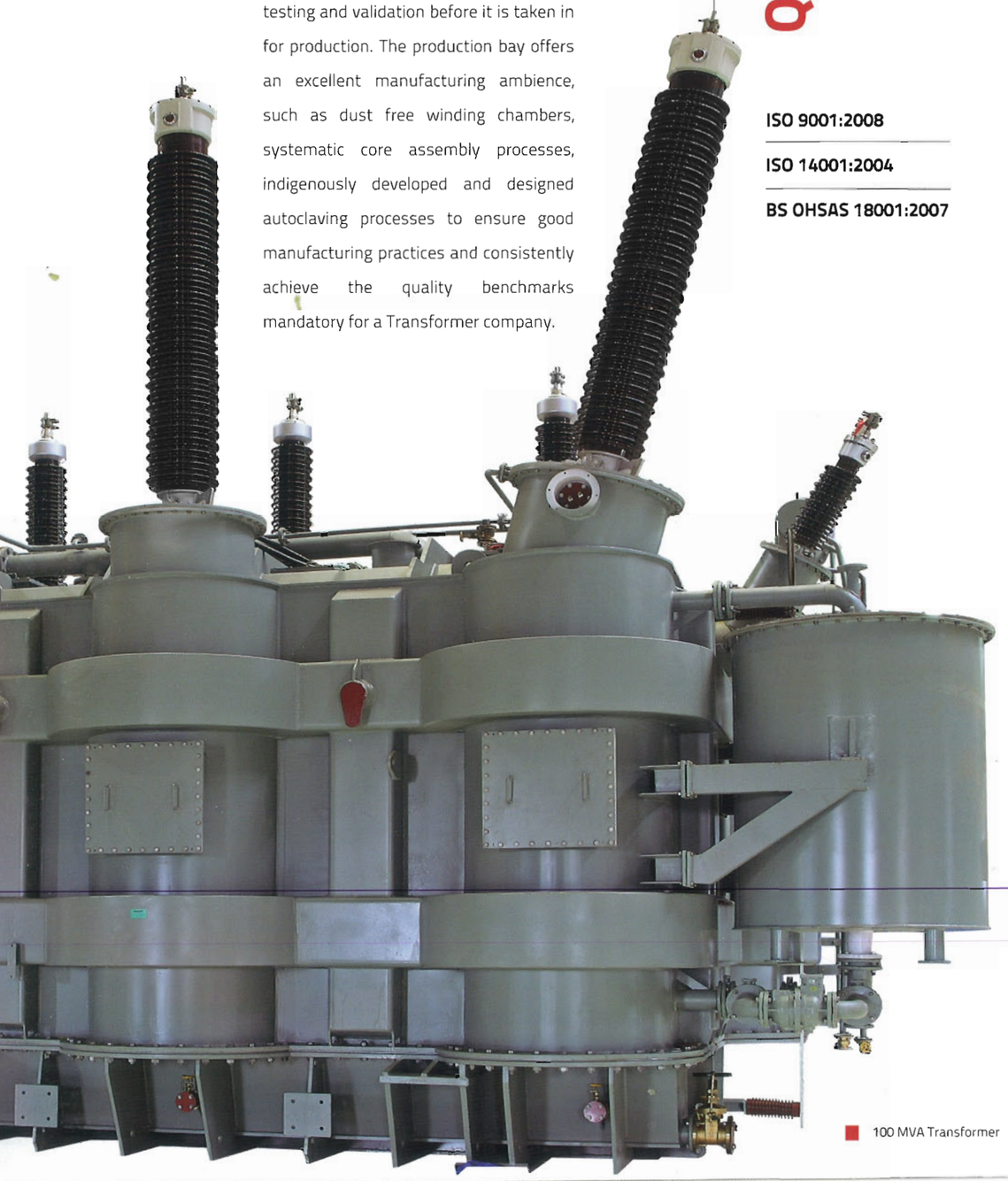
Quality is central to the performance and longevity of a Transformer. At T&R, the focus on quality begins with identification of raw materials, regular inspection, testing and validation before it is taken in for production. The production bay offers an excellent manufacturing ambience, such as dust free winding chambers, systematic core assembly processes, indigenously developed and designed autoclaving processes to ensure good manufacturing practices and consistently achieve the quality benchmarks mandatory for a Transformer company.

ISO 9001:2008

ISO 14001:2004

BS OHSAS 18001:2007





100 MVA Transformer

PRODUCT RANGE



Power Transformer
upto 1000 MVA, 1200 kV Class

Generator Transformer

Power Transformer

Interconnecting Transformer

Unit Auxiliary Transformer

Station Auxiliary Transformer

Rectifier Transformer
upto 160 kA DC

6 Pulse Transformer (IPT)

12/24 Pulse Transformer
(IPT & Double Deck Construction)

12/24 Pulse Transformer
(Bridge Connection)

Furnace Transformer
upto 120 kA

Arc Furnace Transformer

Submerged Arc Furnace Transformer

Ladle Furnace Transformer

Induction Furnace Transformer

DC Arc Furnace Transformer

Distribution Transformer

Ratings above 315 kVA, 11 kV/0.4 kV

Specialty Transformer

Locomotive Traction Transformer

Series & Shunt Reactors upto 765 kV

Mobile Sub-station Transformer

Earthing Transformer & Reactor

OUR TRANSFORMERS CATER TO THE MOST RESPECTED ENERGY AND POWER UTILITIES ACROSS THE GLOBE

WE

GLOBAL PRESENCE

EUROPE

- United Kingdom
- Belgium

AMERICAS

- Canada
- Puerto Rico
- Uruguay

AFRICA

- South Africa
- Ethiopia
- Kenya
- Tanzania
- Zambia
- Ghana
- Nigeria
- Zimbabwe
- Lesotho



ASIA

- India
- Bangladesh
- Nepal
- Bhutan
- Sri Lanka
- Indonesia
- Philippines
- Saudi Arabia
- UAE
- Oman
- Kazakhstan
- Azerbaijan

WE



In our effort to establish our presence in the American, European, African and Asian markets, many of our customers have paid relevant attention to logistic details. We are located on a major National Highway of India, and linked by road, rail and air with Mumbai, a principal business city of India. Mumbai is also a major port of India. On the west, we are linked to the Kandla port, which is one India's busiest ports. Ahmedabad also has a busy international airport and is connected to leading European and American destinations.

INSTALLED OVER

7000

TRANSFORMERS GLOBALLY

INTERNATIONAL CUSTOMERS

- CONCO, RSA
- Active Power Project, RSA
- PREPA, USA
- MGB Electric, Canada
- PDT, UK
- UTE, Uruguay
- NEA, Nepal
- PHCN, Nigeria
- TCN, Nigeria
- MBH Power, Ghana
- MGB, Canada

and many more...

DOMESTIC CUSTOMERS

- National Thermal Power Corporation, INDIA
- GETCO, Vadodara
- Power Grid Corporation, INDIA
- Tamilnadu Electricity Board, Chennai
- Rajasthan Electricity Board, Jaipur
- Torrent Power Ltd., Ahmedabad
- Institute For Plasma Research, Gandhinagar
- Maharashtra State Electricity, Mumbai
- NEG Micon India Private Ltd., Chennai
- Suzlon Energy Ltd., Pune
- ABB, INDIA
- ADANI Enterprises Ltd., Ahmedabad

and many more...

FUTURE

Our growing international base as well as consolidation of our marketing operations in India, presents fresh challenges to us. In the next few years, we will strategically enhance our recognition as manufacturers of speciality transformers. There is also an intent to work towards newer quality benchmarks which will improve our international base. We intend to

- Expand our total installed capacity to 60,000 MVA
- Enhance the manufacturing capacity of Changodar unit
- Exclusively utilize Moraiya plant for 400 kV and above range
- Further backward Integration by adding up
  - > Bushing manufacturing facility
  - > Kitting centers for Insulation
  - > Full Fledged fabrication plant
- Acquire transformer manufacturing companies in the rapidly growing markets

WE

AWARDS



Winner of the

BEST EQUIPMENT SUPPLIER AWARD

SINCE LAST 3 YEARS

from GETCO

(Gujarat Energy Transmission Corp. Ltd.)

one of the leading utilities of India.

AWARDED

Forbes Asia 200 Best Under A Billion

SEPTEMBER 2010



VALUED CUSTOMER AWARD

from CPRI

transformers & rectifiers (india) ltd

ISO 9001:2008 | ISO 14001:2004 | BS OHSAS 18001:2007

Registered Office/Plant

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www.ieema.org

CLASSIFICATION