



## DISTRIBUTION TRANSFORMERS

A division of ACTOM Pty Ltd

Leaders in the design, manufacture and supply of distribution transformers in Southern Africa.

# ACTOM

# ACTOM Distribution Transformers

ACTOM Distribution Transformers plays a vital role in the electrical distribution chain. They provide the link between the distribution network and customers, be they industries, communities or the infrastructure.

ACTOM Distribution Transformers designs and manufactures a wide range of distribution transformers ranging from 16kVA - 5000kVA.

The ACTOM production facility, by its presence in South Africa, offers customers continuous product innovation and support services tailored to their exact requirements.

In close collaboration with utilities, distributors and users, ACTOM has perfected a range of transformer solutions combining high performance and suitability to the electrical and natural environment.

## Environment and Health & Safety

Reduced noise levels, reduced size, resistance to harmonics and PCB free oils are some examples of the performance criteria achieved in the different ranges offered by ACTOM. These developments minimise the impact of ACTOM transformers on the environment whilst providing reliable and long lasting service.

ACTOM Distribution Transformers is an accredited ISO 14001: 2004 and OHSAS 18001:2007 company. ACTOM is a listed ISO 9001:2008 company. The quality management system controls all materials, personnel and processes in the design and manufacture of its transformers, ensuring consistency and uniformity.

Stringently controlled inspection procedures are followed throughout to ensure that products are manufactured to customer requirements, statutory requirements and to the quality and environmental standards to which ACTOM is committed.

## Commitment to Quality

ACTOM's transformers carry the SABS mark of quality, a symbol of our ongoing drive to maintain and improve standards.

ACTOM's robust transformers are double wound, fully insulated, oil immersed and natural air-cooled. The range includes single-phase pole mounted units of cylindrical design and three-phase rectangular units which may be either pole mounted or ground mounted as required. ACTOM has developed a wrap-around tank design to reduce the number of welds.

The use of high quality magnetic core steel and innovative core clamping designs ensures that our transformers are the most compact, low mass units (up to 5000kVA) currently available.

The transformers are designed, manufactured and tested to the well-established SANS 780 specification, with regular independent auditing of the ACTOM manufacturing facility ensuring that this stringent standard is maintained.



*Manufacturing facility located in Gauteng, South Africa.*



*Units being prepared for dispatch in the final assembly department.*



*One of our in-house laser cutting machines.*

## Reliability and Versatility

ACTOM's distribution transformers are designed and manufactured to the highest quality standards to ensure enduring reliability - a characteristic necessary to foster peace of mind amongst customers and consumers.

ACTOM applies the latest technological advances in its range of distribution transformers, introducing innovations to the local and export market to meet changing needs identified through ongoing research.

Thousands of ACTOM distribution transformers are in use in various sectors of the economy, with customers including Eskom, various municipalities, mines as well as general industry and they are favoured by consulting engineers.

## Transformers for Industrial Applications

### Oil-immersed Transformers

These are available in a vast range and enable installation as close as possible to the user:

- in substations or cubicles, for towns, small and medium industrial areas or large industrial sites
- pole mounted, for rural distribution in low consumption areas
- in pad-mounted substations in outlying urban or rural areas, for underground networks
- in various mining applications above and below ground

Conscious of the installation band utilisation constraint, particularly with regard to personal safety, ACTOM offers distribution transformers immersed in P.C.B. free mineral oil

### VSD Applications

ACTOM's Converter Transformers (VSD Drives) are designed, manufactured and tested to the SABS IEC 61378-1 standard. Transformers for variable speed drive applications are manufactured up to 5 000kVA.

The careful design of static screening and the detailed attention to conductor geometry ensures that the units will withstand the typically high electrical stresses and the harmonic content normally associated with variable speed drives.

In addition, the large robust radiators will quickly dissipate any heat created by extra load losses that are normally caused by Eddy currents, therefore obviating the need in the past to de-rate the unit. An ACTOM Converter/VSD Transformer will operate continuously at the full rating plate values.

### SWER Distribution Transformers and SWER Isolating Transformers

Single Wire Earth Return (SWER) distribution transformers were developed mainly for rural electrification with a 19kV phase to neutral connected primary winding and a single phase or center tapped low voltage dual phase winding.

The SWER isolating transformer is a medium voltage phase to phase connected winding and a 19kV secondary winding for SWER application.



16kVA 22/.24kV Single phase pole mounted transformer.



100kVA 22/0.415kV Dyn11 Three phase pole mounted transformer.



2500kVA 11000/400V ground mounted transformer.

## Renewable Energy Applications

Intensive research and development has been undertaken by ACTOM Distribution Transformers on the development of designs to cater for the renewable energy market.

ACTOM Distribution Transformers is the leader in the supply of transformers for the renewable energy sector. Whether the transformers are used for wind, solar or hydro applications, ACTOM Distribution Transformers can supply mineral oil-filled, cast resin dry type or environmentally friendly K-Class Ester oil-filled transformers (IEC 60076-14 & IEC 60076-16).

During operation, these transformers are subjected to additional stresses which, if not taken care of, will lead to premature failure like the following:

- High voltage transients due to switching surges
- Unusually higher harmonic content on the voltage and current wave that lead to:
  - Part winding resonance
  - Higher stray and eddy losses in the magnetic circuit
  - Higher stray and eddy losses in the winding

The special considerations that need to be taken into account during the design of these transformers include:

- Insulation coordination
- Winding structure
- Induction of the magnetic circuit
- Current densities in the conductor

## NECRT Transformers

An NECRT is a combined three phase Neutral Electro-Magnetic coupler / neutral earthing compensator (NEC) with a neutral earthing resistor (R) and an auxiliary transformer (T). The purpose of which is to provide a neutral point in a Delta of a transmission system and limit the earth fault current to a designated level under fault or abnormal conditions. The NEC has a zig-zag connection or inter-star and can be supplied in copper or aluminium windings. The neutral earthing resistor is made of stainless steel plates. The auxiliary transformer is a Dyn11 (or any other vector group) transformer and can be supplied in copper or aluminium with or without an off circuit tap changer. The standard ratings for NECRT's are as follows:

- -6.6kV 300A or 800A
- -11kV 300A or 800A
- -22kV 300A or 800A
- -33kV 300A or 800A
- -44kV 300A or 800A

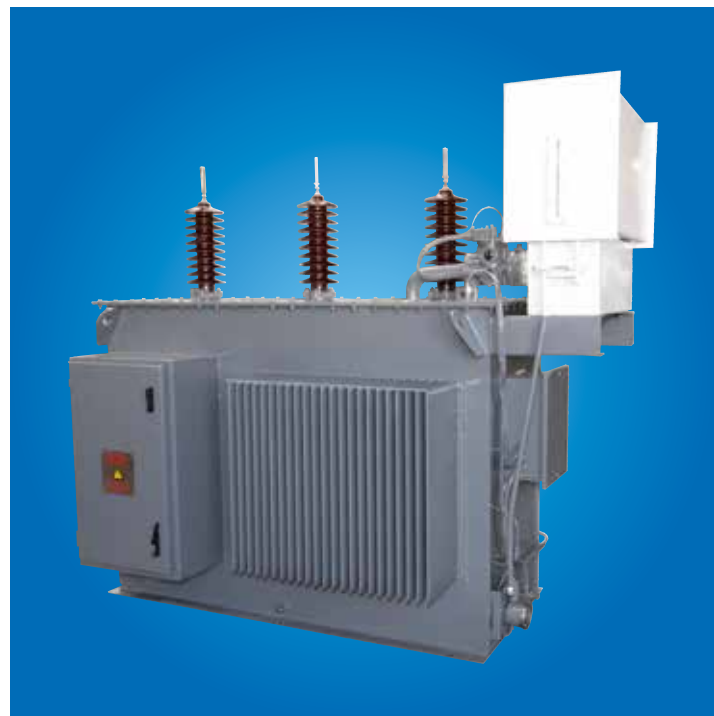
ACTOM Distribution Transformers has conducted extensive research into the cause and prevention of premature failures of NECRTs. We have therefore adapted the entire design to cater for abnormal service conditions which the NECRTs are predominantly exposed to.



1450kVA 22000/300-300V Dyn11yn11 for a solar farm project.



Manufacturing Manager and Production Manager signing off transformers for two solar farm projects and one wind farm project.



11kV NECRT 360A 100kVA 11000/415V Aux Transformer to ESKOM specification.

# Testing Options

## Routine Tests

- Winding resistance
- Voltage ratio and check of phase displacement
- No load loss and current
- Dielectric routine test
- Leak test
- Ratio and polarity of built in CT's
- Insulation resistance of core and frame
- Short circuit impedance and load loss

The following transformers have been successfully short circuit tested to SABS-IEC 60076-5 and Eskom specifications:

- 16kVA 11 & 22kV/240V Single phase
- 32kVA 11 & 22kV/± 240V LV Dual phase
- 25kVA 11 & 22kV/415V Three Phase Dyn11
- 50kVA 11 & 22kV/415V Three phase Dyn11
- 100kVA 11 & 22kV/415V Three phase Dyn11
- 200kVA 11 & 22kV/415V Three phase Dyn11
- 315kVA 11 & 22kV/415V Three phase Dyn11
- 500kVA 11 & 22kV/415V Three phase Dyn11
- 400kVA 11kV/19kV SWER Isolating Trf
- 630kVA 11kV/3.3kV Three phase Dyn11
- 64kVA 11 & 22 kV/±240V Dual phase
- 64kVA 33 & 19 kV/±240V Dual phase
- 1000kVA 11 kV/ 415V
- NECRT 6.6kV 360A 100kVA
- NECRT 11kV 360A 100kVA
- NECRT 33kV 360A 100kVA



*Routine testing being carried out in the Test Bay. Fully automated system on the left and on the right a semi-automated system. Both systems have automatic data capture.*

## Type Tests

- Temperature rise test
- Dielectric type tests (impulse test)
- Determination of sound level
- Measurement of no-load loss and current at 90% and 110% of rated voltage

## Special Tests

- Dielectric special tests (test with lightning impulse chopped on tail) – this includes Partial Discharge testing
- Winding hot-spot temperature-rise measurements
- Determination of capacitances windings-to-earth, and between windings
- Measurement of dissipation factor ( $\tan \delta$ ) of the insulation system capacitances
- Determination of transient voltage transfer characteristics
- Measurement of zero-sequence impedance(s) on three-phase transformers
- Short-circuit withstand test
- Measurement of d.c. insulation resistance each winding to earth and between windings
- Vacuum deflection test on liquid immersed transformers
- Pressure deflection test on liquid immersed transformers
- Vacuum tightness test on site on liquid immersed transformers
- Measurement of frequency response (Frequency Response Analysis or FRA). The test procedure shall be agreed between manufacturer and purchaser
- Check of external coating
- Measurement of dissolved gasses in dielectric liquid
- Mechanical test or assessment of tank for suitability for transport (to customer specification)
- Determination of weight with transformer arranged for transport. For transformers up to 1,6 MVA by measurement For larger transformers by measurement or calculation as agreed between manufacturer and purchaser

# Technical Data for PCB Free

RATED POWER (kVA)	NO LOSS (W)	FULL LOAD LOSS (W)	IMPEDANCE (%)	LENGTH (mm)	WIDTH (mm)	HEIGHT (mm)	OIL VOLUME (L)	TOTAL MASS (kg)
<b>11 000/240 VOLT SINGLE PHASE</b>								
16	80	400	4.5	700	580	700	48	155
25	110	530	4.5	765	632	764	56	176
<b>22 000/240 VOLT SINGLE PHASE</b>								
16	100	400	4.5	800	580	739	48	175
25	140	530	4.5	765	632	799	56	192
<b>6 600/420 VOLT THREE PHASE</b>								
25	120	570	4.5	950	730	670	100	280
50	180	1000	4.5	1000	750	770	150	470
100	300	1700	4.5	1253	1000	850	196	535
200	520	2700	4.5	1587	1100	910	290	1070
315	720	3800	4.5	1689	1268	900	320	1280
400	910	4500	4.5	1639	1618	900	400	1400
500	1100	5400	5	1844	1618	900	495	1700
630	1300	6400	5	1950	1800	1600	495	1900
800	1600	8000	5	2122	1953	1567	612	2250
1000	1900	9500	5	2100	2103	1600	700	2900
1250	2250	11000	5	2450	2100	1600	661	3100
1600	2750	13500	6.5	2714	2100	1600	661	3350
2000	3250	16000	8	3146	2400	1800	930	4150
2500	3800	22500	9	3546	2400	1900	1030	4975
3150	4500	26500	9	3900	2400	1900	1200	5700
<b>11 000/420 VOLT THREE PHASE</b>								
25	120	570	3.6	959	739	688	113	390
50	180	1000	4.5	986	787	786	153	430
100	300	1700	4.5	1262	840	710	196	605
200	520	2700	4.5	1460	901	816	290	800
315	720	3800	4.5	1545	1125	835	380	1660
400	910	4500	4.5	1639	1618	900	400	1476
500	1100	5400	5	1652	1102	932	495	1770
630	1300	6400	5	1950	1800	1600	495	1946
800	1600	8000	5	2122	1953	1567	612	2305
1000	1900	9500	5	2100	2103	1600	700	3030
1250	2300	11000	5	2450	2100	1600	661	3183
1600	2750	13500	6.5	2714	2100	1600	661	3400
2000	3250	16000	8	3146	2400	1800	930	4200
2500	3800	22000	9	3545	2400	1900	1030	4975
3150	4500	26500	9	3900	2400	1900	1200	5700

# Mineral Oil Filled Transformers

RATED POWER (kVA)	NO LOSS (W)	FULL LOAD LOSS (W)	IMPEDANCE (%)	LENGTH (mm)	WIDTH (mm)	HEIGHT (mm)	OIL VOLUME (L)	TOTAL MASS (kg)
<b>22 000/420 VOLT THREE PHASE</b>								
25	150	570	3.6	906	905	652	98	340
50	220	1000	3.5	1010	905	786	159	475
100	360	1700	4.5	1222	958	710	119	590
200	600	2700	4.5	1500	1050	810	296	860
315	840	3800	4.5	1685	1220	831	445	1420
400	990	4500	4.5	2004	1615	900	495	2088
500	1180	5400	5	1862	1200	921	495	1700
630	1400	6400	5	2513	2160	1780	645	2650
800	1650	8000	5	2513	2160	1780	645	2650
1000	1950	9500	5	2513	2160	1780	645	2760
1250	2300	11000	5	2784	2100	1840	1000	3700
1600	2770	13500	5.75	2784	2100	1840	1316	4340
2000	3250	16000	8	2976	2100	1865	1540	5150
2500	3800	22800	9	3146	2400	1900	1800	5900
3150	4500	26500	9	3900	2400	1900	2000	6700
5000	6600	37000	9	3610	1715	2450	3131	7900
<b>33 000/420 VOLT THREE PHASE</b>								
25	170	570	4.5	1000	1100	1050	160	370
50	170	1000	4.5	1036	1183	1081	248	546
100	400	1700	4.5	1263	1430	1101	315	915
200	650	2700	4.5	1554	1482	1226	445	1310
315	890	3800	4.5	1850	1300	1400	486	1500
400	1040	4500	4.5	2100	1700	1400	491	1900
500	1230	5400	5	2100	1700	1372	495	2088
630	1450	6400	5	2600	1700	1550	651	2408
800	1700	8000	5	2513	2160	1700	930	3420
1000	2000	9500	5	2513	2160	1700	930	3420
1250	2350	11000	5	2800	2400	2000	1100	3900
1600	2820	13500	6.5	3100	2400	2000	1200	4500
2000	3300	19300	8	3500	2400	2000	1600	5100
2500	3800	22800	9	3900	2400	2100	2000	6100
3150	4500	26500	9	4300	2400	2100	2300	7000
5000	7000	37000	9	3700	1800	2550	3300	8200

1. Information provided is for guidance purposes only and is subject to change with product improvements and customer specifications.
2. Dimensions to be confirmed when ordering units.
3. Other voltages, vector groups, impedances, SWER and dual ratio transformers are available on request.
4. Welding specifications AWS D1.1/1.1M:2002.

# Customise with Accessories

The range of transformers available from ACTOM reflects the latest trends in transformer design in that cost effective base units are available with the minimum of accessories.

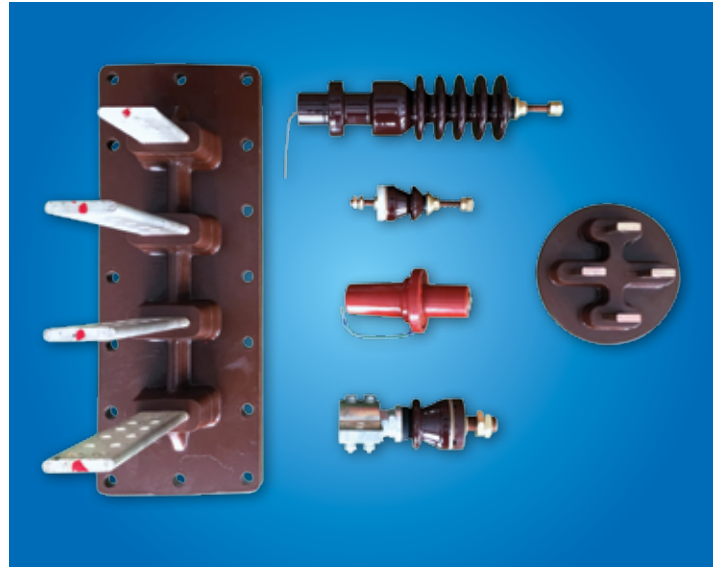
However, an extensive range of accessories has been developed to allow customisation of transformers to meet the specific requirements of individual customers.

## The range of accessories and options includes:

- stainless steel rating plates
- bolted or welded lid
- oil-filling or drain plug
- filler and drain valves
- hermetically sealed or free breathing with a conservator
- top oil temperature thermometer with alarm & trip contacts
- winding temperature indicator
- oil level gauge
- pressure relief valve
- auxiliary terminal box
- Buchholz relay
- HV and LV air cable box
- LV trunking
- jacking pads
- rollers
- skid base / flat base
- surge arrestors
- LV cubicle



Various transformer accessories.



Various transformer bushings.

# Transformer Field Services

ACTOM Distribution Transformers employs teams of skilled technicians that can perform the following services on site:

- Oil purification to SANS 555 standards (IEC60296). This includes the removal of moisture and gases from the oil
- General repairs (gaskets, painting, etc.)
- Onsite welding
- Replacement/refurbishment of bushings
- Oil sampling, testing, diagnosing and reporting
- Monitoring, testing and maintenance of transformers
- Some repairs can be done on-site otherwise the major repairs are conducted at our works



One of our field services vehicles with a mobile oil purification plant.



# Amorphous Low Loss Transformers

## Benefits of Amorphous Cores:

### Energy savings

- No load losses are 17% to 25% of conventional CRGOES transformers (cold rolled grain oriented electrical steel).
- Total ownership cost is reduced over transformer life.
- Reduced cost of generation per kWh consumed.

### Reliability and Quality

- Reduced heat generation due to lower losses, reduced impact on aging of transformer insulation materials (Increased overloading capacity)
- ACTOM's robust transformers are double wound, fully insulated and specifically clamped providing excellent short circuit capability



### Environmental Impact

- Reduction of greenhouse gas emissions from generation facilities

### Applications

- Distribution transformers with typically low load factor where the no load loss makes up a significant part of these losses and the transformer needs to operate 24/7
- Also used in high frequency applications where the frequency ranges between 200 and 400Hz
- 500 Transformers rated 16kVA 22/0.24kV were designed, manufactured and delivered to Eskom on a pilot project. These were deployed in the harshest environments all over South Africa and to date, not one has failed. A sample unit underwent full type and special testing at SABS NETFA and passed all tests



An example of one of the 500 16kVA 22/0.24kV units that were designed and manufactured for Eskom.

CORE LOSS COMPARISON						
Transformer Rating kVA	Typical Core Loss-SANS 780 (W)		Typical Core Loss Amorphous – ACTOM (W)		Loss Reduction %	
	11kV	22kV	11kV	22kV	11kV	22kV
16 (1Ø)	80	100	14	18	-83%	-82%
25 (3Ø)	120	150	30	33	-75%	-78%
32 (LV dual phase)	130	170	31	33	-76%	-81%
50 (3Ø)	180	220	45	55	-75%	-75%
64 (LV dual phase)	210	260	52.5	65	-75%	-75%
100 (3Ø)	300	360	77	87	-74%	-76%
200 (3Ø)	520	600	130	150	-75%	-75%
315 (3Ø)	720	840	180	210	-75%	-75%
500 (3Ø)	1100	1180	275	295	-75%	-75%

# K-Class Ester (Environmentally-Friendly Transformer Oil)

K-class ester has been used in more than a million transformers across 6 continents in distribution and power transformers through 420kV in both new and retrofilled transformers. This ester oil can be used to retrofill in existing transformers, using up to 15% less fluid and it can be mixed with mineral oil. It is a great alternative to Silicon filled transformers and dry type transformers. K-class ester oil meets IEC and IEEE standards and has been recognised by the International Electrochemical Commission, FM Global, Underwriters Laboratories (UL®), and the National Electrical Code ® (NEC®).

## Benefits of using K-class ester fluid:

- Optimizes transformer designs for increased savings on initial cost or total cost of ownership
  - Leverage standardized high temperature capabilities to design smaller, more efficient transformers that could use up to 15% less fluid and up to 3% less construction materials
- Increases load capacity
  - Up to 20% more than mineral oil filled transformers
  - Standardized high temperature capability 20°C higher than mineral oil (IEC C57.154)
- Extends transformer asset life
  - K-class ester oil protects the insulation life 5-8x longer than mineral oil while maintaining reliability and life expectancy of new transformers
  - Retrofilling transformers with K-class ester can extend asset life or increase load capacity, thus avoiding costly replacement costs
- Improves fire safety
  - FM Approved, UL Certified as a K-class less flammable fluid.
  - K-class ester fluid has twice the flash and fire point as mineral oil (360°C vs 160°C respectively)
  - Reduces clearances to buildings, ideal for space constrained locations. Eliminates costly fire walls and deluge systems.
  - K-class ester fluid has a flawless fire safety history
- Improves environmental footprint
  - Made from renewable vegetable oils
  - Biodegradable, non-toxic and non-hazardous in soil and water, and carbon neutral (according to BEES 4.0 lifecycle analysis)
- Does not contain petroleum, halogens, silicones or sulfurs



# Cast Resin Dry Type Transformers

Cast Resin Dry Type Transformers are fabricated with an epoxy resin. The windings are completely embedded under vacuum conditions. This casting method makes it possible to assure void-free epoxy penetration of both the inner layer and turn to turn insulation.

## Benefits of CRTs:

- Moisture proof, making them suitable for use in harsh environments
- Environmentally safe as they do not use oil and do not give off toxic gases
- Maintenance is almost completely unnecessary
- Low noise levels due to the epoxy resin coating of the core
- Excellent fire resistance and is self-extinguishing, reducing costs by eliminating the need for fire mitigation equipment
- High overload capacity and high impulse strength with no risk from partial discharge
- These are designed to suite customers' requirements i.e. kVA, voltage, losses, impedance, vector group, climatic and environmental class, fire behaviour, noise level, etc
- Ideal for wind farm applications as the CRT can be mounted inside the nacelle



500kVA 11/0.4kV Dyn11 Cast Resin Dry Type Transformer.

## Technical Data

12kV Class for S.A., 50Hz  
Dyn11, 75BIL, AL/AL

Standard: IEC 60076-11  
Temperature Rise: 100K (F Class)

Rated POWER (kVA)	Impedance Voltage (%)	No Load Loss (W)	Load Loss (W) at 120°C	Efficiency (%) at 120°C			Exciting Current (%)	Voltage Regulation (%)	Dimensions (mm)				Weight (kg)	
				100% Load	75% Load	50% Load			Width (W)	Depth (D)		Height (H)		
										-	With Fan	-		With Wheel
50	6.0	350	720	97.9	98.0	97.9	1.5	2.5	1060	-	1000	1095	1150	600
100	6.0	440	2000	97.6	97.9	98.1	1.4	2.5	1060	700	1000	1115	1170	650
150	6.0	610	2700	97.8	98.1	98.3	1.3	2.4	1135	700	1000	1215	1270	850
200	6.0	700	3500	97.9	98.2	98.4	1.3	2.4	1135	710	1000	1215	1270	900
315	6.0	850	5000	98.1	98.4	98.6	1.2	2.2	1160	710	1000	1395	1450	1100
400	6.0	1100	6000	98.2	98.5	98.7	1.0	2.1	1250	800	1000	1430	1545	1300
500	6.0	1200	8000	98.1	98.5	98.7	1.0	2.0	1325	900	1000	1570	1625	1550
630	6.0	1400	8800	98.4	98.6	98.8	1.0	1.9	1400	900	1000	1570	1625	1800
800	6.0	1700	9000	98.6	98.8	99.0	1.0	1.6	1535	900	1200	1600	1715	2180
1000	6.0	2000	10500	98.7	98.9	99.0	0.9	1.6	1505	1000	1200	1710	1765	2350
1250	6.0	2400	12500	98.8	99.0	99.1	0.9	1.5	1625	1000	1200	1760	1815	2800
1500	6.0	2800	12800	98.9	99.1	99.2	0.9	1.4	1700	1000	1200	1790	1845	3300
1600	6.0	3000	14000	98.9	99.1	99.1	0.9	1.4	1745	1000	1200	1820	1875	3500
1800	6.0	3500	14500	99.0	99.1	99.2	0.8	1.3	1840	1200	1200	1900	1975	3900
2000	6.0	3800	19500	98.8	99.0	99.1	0.8	1.3	1815	1200	1200	2050	2165	3950
2500	6.0	4800	19500	99.0	99.1	99.2	0.8	1.3	1965	1200	1200	2130	2205	5000
3750	9.0	7300	28000	99.07	99.19	99.24	0.9	1.45	2555	1350	1350	2350	2425	7850

2 Magnet Road  
Knights  
1413

P O Box 13024  
Knights  
1413

Tel: +27 (0) 11 820 5111  
Fax: +27 (0) 11 820 5295/53

Email: [alan.buchholtz@actom.co.za](mailto:alan.buchholtz@actom.co.za)