Megger

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Application Note

5 kV, 10 kV and 15 kV Insulation tester lead sets

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5 kV, 10 kV and 15 kV Insulation tester lead sets

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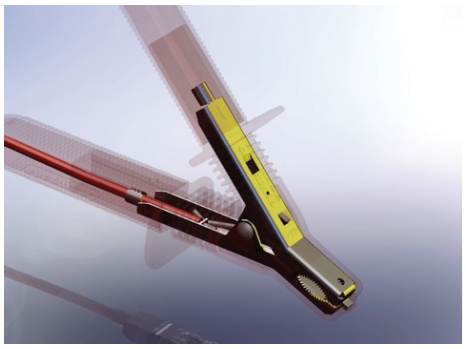
Megger provide a range of lead sets and clips of different sizes and electrical characteristics for use with Megger 5 kV, 10 kV and 15 kV insulation resistance testers, enabling the user to choose the most applicable lead set for the work in hand.

The design of the lead sets is intended to facilitate connection to a variety of de-energised systems for the purpose of making insulation resistance measurements. In all cases it is the responsibility of the user to employ safe working practices and verify that the system is safe before connection. Even electrically isolated systems may exhibit significant capacitance which will become highly charged during the application of the insulation test. This charge can be lethal and connections, including the leads and clips, should never be touched during the test. The system must be safely discharged before touching connections.



Megger test leads – NEW designs using the latest technology

All of the lead sets in this application note are suitable for use with either the current Megger 5 kV, 10 kV or the 15 kV insulation resistance testers.

MEGGER TEST LEADS DESIGNED FOR THE REAL WORLD – PROVIDING SAFETY, RELIABILITY AND PRACTICALITY

At Megger we recognise that test leads are a key component of any precision instrument and that safety, long life, and the ability to provide reliable connections to the wide variety of test pieces found in real applications are of utmost importance.

Careful design ensures repeatable connections, which are practical and safe to use.

Only the best materials and most appropriate materials are used, to provide the essential blend of performance and safety. As an example the careful specification of the cable ensures it remains flexible in all conditions and has extremely good insulation properties which will not effect the measurements made.

Megger uses only the best quality double insulated silicon cable; the inner insulation is specifically manufactured in a different colour to the outer sheath so to instantly highlight any damaged areas; a factor important not just for reliable measurements but safety too.

Using an insulation tester with poor or electrically leaky test leads can provide misleading measurements and may result in perfectly good insulation being diagnosed faulty, wasting both time and money on unnecessary repairs. This is especially so when using long test leads.

NEW MEGGER MIT 5 KV, 10 KV AND 15 KV HV TEST LEADS

The range of HV test leads supplied for use with the MIT and S1 range of 5 kV, 10 kV and 15 kV insulation testers' were developed from years of experience and practical testing, utilising the latest technology. These leads have been designed to be fully compliant with the latest release of the essential safety standard IEC61010-031 : 2008 which requires a fully insulated clip design essential in reducing arc flash accidents.

IEC 61010-031 :2008

Important safety enhancements

The international standard IEC 61010-031 details the Safety requirements for hand-held probe assemblies for electrical measurement and test. This was amended in 2008 and subsequently the new requirements became law early 2011.

A number of amendments were made to the standard, but the most significant was to add a new section; **Prevention of HAZARD from arc flash and short-circuits.**

Two hazards are considered; firstly the dangers of a probe tip or crocodile clip temporarily bridging two high energy conductors, and secondly the dangers of a contact being broken while current is flowing.

These hazards are particularly applicable to many of the environments in which Megger MIT 5 kV, 10 kV and 15 kV instruments are used. Should a probe or clip momentarily short out two high energy conductors during connection an extremely high current will flow heating the metal and melting insulation. This itself may cause serious burns to the operator or bystander near the clip or probe Additionionally should the contact be broken while current is flowing arcing may occur leading to an extremely serious situation known as arc-flash.

The standard describes the danger of arcing as follows:

"The arcing will ionize the air in the vicinity of the arc, permitting continued current flow in the vicinity of the probe tip or crocodile clip. If there is sufficient available energy, then the ionization of the air will continue to spread and the flow of current through the air continues to increase. The result is an arc flash, which is similar to an explosion, and can cause injury or death to an operator or a bystander".

IEC 61010-031 :2008 requires probe tips and crocodile clips to be constructed to mitigate the risk of arc flash and short circuits, and this requirement applies to all crocodile clips or clamps that are rated to Installation Category III or IV (CAT III or CAT IV). The outer surfaces of crocodile clips must not therefore be conductive and no metal parts should be ACCESSiBLE (as defined by the standard) with the clip closed.

During design phase detailed inspection measurement and test procedures are used to assess electrical creepage and clearance paths and compliance with the standard. Accessibility of conductive metalwork is assessed using an IEC standard test finger – see below. The above processes along with extensive practical testing ensure that Megger test leads maintain class leading levels of safety, performance and practicality for the user.

Megger test clip being tested with a IEC standard test finger for creepage and clearance

THE MEGGER SAFETY PHILOSOPHY

The electrical test environment in which Megger products are used often poses significant hazards and safety risks to users requiring high levels of training and competence. In these environments application of safe working practices is essential to ensure the safety of both operators and others.

At Megger, we take product safety extremely seriously and pride ourselves on our reputation for high quality practical equipment designed to minimise the risk to the user. Whether a complex test instrument or a set of test leads the same rigorous process is employed.

Insulation testing in HV, high energy, environments poses a number of unique hazards against which Megger has implemented innovative solutions to provided added protection.

These hazards and protective features are summarised below and listed in order of importance:-

1. Maintaining practicality with a fully insulated clip

In addition to the overall insulation requirements of a clip Megger considered the challenge of providing this protection without compromising the usability of the design.

An insulated clip is great, but if the added insulation impedes the operation and ability to make reliable connection to the wide variety of bus bars, wires and terminals that are needed the design is useless and the operator may be tempted to remove the additional insulation to make connection.

Megger's unique solution has been achieved by the addition of moving jaw covers that flex back when the clip is applied to a test piece.

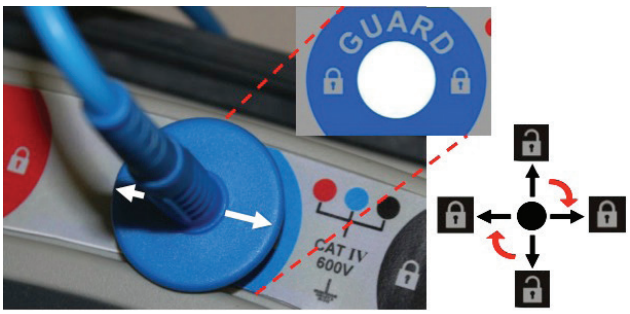
A simple but effective design.

2. Protection from charged capacitance of long cables

Locking HV insulated plugs / Non-removable test clips

All Megger 5 kV, 10 kV and 15 kV insulation testing test leads are fitted with locking HV plugs at the instrument end. This reduces the likely hood of a plug loosing connection or pulling out; a situation which would could result in the load inadvertently remaining lethally charged at the end of a test and the instrument to incorrectly report that no voltage was present.

The lock facility is simple to use and prevents "plug end" disconnection and therefore helps ensure the integrity of load discharge after a test.



Simply align the arrows on the plug finger guard with the padlock symbols on the instrument to lock, and twist 90° to align with the open padlocks to un-lock. In addition, for the same reason, the test clips are not removable from the test lead.

3. Protection from high voltage in CAT IV 600 V environments

As connection is made to more upstream supply systems, (Overvoltage Category IV relates to incoming supplies of inductrial premises), increased protection is required from overvoltages. These are transients that naturally occur on the supply, which are typically caused by switching actions or distant lightning strikes and present the connected equipment, test leads, clips etc with impulses of many thousands of volts. Such equipment must provide protection to the operator during the process of connection. A clip rated for use on a 600 V supply in overvoltage category CAT IV must be able to withstand such impulses up to 8 kV.

Megger Test clips are moulded from a high dielectric strength insulating polymer with carefully defined dimensions to ensure electrical creepage and clearance distances are maintained even under adverse conditions. For instance the unique fins on the front of Meggers large test clips are there not for styling, but to maintain the all important electrical creepage distances necessary for such environments whilst retaining a reasonably small and usable design.

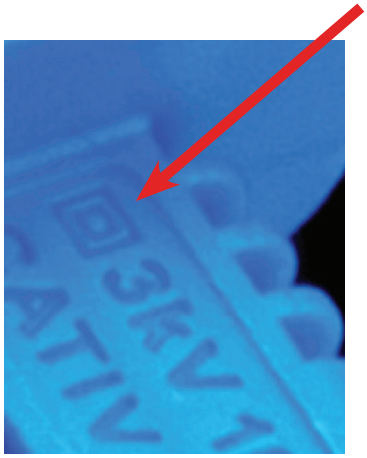
4. Protection from instrument output (5 kV, 10 kV 15 kV)

Many people fear the electrical output from their insulation tester which may be 5, 10 or 15 kV. However, in reality the current available from the instrument is generally limited to a few milliamprers and in itself presents a relatively low hazard. Whilst highly unpleasant a low current shock from an insulation tester will make you jump but under most conditions is only a serious hazard to those with a heart condition or fitted with a pace maker.

The hazard here is not so much the output of the instrument but more the working environment. If the connected load is capacitive, a long cable perhaps, this can provide very significant energy when charged to high voltage by the instrument, and could prove lethal if touched. Additionally when testing insulation in many HV environments, it is not

uncommon to have to climb ladders to reach connections on equipment such as transformers with associated risks of working at height. In such situations even a small electric shock can cause the user to jump with potentially serious circumstances if this causes a fall. Fully insulated Megger clips help minimise the risk.

Test clip markings explained with respect to protection to instrument output



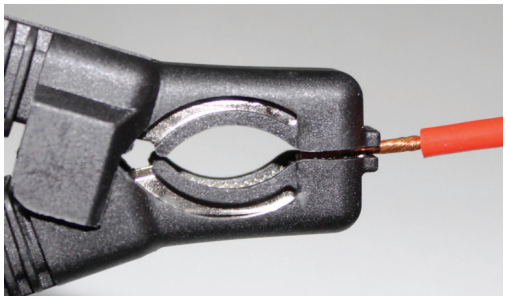
The square inside a square symbol is the IEC symbol for double insulation. In this example the test clip is therefore rated to 3 kV double insulation. In terms of protecting the user from the low energy output of an insulation tester this provides single insulation protection to 6 kV, enough to protect the user from the output of an insulation tester set to a test voltage of up to 6 kV

Likewise a test lead marked double insulated with 5 kV is suitable to protect the user from a insulation tester set to a 10 kV output.

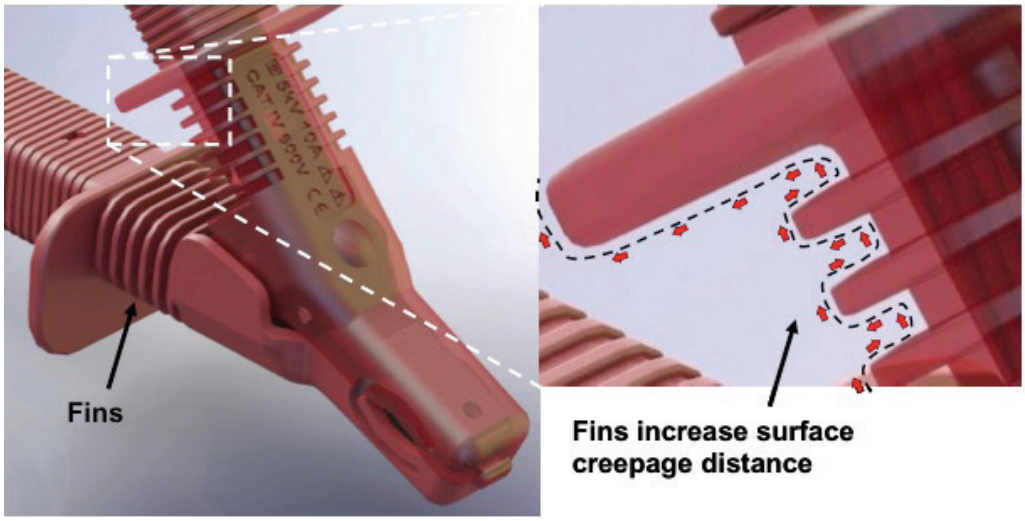
THE ANATOMY OF A GOOD QUALITY HV RATED CAT IV RATED TEST CLIP

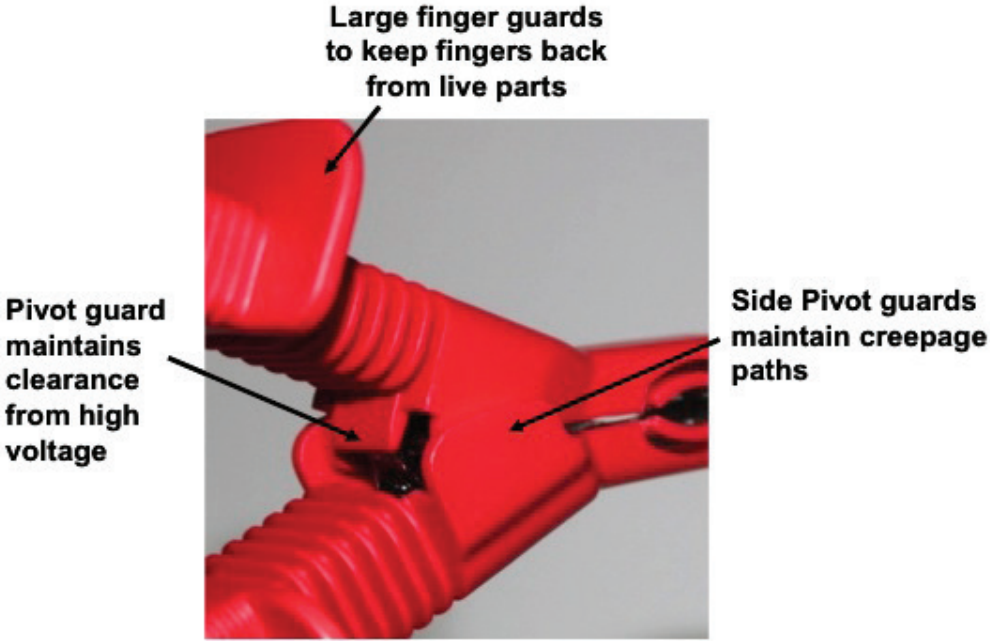
Curved jaws and wire gripping flat jaw tips

Curved jaws to allow reliable connection round test pieces and flat jaw tips to provide excellent connection and gripping of individual wires.



Designed to maintain creepage and clearance





Cable strain relief at both clip and plug designed to withstand 5000 flexes with 10N pull force applied

TEST LEADS AVAILABLE FOR MEGGER 5 KV, 10 KV AND 15 KV INSULATION TESTERS

MEDIUM TEST CLIP LEADS

Clip details:

Dimensions:	139 (L) X 73 (closed) mm
Lead lengths available:	3 m, 10 m and 15 m
Jaw opening:	18 mm diameter max
Number in set:	3
Double insulation rating:	3 kV d.c.
Basic insulation rating:	6 kV d.c.
Safety specification:	IEC61010-31:2008 The clips are therefore touch proof when closed
CAT rating:	600 V a.c. CAT IV

Cable details: 5 kV and 10 kV test leads

Lead lengths available:	3 m, 10 m and 15 m
Insulation rating:	12 kV d.c. (Marked on cable)
Cable type:	Flexible dual insulated silicon (inner insulation layer coloured white to highlight damage)

Cable details: 15 kV test leads

Lead lengths available:	3 m and 10 m
Insulation rating:	6 kV d.c. (Marked on cable)
Cable type:	Flexible dual insulated silicon (inner insulation layer coloured white to highlight damage)

Part numbers:

To fit all MIT and S1 5 kV and 10 kV instruments:

3 m (10 ft)	1002-531
5 m (16 ft)	1002-641
8 m (26 ft)	1002-642
10 m (33 ft)	1002-643
15 m (50 ft)	1002-644

To fit all MIT and S1 15 kV instruments:

3 m (10 ft)	1005-262
10 m (16 ft)	1005-263

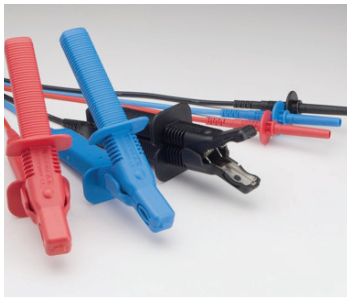
These test leads may also be supplied in none standard lengths to suit a particular application. Please contact Megger for a quotation. Minimum order quantities may apply.

Medium clip application notes:

These clips are designed for clamping on larger diameter test pieces but where space is at a premium. The insulation is designed only to protect the user from the output of Megger 5 kV, 10 kV and 15 kV (set below 6 kV) insulation resistance testers.

The clips cannot in any circumstance be relied on to protect the user from live systems above 600 V a.c. in a CAT IV environment, or 1000 V a.c. in a CAT III environment.

LARGE TEST CLIP LEADS



Clip details:

Dimensions:	220 (L) X 134 (closed) mm
Jaw opening:	34 mm diameter max
Number in set:	3
Double insulation rating:	5 kV d.c.
Basic insulation rating:	10 kV d.c.
Safety specification:	IEC61010-31:2008 The clips are therefore touch proof when closed.
CAT rating:	600 V a.c. CAT IV

Cable details: 5 kV and 10 kV test leads

Lead lengths available:	3 m, 10 m and 15 m
Insulation rating:	12 kV d.c. (Marked on cable)
Cable type:	Flexible dual insulated silicon (inner insulation layer coloured white to highlight damage)

Cable details: 15 kV test leads

Lead lengths available:	3 m, 5m, 10 m and 15 m
Insulation rating:	15 kV d.c. (Marked on cable)
Cable type:	Flexible dual insulated silicon (inner insulation layer coloured white to highlight damage)

Part numbers:

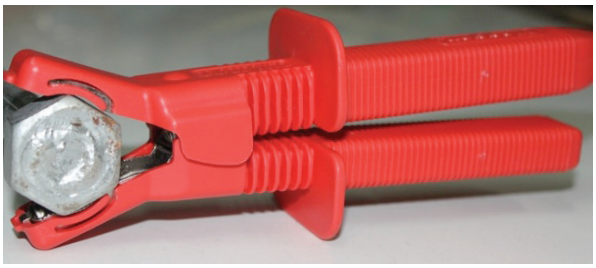
To fit all MIT and S1 5 kV and 10 kV instruments:

3 m (10 ft)	1002-534
5 m (16 ft)	1002-645
8 m (26 ft)	1002-646
10 m (33 ft)	1002-647
15 m (50 ft)	1002-648

To fit all MIT and S1 15 kV instruments

3 m (10 ft)	1002-949
5 m (16 ft)	1005-259
10 m (33 ft)	1005-260
15 m (50 ft)	1005-261

These test leads may also be supplied in none standard lengths to suit a particular application. Please contact Megger for a quotation. Minimum order quantities may apply.



Large test clip application notes:

These clips are designed for clamping on larger diameter test pieces. The insulation is designed only to protect the user from the output of Megger 5 kV, 10 kV and 15 kV (set below 10 kV) insulation resistance testers.

The clips cannot in any circumstance be relied on to protect the user from live systems above 600 V a.c. in a CAT IV environment, or 1000 V a.c. in a CAT III environment.

COMPACT TEST CLIP LEADS

Clip details:

Dimensions:	58 (L) X 25 (closed) mm
Lead lengths available:	3 m, 10 m and 15 m
Jaw opening:	18 mm diameter max
Number in set:	3
Double insulation rating:	None
Basic insulation rating:	None
CAT rating:	Not applicable

Cable details:

Lead lengths available:	3 m, 10 m and 15 m
Insulation rating:	12 kV d.c. (Marked on cable)
Cable type:	Flexible dual insulated silicon (inner insulation layer coloured white to highlight damage)

Part numbers:

To fit all MIT and S1 5 kV and 10 kV instruments

3 m	8101-181
8 m	8101-182
15 m	8101-183

Application notes:

These clips are designed for clamping on test pieces where access is limited. There is no insulation on these clips. Extreme care must be taken to avoid electric shock when connecting/disconnecting due to the bare metallic clips.

CONTROL CIRCUIT TEST SET

Clip details:

Dimensions:	58 (L) X 25 (closed) mm
Jaw opening:	20 mm dia max (clip)
Number in set:	2
Double insulation rating:	1 kV d.c.
CAT Rating:	600 V a.c. CAT III

Probe details:

Number in set:	2
Double insulation rating:	1 kV d.c.
CAT Rating:	600 V a.c. CAT IV

Cable details:

Lead length:	3 m
Insulation rating:	1 kV d.c.
Cable type:	Flexible double insulated silicon (inner insulation layer coloured white to highlight damage

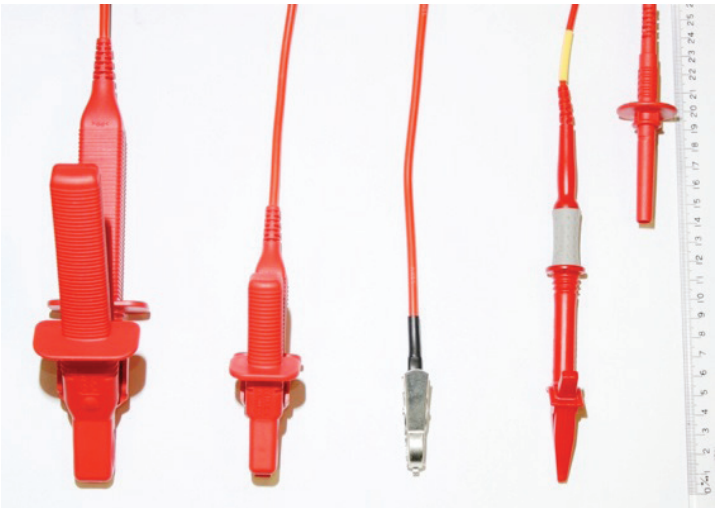
Part number:	To fit all MIT and S1 5 kV and 10 kV instruments 6220-822 To fit all MIT and S1 15 kV instruments 1005-264

Application notes:

These clips are designed for testing low voltage circuits with test voltages up to 1 kV. The insulation is designed only to protect the user from the output of Megger 5 kV and 10 kV insulation resistance testers set to a maximum output voltage of 1 kV.

Do not use this lead set at voltages above 1 kV.

CLIP SIZE COMPARISON



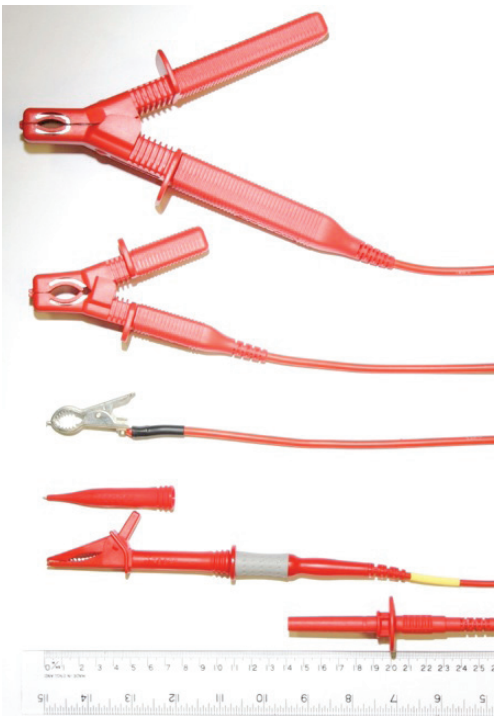
Large *Medium* *Compact* *Control*

Large

Medium

Compact

Control



FUSED PROBE AND CLIP TEST LEAD SET (FOR MIT515, MIT525, MIT1025 AND MIT1525)

Clip details:

Dimensions:	90 (L) X 41 (closed) mm
Jaw opening:	20 mm dia max (clip)
Number in set:	2
Double insulation rating:	1 kV d.c.
CAT Rating:	600 V a.c. CAT IV

Probe details:

Number in set:	2
Double insulation rating:	1 kV d.c.
CAT Rating:	600 V a.c. CAT IV

Cable details:

Lead length:	1.25 m
Insulation rating:	1 kV d.c.
Cable type:	Flexible double insulated silicon (inner insulation layer coloured white to highlight damage
Fuse rating:	FF500 mA 50 kA see notes below
Part number:	**To fit all MIT and S1 5 kV and 10 kV instruments 1002-913**
	To fit all MIT and S1 15 kV instruments 1005-265

Application notes:

This fused probe and clip leadset is designed for testing low voltage circuits with test voltages up to 1 kV. The leadset is GS38 compliant, fitted with FF500 mA 50 kA fuses, which allows voltage measurements to be made in safety when using the user selectable voltage measuring range on the MIT515, MIT525 and MIT1025 instruments.

These clips are designed for testing low voltage circuits with test voltages up to 1 kV. The insulation is designed only to protect the user from the output of Megger 5 kV, 10 kV and 15 kV insulation resistance testers up to a maximum instrument test voltage of 1 kV.

The clips cannot in any circumstance be relied on to protect the user from live systems above 600 V a.c. in a CAT IV environment, or 1000 V a.c. in a CAT III environment.

It is important to check fuse continuity before and after a test

COMPACT TEST CLIP WITH 5 KV OR 10 KV SCREENED CABLE

Clip details

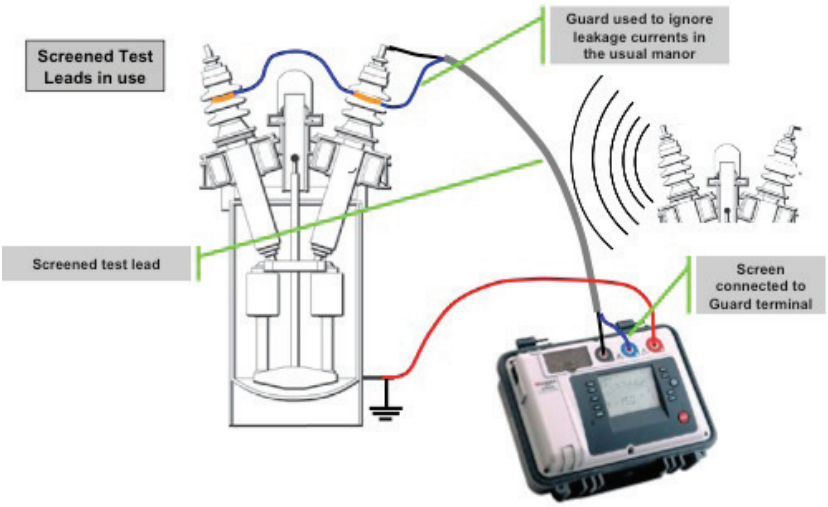
Dimensions:	58 (L) X 25 (closed) mm
Jaw opening:	18 mm diameter max
Number in set:	3
Double insulation rating:	None
Basic insulation rating:	None
CAT rating:	Not applicable

Cable details:

Lead lengths available:	5 kV rated 3 m, 15 m
	10 kV rated 3 m, 10 m, 15 m
Insulation rating:	5 kv or 10 kV d.c.
Cable type:	Flexible screened PVC

Part numbers: To fit all MIT and S1 5 kV and 10 kV instruments

5 kV rated	3 m	6220-835
5 kV rated	15 m	6311-080
10 kV rated	3 m	6220-834
10 kV rated	10 m	6220-861
10 kV rated	15 m	6220-833



COMPACT TEST CLIP WITH 15 KV SCREENED CABLE

Clip details

Dimensions:	208 (L) X 140 (closed) mm
Jaw opening:	28 mm diameter max
Number in set:	2
Double insulation rating:	7.5 kV d.c.
Basic insulation rating:	15 kV d.c.
CAT rating:	1000 V CAT IV

Cable details:

Lead lengths available:	15 kV rated 3 m, 10 m, 15 m, 20 m
Insulation rating:	15 kV d.c.
Cable type:	Flexible screened PVC

Part numbers: To fit all MIT and S1 15 kV instruments

3 m	1005-266
10 m	1005-267
15 m	1005-268
20 m	1005-269

Screened test lead application notes:

Relative motion between unshielded long leads for a D.C. test causes a variation in capacitance between them. This in turn causes very low frequency currents to flow, creating interference with the D.C. being measured. In addition induced current from nearby cables or radiated noise from corona around HV bushings can interfere with measurements causing unstable readings. This can be greatly reduced by using a screened lead set. The positive (red) test lead is not screened as it is usually connected to ground. The negative (black) lead is shielded with the shield connected to the guard terminal. Induced currents flow to the guard terminal and are therefore not measured.

Note: The shielded test lead cannot remove capacitive induced currents from the system. For example, overhead lines moving in the wind can still result in capacitive currents being impressed on the insulation measurement. The effect will be seen as a slow variation in reading. However, this effect can be removed from the measurement by selecting one of the four averaging filters on the S1-1568.

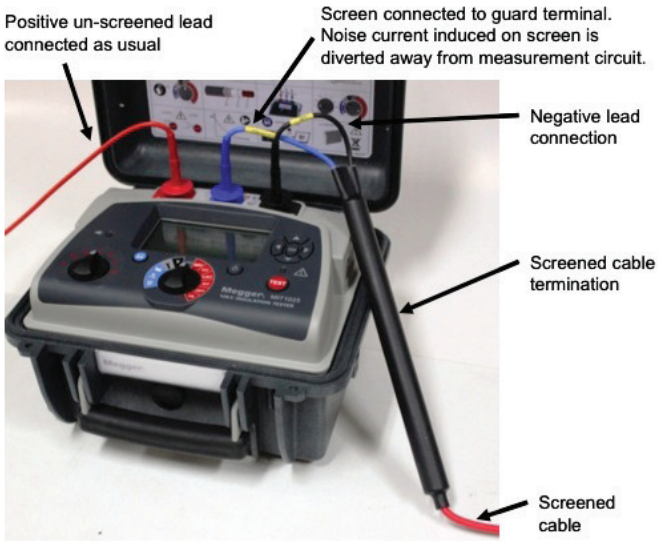
The screened test lead set consists of:

- A black/negative test lead that has been screened. The screen is connected to the guard terminal of the instrument and terminated with a bare clip.

15 kV Screened test leads

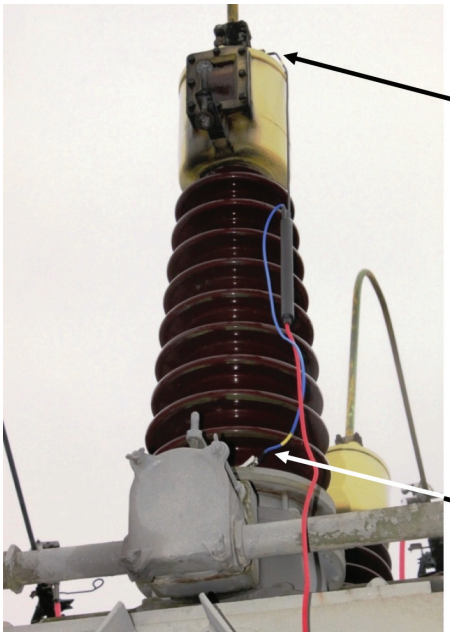
5 kV, 10 kV Screened test leads

- A red/positive test lead that is not screened. Normal practice means that the positive lead is connected to ground (usually to limit the effects of electro-endosmosis), meaning any induced noise current goes straight to earth and not into the instrument.



SCREENED TEST LEAD SET IN USE:

Screened cable running down the side of a transformer to the insulation tester.

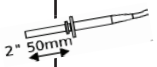
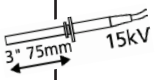
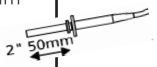
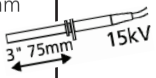
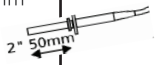


Negative lead connected in usual way

Guard lead connected to remove the effects of leakage (In this case winding to transformer case measuring between windings)

Screened test leads are an important accessory for those working in high noise environments, and/or locations where test lead leakage could be a problem.

5 KV, 10 KV AND 15 KV TEST LEAD SELECTION CHART

Clip type	Clip capacity	HV Plug	Cat. No.	Description	Safety CAT rating	Leads supplied as standard and optional								
						5 kV Insulation testers					10 kV Insulation testers		15 kV Insulation testers	
						BM15	MJ15	MIT515	MIT525	S1-568	MIT1025	S1-1068	MIT1525	S1-1568
Medium test clip	18mm 		1002-531	3m (10ft), 6 kV MEDIUM insulated clip, set of 3	CATIV 600 V	❑	❑	■	■	■	■	■		
			1002-641	5m (16ft), 6 kV MEDIUM insulated clip, set of 3	CATIV 600 V	❑	❑	❑	❑	❑	❑	❑		
			1002-642	8m (26ft), 6 kV MEDIUM insulated clip, set of 3	CATIV 600 V	❑	❑	❑	❑	❑	❑	❑		
			1002-643	10m (33ft), 6 kV MEDIUM insulated clip, set of 3	CATIV 600 V	❑	❑	❑	❑	❑	❑	❑		
			1002-644	15m (50ft), 6 kV MEDIUM insulated clip, set of 3	CATIV 600 V	❑	❑	❑	❑	❑	❑	❑		
			1005-262	3m leadset (x 3, red, blue, black) , medium insulated clips	CATIV 600 V								■	■
			1005-263	10m leadset (x 3, red, blue, black) , medium insulated clips	CATIV 600 V								❑	❑
Large test clip 10 kV	34mm 		1002-534	3m (10ft), 10 kV LARGE insulated clip, set of 3	CATIV 600 V	❑	❑	❑	❑	❑	■	■		
			1002-645	5m (16ft), 10 kV LARGE insulated clip, set of 3	CATIV 600 V	❑	❑	❑	❑	❑	❑	❑		
			1002-646	8m (26ft), 10 kV LARGE insulated clip, set of 3	CATIV 600 V	❑	❑	❑	❑	❑	❑	❑		
			1002-647	10m (33ft), 10 kV LARGE insulated clip, set of 3	CATIV 600 V	❑	❑	❑	❑	❑	❑	❑		
			1002-648	15m (50ft), 10 kV LARGE insulated clip, set of 3	CATIV 600 V	❑	❑	❑	❑	❑	❑	❑		
Large test clip 15 kV	38mm 		1005-259	5m leadset (x 3, red, blue, black) , large insulated clips	CATIV 1000 V								❑	❑
			1005-260	10m leadset (x 3, red, blue, black) , large insulated clips	CATIV 1000 V								❑	❑
			1005-261	15m leadset (x 3, red, blue, black) , large insulated clips	CATIV 1000 V								❑	❑
Compact Clip	18mm 		8101-181	3m (10ft), BARE COMPACT clip, set of 3	NONE	■	■	❑	❑	❑	❑	❑		
			8101-182	8m (26ft), BARE COMPACT clip, set of 3	NONE	❑	❑	❑	❑	❑	❑	❑		
			8101-183	15m (50ft), BARE COMPACT clip, set of 3	NONE	❑	❑	❑	❑	❑	❑	❑		

Continued...

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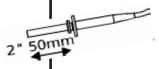
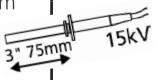
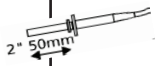
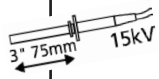
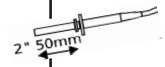
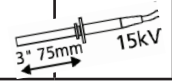
Clip type	Clip capacity	HV Plug	Cat. No.	Description	Safety CAT rating	BM15	MJ15	MIT515	MIT525	S1-568	MIT1025	S1-1068	MIT1525	S1-1568
Compact clip	18mm		6220-835	3m (10ft), BARE COMPACT clip, 5 kV SCREENED black lead, 3 clips, 2 leads	NONE	❑	❑	❑	❑	❑				
			6311-080	15m (50ft), BARE COMPACT clip, 5 kV SCREENED black lead, 3 clips, 2 leads	NONE	❑	❑	❑	❑	❑				
			6220-834	3m (10ft), BARE COMPACT clip, 10 kV SCREENED black lead, 3 clips, 2 leads	NONE						❑	❑		
			6220-861	10m (33ft), BARE COMPACT clip, 10 kV SCREENED black lead, 3 clips, 2 leads	NONE	❑	❑	❑	❑	❑	❑	❑		
			6220-833	15m (50ft), BARE COMPACT clip, 10 kV SCREENED black lead, 3 clips, 2 leads	NONE						❑	❑		
Large test clip 15 kV	38mm		1005-266	3m (9.8ft) Leadset, 15 kV Screened, large insulated clips	CATIV 1000 V								❑	❑
			1005-267	10m (33ft) Leadset, 15 kV Screened, large insulated clips	CATIV 1000 V								❑	❑
			1005-268	15m (49ft) Leadset, 15 kV Screened, large insulated clips	CATIV 1000 V								❑	❑
			1005-269	20m (66ft) Leadset, 15 kV Screened, large insulated clips	CATIV 1000 V								❑	❑
1 kV un-fused	20mm		6220-822	3m (10ft), 1 kV insulated probe and clip set for CONTROL CIRCUIT TESTING, set of 2	Clip = CATIII Probe = CATIV 600 V	❑	❑	❑	❑	❑	❑	❑		
			1005-264	3m (10ft), 1 kV insulated probe and clip set for CONTROL CIRCUIT TESTING, set of 2	Clip = CATIII Probe = CATIV 600 V								❑	❑
1 kV fused	20mm		1002-913	1.25m (4ft) 1 kV insulated FUSED probe and clip set for <1 kV voltage measurements, set of 2.	CATIV 600 V			❑	❑		❑			
			1005-265	1.25m (4ft) 1 kV insulated FUSED probe and clip set for <1 kV voltage measurements, set of 2.	CATIV 600 V								❑	❑

❑ = Optional

■ = Supplied as Standard

= Not avaliable for this model

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ADDITIONAL SAFETY WARNINGS

Safety Warnings must be observed during use.

- The circuit under test must be switched off, de-energised, isolated and checked to be safe before insulation test connections are made. Make sure the circuit is not reenergised whilst the instrument is connected.
- Circuit connections must not be touched during an insulation test.
- After completing a test, capacitive circuits must be completely discharged before disconnecting the test leads. Capacitive charges can be lethal.
- Tested items should be firmly shorted out with a shorting link, after discharge, until required for use. This is to guard against any stored dielectric absorption charge subsequently being released thereby raising the voltage to potentially dangerous levels.
- Test leads, including crocodile clips, must be in good order, clean, dry and with no broken or cracked insulation.
- The lead set should not be used if any part of it is damaged.
- These accessories are not designed to provide full levels of safety isolation to the operator if touched. The required physical dimensions would render this impractical. Safe working practices must be used.
- All safety warnings in the instruments user guide must be fully read and observed during use.

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