Hastings Hot Line Tools
T&C Tester

Catalog Number 6793

TRANSFORMER and CAPACITOR
TESTER

INSTRUCTION MANUAL

HASTINGS
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Tester

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1.0 INTRODUCTION

The HASTINGS Catalog Number 6793 Transformer and Capacitor Tester (T&C) is a battery-operated microcontroller-based device, used to perform a simple quick test on a wide range of de-energized distribution transformers and fully discharged capacitors. It is designed to give maintenance personnel a final confidence check to ensure that no abnormalities exist before energizing the device. Both visual and audible indications are provided to show the condition of the device being checked. Four separate possible results are indicated:
Xfmr OK, Cap OK, OPEN or SHORT. A 'low-battery' warning light will alert the user that the battery should be replaced.

2.0 PRINCIPLE OF OPERATION

The basic operating principle is based on stored energy in the inductance or the capacitance of the device. A low voltage pulse, of short duration, is applied across the device and the resulting current and terminal voltage is monitored during and for a short period after the applied pulse.
If the device is inductive in nature then the current flow through the device should be relatively small and subsequently to the applied pulse a counter

electromotive force (c.e.m.f.) should be detected. If c.e.m.f is detected after the application of the test pulse, the unit will indicate Xfmr OK.

If no c.e.m.f. is detected but test current was present during the test pulse application and decreased over the duration of the test pulse , the unit will indicate Cap OK.

If no c.e.m.f. is detected and test current was present during the test pulse application but did not decreased over the duration of the test pulse, the unit will indicate SHORT.

If no test current was present during the test pulse application, the unit will indicate OPEN.

Due to the extensive range of distribution transformer ratings to which the T&C can be applied, a special test algorithm was developed to cope with the variety of winding inductance and shunt capacitance that may be encountered. In most cases, this test algorithm will also detect and indicate SHORT for shorted windings other than the winding having the test pulse applied.

Due to the low level of the test pulse being applied it is critical the capacitors be fully discharged before being tested. If the capacitance value is too large the T&C will not be able to distinguish it from a short circuit and will indicate a SHORT. Similarly, if the capacitance is too small the T&C will indicate OPEN.

Warning: Partial inter-turn shorts or shorts which only appear when high voltage is applied may not always be detected.

3.0 APPLICATIONS

3.1 TRANSFORMERS

The T&C is used as a field instrument to check single and multi-phase distribution transformer installations. For the most reliable indication of the transformer condition, ALL windings of the transformer should be tested. (See operating procedure 4.2)

The T&C can be used as a quick screening test for transformers taken out of service or before being placed in service. Tests can be performed on any of the transformer windings to reveal short circuits or open circuits caused by open connections, open internal fuses, or tripped breakers. The T&C can also be used on a variety of other transformers such as instrumentation, control, potential, buck-boost and autotransformers.

3.2 CAPACITORS

The T&C is used as a field instrument to check single and multi-phase capacitor installations. For the most reliable indication each of the capacitors should be check individually. (See operating procedure 4.2)

The T&C can be used as a quick screening test for capacitors taken out of service or before being placed in service. Tests can be performed on any of the capacitors to reveal short circuits or open circuits caused by open connections, or open internal fuses.

4.0 OPERATING PROCEDURE

! WARNING !
THE T&C TESTER
MUST ONLY BE USED ON
DE-ENERGIZED EQUIPMENT

4.1 SELF TEST

Whenever the T&C is operated it first performs a self test on its audio alarm and LED indicators as well as performing a low battery level check before testing the connected transformer. To verify proper functioning of the T&C, connect the test leads together and PUSH & HOLD the pushbutton for a minimum of FOUR SECONDS. During the self test the following indications should be received:

- Short double beep
- Single flash of SHORT (red)
- Single flash of OPEN (yellow)
- Single flash of Xfmr OK (green)
- Single flash of Cap OK (green)

Immediately following the self test, the indication should be four audible beeps and a continuous red light. This test confirms that the internal connectivity is intact, including the fuse inside of the T&C. If the same test is repeated with the test leads left open, two audible beeps and the yellow OPEN LED will be indicated. This test will not test for an open fuse inside of the T&C. (See 5.0 Maintenance)

4.2 NORMAL OPERATION

WARNING: Ensure that transformers to be tested are fully de-energized and capacitors are fully discharged!

After performing the self test as described in section 4.1, disconnect the secondary leads and connect the test leads to the device under test. PRESS & HOLD the pushbutton as long as required to obtain a continuous light (approximately 4 seconds).
NOTE: Because the pushbutton applies battery volts to the internal circuitry, it should not be released during the test. Allow about two seconds for the microcontroller to reset after the pushbutton is released and before repeating a test.

Test Results:
SHORT – red LED, 4 short beeps
OPEN – yellow LED, 2 long beeps
Xfmr OK – green LED, 1 long beep
Cap OK – green LED, 1 long beep

Note: It is good practice to perform a self test immediately after an OPEN indication, by moving one test lead and connecting it to the other, pressing the pushbutton and verifying the SHORT result. This will rule out possible open T&C test leads or a blown internal fuse.

5.0 MAINTENANCE

The T&C is housed in a rugged watertight ABS (acrylonitrile-butadiene-styrene) case and contains no user serviceable parts other than the 9V alkaline battery. The unit includes a high interrupting capacity fuse that will blow should the unit be inadvertently connected to an energized transformer secondary of up to 600V. The fuse does not protect the T&C circuitry and no attempt should be made to replace the custom fuse. When the fuse has blown, other components will have been damaged and the complete unit should be returned to the manufacturer for repair or replacement.

6.0 BATTERY REPLACEMENT

The alkaline 9V battery will operate down to about 6V before the low battery LED will flash. To replace the battery, remove the screw cover strips on the rear of the unit and remove the four Philips head screws to open the back cover and gain access to the battery.

7.0 SPECIFICATIONS

Size:	3.2x4.8x2.4 inches leads not included
Case Material:	High impact ABS, NEMA 4, UL94HB flammability rating, Stainless steel cover screws, No external exposed metal
Leads:	#20 AWG stranded, 30 cm coiled, extended to 1.5m each (12 inches coiled, extended to 5 feet each), Alligator clip jaw opening, 1.5 cm (0.6 in)
Outputs:	ultra-bright LEDs, 2400 Hz audio buzzer
Operating Temp:	Operates to -40°F
Storage Temp:	-40°F to 158°F
Battery:	9V alkaline
Battery Life:	In excess of 1 year (Depending on use)
Carrying Case:	Blow moulded black polyethylene

Operating Range

Transformers:	Up to 3300kVA
Capacitors:	0.5 to 300 micro Farads

8.0 WARRANTY

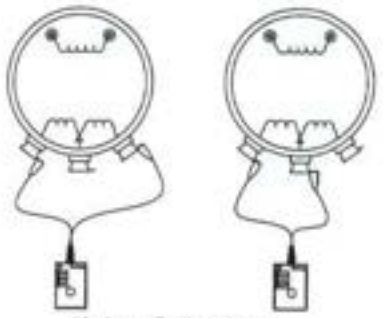
HASTINGS warrants the catalog number 6793 T&C to be free from manufacturing defects, for a period of one year from the date of purchase to the original owner. At the discretion of the company, units returned under this warranty shall be either repaired or replaced at no cost to the customer. This warranty will not apply to normal wear and tear or inappropriate use or abuse of the device.

Connection Diagrams for Single Phase Transformers

TCLC (Transformer and Capacitor Last Check)

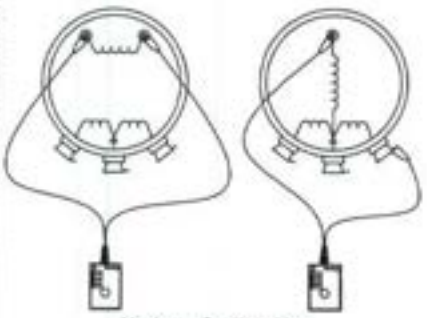
The diagrams below, for single and double bushing overhead transformers, show various connections when using the 6793 tester. We have shown the reading that will be obtained "IF" the transformer is good.

Testing Secondary
Single or Double Bushing



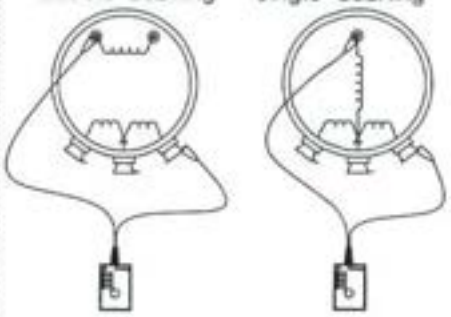
Meter Indication
Green (Xfmr O.K.) Green (Xfmr O.K.)

Testing Primary
Double Bushing Single Bushing



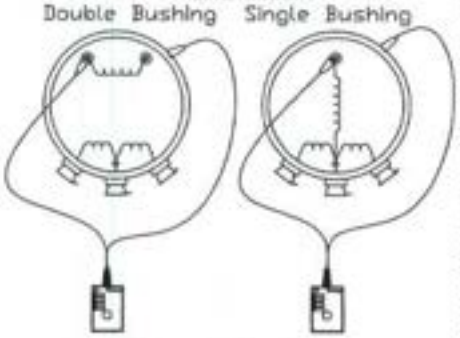
Meter Indication
Green (Xfmr O.K.) Green (Xfmr O.K.)

Testing between Primary
and Secondary
Double Bushing Single Bushing



Meter Indication
Yellow (OPEN) Green (Xfmr O.K.)

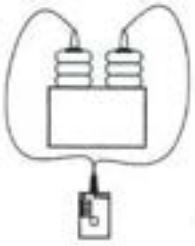
Testing between Primary
and Case
Double Bushing Single Bushing



Meter Indication
Yellow (OPEN) Green (Xfmr O.K.)

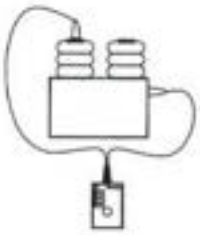
The diagrams below, for single and double bushing capacitors, show various connections when using the 6793 tester. We have shown the reading that will be obtained "IF" the capacitor is good.

Testing between
Bushings



Green (Cap O.K.)

Testing between
one Bushing and Ground



Yellow (OPEN)

Testing between
one Bushing and Ground

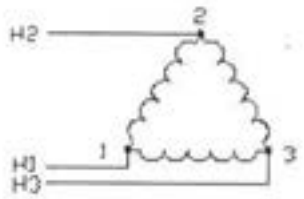
Green (Cap O.K.)

Application of TCLC on 3- Ø Transformers.

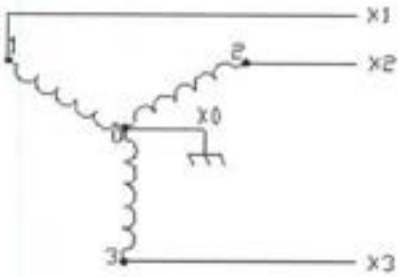
When applying the TCLC to 3-Ø transformers it will be necessary to know the internal connections of the transformer in order to interpret the results. The windings may be configured in either a DELTA or a Y configuration and the Y configuration may or may not be grounded. It is beyond the scope of this manual to detail the appropriate tests for all possible configurations.

Basically, tests will need to be done between each pair of phases as well as from each phase to neutral if present. Tests should also be conducted between the primary and secondary for each phase as well as the commons if they are available. A typical example having a DELTA connected primary and a GROUNDED-Y secondary is shown below.

DELTA CONNECTION



Y GROUNDED CONNECTION



TEST	Delta/Y-Gnd'd
X1 - X2	Xmfr OK
X2 - X3	Xmfr OK
X3 - X1	Xmfr OK
X1 - X0	Xmfr OK
X2 - X0	Xmfr OK
X3 - X0	Xmfr OK
H1 - H2	Xmfr OK
H2 - H3	Xmfr OK
H3 - H1	Xmfr OK
H1 - H0	N/A
H2 - H0	N/A
H3 - H0	N/A
H0 - X0	N/A
H1 - X1	OPEN
H2 - X2	OPEN
H3 - X3	OPEN

H – indicates Primary Winding connection

X – indicates Secondary Winding connection

N/A – not applicable

OPEN – indicates a bad connection or an open transformer winding

SHORT – indicates a short circuit in the transformer (or the connections to it)

For warranty or repair send units to:

HASTINGS FIBER GLASS PRODUCTS
770 South Cook Road
Hastings, MI 49058

Attn: Warranty Repair Department

For Enquiries or technical assistance call:

269-945-9541 or FAX 269-945-4623