

TEST REPORT

Report No. : 09-028

SUBJECT : Manual Motor Starter

TYPE : HMMS32K / HMMS80K

CONTENTS OF TEST : Type tests

Including the rated short circuit making
and breaking capacities test :

Ue	440 V
Icu	6 kA / 10kA
Ics	3 kA / 6kA (50% Icu)
Icm	7.5 kA / 12 kA

TESTED IN ACCORDANCE WITH : IEC 60947-2 (2003),
IEC 60947-4-1(2004)

TEST PLACE : HYUNDAI HEAVY INDUSTRIES CO. , LTD.
ELECTRO ELECTRIC SYSTEMS

TEST PERIOD : FROM 26th May, 2009
TO 27th May, 2009

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L/C NO. : BUF009388700529


PROFORMA INVOICE NO. : 2009EE00207,211

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Note. - The corresponding clause Nos. of IEC are shown in () after each test report clause heading.

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1. Ratings and specifications

Type designation		HMMS-32K, HMMS-80K	
Rated insulation voltage : U_i (ac, v)		690	
Rated current : I_n (A)		0.16, 0.25, 0.4, 0.63, 1, 1.6, 2.5, 4, 6.3, 10, 14, 18, 23, 25, 32, 40, 63, 80	
Rated frequency (Hz)		50, 60	
Number of poles		3, 4	
Rated ultimate short-circuit breaking capacity : I_{cu} (symmetrical r.m.s)		AC 440V	6kA
Rated service short-circuit breaking capacity : I_{cs} (symmetrical r.m.s)		AC 460V	3kA
Reference ambient air temp. (°C)		40, 45	
type of overcurrent release	Overload	Thermal type	
	Short circuit	Magnetic type (INST)	
Type of connections		Front (FC)	
		Rear (RC)	
		Plug-in (PC)	

2. Test sample and test item

Type of circuit-breaker		HMMS-32K, HMMS-80K	
		No.1	No.2
sample	Rated current	32	80
	Number of poles	3	
	Type of connection	PC	
Test items	1. Tripping limits and characteristics	×	×
	2. Dielectric properties	×	×
	3. Mechanical operation and operational performance capability	×	×
	4. Overload performance	×	×
	5. Dielectric withstand	×	×
	6. Temperature-rise	×	×
	7. Overload releases	×	×
	8. Rated ultimate short circuit breaking capacity	×	×

× Indicates test carried out


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3. Test results

3.1 Test of tripping limits and characteristics (8.3.3.1)

3.1.1 Opening under short circuit conditions (INST) (8.3.3.1.2)

Rated current (A)	Instantaneous current setting (A)	Test poles	Non-tripping test	Tripping test		Specified frange of operating current (A)
			Test current (A)	Test current (A)	Tripping time (ms)	
No.1 32	320	A-B	311	3321	6	(3000 to 4000)
		B-C	309	3243	8	
		C-A	306	3768	5	
No.2 80	800	A-B	760	8643	7	(8200 to 9000)
		B-C	750	8534	5	
		C-A	743	8953	4	

Notes 1. - The test current was symmetrical.

2. - The test was performed on all combinations of two poles in series.

3. - Test current duration was 200ms.

3.1.2 Opening under overload conditions (8.3.3.1.3)

3.1.2.1 Conventional non-tripping current and tripping current

Rated current In (A)	Non-tripping		Tripping		Ambient air temp (°C)	IEC Requirement
	Test current (1.05×In) (A)	Duration time	Test current (1.30×In) (A)	Trip time		
No.1 32	33.6	2 h	41.6	5'20"	40	2 * * 1hour when In ≤ 63A
No.2 80	84	2 h	104	5'32"		

' - min , " - sec

3.1.2.2 Checking of the time-current characteristics

Rated current (A)	Percent rated current (%)	Test current (A)	Tripping time	Ambient air temp (°C)	Specified range of tripping time
No.1 32	200	64	2'36"	40	1'20" to 4'10"
No.2 80		160	3'05"		1'20" to 4'10"

' - min , " - sec

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3.2 Test of dielectric properties (8.3.3.2)

3.2.1 Test conditions

Rated current (A)	32	80	IEC Requirement
Rated insulation voltage : U_i (V)	660		
frequency of supply source(Hz)	60		45 to 62
Test voltage (V)	2500		2500 +5% 0
Test duration	1 min		1 min
Application of the test voltage :	<p>a) with the circuit-breaker in the closed position :</p> <p>i) between all live parts of all poles connected together and the frame of the circuit breaker.</p> <p>ii) between each pole and all the other poles connected to the frame of the circuit breaker.</p> <p>b) with the circuit-breaker in the open position and in the tripped position :</p> <p>i) between all live parts of all poles connected together and the frame of the circuit breaker.</p> <p>ii) between the terminals of one side connected together and the terminals of the other side connected together.</p>		Same as test conditions

3.2.2 Test results

Rated current (A)	Test a) - i)	Test a) - ii)	Test b) - i)	Test b) - ii)
No.1 32	Good	Good	Good	Good
No.2 80	Good	Good	Good	Good

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3.3 Tests of mechanical operation and of operational performance capability (8.3.3.3)

3.3.1 Operational performance capability without current (8.3.3.3.3)

3.3.1.1 Test conditions

Rated current (A)	No.1	No.2	IEC requirement
	32	80	
Number of operating cycles per hour (c/h)	120	60	120 / 60
Number of operating cycles (c)	7500	4000	7500 / 4000

Note. - Test was made without current.

3.3.1.2 Test result

Circuit breaker was in satisfactory condition as before test.

3.3.2 Operational performance capability with current (8.3.3.3.4)

3.3.2.1 Test conditions

Rated current (A)	No.1	No.2	IEC Requirement
	32	80	
Number of phases	3	3	
Frequency (Hz)	60	60	45 to 62
Test current (A)	33	81	Ith : +5% 0
Test voltage (V)	662	664	Uemax : 660+5% 0
Power factor	0.79	0.8	0.8 ±0.05
Number of operating cycles per hour (c/h)	120	60	120 / 60
Number of operating cycles (c)	1000	1000	1000

3.3.2.2 Test results

Circuit breaker was in satisfactory condition as before test.

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3.4 Overload performance (8.3.3.4)

3.4.1 Test conditions

Rated current I_n (A)	No.1	No.2	IEC Requirement
		32	
Number of poles	3	3	
Frequency (Hz)	60	60	45 to 62
Test current (A)	193	482	$6 \times I_n : +5\%$ 0
Test voltage (V)	664	664	$U_{max} : 660 + 5\%$ 0
Power factor	0.50	0.49	0.5 ± 0.05
Recovery voltage (V)	700	700	$1.05 \times U_{max} : 693 + 5\%$ 0
Number of operating cycles per hour (c/h)	120	60	120 / 60
Number of operating cycles (c)	12	12	12

3.4.2 Test results

The circuit breaker closed and opened satisfactorily during all the tests. None of the components, including the contacts, showed signs of excessive wear. The mechanical parts were not deformed.

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3.5 Verification of dielectric withstand (8.3.3.5)

3.5.1 Test conditions

Rated current (A)	No.1	No.2	IEC Requirement
	32	80	
Rated insulation voltage : U_i (V)	660		
frequency of supply source(Hz)	60		45 to 62
Test voltage (V)	1380		$2 \times U_i : 1320 + 5\%$ 0
Test duration	1 min		1 min
Application of the test voltage :	<p>a) with the circuit-breaker in the closed position :</p> <p>i) between all live parts of all poles connected together and the frame of the circuit breaker.</p> <p>ii) between each pole and all the other poles connected to the frame of the circuit breaker.</p> <p>b) with the circuit-breaker in the open position and in the tripped position :</p> <p>i) between all live parts of all poles connected together and the frame of the circuit breaker.</p> <p>ii) between the terminals of one side connected together and the terminals of the other side connected together.</p>		Same as test conditions

3.5.2 Test results

Rated current (A)	Test a) - i)	Test a) - ii)	Test b) - i)	Test b) - ii)
No.1 250	Good	Good	Good	Good
No.2 400	Good	Good	Good	Good

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3.6 Verification of temperature-rise (8.3.3.6)

3.6.1 Test conditions

Rated current (A)	No.1	No.2	IEC Requirement
	32	80	
Supply source	Single phase		may be single phase current
Frequency (Hz)	60		-
Test current (A)	32	80	Ith : +5% 0
Test connections	PVC insulated conductors: Size... 150 mm ²	PVC insulated conductors: Size... 240mm ²	Same as test conditions
	Length of connection from terminal to terminal : 2m		
Test duration (h)	2.5	3.0	-
Ambient air temperature (°C)	27.6	28.1	+10 to +40
Use of enclosure	No	No	-

3.6.2 Test results (Temperature rise k)

Rated current (A)				No.1	No.2	Temperature rise limits *1
				32	80	
Type of connection				PC	PC	
Description of parts	Top side terminals	Pole	A	45.6	47.6	80 (75)
			B	42.6	50.8	
			C	44.5	52.2	
	Bottom side terminals	Pole	A	46.2	52.3	80 (75)
			B	45.4	54.4	
			C	43.2	50.7	
	Manual operating handle				13.3	14.7

* 1 - Standard ambient air temperature : 40°C

For an ambient air temperature of 45°C, the limits are shown in ().

* 2 - Determined from the limit on adjacent insulating materials of class B

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3.7 Verification of overload releases (8.3.3.7)

Rated current In (A)	Test current (1.45×In) (A)	Tripping time	Ambient air temp (°C)	Specified Tripping time
No.1 32	46.4	5' 27"	40	2* 1 hour when In ≤ 63A
No.2 80	116	5' 45"		

Note. - All three poles were connected in series.

' - min , " - sec

3.8 Rated ultimate short circuit breaking capacity (8.3.5)

3.8.1 Verification of overload releases (8.3.5.1)

Sample No.	Rated current (A)	Percent rated current (%)	Test pole	Test current (A)	Tripping time	Ambient air temp (°C)	Specified range Tripping time
No.1 32	32	200	A	64	2'32"	40	1'10" to 4'20"
			B	64	2'42"		
			C	64	2'28"		
No.2 80	80	200	A	160	3'06"		1'10" to 4'20"
			B	160	3'04"		
			C	160	3'12"		

' - min , " - sec

3.8.2 Rated ultimate short circuit breaking capacity test

3.8.2.1 Prospective current calibration

Sample No.& In	Assigned rated breaking capacity Icu	Osc. No.	Frequency	Phase	Prospective breaking current(kA,rms)	Power factor
No.1 32A	6kA at 440V	04072706	60Hz	A	6.2	0.21
				B	6.3	0.20
				C	6.1	0.24
				Average 3 phases	6.2	0.22

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3.8.2.2 Oscillogram data for rated ultimate short-circuit breaking capacity
In (Rated current) to test sample : 80A

Sample No. & In	Test condition	Osc. No. (Operation)	Phase	Let through current peak (kA)	Recovery voltage * (Average 3phases) (V)
No.2 80A	Applied line voltage : 460V	04062707 (O) 3(mim)	A	27.7	270.0
			B	35.7	
			C	28.2	
	Prospective sym. current : 25kA	04062708 (CO)	A	25.7	270.4
			B	34.1	
			C	30.7	

* Minimum required voltage (line to line) of average 3 phases : $U_e \times 1.05$

3.8.2.3 Behaviour of the circuit breaker during short-circuit making and breaking tests (8.3.2.6.5)

Rated current	Results	IEC Requirement
32A	Good	There shall be neither arcing nor flashover between poles, or between poles and frame and no melting of the fusible element F in the leakage detection circuit.
80A	Good	

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Kehar Singh

3.9 Verification of dielectric withstand (8.3.5.3)

3.9.1 Test conditions

Rated current (A)	32 / 80	IEC Requirement
Rated insulation voltage : U_i (V)	660	
Frequency of supply source (Hz)	60	45 to 62
Test voltage (V)	1000	$2 \times U_e$ (not less than 1000) : 1000+5% 0
Test duration	1 min	1 min
Application of the test voltage :	<p>a) with the circuit-breaker in the closed position :</p> <p>i) between all live parts of all poles connection together and frame of the circuit breaker.</p> <p>ii) between each pole and the other poles connected to the frame of the circuit breaker.</p> <p>b) with the circuit-breaker in the open position and in the tripped position :</p> <p>i) between all live parts of all poles connected together and the frame of the circuit breaker.</p> <p>ii) between the terminals of one side connected together and the terminals of the other side connected together.</p>	Same as test conditions

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3.9.2 Test results

Test sample	Test a) - i)	Test a) - ii)	Test b) - i)	Test b) - ii)
32A	Good	Good	Good	Good
80A	Good	Good	Good	Good

3.10 Verification of overload releases (8.3.5.4)

Sample No.	Rated current (A)	Percent rated current (%)	Test pole	Test current (A)	Tripping time	Ambient air temp (°C)	specified range of tripping time
No.1 32A	32	250	A	80	1'16"	40	40" ~ 2'10"
			B	80	1'20"		
			C	80	1'22"		
No. 2 80A	80		A	200	1'18"		40" ~ 2'10"
			B	200	1'17"		
			C	200	1'14"		

Note. - Tested on each pole separately.

' - min , " - sec

3.11 Rated service short circuit breaking capacity test (8.3.4.1)

3.11.1 Prospective current calibration

Sample No.	Assigned rated breaking capacity Ics	Osc. No.	Frequency	Phase	Prospective breaking current(kA,rms)	Power factor
80A	10kA at 440V	05011305	60Hz	A	10.2	0.29
				B	10.4	0.30
				C	10.2	0.29
				Average 3 phases	10.3	0.29

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3.11.2 Oscillogram data for rated service short-circuit breaking capacity
In (Rated current) to test sample : 80A

Sample No. & In	Test condition	Osc. No. (Operation)	Phase	Let through current peak (kA)	Recovery voltage * (Average 3phases) (V)
No.2 80A	Applied line voltage : 440V Prospective sym. current : 10kA	05011306 (O) 3(min)	A	10.2	271
			B	10.3	
			C	10.0	
		05011307 (CO) 3(min)	A	9.7	272
			B	9.7	
			C	9.9	
		05011308 (CO)	A	10.0	272
			B	10.2	
			C	10.1	

* Minimum required voltage (line to line) of average 3 phases : $U_e \times 1.05$

3.11.2 Behaviour of the circuit breaker during short-circuit making and breaking tests (8.3.2.6.5)

Rated current	Results	IEC Requirement
32A	Good	There shall be neither arcing nor flashover between poles, or between poles and frame and no melting of the fusible element F in the leakage detection circuit.
80A	Good	

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3.12 Verification of operational capability with current (8.3.4.2)

3.12.1 Test conditions

Rated current (A)	No.1 32	No.2 80	IEC Requirement
Number of phases	3	3	
Frequency (Hz)	60	60	45 to 62
Test current (A)	32	81	Ith : +5% 0
Test voltage (V)	664	664	Uemax : 660+5% 0
Power factor	0.79	0.78	0.8 ±0.05
Number of operating cycles per hour (c/h)	120	60	120 / 60
Number of operating cycles (c)	50	50	50

3.12.2 Test results

Circuit breaker was in satisfactory condition as before test.

3.13 Verification of dielectric withstand (8.3.4.3)

3.13.1 Test conditions

Please refer the condition sheet written in the next page

3.13.2 Test results

Rated current (A)	Test a) - i)	Test a) - ii)	Test b) - i)	Test b) - ii)
No.1 32	Good	Good	Good	Good
No.2 80	Good	Good	Good	Good

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Rated current (A)	32 / 80	IEC Requirement
Rated insulation voltage : U_i (V)	660	
Frequency of supply source (Hz)	60	45 to 62
Test voltage (V)	1000	$2 \times U_e$ (not less than 1000) : $1000 + 5\%, -0$
Test duration	1 min	1 min
Application of the test voltage :	<p>a) with the circuit-breaker in the closed position :</p> <p>i) between all live parts of all poles connection together and frame of the circuit breaker.</p> <p>ii) between each pole and the other poles connected to the frame of the circuit breaker.</p> <p>b) with the circuit-breaker in the open position and in the tripped position :</p> <p>i) between all live parts of all poles connected together and the frame of the circuit breaker.</p> <p>ii) between the terminals of one side connected together and the terminals of the other side connected together.</p>	Same as test conditions

3.14 Verification of temperature-rise (8.3.4.4)

3.14.1 Test conditions

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Rated current (A)	No.1	No.2	IEC Requirement
	32	80	
Supply source	Single phase		may be single phase current
Frequency (Hz)	60		-
Test current (A)	32	80	Ith : +5%, -0
Test connections	PVC insulated conductors: Size... 150mm ²	PVC insulated conductors: Size... 240mm ²	Same as test conditions
	Length of connection from terminal to terminal : 2m		
Test duration (h)	2.6	3.2	-
Ambient air temperature (°C)	27.6	28.4	+10 to +40
Use of enclosure	No	No	-

3.14.2 Test results (Temperature rise k)

Rated current (A)				No.1	No.2	Temperature rise limits *1
				32	80	
Type of connection				PC	PC	
Description of parts	Top side terminals	Pole	A	52.0	52.0	80 (75)
			B	55.3	54.6	
			C	55.3	61.4	
	Bottom side terminals	Pole	A	48.7	54.0	80 (75)
			B	49.1	62.5	
			C	50.7	56.8	
	Manual operating handle				13.2	15.7

* 1 - Standard ambient air temperature : 40°C

For an ambient air temperature of 45°C, the limits are shown in ().

* 2 - Determined from the limit on adjacent insulating materials of class B

3.15 Verification of overload releases (8.3.4.5)

Rated current In (A)	Test current (1.45×In) (A)	Tripping time	Ambient air temp (°C)	Specified Tripping time
No.1 32	46.4	5' 05"	40	2* 1 hour when In ≤ 63A
No.2 80	116	5' 24"		

Note. - All three poles were connected in series.

' - min , " - sec

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