Factory and Site Acceptance Testing

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1. Introduction

Acceptance testing is an important process in the implementation of any traffic signal installation, be it brand new or modification of an existing one. Testing is generally carried out in two stages. Firstly the configuration and controller hardware are tested prior to installation on street. Secondly the completed installation is tested prior to the signals being switched on.

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2. Factory Acceptance Testing

This process is used to validate the configuration and/or hardware of a traffic signal controller, historically referred to as a Factory Acceptance Test (FAT) as it always used to be performed at the factory of the controller manufacturer. However, these days configuration testing is often carried out remotely using an emulation/simulation software package and this could be:

- In the Customer's office
- At the office of a independent configuration specialist
- At the local depot of the installation company
- At some other third party location

If configuration testing is carried out remotely it is then sometimes followed up by a hardware test at the factory/depot and this would include green conflict testing. If a hardware test is not attended then it is wise to ask the installation company to carry out green conflict testing and provide certified evidence of this.

It is important that these tests are carried out prior to installation on site, but there are occasions when these tests may be omitted, e.g. if only making minor timing changes to an existing site. Anything that changes site operation or safety related facilities should have a FAT.

Testing is essentially a check that the data configured matches the controller specification forms and that it provides the required method of control. It is recommended that tests are conducted to a previously prepared schedule, but time should be made available for unstructured testing. Particular attention during tests should be paid to input data consisting of safety related items and specially conditioned functions.

There are a lot of different test schedules in existence with many organisations having their own customised versions. However there are still some who just work through the controller specification checking the data on each form. The advantage of using a test schedule is that you end up with a signed record of the testing that was performed for future reference.

I have my own Factory/Site Acceptance Test Schedule, originally created 18 years ago, (see section 4). This has evolved over time to cover the latest facilities available and to incorporate improvements. The factory testing section covers the following areas:

- Start-up
- Phases/stages
- Controller timings
- Mode priority
- Manual panel
- Detector inputs/timings
- Modes of operation (FT, VA, CLF, UTC, MOVA, Part-Time, Hurry Call, Vehicle Priority)
- All red and/or intergreen extensions
- Pedestrian linking
- Lamp monitoring
- Special conditioning
- Green conflicts

3. Site Acceptance Testing

This process is used to validate the installation of a traffic or pedestrian signal installation. Site Acceptance Testing (SAT), also referred to as commissioning, is always required for new installations and a reduced version is advisable when changes are made to operation or safety related facilities on existing sites.

It is important that these tests are carried out prior to the signals being switched on, but there are occasions when these tests may be omitted, e.g. if only making minor timing changes to an existing site.

Testing is essentially a check that the site has been installed correctly to the design drawings/specifications and that everything is operating as it should. As with the FAT it is recommended that tests are conducted to a previously prepared schedule and again there are a lot of different ones in existence.

The site acceptance test section of my schedule (see section 4) covers the following areas:

- General items, (including visual inspection, labelling, flash testing, signal equipment, head alignments, phase clearances, dimming, time/date, cable testing)
- Detection connected/operating correctly
- UTC operation
- MOVA operation (Validation usually carried out later on)
- Remote monitoring operation
- Lamp monitoring
- Linking

A site should never be switched on unless all safety related items are fully operational. However, it can be switched on with some minor snags still to be resolved if they will not compromise site operation. For example a faulty IN loop will not prevent the site running and neither would an OMU that has not been set-up properly.

4. Factory/Site Acceptance Test Schedule

Following is an example copy of my test schedule for Siemens controllers. I also have a version for Microsense/Telent controllers.

Copies of these are available on request.

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FACTORY/SITE ACCEPTANCE

TEST SCHEDULE

FOR TR2500 CONTROLLER

CUSTOMER :	
SITE NAME :	
SITE REFERENCE :	
CONTROLLER TYPE :	***SIEMENS*** ***T400 / ST700 / ST800 / ST750 / ST900 / ST950*** ***LV / ELV***
CONFIG REFERENCE :	***E***
CONFIG ISSUE :	

FACTORY ACCEPTANCE TEST RESULTS

DATE OF TEST :		PASSED / FAILED (delete as appropriate)
TEST METHOD:	CONTROLLER / TEST RIG / EMULATOR (delete as appropriate)	
COMMENTS		
LATEST DATE FOR CORRECTIVE ACTION :		
SUPPLEMENTARY FAT REQUIRED YES / NO (delete as appropriate)		
TRAFFIC SIGNAL ENGINEER :	Name: Signature:	
SIGNAL COMPANY ENGINEER OR CONSULTANT :	Name: Signature:	

FACTORY ACCEPTANCE TESTS

General:

	Pass/Fail
Check Configuration Identity Code Number & Issue with the Specification (CIC)	
Note serial number of controller, (if available)	

Set all detectors to off, all computer bits to off, select Normal on the Manual Panel. Switch on mains supply, initialise RAM (PME, TKE, LRN, CNN), check time/date (STM, CKL, TOD, DAY, WEK) and switch signals on, (N/A if using Emulator). NB. Use PME=249 to obtain level 3 access.

Check controller starts up in correct stage and that the correct indications are given	
Check the starting inter-green time (IGS)	
Check that the controller serves all specified phases/stages after start-up	
Check phase appearance and termination types	
Check dimming is configured, if requested	

Use the handset to check the following basic parameters are as specified:-

Minimum Green times (MIN)	
Phase Green Extension times (EXT)	
Maximum Green times (MAX, MBX, MCX, MDX, MEX, MFX, MGX, MHX)	
Pedestrian Blackout times (PBT)	
Pedestrian Window times (PWN)	
Intergreen times (IGN)	
Phase Delay times (DPG, DMV, DFZ, DMF, DMT)	
Timetable Entries and Event Parameters (TSW, TDY,TTB)	
Handset Limit Values (MTV, ITV) – try setting some times outside limit values	
Pedestrian Sequence times (PAR, PIT, PBT, CMX, CDY, CRD)	

Mode Priority:

Check that the mode priority operates as specified (MOD, STS)	

Manual Mode:

Check manual disable via handset, if specified (MND)	
Select each configured manual button & check stage/phase relationship is correct	
Check any optional appearance phases under manual mode are as specified	
Check permitted stage to stage movements	
Check that non-permitted movements give the correct indication	
Check that leaving manual mode inserts demands for all specified phases/stages	
Check operation of all other buttons/switches on the manual panel	

FACTORY ACCEPTANCE TESTS – continued

Detection:

	Pass/Fail
Check DFM times are as specified (DFD, DGP, DSA, DSI)	
Check Call/Cancel times are as specified (DCL & DCN)	
Check for correct active states on each detector input (IPS)	
Check for correct DFM force states on each detector input (DFA)	
Check Input Extension times are as specified (IPX)	
Check that all inputs perform the correct functions, e.g. latched/unlatched demands, green extensions, light wait indicators, etc (SPH)	
Check SD/SA loop spacing is as specified	
Check SD/SA Extension times are as specified	
Check SD/SA Extra Intergreen times are as specified (SCT)	
Check SD/SA operation	

FT Mode:

Select fixed time mode and check for correct stage sequence	
Check fixed time stage durations, if specified (FIX, FTS, LFT)	
Check fixed time runs to current phase maximums (if specified)	
Check any demand dependant stages/phases	
Check that leaving fixed time mode inserts demand for all specified phases/stages	
Check fixed time data/operation for Reserve State (FIX) – ST950 only	

VA Mode:

Check stage change logic and stage movement constraints (i.e. permitted, prohibited, alternative moves)	
Check that arterial reversion occurs to the correct stage/phase if no demands/extensions present (if specified)	
Check that correct revertive phase demands occur if extension running when maximum green expires (SPH)	
Check operation of signals with permanent demands on all detectors ensuring that all phases are satisfied	

CLF Mode:

Check plan timings/influences are as specified (PLT, PLI, IFA, IFB, IFC, IFD, CYC, PLE, PLX, OFF, IFN, IFS)	
Check that all plans operate, especially demand dependant stages	
Check CLF permitted movements by writing a plan with a non-permitted move in it	

FACTORY ACCEPTANCE TESTS – continued

UTC Mode:

	Pass/Fail
Check mode changes when force bit is active, with TC bit if specified (MOD, STS)	
Check operation of non-demand dependant force bits	
Check operation of demand dependant force bits with both street demands and D-bits and check that any stage demand reply bits are returned correctly	
Check stage change logic and stage to stage movement restrictions (i.e. permitted, prohibited, alternative)	
Check for correct operation with multiple force bits	
Check DX bit runs specified stages/phases to maximum in VA mode	
Check operation of any other miscellaneous control bits	
Check that the correct G-bit replies are returned for each stage	
Check reply bits for specific controller conditions (lamps off, DFM, manual, etc)	
Check operation of any other miscellaneous reply bits	
Check operation of serial SCOOT detectors	

MOVA Mode (Integral or add-on):

Check mode changes when force bit is active with TO bit (MOD, STS)	
Check operation of force bits	
Check stage change logic and stage to stage movement restrictions (i.e. permitted, prohibited, alternative)	
Check for correct operation with multiple force bits	
Check that the correct G-bit replies are returned for each stage	
Check that any phase confirm bits are correctly returned	
Check operation of CRB reply bit (PIR, CDT, MVC, MVD, MVR)	
Check operation of serial MOVA detectors	

Part Time Mode:

Check timetable change points by altering the clock (STM, CKL, TOD)	
Check that signals switch off in correct stage, once mins have expired (MOD, STS)	
Check queue detector operation	
Check minimum on/off operating timers if specified	
Check operation of part-time inhibit switch	

FACTORY ACCEPTANCE TESTS – continued

Hurry Call Mode:

	Pass/Fail
Check Hurry Call Delay times are as specified (DHC)	
Check Hurry Call Hold times are as specified (HHC)	
Check Hurry Call Prevent times are as specified (PHC)	
Check operation of request detectors	
Check operation of cancel detectors	
Check that correct stage is called in relation to the detector (MOD, STS)	
Check that mode change cannot cause a lock-up situation	

Vehicle Priority Mode:

Check Priority unit basic requirements are as specified (PUT, PUP, PMT, PDE, PRE, PRI, PDR, PUI, PSE, PSA, PVG)	
Check Priority Extension times are as specified (PVE)	
Check Priority Maximum times are as specified (PVM)	
Check Inhibit times are as specified (PVI)	
Check Phase Compensation times are as specified (PCn)	
For each priority unit check operation of priority demands/extensions, inhibit periods and compensation periods (PVU, PVP, PVS, PIA, PDS, PIU)	

All Red Extensions:

Check All Red Extension times are as specified (REX)	
Check All Red Maximum times are as specified (RMX)	
Check that appropriate detectors extend appropriate stage moves	
Check Extensions are operative or auto-extend to max in the appropriate modes	

Intergreen Delays:

Check Intergreen Delay data is as specified (IDL, IDG, IDP)	
Check operation of Intergreen Delays (IDI)	
Check Delays are operative or auto-extend to max in the appropriate modes	

Pedestrian Linking:

Check Pedestrian Link timings are as specified (PIR, CDT)	
Check operation of pedestrian link	
Check operation of override timer	

FACTORY ACCEPTANCE TESTS – continued

Lamp Monitoring:

	Pass/Fail
Check that general lamp monitoring operates if required	
Check that 1 red lamp out extends appropriate intergreens by the specified duration (SIE, RLT)	
Check that 2 reds out inhibit conflicting ped phases or shutdown part-time streams	
Check that failure of all (or 2) monitored reds on a channel of a stand-alone pedestrian stream causes shutdown	
Check that red lamp failure actions cease when lamps are replaced, (if required)	

Special Conditioning:

Check operation of any special conditioning not already covered	

Green Conflict Monitoring:

Check all green/green conflicts using a test box (or CFZ on IC4 Emulator)	
Check fault log for correct conflict data (FLF, FLD, FFS, FDS, LOG)	

NB. See next page for conflict test record sheet.

Miscellaneous:

Perform any other miscellaneous tests that may be required (define below):-

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GREEN CONFLICT TEST RECORD SHEET

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A2	B2	C2	D2	E2	F2
A																																
B																																
C																																
D																																
E																																
F																																
G																																
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Y																																
Z																																
A2																																
B2																																
C2																																
D2																																
E2																																
F2																																

Site Name:		Config Ref:	**E**	Config Issue:	
Name:		Signature:		Date of test:	

SITE ACCEPTANCE TEST RESULTS

DATE OF TEST :		PASSED / FAILED (delete as appropriate)
COMMENTS		
LATEST DATE FOR CORRECTIVE ACTION :		
SUPPLEMENTARY SAT REQUIRED YES / NO (delete as appropriate)		
TRAFFIC SIGNAL ENGINEER :	Name: Signature:	
SIGNAL COMPANY ENGINEER OR CONSULTANT :	Name: Signature:	

SITE ACCEPTANCE TESTS

General:

	Pass/Fail
Perform visual inspection for neat wiring, base seal, ancillary equipment fitted, etc	
Check that cables and equipment are labelled as required	
Perform flash testing to ensure all signal aspects are wired correctly & operating	
Check all signal equipment installed as per site drawings and check head alignments	
Check that all phase clearances are of a safe duration	
Check for correct dimming voltage connection	
Check operation of solar cell by covering	
Check that time and date are correct (STM, CKL, TOD, DAY, WEK)	
Check that BST Changeover Weeks are correct (BSA, BSR, CKA, CKR)	
Check that electrical cable and earthing tests have been performed, (certificates should be provided)	

Detection:

Check all loop detector packs for the correct settings	
Check that all loops are connected to the correct controller input (IOP, DET)	
Check that all above ground detectors are connected to the correct controller input	
Check that all push button units are connected to the correct controller input	
Check that all wait indicators are functioning correctly along with any tactiles/audibles	
Check for correct operation of push buttons with kerbside detection	
Check for correct operation of on-crossing detectors	
Check SD/SA for correct operation with Soundmark Test set	
Check for correct operation of any Hurry Call inputs	

UTC Mode (or add-on MOVA):

Check that all control bits are connected to the correct controller input (IOP)	
Check that all reply bits are connected to the correct controller output (IOP)	

MOVA:

If not Validating MOVA immediately check that the mode runs	
Validate MOVA data set(s)	

NB: refer to MCH 1542 for the full MOVA commissioning procedure

Remote Monitoring:

Check that OMU can be dialled from instation	
Check that correct controller status/fault information is returned to the instation	

SITE ACCEPTANCE TESTS - continued

Lamp Monitoring:

	Pass/Fail
Check that general lamp failures are detected and reported correctly	
Check that 1 red lamp out extends appropriate intergreens by the specified duration	
Check that 2 reds out inhibit conflicting ped phases or shutdown part-time streams	
Check that failure of all (or 2) monitored reds on a channel of a stand-alone pedestrian stream causes shutdown	
Check that red lamp failure actions cease when lamps are replaced, (if required)	

Linking:

Check that any linking signals operate correctly	

Miscellaneous:

Perform any other miscellaneous tests that may be required (define below):-

1.	
2.	
3.	
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