FILTER WHEEL SPECIAL TEST

This test should be run on real hardware.

Before running the test, disable ITOS range checking on;
the Filter parameter in iFWFilter,
the Pos parameter in iFWAbs,
the Steps parameter in iFWRelative,
the NumPulses parameter in iFWPulse,
the Current parameter in iFWSetCoarse,
the Current parameter in iFWSetFine,
and the PullInRate, CruiseRate and Acceleration parameters in iFWSetRate.

After the test has finished, re-enable the range checks.

For information, the filter positions are;

Station on filter wheel (same as filter number)	**Optic name**	**Filter wheel step count after datum**
0	Blocked (or Datum or Blank)	0
1	Grism1 (UV)	200
2	UVW2	400
3	V	600
4	UVM2	800
5	Grism2 (visible)	1000
6	UVW1	1200
7	U	1400
8	Magnifier	1600
9	B	1800
10	White	2000

This table will have to be referred to throughout the filter wheel testing.

This informal test is adapted from the Build 3 Test, and any ancillary testing done should be hand documented and attached to this document.

1.1 Initial conditions

Before starting to move the filter wheel it must be positioned at datum, as once this has been done initially, the software then works by dead reckoning from that position onwards. The filter wheel is automatically positioned at datum on start-up. The tests below force a problem in positioning at datum.

Send the commands
```
/iFWSetCoarse Current=0
/iFWDatum
```

An error message should be received, stating 'FW lost position', and a verification message stating 'Unsuccessful Execution'.

'FW Lost Position' received Y/N _____________
'Unsuccessful Execution' received Y/N_________

Send the command
```
/iFWFilter 5
```

An error message should be received, stating 'FW not yet datumed'.

Error message received Y/N _____________

If both responses above are Y's then the test is successful.

Test Successful __________

Initials _________ Date ___________ Time ___________

To continue testing ensure that the filter wheel is datumed.
Send the commands
```
/iFWSetCoarse Current=8
/iFWDatum
```

1.2 Set filter wheel position by filter

Make a note here of the current value of FW Rotation Count in housekeeping ________

From housekeeping, check that the mechanism task is asleep and its counter is not increasing.

Task mechanism asleep Y/N_____________________
Mechanism task counter unchanging Y/N___________

Send the command
```
/iFWFilter Filter=10
```

Then repeat this command ten times with the number changed to 9, 8, 7, 6, 5, 4, 3, 2, 1, and 0 respectively. This number is the filter number, which is the same as the number of the filter station on the filter wheel.

While the first command is being run, check that the mechanism task comes alive and its counter increases at 20 per hk packet.

Task mechanism alive Y/N_____________________
Mechanism task counter increases by 20 per hk packet Y/N___________

In each case, a 'successful acceptance' verification packet should be received, and the filter wheel should move to the position requested, as seen on both the hardware and the housekeeping display. After each command bar the first, the FW rotation count in housekeeping should increase by 1.

Station on filter wheel	**'Successful acceptance' received Y/N**	**Filter wheel seen at position requested on hardware Y/N**	**Filter wheel seen at position requested in housekeeping Y/N**
10			
9			
8			
7			
6			
5			
4			
3			
2			
1			
0			

FW Rotation count after all commands sent ____________

Increase in rotation count is 10 Y/N______________

Also send the command
`/iFWFilter Filter=19`

A verification error message should be received, stating 'illegal parameter values'.

Error message received Y/N ___________________________________

If all the responses in columns 2, 3 and 4 of the table above are Y's and the final response is a Y then the test is successful.

Test Successful __________

Initials _________ Date ___________ Time ___________

1.3 Set filter wheel position absolutely

Send the command
`/iFWAbs Pos=2199`

Then repeat this command ten times with Pos set to 1800, 1600, 1400, 1200, 1000, 800, 600, 400, 200 and 0 respectively. Pos takes the number of steps from datum of the required position.

In each case, a 'successful acceptance' verification packet should be received, and the filter wheel should move to the position requested, as seen on both the hardware and the housekeeping display.

Position	**'Successful acceptance' received Y/N**	**Filter wheel seen at position requested on hardware Y/N**	**Filter wheel seen at position requested in housekeeping Y/N**
2199			
1800			
1600			
1400			
1200			
1000			
800			
600			
400			
200			
0			

Also send the command
`/iFWAbs Pos=2200`

A verification error message should be received, stating 'illegal parameter values'.

Error message received Y/N ______________________________________

If all the responses in columns 2, 3 and 4 of the table above are Y's and the final response is a Y then the test is successful.

Test Successful __________

Initials _________ Date ___________ Time ___________

1.4 Set filter wheel position relative to current position

First position the filter wheel at a filter with the command
`/iFWFilter Filter=5`

Then send the command
`/iFWRelative Steps=0`

Repeat these two commands four times with Steps set to 100, 200, 2200 and 2201 respectively. Steps takes the number of steps that the filter wheel is required to move.

In the first and last cases, an 'illegal parameter values' message should be received and the filter wheel should not move.
In the other cases, a 'successful acceptance' verification packet should be received, and the filter wheel should move by the amount requested, to the position shown in the table below. The movement should be seen on both the hardware and the housekeeping display.

For Steps=0, error message received Y/N ______________
And filter wheel does not move Y/N ______________________
And filter wheel shown at 5 on housekeeping Y/N____________

Steps	**Expected final position of filter wheel**	**'Successful acceptance' received Y/N**	**Filter wheel seen at position requested on hardware Y/N**	**Filter wheel seen at position requested in housekeeping Y/N**
100	1100			
200	1200 ie on filter 6			
2200	1000			

For Steps=2201, error message received Y/N ___________
And filter wheel does not move Y/N ______________________
And filter wheel shown at 5 on housekeeping Y/N____________

If all the responses including those in columns 3, 4 and 5 of the table above are Y's then the test is successful.

Test Successful __________

Initials _________ Date ___________ Time ___________

1.5 Set filter wheel position by fine sensor pulses

First position the filter wheel between filters with the commands
`/iFWFilter Filter=5`
`/iFWRelative Steps=100`

Send the command
`/iFWPulse NumPulses=0`

Then repeat these three commands four times with NumPulses set to 1, 6, 11 and 12 respectively. NumPulses takes the number of fine sensor pulses that the filter wheel is required to move past, settling on the last one.

In the first and last cases, an 'illegal parameter values' message should be received and the filter wheel should not move.
In all the other cases, a 'successful acceptance' verification packet should be received, and the filter wheel should move by the amount requested. The movement should be seen on both the hardware and the housekeeping display.

For NumPulses=0, error message received Y/N ______________
And filter wheel does not move Y/N _______________________
And the filter wheel stays at 1100 in housekeeping Y/N________

NumPulses	Expected final position of filter wheel	'Successful acceptance' received Y/N	Filter wheel seen at position requested on hardware Y/N	Filter wheel seen at position requested in housekeeping Y/N
1	On filter 6			
6	On datum			
11	On filter 5			

For NumPulses=12, error message received Y/N _____________
And filter wheel does not move Y/N _______________________
And the filter wheel stays at 1100 in housekeeping Y/N________

If all the individual responses and all the responses in columns 3, 4 and 5 of the table above are Y's then the test is successful.

Test Successful __________

Initials _________ Date ___________ Time ___________

1.6 Move filter wheel to datum

First, position the filter wheel at datum and then command it to move to datum

```
/iFWFilter Filter=0
/iFWDatum
```

Second, position the filter wheel at a filter and then command it to move to datum

```
/iFWFilter Filter=5
/iFWDatum
```

Third, position the filter wheel between filters and then command it to move to datum

```
/iFWFilter Filter=5
/iFWRelative Steps=100
/iFWDatum
```

In each case, a 'successful acceptance' verification packet should be received. In the first case the filter wheel should not move. In the latter two cases the filter wheel should move to datum. The movement should be seen on both the hardware and the housekeeping display.

Filter wheel position before move to datum	**'Successful acceptance' received Y/N**	**Filter wheel moved to/stayed at datum as seen on hardware Y/N**	**Filter wheel moved to/stayed at datum as seen in housekeeping Y/N**
Datum			
5			
Between 5 and 6			

In the latter two cases a 'FW at Requested Position' message should also be received.

First 'FW at Requested Position' received Y/N__________
Second 'FW at Requested Position' received Y/N__________

If all the responses in columns 2, 3 and 4 of the table above and the responses above are Y's then the test is successful.

Test Successful __________

Initials _________ Date ___________ Time ___________

1.7 Move filter wheel to coarse sensor position

First, position the filter wheel at datum and then command it to move to the coarse sensor position

```
/iFWDatum
/iFWCoarse
```

Second, position the filter wheel at a filter and then command it to move to the coarse sensor position

```
/iFWFilter Filter=5
/iFWCoarse
```

Third, position the filter wheel between filters and then command it to move to the coarse sensor position

```
/iFWFilter Filter=5
/iFWRelative Steps=100
/iFWCoarse
```

In each case, a 'successful acceptance' verification packet should be received. In the first case the filter wheel should not move. In the latter two cases the filter wheel should move until it first picks up the coarse sensor, x steps around the filter wheel. The movement should be seen on both the hardware and the housekeeping display. This test also acts as the calibration test – the value of x should be consistent throughout.

X value _______________

Filter wheel position before move	**'Successful acceptance' received Y/N**	**Filter wheel moved to/stayed at coarse sensor as seen on hardware Y/N**	**Filter wheel moved to/stayed at coarse sensor as seen in housekeeping Y/N**
Datum			
5			
Between 5 and 6			

If all the responses in columns 2, 3 and 4 of the table above are Y's then the test is successful.

Test Successful __________

Initials _________ Date ___________ Time ___________

1.8 Stop filter wheel moving

First send the command
`/iFWStop`

A 'successful acceptance' verification packet should be received, and the filter wheel should not move. In housekeeping the filter wheel should stay in the same position.

'Successful Acceptance' received Y/N_________
Filter wheel moves Y/N____________________

Second, datum the filter wheel and then set it moving and stop it while it's in motion with the commands given below. The third command must be entered within 4s of entering the second.

```
/iFWDatum
/iFWAbs Pos=2190
/iFWStop
```

A 'successful acceptance' verification packet should be received, and the filter wheel should stop apparently immediately (actually within 4ms) . This can only be observed on the hardware as the housekeeping sampling rate is too low. The housekeeping display should also show a reasonable value as the filter wheel position. An NHK packet should also be received, with the message 'FW Move Aborted'

'Successful Acceptance' received Y/N_________
Filter wheel stops Y/N______________________
Reasonable position shown on hk Y/N_________
'FW Move Aborted' received Y/N____________

Then resume the originally commanded move.
`/iFWAbs Pos=2190`

The filter wheel should move to the requested position, and an NHK 'FW At Requested Position' message should be received.

Filter wheel moves Y/N_____________________
Position 2190 shown on housekeeping Y/N_______
'FW At Requested Position' received Y/N_______

Then reset the filter wheel with the command
`/iFWDatum`

If the responses above are Y, N, Y, Y, Y, Y, Y, Y and Y respectively then the test is successful.

Test Successful __________

Initials _________ Date ___________ Time ___________

1.9 Set coarse position sensor LED current

Send the commands

```
/iFWSetCoarse Current=0
/iFWRelative Steps=2200
```

Then repeat these commands twice with Current set to 15 and 8 respectively. Current takes a scaled value of the actual current. Leave it set on 8 after the test, as this is the default value.

In each case, a 'successful acceptance' verification packet should be received, and the housekeeping display and hardware should register the new current setting. The housekeeping display may refer to this value as the 'coarse sensor bias'. The LED is only turned on when the filter wheel is in motion, which is why the relative command is necessary.

Current	**'Successful acceptance' received Y/N**	**Current correct on housekeeping display Y/N**	**Current correct on hardware Y/N**
0			
15			
8			

Send the commands

```
/iFWSetCoarse Current=16
/iFWSetCoarse Current=-1
```

In both cases an 'Illegal Parameter Values' NHK message should be received.

For current=16, 'Illegal Parameter Values' received Y/N_____________
For current=-1, 'Illegal Parameter Values' received Y/N_____________

If all the responses in columns 2, 3 and 4 of the table above and the subsequent two responses are Y's then the test is successful.

Test Successful __________

Initials _________ Date ___________ Time ___________

1.10 Set fine position sensor LED current

Send the command
`/iFWSetFine Current=0`
`/iFWRelative Steps=2200`

Then repeat these commands twice with Current set to 15 and 9 respectively. Current takes a scaled value of the actual current. Leave it set on 9 after the test, as this is the default value.

In each case, a 'successful acceptance' verification packet should be received, and the housekeeping display and hardware should register the new current setting. The housekeeping display may refer to this value as the 'fine sensor bias'. The LED is only turned on when the filter wheel is in motion, which is why the relative command is necessary.

Current	**'Successful acceptance' received Y/N**	**Current correct on housekeeping display Y/N**	**Current correct on hardware Y/N**
0			
15			
8			

Send the commands
`/iFWSetFine Current=16`
`/iFWSetFine Current=-1`

In both cases an 'Illegal Parameter Values' NHK message should be received.

For current=16, 'Illegal Parameter Values' received Y/N_____________
For current=-1, 'Illegal Parameter Values' received Y/N_____________

If all the responses in columns 2, 3 and 4 of the table above and the subsequent two responses are Y's then the test is successful.

Test Successful __________

Initials _________ Date ___________ Time ___________

1.11 Set filter wheel step rates

Send the commands

1. `/iFWSetRate PullInRate=100, CruiseRate=420, Acceleration=2000`
2. `/iFWSetRate PullInRate=200, CruiseRate=200, Acceleration=2000`
3. `/iFWSetRate PullInRate=200, CruiseRate=310, Acceleration=2000`
4. `/iFWSetRate PullInRate=200, CruiseRate=420, Acceleration=2000`
5. `/iFWSetRate PullInRate=200, CruiseRate=420, Acceleration=1000`

each followed by the command
`/iFWPulse NumPulses=11`
and use a stopwatch to time the filter wheel as it makes its full rotation.

In each case, a 'successful acceptance' verification packet should be received and the time the filter wheel takes to do a full rotation should be approximately as given in the table below. This can only be observed on the hardware as the housekeeping sampling rate is too low.

Command	Expected full rotation time	'Successful acceptance' received Y/N	Full rotation time as expected Y/N
1	5s		
2	10.5s		
3	6.8s		
4	5s		
5	5s		

Send the commands

1. `/iFWSetRate PullInRate=1, CruiseRate=1, Acceleration=0`
2. `/iFWSetRate PullInRate=200, CruiseRate=420, Acceleration=2000`
3. `/iFWSetRate PullInRate=100, CruiseRate=200, Acceleration=0`
4. `/iFWSetRate PullInRate=100, CruiseRate=100, Acceleration=1000`
5. `/iFWSetRate PullInRate=100, CruiseRate=50, Acceleration=1000`

In the first two cases a a 'successful acceptance' verification packet should be received and in the latter three an 'Illegal parameter Values' NHK message should be received.

For command 1, 'Successful Acceptance' received Y/N__________

For command 2, ‘Successful Acceptance’ received Y/N__________
For command 3, ‘Illegal Parameter Values’ received Y/N__________
For command 4, ‘Illegal Parameter Values’ received Y/N__________
For command 5, ‘Illegal Parameter Values’ received Y/N__________

If all the responses in columns 3 and 4 of the table above, and the subsequent five responses, are Y’s then the test is successful.

Test Successful __________

Initials _________ Date ___________ Time ___________

1.12 Error Conditions

Load flight code icu.hex.

Check on the housekeeping display that the ICU is in the safe state.

ICU safe Y/N ______________

Send the command
```
/iFWPulse NumPulses=2
```

Check on the NHK display that an ‘Invalid for this State’ message has been received.

‘Invalid for this State’ received Y/N ____________

If all the responses above are Y’s then the test is successful.

Test Successful __________

Initials _________ Date ___________ Time ___________

1.13 Move the dichroic – optional test

This test has already been run for Build 3 with the telescope simulator. It would be desirable to rerun it with real hardware if that were possible.

Check from the telescope simulator display that the dichroic is in its default position ie. at the primary position, 0. Note that the housekeeping display shows the last movement made by the dichroic mechanism, not its actual position, and unlike most housekeeping counters, it shows a signed, decimal value.

1 - Send the command
`/iDMMove Number=1, Maximum`

A 'successful acceptance' verification packet and an NHK 'DM at Requested Position' message should be received and the dichroic should move to the redundant position, 31 on the telescope simulator, while housekeeping should show 32.

2 - Send the command
`/iDMMove Number=-1, Maximum`

A 'successful acceptance' verification packet and an NHK 'DM at Requested Position' message should be received and the dichroic should move to the primary position, 0 on the telescope simulator, while housekeeping should show -31.

3 - Send the command
`/iDMMove Number=-1, Maximum`

A 'successful acceptance' verification packet and an NHK 'DM at Requested Position' message should be received and the dichroic should stay at the redundant position, 31 on the telescope simulator, while housekeeping should settle at 32 after some movement.

4 - Send the command
`/iDMMove Number=0, Maximum`

An 'illegal parameter values' verification packet should be received and the telescope simulator and housekeeping displays should not change.

5 - Send the command
`/iDMMove Number=20, Magnitude`

A 'successful acceptance' verification packet and an NHK 'DM at Requested Position' message should be received and the dichroic should move to position 20 on the telescope simulator, while housekeeping should also show 20.

6 - Send the command
`/iDMMove Number=-20, Magnitude`

A 'successful acceptance' verification packet and an NHK 'DM at Requested Position' message should be received and the dichroic should move to the primary position, 0, on the telescope simulator, while housekeeping should show -20.

7 - Send the command
`/iDMMove Number=0, Magnitude`

An 'illegal parameter values' verification packet should be received and the telescope simulator and housekeeping displays should not change.

8 - Send the command
`/iDMMove Number=-20, Magnitude`

A 'successful acceptance' verification packet and an NHK 'DM at Requested Position' message should be received and the dichroic should stay at the primary position, 0 on the telescope simulator, while housekeeping should show -20.

Leave the dichroic in this position, which is the default.

Command	**'Successful acceptance' received Y/N**	**'DM at Requested Position' received Y/N**	**'Illegal parameter values' received Y/N**	**Dichroic behaved as expected on telescope simulator Y/N**	**Dichroic behaved as expected in housekeeping Y/N**
1			N/A		
2			N/A		
3			N/A		
4	N/A	N/A			
5			N/A		
6			N/A		
7	N/A	N/A			
8			N/A		

If all the responses in columns 2, 3, 4, 5 and 6 of the table above are Y's then the test is successful.

Test Successful __________

Initials _________ Date ___________ Time ___________

1.14 Stop the dichroic

Since this is a command that has altered since Build 3, this test must be performed, either on real hardware or on the telescope simulator.

First send the command
`/iDMStop`

A 'successful acceptance' verification packet should be received, and the dichroic should not move.

Second, set the dichroic moving and stop it while it's in motion with the commands given below. Check that the first command has taken effect before entering the second.
```
/iDMMove Number=1, Maximum
/iDMStop
```

A 'successful acceptance' verification packet should be received, and the dichroic should stop apparently immediately (actually within 0.5s) . This can only be observed on the hardware or telescope simulator as the housekeeping sampling rate is too low. An NHK 'DM Lost Position' message should be received. The housekeeping display should show the same number as the hardware or telescope simulator in this case.

After the test, reset the dichroic to its default position with the command
`/iDMMove Number=-1, Maximum`

Situation	**'Successful acceptance' received Y/N**	**'DM Lost Position' received Y/N**	**Dichroic behaved as expected on hardware or telescope simulator Y/N**	**Dichroic behaved as expected in housekeeping Y/N**
Command sent while stopped		N/A		
Command sent while moving				

If all the responses in columns 2, 3, 4 and 5 of the table above are Y's then the test is successful.

Test Successful __________

Initials _________ Date ___________ Time ___________

1.15 Motor Inhibit

This test can only be performed on the real hardware.

Check on the housekeeping that the motor inhibit circuit is enabled – this is the default.

Circuit enabled on housekeepingY/N______

Send the following commands, with a 1min wait between them

```
/iMotorInhibit Off
/iMotorInhibit On
```

Check on the housekeeping display that the motor inhibit circuit is disabled and then re-enabled. If it possible to probe the circuit directly do this as well.

Circuit disabled on housekeepingY/N________
Circuit re-enabled on housekeepingY/N______

Circuit disabled on hardware Y/N___________
Circuit re-enabled on hardware Y/N_________

If all the responses above are Y's then the test is successful.

Test Successful __________

Initials _________ Date ___________ Time ___________

1.16 Reset Camera Head

Load a window table and start integration using

```
/iBPEStartWndwLd Verify=Off, Force=1, Nwdw=1, xLow1=0,
yLow1=1, xSize1=255, ySize1=255
/iBPEInteg On
```

Check by probing that camera head currents go up

Currents go up Y/N___________

Send the reset camera head command

```
/iBPEHead
```

Check that the currents drop

Currents drop Y/N____________________

If both the responses above are Y's then the test is successful.

Test Successful __________

Initials _________ Date ___________ Time ___________

1.17 Safety Circuit Configuration

Send the commands

1. `/iBPESftyConfig OpRST=0, SysEn=0, AlertEn=0, PCThold=0, FCThold=0, SThold=0, RThold=0`
2. `/iBPESftyConfig OpRST=1, SysEn=0xF, AlertEn=0XFF, PCThold=0x7F, FCThold=0x1F, SThold=0xFF, RThold=0xFF`
3. `/iBPESftyConfig OpRST=0, SysEn=0, AlertEn=0, PCThold=0x80, FCThold=0, SThold=0, RThold=0`
4. `/iBPESftyConfig OpRST=0, SysEn=0, AlertEn=0, PCThold=0, FCThold=0x20, SThold=0, RThold=0`
5. `/iBPESftyConfig OpRST=0, SysEn=0, AlertEn=0, PCThold=0, FCThold=0, SThold=0x100, RThold=0`
6. `/iBPESftyConfig OpRST=0, SysEn=0, AlertEn=0, PCThold=0, FCThold=0, SThold=0, RThold=0x100`

Check on the housekeeping display that in the first case all values are off or 0, in the second case all values are on or as commanded. In all other cases check on the NHK display that an 'Illegal Parameter Values' message is received.

For command 1, all values off or 0 Y/N___________________
For command 2, all values on or as commanded Y/N_________
For command 3, 'Illegal Parameter Values' received Y/N______
For command 4, 'Illegal Parameter Values' received Y/N______
For command 5, 'Illegal Parameter Values' received Y/N______
For command 6, 'Illegal Parameter Values' received Y/N______

If all the above responses are Y's then the test is successful.

Test Successful __________

Initials _________ Date ___________ Time ___________

1.18 Fast commanding

From the housekeeping display write down the number of good and bad telecommands received so far;
TC Good________
TC Bad_________

Run the ITOS script fastfwcommands.proc with the command
```
Start fastfwcommands
```

Wait until the script finishes. This sends 30 commands to move or stop the filter wheel, load and stop loading tables and ramp or stop ramping the high voltages, at 20Hz. This is an unrealistic situation as this kind of chaotic commanding could only take place if flags in the ACS messages went haywire, and actions based on ACS have an automatic 1s delay in them to combat ACS glitches. However, this test will check that the high commanding rate does not crash the code.

From the housekeeping display write down the number of good and bad telecommands received now;
TC Good________
TC Bad_________

Check on the NHK display that no error messages have been received ('Busy' is acceptable).

NHK error messages received Y/N_________

If the number of good telecommands has increased by 30, the number of bad telecommands has not increased, no NHK error messages have been received, the filter wheel stops somewhere before filter 10, and the cathode voltage is near zero then the test is successful.

Test Successful _________

Initials ________ Date __________ Time __________

Don't forget to re-enable the range checks in ITOS that were disabled at the beginning of this test.