TEST REPORT BY REX BOYER

SERVO SPECIAL

A detailed analysis of eight of the most popular currently available servos from British and Foreign manufacturers

As most digital R/C systems are now compatible it has become fairly common practice to interchange Tx-Rx-servo combinations of different manufacture in order to achieve a desired performance.

So that an assessment of different servos could be made we contacted all the UK manufacturers and importers in order to obtain samples of servos which they are currently offering. The servos submitted fell into three groups, Group 1 is the 'standard' range not standard as opposed to deluxe but a similar physical size. Eight servos which are the subject of this review were tested. The second group are the mini type and the third-retract, which will be the subjects of future reports.

In order to assess the performance of the servos they were all fed with a similar input from a pulse generator to represent the output of a Tx at an average frame rate calculated from known figures of the most popular systems available at the moment. It must be stressed that all servos were tested to the same signal and it is possible that their performance could be improved by correction to their particular system timings.

The signal used was 1-2 ms at 18 ms frame time. Bearing in mind the statement in the previous paragraph variations in frame times were tried. In all cases results showed no significant variation in performance.

In order to test the servos they were mounted on our standard test rig, a device which only puts a tortional load on the servo about its output axis which is in turn coupled to a cam corrected precision potentiometer. This in turn is fed to an Ultra-Violet recorder which records the rotation of the potentiometer onto a paper trace. This can then be analysed and a true read-out of the rotation against time of the servo can be seen.

Several points should be taken into account when reading these results. Firstly, we have yet to see a servo which rotates at the same speed in both directions. This is usually due to the motor, but in some cases the output drive stages of the amplifier. This is relatively unimportant as long as the difference is not too significant. Secondly, the rotation against input pulse length – in a perfect servo this would be absolutely linear. There are two things which govern this linearity.

1. The accuracy of the feedback pot; which in most servos is only of commercial quality and accuracy. Some manufacturers do select these.
2. The inbuilt servo amplifier comparator monostable. Most of the early i.c. amplifier chips suffered in the second category in having restricted monostable ranges which are very non linear outside these restrictions. It would appear that the latest set of i.c. amplifiers now on the market and as used in the eight tested servos have largely overcome this problem.

It is felt that if a 5 per cent error in position accuracy of the servo can be achieved it is quite satisfactory. Note, I say in the servo – overall system accuracy can be as bad as 15 per cent.

Turning to the physical aspects of the servos, i.e. gearboxes appeal etc. then without a doubt the Japanese servos are way ahead of any others on the market. Before anyone accuses me of being anti British I would add that the initial tooling costs to achieve this mechanical standard could just not be justified by a British manufacturer as the worldwide markets are to a great extent beyond the promotional reach of British manufacturers. Let us hope this situation will improve.

The main assets of the Japanese mechanics are the gearboxes, which start off with small gear tooth sizes at the high speed end of the train and increase towards the output end – rather like the gears in a watch are graded.

In all cases (except one) we have given the gearbox details as well as the overall ratio. It is significant to note that they vary quite noticeably for the same stalled torque, except the *MacGregor* which has a lower ratio by some 20 per cent, yet still achieves a comparable stalled torque. We would assume it to be an efficient electronics/gearbox combination.

Amplifier performance on the whole has greatly improved and indeed the best two amplifiers tested in the group are up to discrete amplifier standard, others fall far behind. It would appear that under the higher load parts of the torque tests the output stages of the amplifiers are coming out of saturation when only subjected to small error signals. This has always been a problem with the i.c. amplifier, but as stated two types seem to have got it sorted out.

The significance of the problem is that if the servo never quite gets to the requested position (due to this droping out of saturation) then under high loads the servo will sit just short of target drawing a lot of current, getting hot and running down the batteries.

Now for the results – input signal to all servos 1-2 ms at 18 ms frame rate, +ve pulse.

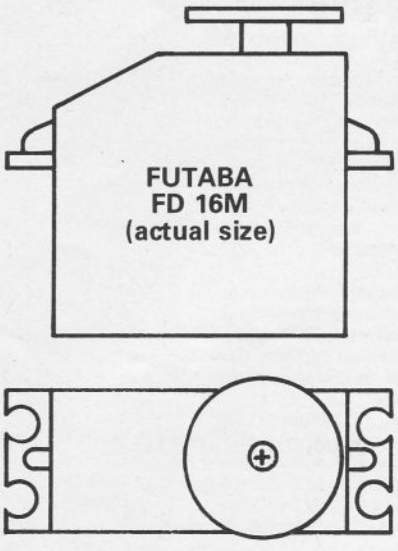
Servo No. 1 Futaba FD 16M

Load in oz/in.	Times actual in secs Against load	With load	±35° Against load	With load
0	.5	.475	.403	.383
2	.525	.425	.423	.342
4	.55	.425	.443	.342
8	.613	.4	.493	.322
12	.7+.15	.4	.564+.12	.322
16	.85+.25	.337	.68+.2	.272

Just stalled load 27 oz/in. Total travel 93°

1 ms=47°
2 ms=−46°

Amplifier 2 i.c.'s type BA 606 and BA 607A
Gearbox ratio's
Motor 10T-50T 12T-50T 10-38 12-36 output square
Total ratio 239:1
Motor type (unmarked)



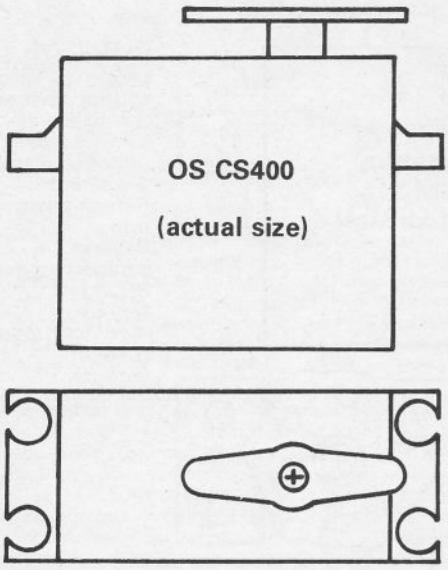
Weight: 44 gms.
Output devices: Long and short arms. Drilled and plain discs. 'T' arm.
Reverse rotation model: Label colour different.

Servo No. 2 OS CS400

Load oz./in.	Time actual in secs Against load	With load	±35° Against load	With load
0	.362	.364	.28	.26
2	.434	.35	.31	.25
4	.462	.322	.33	.23
8	.602	.308	.43	.22
12	.756	.308	.54	.22
16	1.33	.244	.94	.21

Just stalled load 20 oz./in. Total travel 105° 1 ms=+51° 2 ms=−54°

Amplifier XR 1 off i.c. 2262CP
Gearbox Motor 11T-55T 14T-42T 14T-42T 12T-42T
Overall ratio 158:1 output splined
Motor type 16 mm unmarked



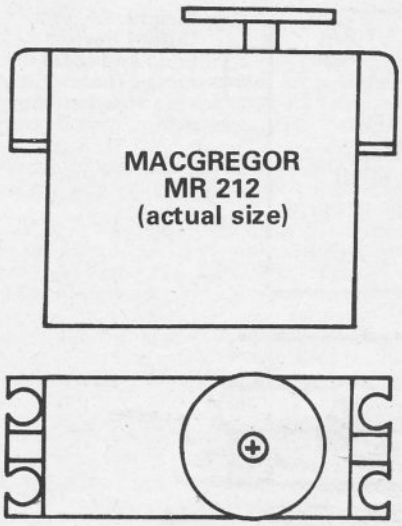
Weight: 45 gms.
Output devices: Arm and disc.
Reverse rotation model: CS400R

Servo No. 4 MacGregor MR 212

Load in oz./in.	Time actual in secs Against load	With load	±35° Against load	With load
0	.4	.388.	.291	.282
2	.45	.388	.327	.282
4	.475	.375	.346	.273
8	.525	.375	.382	.273
12	.6	.350	.436	.254
16	.75	.350	.546	.254

Just stalled load 27 oz./in. Total travel 103° 1 ms=+58° 2 ms=−55°

Amplifier DIL unmarked +2 transistors
Gearbox Motor 8T-38T 10T-38T 10T-38T 12-36
Overall ratio 207:1
Motor type 16 mm



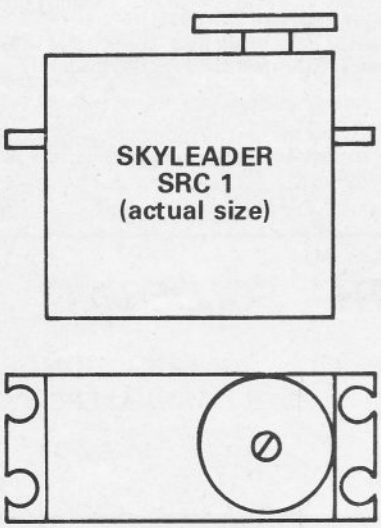
Weight: 40 gms.
Output devices: Arm and disc. Heavy duty car steering arm.
Reverse rotation model: Connector leads colour coded.

Servo No. 3 Skyleader SRC 1

Load oz/in.	Time actual in secs Against load	With load	±35° Against load	With load
0	.45	.425	.351	.33
2	.475	.4	.371	.31
4	.5	.4	.390	.31
8	.55	.375	.430	.292
12	.625+.2	.35	.488+.16	.277
16	.7+.15	.35	.547+.12	.270

Just stalled load 28 oz./in. Total travel 96° 1 ms=50° 2 ms=−46°

Amplifier SRC 419P+2 transistors
Gearbox Motor 8T-40T 9T-40T 9T-40T 16T-40T
Overall ratio 242:1 Output conical serrated
Motor:- Mitsumi



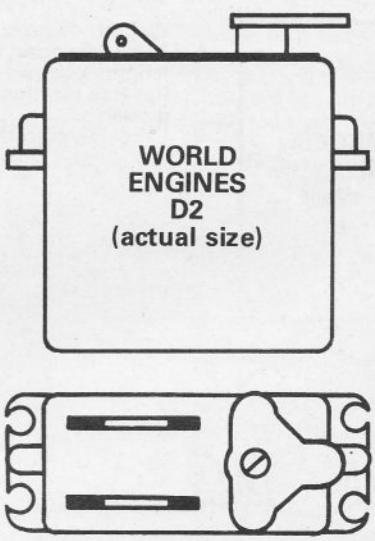
Weight: 40 gms.
Output devices: 1 arm. Large and small disc.
Reverse rotation model: Colour spot on case.
Interchangeable rack or rotary output.

Servo No. 5 World Engines D2

Load in oz./in.	Time actual in secs Against load	With load	±35° Against load	With load
0	.338	.325		
2	.375	.313	Actual rotation	
4	.413	.308	identical to	
8	.525(+.09)		corrected rotation	
12	.78(+.4)			

Just stalled load 14 oz./in. Total travel 70° 1 ms=+32° 1 ms=−37°

Gearbox overall ratio 205:1
Amplifier 1 off NE544 i.c.
Motor type Furuichi 16 mm.
} figures quoted by manufacturer



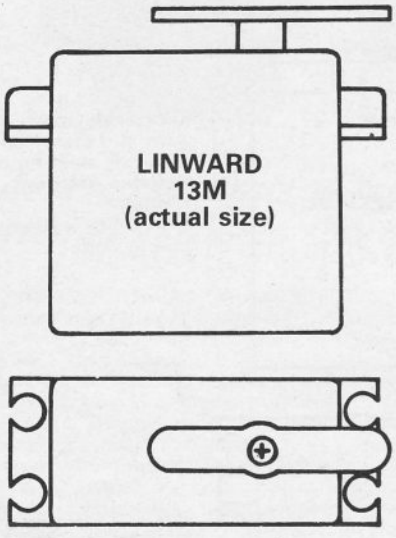
Weight: 38 gms.
Output devices: 'T' arm, straight arm.
Reverse rotation model: Colour spot on case.

Servo No. 6 Linward 13M (SLM ball bearing mechanics).

Load in oz./in.	Times actual in secs Against load	With load	±35° Against load	With load
0	.375	.3	.319	.256
2	.475	.275	.404	.344
4	.65+.1	.25	.554+.08	.213
6	1.375	.25	1.17	.213
12	STALLED. Never got to desired position			
16				

Just stalled load 7.5 oz. Total travel 89° 1 ms=47° 2 ms=−42°

Amplifier *Signetics* NE 544N
Gearbox Motor 10T-36T 10T-36T 10T-36T 17T-42T
Note output gears are of metal with ballbearings on output shaft.
Overall ratio 116.7:1
Motor type 16 mm Mitsumi



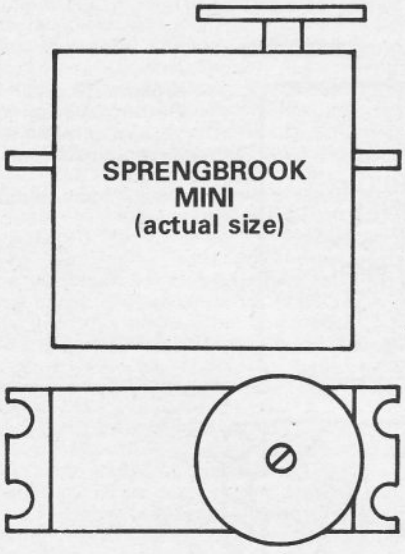
Weight: 55 gms.
Output devices: Long and short offset arms. 'T' arm. Single side arm. Retract type arm.

Servo No. 7 Sprengbrook

Load in oz./in.	Times actual in secs Against load	With load	±35° Against load	With load
0	.4	.38	.341	.33
2	.45	.375	.383	.319
4	.475	.362	.405	.308
8	.55	.35	.469	.298
12	.575+.175	.35	.490+.149	.298
16	.65+.35	.35	.553+.298	.298

Just stalled load 27 oz./in. Total travel 88° 1 ms=41° 2 ms=47°

Amplifier 2 i.cs. DIL
Gearbox Motor 10T-38T 10T-38T 10T-38T 10T-38T
Overall ratio 208:1
Motor type 16 mm unmarked



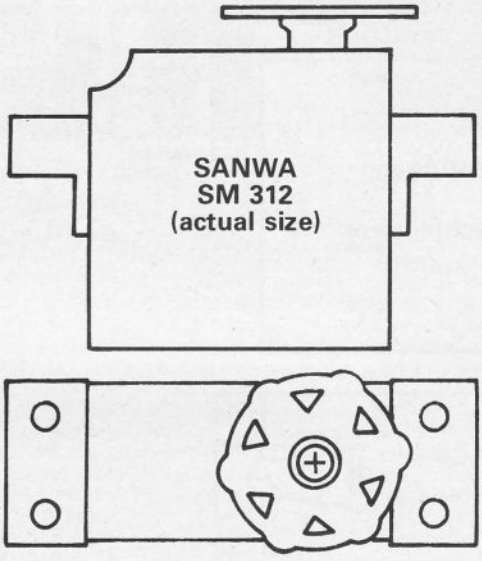
Weight: 45 gms.
Output devices: Disc 3 lengths of arm.
Reverse rotation model: Label identification.

Servo No. 8 Sanwa SM312

Load in oz./in.	Times actual in secs Against load	With load	±35° Against load	With load
0	.537	.475	.383	.34
2	.562	.475	.401	.34
4	.592	.45	.423	.32
8	.662	.425	.473	.30
12	.75	.425	.536	.30
16	.85+'.162	.413	.607+.12	.29

Just stalled load 27 oz./in. Total travel 113° 1 ms=54° 2 ms=59°

Amplifier i.c. DIL 2 off one on top of other.
Type BA 620-650
Gearbox Motor 10T-50T 10T-50T 10T-50T 19T-38T
Overall ratio 250:1
Motor type 16 mm Mitsumi



Weight: 55 gms.
Output devices: 2 sizes 6 way arms. 2 sizes undrilled discs. 4 way arm. Retract type arm.
Reverse rotation model: SM311.
Unique moulded rubber cushion mounts.

At a glance

Servo	Gear ratio	Against load Max. Pull oz./in.	Fastest speed	Fastest 16-oz.	Motor
Futaba	239:1	27	.403	.68+.2	16mm
O.S.	158:1	20	.28	.94	16mm
Skyleader	242:1	28	.351	.547+.12	16mm
MacGregor	207:1	27	.291	.546	16mm
World Engines	205:1	14	.338	——	16mm
Linward	116.7:1	7.5	.319	——	16mm
Sprengbrook	208:1	27	.341	.553+.298	16mm
Sanwa	250:1	27	.383	.607+.12	16mm

From the 'at a glance' chart it can be seen that no individual servo can claim best results in all areas tested.

The *Skyleader* has just the edge on max torque but falls far behind, on speed to achieve this result. The *OS CS400* comes out the faster on 'No load' and remains linear over the load range but suffers from a large drop-off in speed at the high loads. It would appear that a slightly higher gearbox ratio would improve this servo.

The *MacGregor* servo gives the best 'under load' speed again without falling out of saturation as does its nearest rival the *Skyleader*.

Conclusion

From a performance point of view the best all round performance goes to the *MacGregor*. Whether its lack of eye appeal and relatively noisy gearbox put you off is up to you.

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