FOR OFFICIAL USE ONLY

[*Notified in Army Orders for January*, 1932.

57/General/6076

REGULATIONS

FOR

ARMY ORDNANCE SERVICES

PART II

PAMPHLET No. 28

1932

Repairs to Rangefinding, Optical, and other Stores by Armament Artificers, Rangefinding Section, R.A.O.C.

By Command of the Army Council,

H. J. Creedy

THE WAR OFFICE,
31*st January*, 1932.

LIST OF ABBREVIATIONS

A.A.		Anti-Aircraft.
Arty.	...	Artillery.
C.D.R.F.	...	Coast Defence Range Finding.
Cms. ...	...	Centimetres.
C. & P. of A.E.		Regulations for the Care and Preservation of Artillery Equipments.
C. & R.	...	Curvature and Refraction.
D.R.F.	...	Depression Range Finder.
E.R. ...	...	Equipment Regulations.
Elec. ...	...	Electricity.
Ft. ...	...	Feet.
H.B. ...	...	Handbook.
H.B. of A.I.		Handbook of Artillery Instruments.
H. & R.F.	...	Height and Range Finder.
In. ...	...	Inch.
I.R. & C.R.	...	Insulation Resistance and Conductivity Resistance.
M.C. of S.	...	Military College of Science.
M.F. ...	...	Moveable Face.
M.G. ...	...	Machine Gun.
Mins.	...	Minutes.
N.I.V.	...	Not in Vocabulary of Army Ordnance Stores.
No. ...	...	Number.
O.Gs. ...	...	Object Glasses.
P.F. ...	...	Position finder.
Q. and I.	...	Quantity and Intensity.
R.A.O.S.	...	Regulations for Army Ordnance Services.
R.F.	...	Range Finder or Finding.
R. or B.	...	Range or Bearing.
S/C ...	...	Screw cutting.
T.E. ...	...	Tangent Elevation.
(U.B.2)	...	Height and Range-finder, No. 2, Mk. II.
U.S.G.	...	Uniform scale gear.
V.S. ...	...	Variable speed.
Yd. ...	...	Yard.

REGULATIONS FOR ARMY ORDNANCE SERVICES, PART II

PAMPHLET No. 28

REPAIRS TO RANGEFINDING, OPTICAL, AND OTHER STORES

General notes on instrument repairs, with list of permissible workshop operations, and prohibitions for each instrument and complete list of references to other service publications.

GENERAL NOTES

1. Workshop requirements.

The operations and limitations laid down in this pamphlet are only applicable to rangefinding workshops which are suitably sited and equipped. In other cases operations will be restricted and limitations increased with regard to the facilities available.

The following lay-out of rangefinding workshops will be provided whenever possible.

Optical and delicate mechanical operations will be carried out in a clean dry workshop sited clear of external dust, and having good lighting to the north if possible.

Testing points are required at 100 yds. for a definition board, at 500–800 yds. for a special testing lath for rangefinders, and whenever possible at 3,000–8,000 yds. for a known range check for rangefinders. The medium range should be known to a foot, and the long range to within a third of the standard of accuracy of the rangefinder, under test.

These points must be visible from the test bench or benches by means of sash windows fitted with plate glass, and made to open from 3 ft. 6 in. to 5 ft. 4 in. above floor-level, for testing high-power instruments.

For rangefinders openings must be spaced to take the various base lengths of 80 and 100 cms. at 9 in. above bench level. For heightfinders (U.B.2) the openings must be spaced 200 cms. at tripod level (4 ft. 9 in.).

The test benches should be 36 in. high and covered with

linoleum. A wooden or metal angle lip will prevent work from rolling off.

Testing apparatus for rangefinders must include a special testing lath to set up at the 500–800 yds. test point, a holder for cleaning the dividing line of the centre prisms, and a bench stand for stripping and testing.

Collimators for binocular and dial sight testing, and a definition board for mounting at the 100 yds. test point are also required.

A concrete pedestal 3 ft. 8 in. high is required for the general testing of dial sights, directors, etc. These are mounted in special holders on a stand carried by a D.R.F. base plate, so that the definition board is visible through a plate-glass window which is made to open. One or two fixed collimators will serve in lieu of outside horizontal and vertical marks.

Floors should be covered with linoleum ; the walls should be smooth, and all crevices, etc., which may collect dust should be avoided.

Electric radiators should be used for heating when possible ; otherwise steam pipes, or flues through the shop, are suitable, but gas radiators are unsuitable.

General instrument repairs, and all work for which cleanliness is not so essential, or which involves chalk brushing, or other dust forming operations, should be carried out in the adjoining instrument workshop, separation being made by means of a glazed partition and sliding door.

The instrument shop equipment should include a 3½-in. precision lathe, an engraving machine, a vertical drill, and a grinder and polisher, each with separate motor drive.

Bronzing and acid work should be carried out in a separate room or cubicle, with good ventilation to the outside air. It should be fitted with a water supply, sink, and draining board, and a gas supply and air blower.

A small store is required to lock up materials and technical stores.

2. Optical Repairs.

No grinding or polishing operations to lenses or prisms can be carried out, as this work requires special machinery and optical glass workers.

The re-balsaming of lenses can be carried out provided that they can be removed from their cells.

Prisms cannot be re-balsamed, as a special jig is required to hold the parts in position during the special " baking " process.

The silvering of optical parts cannot be carried out.

Subject to certain exceptions, optical parts are considered

to be standard for instruments of the same service pattern, and by the same maker. These parts may be fitted to instruments locally when transport or correspondence can be saved.

The parts may be demanded from store, or when equipment is urgently required, they can be taken from other unserviceable instruments of the same service pattern, and make, if such are available.

In other cases instruments requiring new optical parts should be returned to Woolwich for repair.

After fitting, or re-setting any new optical parts, it is important that the instrument should be tested on a definition board, quality being assessed by a comparison with similar instruments which are usually available.

Magnification and " field of view " will not be affected by the fitting of spare parts which are not prohibited, and these tests need not be applied.

All other tests and adjustments for the instrument must be carried out.

All interior parts of optical instruments must be perfectly clean when assembled. Lenses and prisms will be cleaned in accordance with the latest instructions, as, when cleaning is properly carried out, the effects of condensation, such as filming, are reduced and the instrument will have a longer life, and a more brilliant field.

3. Mechanical Repairs.

This includes the manufacture of minor parts.

Spare parts may be fitted to instruments locally when transport or correspondence can be saved.

These parts may be demanded from store, or where completion is urgent they can be taken from other unserviceable instruments of the same service pattern, and by the same manufacturer, if such are available.

In other cases, instruments requiring new parts should be returned to Woolwich.

After fitting spare parts, the tests and adjustments for the instrument must be carried out, also " manufacturers tests " for any parts, the adjustment of which may be affected.

Mechanical repairs are restricted mainly by lack of special workshop equipment of the necessary accuracy.

For example, accurate wormwheels, quadrants and bubble arms cannot be re-cut, but the worn part of a wheel can sometimes be turned round, or the error remedied by the removal of small burrs, allowing the wormspindle to bed down in the undamaged portions of the teeth.

Worm, bevel and spiral gears also require special machinery, but spur gears can sometimes be made.

In many cases, new teeth can be inserted in gears in order to keep an instrument in action while the new part is being supplied.

Degree scales can usually be re-cut when the plate is mounted with a wormwheel which can be used for dividing purposes, an engraving machine or " scratcher " being used to mark the divisions.

Small degree scales can be cut to the dividing head of the engraving machine, to approximately 5 mins. of accuracy.

Rules and scales up to about 10 in. in length can also be cut on the engraving machine, using the table feed as the lead screw, but long scales cannot be cut.

All figuring and lettering can be carried out.

The ordinary wear of the centre pivots of accurate instruments such as D.R.F., P.Fs. and Directors can be taken up, but if a pivot is bent, replacement is necessary.

Height screws of P.Fs. and D.R.Fs. can only be touched up over the unworn parts by a very small amount to eliminate back-lash.

Worn bearing rings of P.F. and D.R.F. telescopes should be corrected locally. The bearing rings or bodies of sighting telescopes must be tested as detailed in Appendix I. Telescopes which fail to pass these tests are unserviceable, and must be returned to Woolwich.

Repairs to clocks and similar mechanisms can be dealt with, also minor repairs to watches, including the replacement of glasses, hands, screws, keyless work winding stems, sleeves, and buttons, etc., if available.

No practical instruction is given in the finer details of watch repair work; but such work, carried out by civilian employees or outside contractors, can be supervised and examined.

When an instrument is returned owing to wear or damage, details of the fault should always be given (*i.e.* position of wormwheel damage, bend in sighting telescope, etc.).

Full particulars of type, mark, maker, registered number and date of manufacture should accompany any special demand for spare parts.

4. Testing and adjusting.

After repair, any new parts which have been fitted must be tested and adjusted.

The ordinary tests and adjustments as laid down in service publications must also be carried out.

Further details relating to tests and adjustments are given during instruction at the M.C. of S., and should be in the possession of all rangefinding artificers.

5. Blacking, Bronzing, Silvering and Lacquering.

All instruments should be refinished locally as considered necessary for maintenance.

Bronzing, silvering, and lacquering can be carried out as satisfactorily as by the makers, while the new cellulose finishes provide an excellent substitute for stove enamelling.

A well-finished instrument will always receive greater care and attention than a shabby one, although both may be equally accurate, and every effort should be made to make instruments look as attractive as possible.

General References :—

General Instructions	Regs. for Care and Preservation of Artillery Equipment, 1930, Sec. I.
Maintenance and Inspection.	R.A.O.S., Part I, 1929, paras. 179–196.
Care and Preservation	Handbook of Artillery Instruments, 1914, pages 170–178.
,, ,, ,,	Manual of C.D.R.F., Part I, 1927, page 74.
,, ,, ,,	Manual of C.D.R.F., Part II, 1925, page 49.
,, ,, ,,	Regs. for Care and Preservation of Artillery Equipment, 1930, paras. 429–439.
Workshops, etc. ...	R.A.O.S., Part I, 1929, Sect. III (II).
Tools, etc.	Regs. for the Equipment of the Army, Part 2, Sect. XII (*a*), 1914.
Persons qualified to carry out repairs.	Regs. for Care and Preservation of Artillery Equipment, 1930, para. 439.
Optical principles of Service Instruments.	Notes on Optics, 1927.
Electrical Stores ...	Notes on Electricity, 1926.
Registered numbers of Stores, recording of.	Regs. for the Equipment of the Army, Part I, 1923, Appendix XXXV.

APPENDIX I

Sighting Telescopes Nos. 1, 3 and 7. Tests for Worn Bearing Rings

(i) The bearing rings or bodies of Sighting telescopes Nos. 1, 3 and 7 must be tested in a selected sight bracket which shows no sign of wear, and which, when tested with a " bar, testing sight," has no shake.

(ii) The Sighting telescope, clamped in this sight bracket, must be tested for presence of shake throughout the length of its bearings. This must not exceed 0·002 in. at any place.

(iii) The telescope will then be collimated as accurately as possible with the " collimator, testing sighting telescopes," using the collimating eye-cap to cut out parallax.

(iv) A test board showing a 12-in. circle with intersecting (central) cross lines must be set up 200 yds. distant from the selected sight bracket.

(v) The telescope, placed in the selected sight bracket, has the tip of its pointer laid on the intersection of the cross lines, and is then rotated through 360 degrees; the tip of the pointer must not move outside the circle.

This test must be repeated throughout the length of the bearings.

Telescopes which fail to pass this test are unserviceable and must be returned to C.O.D., Woolwich, with a certificate of examination.

Instrument.	Operations.	Prohibitions.	References to
Section V.1.			*Service Publications.*
Apparatus, Anti-parallax	Normal repairs to instrument parts.	—	
Apparatus, Firing Puffs	Normal.	—	R.A.O.S., Part 1, para. 378.
Apparatus, Illuminating sights.	,,	—	Notes on Elec., pp. 229–230.
Apparatus, Observation of fire.	Inserting new square and refitting quadrant.	Recutting worm-wheel, quadrant teeth, or degree scale.	C. & P. of A.E., para. 469.
	Replacing lenses of like make as available.		E.R., Part 2, XII(*a*), paras. 120–5, 187; Table 51.
	Replacing broken webs in diaphragm.		H.B. of A.I., pp. 54–63.
	Backlash not to exceed 2 mins.		
Apparatus, Training gunlayers.	Normal.	—	
Apparatus, Testing coincidence.	,,	—	
Apparatus Rangefinding :—			
Attachment Horizontal	Making and fitting detents.	Recutting worm, worm-wheel, or small wheel teeth.	C.D.R.F., Part II, pp. 109–114.
	Refitting, uprighting, etc., cocks armatures and magnets.		C. & P. of A.E., para. 454.
	Rebushing mirror arbor.	Repolishing mirrors.	E.R., Part 2, XII(*a*), paras. 112–113, Table 42.
	Fitting armatures, cores and coils as available.		
Bells, Electric ...	Normal.	—	Notes on Elec., pp. 220–222.

Instrument.	Operations.	Prohibitions.	References to
Section V.1.—*contd.* Apparatus, Rangefinding —*contd.*			*Service Publications.*
Boards, Terminal ...	Normal cleaning and repolishing.	—	C.D.R.F., Part II, pp. 160–161.
,, Supporting R.F., R. or B. dials (N.I.V.).			C.D.R.F., Part I., pp. 29–31.
Boxes, Dial			C.D.R.F., Part I, pp. 39–41.
Brackets, Lampholder	Normal.	—	—
Dials, Electric ...	Fitting new wheels, pinions, coils to magnets, sliding hands and collets. Making and fitting new detents, arbors and like parts. Fitting magnet cores and armatures as available. Re-silvering and lacquering dial face. Normal repairs to case and moveable face gear. Fitting new clamp-down glasses (state diameter when ordering). Bezels should be returned when ordering snap-in glasses.	Re-cutting scale on dial face. Re-cutting wheels or pinions.	C.D.R.F., Part II, pp. 137–156. E.R., Part 2, XII (*a*), paras. 112–113, Table 42. C.D.R.F., Part I, pp. 37–41.
Dials, Mechanical ...	Making and fitting new contact springs and contact studs.	Re-cutting worm "A," Mk. I. "E." and	C.D.R.F., Part II, pp. 120–136.

	Normal repairs to sliding hand stop work gear, and moveable face gear. Re-cutting worm spindle "A" Mk. II.	"F" dials.	C.D.R.F., Part II, p. 178.
	Engraving dial faces "A," dials.	Re-cutting worm-wheel teeth.	C.D.R.F., Part I, pp. 34–37.
		Dividing dial face scales "E" and "F" dials.	E.R., Part 2, XII(*a*), Tables 43, 59, paras. 112–113.
Faces, correction ...	Divide and engrave zinc discs to suit M.F. gear.	—	E.R., Part 2, XII(*a*), paras. 112–113, Table 42.
Position finders :—			
Telescopes	Making new eye-cups.	—	C.D.R.F., Part I, Chapters 1–12.
	Fitting new focussing racks and pinions. Re-turning bearing rings.		C.D.R.F., Part I, pp. 56–73.
	Replacing lenses of like make as available.	—	E.R., Part 2, XII(*a*), paras. 109–119, 188, Tables 42, 51E.
	Replacing broken webs in diaphragms.		C. & P. of A.E., 1930, paras. 448–454, 459–465.
Telescope arm bracket and height screw.	Refitting drum to bracket.	Refitting height screw to drum when wear is excessive, and backlash can not be taken up by adjustment.	
	Refitting height screw to drum when wear is not excessive.		
	Refitting plunger to height screw.		
	Refitting bracket for verticality tests.		
	Refitting swivel joint to height screw and flange.	Refitting height screw to bracket if bent.	
	Refitting telescope arm to swivel joint.	Making new height screw without special authority.	
	Refitting new height screw.		

Instrument.	Operations.	Prohibitions.	References to
Section V.1.—*contd.*			*Service Publications.*
Apparatus, Rangefinding —*contd.*			
Position finders—*contd.*			
Telescope arm ...	Recurving of under face.	—	
Telescope arm rollers	Re-surfacing tread.	—	
	Fitting end pieces to take up backlash.		
	Making and fitting new pivots and new indexes.		
	Fitting new rollers.		
Gun arm, and gun arm slider.	Re-surfacing gun arm and re-fitting slider.	Repairs to badly damaged range screw.	
	Bushing nut of range screw when a suitable s/c lathe is available.	Making range, or training gears other than spurs.	
	Removing end shake from range screw.		
	Re-turning, and re-bushing gun arm roller, or re-positioning where possible to give fresh track on arc.		
	Re-depthing training rod. Making new handle parts, contact springs and studs. Fitting new training gears. Fitting		

	new leads. Taking up ordinary wear of gun arm pivot. Fitting new gun arm pivots.		
Bed plate	Re-surfacing of toothed arc. Re-facing board with opaque celluloid. Removing and replacing board to bed plate. Re-bedding gun arm pivots for verticality tests. Cutting degree scales on chart. Cleaning off and varnishing charts. Re-charting. Refixing bridge.	—	
Range correction gear	Making and fitting new contact springs, fitting new gears. Making and fitting new reader screw. Re-graduating, and re-figuring as necessary. Re-bushing and like operations.	—	
Holders, central pencil	All repairs.	—	
Telephone installation.	Normal.	—	C.D.R.F., Part I, pp. 32–33. C. & P. of A.E., paras. 455–458. Notes on Elec., pp. 182–184. E.R., Part 2, XII(*a*), Table 42.

Instrument.	Operations.	Prohibitions.	References to
Section V.I.—*contd.*			*Service Publications.*
Apparatus, Rangefinding —*contd.*			
Position finders—*contd.*			
Transmitters, horizontal.	Making and fitting new contact springs, studs, cam rollers and handle parts. Refitting and re-facing cams. Refitting frames. Repairs to base plate and case. Taking up ordinary wear in pivot. Re-bushing and like operations. Refitting telescope parts, and making new eye-cups, etc. Replacing lenses of like make as available.	Re-cutting worm, and worm-wheel teeth.	C. & P. of A.E., paras. 448–458. C.D.R.F., Part II, pp. 104–109. E.R., Part 2, XII(*a*), paras. 112–113, Table 42.
Receivers, deflection ...	Normal.	—	C.D.R.F., Part III, pp. 62–71.
Receivers, order ...	,,	—	C.D.R.F., Part III. pp. 62–71.
Receivers, range ...	,,	—	C.D.R.F., Part III, pp. 62–71.
Switches, change over	,,	—	C.D.R.F., Part III, pp. 73–74.
Transmitters, deflection	,,	—	C.D.R.F., Part III, pp. 62–71.

Transmitters, order ...	,,	—	C.D.R.F., Part III, pp. 62–71.
Transmitters, range ...	,,	—	C.D.R.F., Part III, pp. 62–71.
Apparatus, recording sound ranging.	No instruction is given to R.F. Artificers on this apparatus.	—	
Apparatus, training sound ranging.	The repair of the separate components such as Galvanometers, etc., can be carried out as required.	—	
Binoculars, Prismatic ...	All normal repairs. Replacement of all mechanical parts of like number and make as available.	Replacement of O.Gs. when equal magnification cannot be tested.	E.R., Part I, paras. 31, 288.
	Eye-cups of any service pattern are interchangeable.	Cleaning No. 4 Binoculars, Prismatic, without proper optical facilities to ensure the maximum illumination for A.A. night use.	E.R., Part I, Appendix XXX.
	Correction of parallelism.		H.B. of A.I., pp. 33–40; 170–178.
	Replacing lenses and prisms of like number and make as available.		Notes on Optics, pp. 95–98; 102–107.
Binoculars	Normal.		C. & P. of A.E., paras. 459–465.
	Replacing lenses of like make as available.		
Boards, Artillery ...	Normal.	—	
Boxes	,,	—	
Bubbles, Spirit, glass ...	Replacement and adjusting to instrument.	—	H.B. of A.I., pp. 161–163; 177–178.
Calculators, range correction.	Normal.	—	
Calculators, wind deflection.	,,	—	

Instrument.	Operations.	Prohibitions.	Reference to
Section V.1.—*contd.*		—	*Service Publications.*
Cases	Normal.		
Clinometers, Field, Mk. IV, V, and VI.	Re-surfacing bases.	Repairs when bubble arm or quadrant arc has been distorted.	E.R., Part II, XII(*a*), Table 59.
Clinometers, Inspectors ...	Refitting nut to screw when wear is not excessive.	Repairs giving rise to alteration in drum readings such as damaged hardened steel piece of drum; or to steel piece of bubble arm, damage to drum, and main screw.	H.B. of A.I., pp. 72–82.
Clinometers, large ...	Re-surfacing bases. Testing.		H.B. of A.I., pp. 172–177. H.B. of A.I., pp. 196–198.
Clinometers, Sight ...	Re-engraving and normal operations.	Re-cutting worm-wheel teeth.	C. & P. of A.E., paras. 282–288.
Clinometers, Vicker's ·303 in. M.G.	Backlash of sight clinos not to exceed 2 mins.	Re-cutting worm-wheel teeth.	H.B. of A.I., pp. 80–82.
Collimators, Binocular, Mk. II. and III.	All repairs. Replacement of lenses and prisms of like make as available.	— —	
Collimators, Telescope Sighting (N.I.V.).	Do. do.	—	H.B. of A.I., pp. 163–164.
Covers	—	—	

Dials Order :—			
Receiver	Fitting new ratchet and normal repairs to case and movement.	—	C.D.R.F., Part II, pp. 156–159.
Transmitter			C.D.R.F., Part I, pp. 41–42.
Diaphragms, Iris ...	Normal.	—	H.B. of A.I., p. 164.
Directors, No. 4	,,	Re-cutting bubble arm teeth.	C.D.R.F., Part I, pp. 25–26.
Directors, No. 5	Refitting quadrant to trunnion.	Re-cutting worm-wheel, quadrant or bubble arm teeth.	H.B. of A.I., pp. 190–192 ; 195–196.
	Replacing lenses of like make as available.		
Directors, No. 6	Replacing lenses and prisms of like make. Re-figuring and Re-graduating. (Backlash in traversing gears must not exceed 4 mins.)	Re-cutting teeth of worm-wheels. Removal of diaphragm from cell.	C. & P. of A.E., paras. 474–478.
Heightfinders, No. 5 ...	All telescope repairs.	Excessive repairs affecting alignment of the main pivots.	C. & P. of A.E., para. 466.
	Replacing lenses and prisms of like make as available.		
	Alignment of axes.	Engraving plates.	
Height and Rangefinders, No. 2, Mk. II.	Repairs to stand, mounting, and traversing gears.	Re-cutting of worm-wheels, gears or racks on any part of the instrument.	H.B. of Height and Rangefinder, No. 2, Mk. II.
	Repairs to elevating gears.		
	Repairs to external fittings of outer tube.	Removal of centre prism from its mount.	C. & P. of A.E., paras. 466–467.
	Replacement of lenses and prisms of viewfinder, eyepiece, scale reader and prisms, and windows as available.	Exchange or removal of pentagonal prisms from their bases.	
	Stripping and normal repairs to long frame, short frame, and height scale gear.	Exchange of O.Gs., astigmatiser	

Instruments.	Operations.	Prohibitions.	Reference to
Section V.1.—*contd.*			*Service Publications.*
Height and Rangefinders, No. 2, Mk. II—*contd.*	Repairs to halving adjusting gear, astigmatiser gear, working head, coincidence adjusting head. Removal of centre prism mount from long frame for cleaning purposes, replacement, and coincidence adjustment. Adjustment only of astigmatiser glasses and pentagonal prisms. Repairs to illuminating gear. These H. & R.F. repairs may only be carried out by Rangefinding Artificers who have had the full A.A. Course at the Military College of Science.	glasses, deflecting prisms, range scales, height scale gear cam wheels, and like parts without special authority.	
Instruments, Angle of Sight.	Normal.	Re-cutting quadrant teeth.	H.B. of A.I., paras. 159–161.
Instruments, Indicating Height and Fuze.	,,	—	C. & P. of A.E., para. 466.
Instruments, Measuring velocity and direction of wind.	Adjusting heights of aperture.	—	,, ,, ,,
Instruments, Observer A.A.	All normal repairs and replacing lenses and prisms of like make as available.	—	,, ,, ,,
Instruments, Time of flight	Normal.	Escapement repairs.	

Instruments, Testing C. & R.	,,	—	
Instruments, testing tank gun-layers.	Replacing mechanical parts, lenses and prisms of like make as available.	—	
Lamps, Electric, telescope	Normal.	—	Notes on Elec., pp. 227–229. H.B. of A.I., pp. 164–167. C.D.R.F., Part I, pp. 26–28.
Laths, adjusting ...	Checking and normal repairs.	—	H.B. of R.F. Arty., No. 2, pp. 18–20. H.B. of A.I., pp. 192–193. H.B. of H., and R.F. No. 2.
Monoculars	As for Binoculars, Prismatic.	—	Notes on Optics.
Paralleloscopes	Normal.	—	
Periscopes	,,	—	H.B. of A.I., pp. 194–195. C. & P. of A.E., paras. 459–465.
Plotters, Aircraft observation.	,,	—	C. & P. of A.E., para. 466.
Plotters, Field	,,	—	H.B. of A.I., pp. 69–71.
Plotters, Observation of Fire.	,,	—	
Predictors, A.A.	Removing, cleaning, repairing and adjusting the clock and all transmitter elements. Fitting and adjusting new bubbles. Removing and cleaning the "Wind," the "Lateral deflection in plane of sight," the "Traversing," the "Elevating" and the "Fuze" units. Changing fuze cam, T.E. and time drums.	General overhaul, or repairs to any parts affecting the "unit" settings of the ball carriers. This includes removal of rust marks on the V.S. Discs and rollers. Also any repairs affecting fuze, sin DA,	History sheet of repairs to A.A. Predictors. C. & P. of A.E., paras. 466, 468.

Instruments.	Operations.	Prohibitions.	Reference to
Section V.1.—*contd.*			*Service Publications.*
	Cleaning and adjusting telescope and replacing lenses and prisms as available. Repairs to transmission and lighting circuits, including dials on gun. Adjustment of clutches. Cleaning of parts made accessible by the removal of the units specified above, and all minor repairs such as may be caused by looseness or loss of taper pins and screws, causing backlash or damage to gears. Predictor repairs may only be carried out by R.F. Artificers who have the full Vicker's Predictor Course at the Military College of Science.	or complementary cam forms, except by special authority.	
Range, Artillery, miniature.	Repairs to episcope, telescope, electrical and other instrument parts. Normal.	—	

Rangefinders, Arty. No. 2 Rangefinders, Infantry No. 2.	Repairs to mechanical parts. Removal, replacement and adjustment of range scale prism and eyepieces, coincidence eyelenses, and end windows as available. Adjustment only of centre prism mount to holder, O.Gs., astigmatiser glasses, and pentagonal prisms.	Any repairs which necessitate the separate adjustment of the prisms forming the centre combination unless the special testing apparatus is available. Exchange of pentagonal prisms. Exchange of O.Gs., astigmatiser glasses, deflecting prisms, and range scales without special authority.	H.B. of R.F. Arty., No. 2, 1926. H.B. of R.F. Infantry, No. 2, 1932. H.B. of A.I., 1914, Chapter VII. E.R., Part I, para. 281. E.R., Part I, App. XXII. C. & P. of A.E., para. 444. R.A.O.S., Part I, para. 179.
Rangefinders, Arty. No. 4–10.	Repairs as R.F. Arty. No. 2. Also adjustment of internal adjuster of No. 9 R.F. (30 ft.). Adjustment to uniform scale gear without dismantling cam wheels. Repairs to mountings.	As R.F. Arty. No. 2. Recutting of worm-wheel teeth, or gears of inner frame and U.S.G.	C.D.R.F., Part III, Chapters I–XI. C. & P. of A.E., paras. 440–443.
Rangefinders, Arty. No. 7, 8, 9. Gear Illuminating	Normal.	—	C.D.R.F., Part III, p. 22 and Plate VII.
Rangefinders, Depression :— Telescopes	Making new eye-cups. Re-turning bearing rings, and repairs to eyepiece and focusing parts. Replacing lenses of like make as available.	—	C.D.R.F., Part I. E.R., Part 2. XII(*a*), paras. 102–108. C. & P. of A.E., paras. 445–447. C. & P. of A.E., paras. 449–465.

Instrument.	Operations.	Prohibitions.	Reference to
Section V.1.—*contd.*			*Service Publications.*
Rangefinders, Depression —*contd.*			
Height drum screw socket.	Refitting key to height drum screw keyway socket.	Refitting height drum screw to socket when wear is excessive.	
	Refitting height drum screw to socket when wear is not excessive.	Repairs to height drum screw if bent.	
	Refitting plunger to height screw and socket.		
	Refitting telescope arm to joint.		
Telescope arm ...	Re-curving of underface.		
	Re-conditioning.		
Range arm, Slider, and Roller.	Re-surfacing range arm.		
	Refitting range arm slider.		
	Fitting new racks, and pinions.		
	Repairs to range correction scale.		
	Re-surfacing, or making new rollers.		
	Making and fitting new roller pivots.		
Stand and Plate ...	Fitting new levelling screws.	Re-cutting worm-wheel teeth.	
	Refitting main pivot.		
	Repairs to minute drum, worm-spindle and parts.		

Rangefinders, Depression and P.Fs. :—			
Gear, Illuminating ...	Normal.	—	Notes on Elec., pp. 227–229. C.D.R.F., Part I, p. 26.
Recorder, Track, aircraft	,,	—	
Rules	,,	—	H.B. of A.I., Chap. III, p. 168.
Shades, Rain	,,	—	C.D.R.F., Part I, p. 26.
Sights, Dial, No. 7 ...	Fitting new mechanical parts, lenses, prisms and windows of like make as available.	Re-cutting worm-wheel teeth.	C. & P. of A.E., paras. 282–291. H.B. of A.I., Chapter V. H.B. of Dial, No. 7, 1932.
Stands	Normal.	—	
Stereometers	,,	—	C. & P. of A.E., para. 466.
Telescopes, Marine	Removal of dents from draw tubes.	—	
Telescopes, Scouts Regt.	Repairing and re-packing spring boxes, and normal repairs.		Notes on Optics, pp. 92–102.
Telescopes, Signalling			
Telescopes, Identification, A.A.	Replacing mechanical parts and lenses of like make as available. Normal repairs.		H.B. of A.I., pp. 1–32.
Telescopes, Sighting, Nos. 1, 3, 7, 8 and 9.	,, ,,	Re-turning worn bearing rings.	E.R., Part I, para. 282.
Telescopes, Sighting, Nos. 15, 21, and .	Replacing broken cross wires in the No. 9 Sighting telescope.		C. & P. of A.E., paras. 434–436.
Telescopes, Stereoscopic	Replacing mechanical parts, lenses, and prisms of like make as available.	—	C. & P. of A.E., paras. 459–465.
Telescopes, Testing A.A. gun-layers.			
Telescopes, Variable power	Normal repairs.		See Appendix I.

Instrument.	Operations.	Prohibitions.	Reference to
Section V.2.			*Service Publications.*
Barometers, Aneroid ...	Repairs to case, hand, hand arbor, bracket and bracket base plate. Fitting new chains.	Repairs or adjustments to lever arm, crank arm, vacuum chamber, spring and carriage screws, unless a test chamber and standard barometer are available for resetting.	
Barometers, Standard ...	External mechanical repairs only.	—	
Compasses, Magnetic ...	Fit spare parts and exchange as available.	—	
Compasses, Prismatic ...	Making, sharpening and adjusting pivot. Refilling liquid compasses. Repairing cases, lifters, etc., and fitting spare parts as available.	—	
Theodolites ... Levels	Refitting centre pivot, and equalising trunnions to suit tests. Replacing bubbles as available. Making and fitting screws and all small parts as necessary. Cleaning scales with willow charcoal. Cleaning and adjusting as necessary.	Repairs to centre pivot if wear is excessive, or if damaged in any way. Repairs to divided horizontal and vertical circles and verniers.	

Watches	Replacing hands and glasses, etc.	R.F. Artificers are not instructed in further repairs.	
Section K.			
Clocks	Rebushing holes. Fitting new pivots, suspension springs, mainsprings, or other parts.		
Section W.2.			
Cells, Leclanche, " C " ...	All repairs.	—	E.R., Part 2, XII(*a*), para. 189, Tables 42, 45. Notes on Elec., pp. 68 ; 122–126. C. & P. of A.E., paras. 455–457. C. & P. of A.E., paras. 321–352.
Coils, Resistance, 10,000 ohms.	Repairs to case, keys, terminals and blocks.	I.R. and C.R. repairs of coils.	Notes on Elec., pp. 52–56 ; 109–112. E.R., Part 2, XII(*a*), Table 59.
Exploders, Dynamo ...	Normal.	I.R. and C.R. repairs of armature and field windings.	Notes on Elec., pp. 165–167.
Detectors, No. 2 ...	,,		
Detectors, Q. & I. ...	Repairs to cases, coils, pivots, fitting needles, and testing.	I.R. and C.R. repairs of coils.	Notes on Elec., pp. 44 ; 138–143.
Galvanometers, Horizontal.	Return bezels of snap-on glasses for fitting new.	(Demand new assembly.)	E.R., Part 2, XII(*a*), Table 59.
Volt-ammeters			
Bridge megger	—	Sealed by makers. Return for repairs.	Notes on Elec., pp. 57, 117–121.
Megger, Insulation tester			

Instrument.	Operations.	Prohibitions.	Reference to
Section Y.			*Service Publications.*
Fullerphones ... ... Telephones	All repairs, fitting any new parts as available.	I.R. and C.R. repairs of large or finely wound coils. (Demand new assembly).	Notes on Elec., pp. 212–218. Notes on Elec., pp. 169–227. C. & P. of A.E., paras. 455, 458.
Heliographs	Normal.	—	
Lamps, Signalling, Daylight.	,,	—	Notes on Elec., pp. 231–233.

6/41 (3390) Wt. 25796/9045/23048. 2,000. 8/41. P.L.H. & CO. LTD. G.943.