2019 Collegiate Turf Bowl Competition Study Guide

GCSAA would like to thank Leah Brilman, Ph.D., a member of the Turfgrass Breeders Association, and Gwen Stahnke, Ph.D., facilitators of the Turf Bowl, for their work updating and modifying the exam each year.

The Turf Bowl Competition consists of physical and visual identification of samples, multiple choice, fill-in-the-blank, essay, short answer and matching questions.

A list of resources to study for this portion of the exam is included in this document. We also recommend reaching out to local superintendents, chapters or alumni for their help in preparing for the case study/essay section.

If you have any questions about the competition, contact Diana Kern at dkern@gcsaa.org or (785) 832-3600.

Eligibility

To participate in the GCSAA Collegiate Turf Bowl Competition, students must meet all of the following eligibility criteria:

- Must be currently enrolled in an undergraduate turf program or have graduated at the end of the most recent fall semester but not yet entered a graduate program or begun full-time employment at a golf facility
- Meet GCSAA student member eligibility criteria
- Be a registered attendee at the GCSAA Education Conference and Golf Industry Show

Area of Study

Turfgrass Identification
- Identify live turf specimens and seed specimens by their common names.
- Know common name vs. scientific name.
- For specific turfgrass species, please see Addendum 1.

Turfgrass Growth and Development
- Identify parts of the grass plant.
- Know management and environmental factors that influence growth.
- Understand turfgrass physiology and how it is influenced by management practices.
- Understand plant growth regulators – Use and influence on biology
Turfgrass Soils and Soil Fertility
- Know greens construction, particle sizes, soils and fertility.
- Know of macronutrients and micronutrients, and their influence on growth.
- Soil types and classification

Weed Identification and Control
- Identify common weeds. Note: Any turfgrasses on list can also be weeds.
- Know herbicides, what weeds they control and mode of action.
- Know the life cycle of weeds and how management influences weed growth.
- Know seed labeling for crops and weeds.
- For specific weeds, please see Addendum 2.

Turfgrass Diseases
- Identify common diseases on turf stands.
- Know environmental and management conditions, and the types of diseases that favor.
- Know common fungicides.
- Know grass species corresponding to various diseases.
- For specific diseases, please see Addendum 3.

Turfgrass Mathematics
- Calculate application rates of chemicals and fertilizers.
- Know quantities of sand and seed to use.
- Know how to correctly calibrate application equipment.
- Know how to use both the Metric and English units in calculations.

Turfgrass Insects
- Identify specimens of larval and adult forms of insects that attack turf.
- Know life cycles, preferred foods, feeding methods and other characteristics important in controlling insects.
- For specific insects, please see Addendum 4.

Irrigation
- Know how to evaluate turfgrass water needs and adjust various irrigation methods and rates accordingly to ensure the efficiency and effectiveness of the irrigation system.
- Calculate water usage.
- Know how to read an irrigation nozzle flow chart.
- Know the basics of using reclaimed water for irrigation.
Water Management
- Understand how turfgrasses process water, including transpiration.
- Understand water terminology
- Know the symptoms of water stress in various turfgrasses and how to remedy.
- Know the causes of pesticide and nutrient runoff and how to prevent.

Business Management
- Employment laws
- Budget, accounting and financial management principles
- Equipment leases
- Depreciation
- Staff management
- Employee training
- Employee performance management
- Amortization

Case Study
- The essay will be graded based on a team’s ability to:
  - Follow instructions given in the scenario.
  - Provide clear and concise answers.
  - Demonstrate critical thinking.
  - Use proper spelling and grammar.
- Students will have 30 minutes to write their answer to one of the following scenarios. Only one of the scenarios will be selected to address.
- Again, students are strongly encouraged to seek out local superintendents, chapters or alumni to help them research their answers to these real-world scenarios. Valuable information may also be found in member sections of gcsaa.org and on eifg.org.

Wakanda Golf and Country Club
Wakanda Golf and Country Club is a private 18-hole course in San Jose, California. The course, built in 1954, is situated on 135 acres, with 30 acres of fairway and 51 acres of rough. Over the last 14 years, it has been the host to LPGA and Nike Tour events. The greens are bentgrass, and the tees and fairways are perennial ryegrass. Greens fees are $108.00.

Anthony Challa, CGCS, has been the superintendent at Wakanda Golf and Country Club for the past seven years. In addition to Anthony, there is a maintenance team of eleven
full time employees and eight seasonal employees, including one assistant, one equipment manager and one equipment technician.

Approved Budget for 2019:

**Operating**

- Payroll: $700,000
- Fertilizer/Chemicals: 140,000
- Water: 260,000
- Seed: 28,000
- Equipment Maintenance/Leasing: 65,000
- Supplies: 47,500
- Fuel: 36,000
- Professional Development: 8,500

**Total:** $1,285,000

**Capital**

- Golf Course: $230,000
- Buildings/Grounds: 225,000
- Equipment: 235,000

**Total:** $690,000

**Scenario 1:** The state of California has imposed mandatory water restrictions. Your county requires a 25% reduction in overall irrigation use for the current year. Develop a water conservation plan which includes three practices you will implement to come under compliance. In addition, account for probable continued reductions.

**Scenario 2:** The golf course was used as a staging area for emergency equipment responding to the wildfires. The fairways, greens and tee boxes for holes 1, 9, 10 and 18 have damage, which includes collapsed drain tile, rutting and dead turf from heavy traffic. Formulate a plan to remediate the current damage. Provide justification for the procedures in your plan. Create a future emergency response plan designed to minimize damage to the course.

**Scenario 3:** The course has a 25-year-old irrigation system that utilizes a block design with hydraulic controllers. Irrigation labor hours has increased 6% over the last three years and now account for 10% of total labor. Parts costs are now 25% of the supplies budget, a 50% increase in just five years. Develop an outline for a presentation to your Green Committee, highlighting the need to replace the old system. Identify three selling points for a new system.

**Scenario 4:** The course usually does fall aeration in mid-August. Some of the membership are complaining that the course isn’t ready for play for the Labor Day weekend; however, others prefer this timing to ensure the course is in great shape for member championship tournament held in late September. For the upcoming club’s newsletter, write an article explaining aerification. Be sure to address the timing and benefits of the maintenance practice.
Equipment Identification Section

Teams will be asked to identify parts of the irrigation head and valves. Schematics for this piece of equipment are included in Addendum 5, at back of the study guide.

Resources

The following resources, along with GCSAA’s monthly publication *Golf Course Management* magazine, are recommended as study resources. The textbooks may be available through your school library, local bookstore or through the GCSAA Store online at [www.cswebstore.net/gcsaa/](http://www.cswebstore.net/gcsaa/).

3. **Turfgrass Management** (*Fifth or Sixth Edition*) – A.J. Turgeon
4. **Fundamentals of Turfgrass Management** – Nick Christians
5. **Turf Management for Golf Courses** (*2nd Edition*) – James B. Beard
6. **Salt-Affected Turfgrass Sites: Assessment and Management** – R.N. Carrow and R.R. Duncan
7. **Managing Turfgrass Pests** – Thomas L. Watschke, Peter H. Dernoden and David J. Shetlar
9. **Creeping Bentgrass Management: Summer Stresses, Weeds and Selected Maladies** – Peter H. Dernoden
10. **Human Resource Management for Golf Course Superintendents**, ch. 6 – Bob Milligan and Tom Maloney
13. **Identifying Turf and Weedy Grasses of the Northern United States** – D. Pedersen and T. Voight Illinois Pocket ID series University of Illinois Extension [pubsplus.uiuc.edu](http://pubsplus.uiuc.edu)
14. **Turfgrass Identification Tool** – Purdue University Turfgrass Science Department of Agronomy (vernation) - [agry.purdue.edu/turf/tool/index.html](agry.purdue.edu/turf/tool/index.html)

15. **Turfgrass Identification** (vernation) - David Gardner, The Ohio State University [buckeyeturf.osu.edu/pdf/01_turfgrass_identification.pdf](buckeyeturf.osu.edu/pdf/01_turfgrass_identification.pdf)


18. Golf Course Environmental Profile [eifg.org/research/golf-course-environmental-profile](eifg.org/research/golf-course-environmental-profile)

### Addendum 1

**Cool Season Grasses**

<table>
<thead>
<tr>
<th>Common name</th>
<th>Scientific name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Kentucky bluegrass</td>
<td><em>Poa pratensis</em></td>
</tr>
<tr>
<td>2. Perennial ryegrass</td>
<td><em>Lolium perenne</em></td>
</tr>
<tr>
<td>3. Tall fescue</td>
<td><em>Festuca arundinacea</em> = <em>Schedonorus arundinaceus</em> = <em>Lolium arundinaceum</em></td>
</tr>
<tr>
<td>4. Hard fescue</td>
<td><em>Festuca brevipila</em> (F. trachyphylla)</td>
</tr>
<tr>
<td>5. Chewings fescue</td>
<td><em>Festuca rubra</em> ssp. commutata (ssp. fallax)</td>
</tr>
<tr>
<td>6. Creeping bentgrass</td>
<td><em>Agrostis stolonifera</em></td>
</tr>
<tr>
<td>7. Colonial bentgrass</td>
<td><em>Agrostis capilaris</em></td>
</tr>
<tr>
<td>8. Strong creeping red fescue</td>
<td><em>Festuca rubra</em> ssp. rubra</td>
</tr>
<tr>
<td>9. Slender creeping red fescue</td>
<td><em>Festuca rubra</em> ssp. litoralis</td>
</tr>
<tr>
<td>10. Velvet bentgrass</td>
<td><em>Agrostis canina</em></td>
</tr>
<tr>
<td>11. Rough bluegrass</td>
<td><em>Poa trivialis</em></td>
</tr>
<tr>
<td>12. Annual bluegrass</td>
<td><em>Poa annua</em></td>
</tr>
<tr>
<td>13. Annual ryegrass</td>
<td><em>Lolium multiflorum</em></td>
</tr>
</tbody>
</table>

### Warm Season Grasses

<table>
<thead>
<tr>
<th>Common name</th>
<th>Scientific name</th>
</tr>
</thead>
<tbody>
<tr>
<td>14. Japanese / Korean lawngrass</td>
<td><em>Zoysia japonica</em></td>
</tr>
<tr>
<td>15. Manilla grass</td>
<td><em>Zoysia matrella</em></td>
</tr>
<tr>
<td>16. Hybrid bermudagrass</td>
<td><em>Cynodon dactylon</em> X <em>C. transvaalensis</em></td>
</tr>
<tr>
<td>17. Common bermudagrass</td>
<td><em>Cynodon dactylon</em></td>
</tr>
<tr>
<td>18. Centipedegrass</td>
<td><em>Eremechloa ophiuroides</em></td>
</tr>
</tbody>
</table>
19. Seashore paspalum  
Paspalum vaginatum
20. Buffalograss  
Buchloe dactyloides
21. St. Augustinegrass  
Stenotaphrum secundatum
22. Kikuyugrass  
Pennisetum clandestinum
23. Bahiagrass  
Paspalum notatum

**Addendum 2**

**Weeds**

Alkaligrass  
Puccinella distans
Barnyardgrass / Watergrass  
Echinochloa crus-galli
Bedstraw / Catchweed  
Galium aparine
Bindweed, Field  
Convolvulus arvensis
Brassbuttons, Souther  
Cotula australis
Buttonweed, Virginia  
Diodia virginia
Carpetweed  
Mollugo verticillata
Carrot, Wild  
Daucus carota
Chess, Soft  
Bromus hordeaceus
Chickweed, Common  
Stellaria media
Chickweed, Mouseear  
Cerastium vulgatum
Chicory  
Cichorium intybus
Clover, White  
Trifolium repens
Crabgrass, Hairy (Large)  
Digitaria sanguinalis
Crabgrass, Smooth  
Digitaria ischaemum
Cudweed, purple  
Gnaphalium purpureum
Dallisgrass (smooth paspalum)  
Paspalum dilatatum
Dandelion, False /spotted catsear  
Hypocheris radicata
Dandelion  
Taraxacum officinale
Dichondra  
Dichondra repens
Dock, Curly  
Rumex crispus
Downy Brome / cheatgrass  
Bromus tectorum
English Daisy  
Bellis perennis
Foxtail, Yellow (pigeon / bristle grass)  
Setaria glauca (pumilla ssp pumilla)
Foxtail , Green  
Setaria viridis
Garlic , Wild  
Allium vineale
Geranium, Carolina / dovefoot  
Geranium ssp.
Goosegrass/Silver Crab/ Crowfoot  
Elusine indica
Ground Ivy (Creeping Charlie/Jenny)  
Glechoma hederacea
Hawkweed  
Hieracium pratense
Henbit  
Lamium amplexicaule
Johnsongrass  
Sorghum halapense
Kikuyugrass  
Pennisetum clandestinum
<table>
<thead>
<tr>
<th>Plant Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knotweed, Prostrate / Common</td>
<td>Polygonum aviculare</td>
</tr>
<tr>
<td>Kochia</td>
<td>Kochia scoparia</td>
</tr>
<tr>
<td>Kyllinga, Annual / Fragrant</td>
<td>Kyllinga odorata</td>
</tr>
<tr>
<td>Kyllinga, Green / Perennial</td>
<td>Kyllinga brevifolia</td>
</tr>
<tr>
<td>Lambsquarter</td>
<td>Chenopodium album</td>
</tr>
<tr>
<td>Lettuce, Prickly</td>
<td>Lactuca serriola</td>
</tr>
<tr>
<td>Mallow, Common</td>
<td>Malva neglecta</td>
</tr>
<tr>
<td>Medic, Black</td>
<td>Medicago lupulina</td>
</tr>
<tr>
<td>Moss, silvery thread</td>
<td>Bryum argenteum</td>
</tr>
<tr>
<td>Mullein, Common</td>
<td>Verbascum thapsus</td>
</tr>
<tr>
<td>Nimblewill</td>
<td>Muhlenbergia schreberi</td>
</tr>
<tr>
<td>Nutsedge, Purple</td>
<td>Cyperus rotundus</td>
</tr>
<tr>
<td>Nutsedge, Yellow</td>
<td>Cyperus esculentus</td>
</tr>
<tr>
<td>Oats, Wild</td>
<td>Avena fatua</td>
</tr>
<tr>
<td>Orchardgrass</td>
<td>Dactylis glomerata</td>
</tr>
<tr>
<td>Pearlwort</td>
<td>Sagina apetala (procumbens)</td>
</tr>
<tr>
<td>Pennywort / dollarweed</td>
<td>Hydrocotyle umbellate</td>
</tr>
<tr>
<td>Peppergrass / pepperweed</td>
<td>Lepidium virginicum</td>
</tr>
<tr>
<td>Pigweed, Prostrate</td>
<td>Amaranthus blitoides</td>
</tr>
<tr>
<td>Pineapple Weed / wild chamomile</td>
<td>Matricaria discoidea</td>
</tr>
<tr>
<td>Plaintain, Broadleaf</td>
<td>Plantago major</td>
</tr>
<tr>
<td>Plantain, Buckhorn / Narrowleaf</td>
<td>Plantago lanceolata</td>
</tr>
<tr>
<td>Puncture Vine / goatshead</td>
<td>Tribulus terrestris</td>
</tr>
<tr>
<td>Purslane, common</td>
<td>Portulaca oleracea</td>
</tr>
<tr>
<td>Quackgrass</td>
<td>Elytrigia repens</td>
</tr>
<tr>
<td>Rattail fescue</td>
<td>Vulpia myuros</td>
</tr>
<tr>
<td>Redtop</td>
<td>Agrostis gigantean (alba)</td>
</tr>
<tr>
<td>Salsify, Western</td>
<td>Tragopogon dubius</td>
</tr>
<tr>
<td>Sandbur / grassbur</td>
<td>Cenchrus incertus</td>
</tr>
<tr>
<td>Sedge, Annual</td>
<td>Cyperus compressus</td>
</tr>
<tr>
<td>Shepherd’s Purse</td>
<td>Capsella bursa-pastoris</td>
</tr>
<tr>
<td>Signalgrass</td>
<td>Urochloa subquadripara</td>
</tr>
<tr>
<td>Smartweed, Spotted (Ladysthumb)</td>
<td>Polygonum persicaria</td>
</tr>
<tr>
<td>Smutgrass</td>
<td>Sporobolus indicus</td>
</tr>
<tr>
<td>Sorrell, Red / Sheeps</td>
<td>Rumex acetosella</td>
</tr>
<tr>
<td>Speedwell, creeping</td>
<td>Veronica filiformis</td>
</tr>
<tr>
<td>Spurge, Prostrate / Spotted</td>
<td>Chamaesyce maculata (Euphorbia)</td>
</tr>
<tr>
<td>Star of Bethlehem</td>
<td>Ornithogalum umbellatum</td>
</tr>
<tr>
<td>Strawberry, Wild</td>
<td>Fragaria virginiana</td>
</tr>
<tr>
<td>Swinecress</td>
<td>Coronopus didymus</td>
</tr>
<tr>
<td>Thistle, Bull</td>
<td>Cirsium vulgare</td>
</tr>
</tbody>
</table>
Thistle, Canada  
Thistle, Musk  
Torpedograss  
Velvetgrass, German  
Violet  
Woodsorrel, Creeping  
Woodsorrel, Yellow (Oxalis)  
Yarrow  
Yellowcress

Cirsium arvense
Carduus nutans
Panicum repens
Holcus mollis
Viola ssp.
Oxalis corniculata
Oxalis stricta
Achillea millefolium
Rorippa palustris

Addendum 3

Bacterial Diseases

Bacterial wilt  
Bacterial etiolation and decline

Xanthomonas translucens  
Acidovorax avenae

Fungal Diseases

Anthracnose  
Ascochyta leaf blight  
Bermudagrass decline  
Blister smut  
Brown patch (C3) & large patch (C4)  
Brown ring patch  
Brown stripe  
Cladosporium eyespot  
Copper spot  
Coprinus snow mold  
Crown rust  
Curvularia blight  
Dead spot  
Dollar spot

Colletotrichum cereale, C. eremotheloae  
Ascochyta avenae  
See Root decline of warm-season grasses  
Jamesdicksonia dactylidis  
Rhizoctonia solani  
Waitea circinata var. circinata  
Mycosphaerella recutita  
Cladosporium phlei  
Gloeocercospora sorghi  
Coprinopsis psychromorbida  
Puccinia coronata  
multiple Curvularia sp.  
Ophiosphaerella agrostis  
Clarireedia is new genus  
Clarireedia homeocarpa on Festuca rubra, UK only  
Clarireedia bennettii on mostly cool season grasses, UK, Netherlands, USA  
Clarireedia monteithiana on Warm-season grasses; found worldwide  
Clarireedia jacksonii on cool-season grasses; found worldwide

Drechslera leaf spots and melting-out  
Endophytic fungi  
Fairy ring

multiple Drechslera and Marielliottia sp.  
Neotyphodium coenophialum, N. lolii, Epichloe typhina  
Species of Agraricales and Gastromycetales, mostly in the genera Agaricus, Calvatia,
Chlorophyllum, Clitocybe, Lepiota, Lycoperdon, Marasmius, Scleroderma, and Tricholoma.

Flag smut
Gray leaf spot
Gray snow mold
Leaf and sheath spot
oryzae
Leaf rust
Leptosphaerulina leaf blight
Mastigosporium leaf spot (leaf fleck)
Microdochium patch
Necrotic ring spot
Phyllosticta leaf blight
Guignardia
Physoderma leaf spot and leaf streak
Pink patch and cream leaf blight
Pink snow mold
Powdery mildew
Pythium foliar blight
Pythium root and crown rot
Pythium root dysfunction:
Rapid blight
Red thread
Root decline of warm-season grasses
Septoria leaf spot
Snow scald
Southern blight
Speckled snow mold
Spring dead spot
herpotricha
Stem rust
Stripe rust
Stripe smut
Summer patch
Take-all patch
Tar spot
Thatch collapse
Yellow patch
Yellow tuft
Yellow ring

Urocystis agropyri
Pyricularia grisea
Typhula incarnata
Waitea circinata var. zeae, W. circinata var.
Puccinia brachypodii
Leptosphaerulina trifolli
Mastigosporium rubricosum
Microdochium nivale
Ophiosphaerella korrae
Multiple species of Phyllosticta and
Guignardia
Physoderma graminis
Limonomycyes roseipellis
See Microdochium patch
Blumeria graminis
Pythium aphanidermatum, P. graminicola,
P. ultimum, Several other Pythium species
Pythium arnitosporum, P. arrhenomanes,
Pythium volutum, several other Pythium species
Pythium volutum, P. arrhenomanes, P.
arnitosporum, several other Pythium species
Labyrinthula terrestris
Laetisaria fuciformis
Gaeumannomyces graminis var. graminis,
Magnaporthiopsis incrustans,
G. wongoonoo
several Septoria species
Sclerotinia borealis
Athelia rolfsii
Typhula ishikariensis
Ophiosphaerella narmari, O. korrae, O.
herpotricha
Puccinia graminis
Puccinia striiformis
Ustilago striiformis
Magnaporthiopsis poae
Gaeumannomyces graminis
Phyllachora spp.
P. arnitosporum, several other Pythium species
Sphaerobollus stellatus
Rhizoctonia cerealis
Sclerophthora macrospora
Trechispora alnicola
Nematodes, Parasitic

Awl: *Dolichodorus* spp. Cobb
Cyst: *Heteroderda* spp. Schmidt
Dagger: *Xiphinema* spp. Cobb
Lance: *Hoplolaimus* spp. Daday
Lesion: *Pratylenchus* spp. Filipjev
Needle: *Longidorus* spp. (Micoletzky) Thorne & Swanger
Pin: *Paratylenchus* spp.
Pseudo-root knot: *Hypsoperine* spp. Sledge & Golden
Ring: *Criconemella*, *Criconemoides*, *Macroposthonia*, and *Mesocriconema* spp.
Root gall: *Subanguina* spp.
Root knot: *Meloidogyne* spp. Goeldi
Sheath: *Hemicycliophora* spp.
Sheathoid: *Hemicriconemoides* spp.
Spiral: *Helicotylenchus* spp. Steiner
Sting: *Belonolaimus* spp. Steiner
Stubby root: *Paratrichodorus* and *Trichodorus* spp.

Stylet or stunt: *Tylenchorhynchus* spp. Cobb

Miscellaneous Diseases or Disorders

Black Layer: A
   Anaerobic soil plus blue-green algae and/or sulfate-reducing bacteria
Slime Molds (superficial, not pathogenic):
   *Mucilago crustacea*
   : *Didymium squamulosum*
   : *Physarum cinereum*.
   : Species of *Physarum* and *Fuligo*

Addendum 4:

Insects

annual bluegrass weevil
billbugs
   - bluegrass billbug
   - hunting billbug
black turfgrass ataenius
chinchbugs
   - hairy chinchbug
- southern chinchbug

craneflies
  - European cranefly \textit{(Tipula paludosa)}
  - "common" cranefly \textit{(Tipula oleraceae)}

Caterpillars and adults
  - armyworm
  - black cutworm
  - fall armyworm
  - winter cutworm

mole crickets
  - southern mole cricket
  - tawny mole cricket

red imported fire ant

turfgrass ant

white grubs
  - Asiatic garden beetle
  - European chafer
  - Japanese beetle
  - masked chafer (southern)
  - masked chafer (northern)
  - oriental beetle

Wasps
  - Scoliid
  - Cicada Killers
  - yellow jacket
  - Paper wasp

\textbf{Beneficials}

Honey bees

Assassin bugs

Ground beetle

Lacewing

Praying Mantis
Addendum 5

1" DRIP CONTROL VALVE

(FIELD LOCATE APPROX. 3 OF THESE COMPONENTS AT SELECTED BUNKERS)

NOTE: VALVE WILL NEED TO BE CONVERTED FOR ICM SYSTEM USE.

1. FINISH GRADE/TOP OF MULCH
2. VALVE BOX WITH COVER:
   RAIN BIRD VS-STD
3. 30-INCH LINEAR LENGTH OF WIRE, COILED
4. WATERPROOF CONNECTION:
   RAIN BIRD DB SERIES
5. 1-INCH BALL VALVE (INCLUDED IN KIT)
6. REMOTE CONTROL VALVE:
   RAIN BIRD P38B (INCLUDED IN XCZ-100-PRB-COM KIT)
7. PRESSURE REGULATING QUICK CHECK BASKET FILTER:
   RAIN BIRD PB-OKCHK-100
   (INCLUDED IN XCZ-PRB-100-COM KIT)
8. PVC SCH 40 FEMALE ADAPTOR
9. LATERAL PIPE
10. PVC SCH 80 NIPPLE (LENGTH AS REQUIRED)
11. PVC SCH 40 ELL
12. PVC SCH 80 NIPPLE (2-INCH LENGTH, HIDDEN) AND PVC SCH 40 ELL
13. PVC SCH 40 TEE OR ELL
14. MAINLINE PIPE
15. 3-INCH MINIMUM DEPTH OF 3/4-INCH WASHED GRAVEL
16. PVC SCH 80 NIPPLE, CLOSE (INCLUDED IN XCZ-PRB-100-COM KIT)
1. GAUGES SHALL BE INSTALLED SO THEY CAN BE READ FROM THE TOP.
2. CONTRACTOR TO SUBMIT SHOP DRAWINGS OF VAULT.
3. PRV TO BE LOCATED OUTSIDE OF TURF.

PRESSURE REGULATING VALVE FOR HOLES 5, 6, 7, 8

NOTES:
Cutaway of Eagle 700 Rotor (Vista Interior del Rotor Eagle 700)

- Arc Adjustment Screw (Tornillo de Ajuste del Arco)
- Range Nozzle (Boquilla Principal)
- Internal Assembly (Ensamblaje Interno)
- Bearing Guide (Taza Guía)
- Retract Spring (Resorte Retractor)
- Motor Housing Assembly (Ensamblaje del Casco del Motor)
- Turbine (Turbina)
- Stator
- Screen (Cedazo)
- Lower Dual Snap Rings (Anillos Retenedores Inferiores)
- Valve Assembly (Ensamblaje de la Valvula)
- Top Serviceable Rock Screen (Cedazo con Servicio en la Parte Superior)
- Case Threads (Roscas del Casco)
Note: Part numbers enclosed in brackets ( ) are not available individually, but may be sold in assemblies or kits.
# Case Assembly

**Catalog Number 458**

**EAGLE 500 / 550 / 700 / 750 SERIES**

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Part Description</th>
<th>Qty.</th>
<th>Electric</th>
<th>SAM/Hydraulic</th>
<th>B case</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CASE ASSEMBLIES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>EAGLE 700 / 750</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Case Assembly (NPT)</td>
<td>1</td>
<td>(A) –</td>
<td>211489-01</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Case Assembly (BSP)</td>
<td>1</td>
<td>(B) 212462-xx</td>
<td>212464</td>
<td>211489-02</td>
</tr>
<tr>
<td></td>
<td>Case Assembly (ACME)</td>
<td>1</td>
<td>(B) 212466-xx</td>
<td>212468</td>
<td>211489-03</td>
</tr>
<tr>
<td><strong>EAGLE 500 / 550</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Case Assembly (NPT)</td>
<td>1</td>
<td>(A) –</td>
<td>211489-01</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Case Assembly (BSP)</td>
<td>1</td>
<td>(B,C) –</td>
<td>212464</td>
<td>211489-02</td>
</tr>
<tr>
<td></td>
<td>Case Assembly (ACME)</td>
<td>1</td>
<td>(B,C) –</td>
<td>212468</td>
<td>211489-03</td>
</tr>
<tr>
<td></td>
<td>PRS/Selector Housing Assy (&gt;6/95)</td>
<td>1</td>
<td></td>
<td>211418</td>
<td>–</td>
</tr>
<tr>
<td>3</td>
<td>Selector Cap</td>
<td>1</td>
<td>(D)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>4</td>
<td>Stem Cover O-Ring</td>
<td>1</td>
<td>(D)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>5</td>
<td>Compression Spring</td>
<td>1</td>
<td>(D)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>6</td>
<td>Selector Spring Washer</td>
<td>1</td>
<td>(D)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>7</td>
<td>PRS Cartridge, Upper Stem (Black)</td>
<td>1</td>
<td>(D)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>8</td>
<td>Selector Seal (Green)</td>
<td>1</td>
<td>(D,E) 212244</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>9</td>
<td>Solenoid Base O-Ring</td>
<td>1</td>
<td>211237</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>10</td>
<td>Base Nut</td>
<td>1</td>
<td>602606</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>11</td>
<td>Plunger Core Tube Assy</td>
<td>1</td>
<td>(G)212972-01S</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>12</td>
<td>Tubing</td>
<td>2</td>
<td>(E)211607</td>
<td>(E)211607</td>
<td>–</td>
</tr>
<tr>
<td>13</td>
<td>Solenoid Assy</td>
<td>1</td>
<td>206920-01</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>14</td>
<td>U-Frame</td>
<td>1</td>
<td>212124S</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>15</td>
<td>Encapsulated Coil</td>
<td>1</td>
<td>602118</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>16</td>
<td>Solenoid Retainer</td>
<td>1</td>
<td>627167</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>17</td>
<td>Lower Snap Ring</td>
<td>2</td>
<td>210470</td>
<td>210470</td>
<td>–</td>
</tr>
<tr>
<td>18</td>
<td>Valve Assembly (700 / 750 Series)</td>
<td>1</td>
<td>211468</td>
<td>212322</td>
<td>–</td>
</tr>
<tr>
<td>18</td>
<td>Valve Assembly (500 / 550 Series)</td>
<td>1</td>
<td>212089S</td>
<td>212322</td>
<td>–</td>
</tr>
<tr>
<td>19</td>
<td>Probe O-Ring</td>
<td>2</td>
<td>211238</td>
<td>211238</td>
<td>–</td>
</tr>
<tr>
<td>20</td>
<td>Universal Filter</td>
<td>1</td>
<td>206092-02</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>21</td>
<td>Inlet Rubber Seal</td>
<td>1</td>
<td>212328S</td>
<td>212221</td>
<td>–</td>
</tr>
<tr>
<td>22</td>
<td>Seal Nut</td>
<td>1</td>
<td>211174</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>23</td>
<td>Top-Serviceable Rock Screen (TSRS) (&gt;4/98) (White)</td>
<td>1</td>
<td>211714-01</td>
<td>211714-01</td>
<td>–</td>
</tr>
<tr>
<td>24</td>
<td>O-Ring for TSRS (Yellow)</td>
<td>1</td>
<td>210366</td>
<td>210366</td>
<td>–</td>
</tr>
<tr>
<td><strong>KITS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>–</td>
<td>ACME Case (with elbows and TSRS only)</td>
<td>1</td>
<td>212479</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>–</td>
<td>Tubing Repair Kit (E)</td>
<td>1</td>
<td>211607</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>–</td>
<td>Quick Connects for Tube Cuts</td>
<td>1</td>
<td>212159</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>–</td>
<td>Rubber Cover Kit (B case Only)</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>211355</td>
</tr>
<tr>
<td>–</td>
<td>Rubber Cover Kit (500/550/700/750) - Smooth Case Rotor</td>
<td>1</td>
<td>211602</td>
<td>211602</td>
<td>–</td>
</tr>
<tr>
<td>–</td>
<td>Rubber Cover Kit (500/550/700/750) - Ribbed Case Rotor</td>
<td>1</td>
<td>212551</td>
<td>212551</td>
<td>–</td>
</tr>
<tr>
<td><strong>TOOLS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>–</td>
<td>Selector Service Tool Key (Orange Tool)</td>
<td>1</td>
<td>B41720</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>–</td>
<td>7&quot; Selector Valve Key</td>
<td>1</td>
<td>D02215</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>–</td>
<td>18&quot; Selector Valve Key</td>
<td>1</td>
<td>D02221</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>–</td>
<td>Snap Ring Pliers</td>
<td>1</td>
<td>D02236</td>
<td>D02236</td>
<td>D02236</td>
</tr>
<tr>
<td>–</td>
<td>Valve Insertion Tool</td>
<td>1</td>
<td>B41710</td>
<td>B41710</td>
<td>–</td>
</tr>
<tr>
<td>–</td>
<td>Installation Socket for TSRS</td>
<td>1</td>
<td>D02237</td>
<td>D02237</td>
<td>D02237</td>
</tr>
<tr>
<td>–</td>
<td>Universal Hose Adaptor</td>
<td>1</td>
<td>D05205</td>
<td>D05205</td>
<td>–</td>
</tr>
</tbody>
</table>

(A) 1 1/4" NPT cases not available. Upgrade to ACME case w/NPT to ACME adapter (212947S).

(B) For Electric Case Assemblies specify pressure setting when ordering. -01 corresponds to 60psi (4,1 bars), -02 = 70 psi (4,8 bars), -03 = 80 psi (5,5 bars), and -04 = ~100psi (~6,9 bars). Pressure settings are identified as follows: 60PSI-Black, 70PSI-Blue, 80PSI-White, 100PSI-Red.

(C) Use EAGLE 700/750 case assembly and replace valve with 500/550 valve assembly (212089S)

(D) Included in PRS/Selector Repair Kit: Pre 4/01 use # 210166 (includes rust seal.), Post 4/01 use #212150 (includes green seal).

(E) Tubing Repair Kit includes 20 tubes, ferrules and metal barbs.

(F) Selector Seal, Rust (<4/01) #211663

(G) For salt water Plunger Core Tube Assy - use Part # 212732

Note: Part numbers enclosed in brackets ( ) are not available individually, but may be sold in assemblies or kits.
EAGLE 750 INTERNAL ASSEMBLY

1. Part Circle Rotor

452 Catalog Number

Note: Part numbers enclosed in brackets ( ) are not available individually, but may be sold in assemblies or kits.

TO BUY GENUINE RAIN BIRD PARTS, CONTACT YOUR LOCAL DISTRIBUTOR OR VISIT OUR ONLINE STORE AT WWW.RAINBIRD.COM
**Part Circle Rotor**

**EAGLE 750 INTERNAL ASSEMBLY**

**Catalog Number** 452

### SNAP RINGS

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Part Description</th>
<th>Qty.</th>
<th>750-E</th>
<th>750-S/H</th>
<th>750-B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Snap Cover (excluding BRC)</td>
<td>1</td>
<td>211921-01</td>
<td>211921-01</td>
<td>211921-01</td>
</tr>
<tr>
<td>2</td>
<td>Rubber Cover Kit</td>
<td>1</td>
<td>212552</td>
<td>212552</td>
<td>211355</td>
</tr>
</tbody>
</table>

### INTERNAL ASSEMBLY

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Part Description</th>
<th>Qty.</th>
<th>751544-xx</th>
<th>211544-xx</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Internal Assembly (A)</td>
<td>1</td>
<td>211544-xx</td>
<td>211544-xx</td>
</tr>
</tbody>
</table>

### COVER ASSEMBLY

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Part Description</th>
<th>Qty.</th>
<th>210974</th>
<th>210974</th>
<th>210974</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Self-Tapping Screw</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Housing Cover</td>
<td>1</td>
<td>210355</td>
<td>210355</td>
<td>210355</td>
</tr>
<tr>
<td>6</td>
<td>Cover Screw O-Ring</td>
<td>2</td>
<td>211236</td>
<td>211236</td>
<td>211236</td>
</tr>
</tbody>
</table>

### NOZZLES

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Part Description</th>
<th>Qty.</th>
<th>211982-01</th>
<th>211982-01</th>
<th>211982-01</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Dual-Spreader™ Nozzle Housing(B)(D)</td>
<td>1</td>
<td>211982-01</td>
<td>211982-01</td>
<td>211982-01</td>
</tr>
<tr>
<td>8</td>
<td>Range Nozzle Assembly</td>
<td>1</td>
<td>213750-xx</td>
<td>213750-xx</td>
<td>213750-xx</td>
</tr>
<tr>
<td>9</td>
<td>Retract Seal</td>
<td>1</td>
<td>210354</td>
<td>210354</td>
<td>210354</td>
</tr>
<tr>
<td>18</td>
<td>Stator/Screen Kit</td>
<td>1</td>
<td>210403-01</td>
<td>210403-01</td>
<td>210403-01</td>
</tr>
<tr>
<td></td>
<td>-Stator</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-Poppet</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-Screen</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Seal-a-Matic™ Screen Assy (B/BRC Only)</td>
<td>1</td>
<td></td>
<td></td>
<td>211292</td>
</tr>
</tbody>
</table>

### BEARING / RISER-MOTOR ASSEMBLY

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Part Description</th>
<th>Qty.</th>
<th>210366</th>
<th>210366</th>
<th>210366</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Nozzle Housing O-Ring</td>
<td>1</td>
<td>210366</td>
<td>210366</td>
<td>210366</td>
</tr>
<tr>
<td>11</td>
<td>Arc Adjustment Stem O-Ring</td>
<td>1</td>
<td>210366</td>
<td>210366</td>
<td>210366</td>
</tr>
<tr>
<td>12</td>
<td>Arc Adjustment Stem</td>
<td>1</td>
<td>210420</td>
<td>210420</td>
<td>210420</td>
</tr>
<tr>
<td>13</td>
<td>Bearing Guide Assy, STD</td>
<td>1</td>
<td>211147</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Bearing Guide Assy, LO-FLOW (C)</td>
<td>1</td>
<td>211263</td>
<td>211263</td>
<td>211263</td>
</tr>
<tr>
<td>15</td>
<td>Bearing Guide Assy, LO-FLOW (C)</td>
<td>1</td>
<td>211263</td>
<td>211263</td>
<td>211263</td>
</tr>
<tr>
<td>16</td>
<td>Riser Motor Assembly</td>
<td>1</td>
<td>210353</td>
<td>210353</td>
<td>210353</td>
</tr>
<tr>
<td>17</td>
<td>Nozzle Base Replacement Kit w/ Seals</td>
<td>1</td>
<td>211841</td>
<td>211841</td>
<td>211841</td>
</tr>
<tr>
<td>18</td>
<td>Nozzle Base Replacement Kit w/ Seals</td>
<td>1</td>
<td>211841</td>
<td>211841</td>
<td>211841</td>
</tr>
<tr>
<td>19</td>
<td>Pop-up Seal (White)</td>
<td>1</td>
<td>210399</td>
<td>210399</td>
<td>210399</td>
</tr>
</tbody>
</table>

### CASE ASSEMBLY

See Catalog No. 464

- **(B)** For non-potable applications use standard part and purple snap ring (Part # 211921-04)
- **(C)** The LO-FLOW Bearing Guide #211263 may also be used on the 750 Series Electric rotors.
- **(D)** For casade nozzle housing upgrade to Dual-Spreader™ nozzle housing - Part # 211982-01 and Nozzle - part # 213750-xx
- **(E)** For smooth case rotors use Part # 211602
- **(F)** Also requires Seal-O-Matic™ Screen Assy (B/BRC)-Part # 211292

### KITS & ACCESSORIES

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Part Description</th>
<th>Qty.</th>
<th>P/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Snap-Cover, Yellow</td>
<td>1</td>
<td>211921-02</td>
</tr>
<tr>
<td>2</td>
<td>Snap-Cover, White</td>
<td>1</td>
<td>211921-03</td>
</tr>
<tr>
<td>3</td>
<td>Snap-Cover, Purple (Non-Potable)</td>
<td>1</td>
<td>211921-04</td>
</tr>
<tr>
<td>4</td>
<td>Rubber Cover Kit (E/H/S)</td>
<td>1</td>
<td>(E)212551</td>
</tr>
<tr>
<td>5</td>
<td>Rubber Cover, Snap Ring</td>
<td>1</td>
<td>212551</td>
</tr>
<tr>
<td>6</td>
<td>Rubber Cover, Housing</td>
<td>1</td>
<td>211355</td>
</tr>
<tr>
<td>7</td>
<td>Rubber Case Ring (E/H/S)</td>
<td>1</td>
<td>211355</td>
</tr>
<tr>
<td>8</td>
<td>Cover, Yardage Marker Blank (White)</td>
<td>1</td>
<td>211996-03</td>
</tr>
<tr>
<td>9</td>
<td>Cover, Yardage Marker Blank (Black)</td>
<td>1</td>
<td>211996-01</td>
</tr>
<tr>
<td>10</td>
<td>Diffuser Screw Kit, Dual-Spreader (B)</td>
<td>1</td>
<td>212295</td>
</tr>
<tr>
<td>11</td>
<td>Nozzle Housing, Drilled &amp; Tapped</td>
<td>1</td>
<td>212287</td>
</tr>
<tr>
<td>12</td>
<td>Diffuser Screw (not shown)</td>
<td>1</td>
<td>211452</td>
</tr>
<tr>
<td>13</td>
<td>Housing Cover (Notched)</td>
<td>1</td>
<td>210355</td>
</tr>
<tr>
<td>14</td>
<td>Retract Seal</td>
<td>1</td>
<td>210355</td>
</tr>
<tr>
<td>15</td>
<td>Cover Screw O-Ring</td>
<td>2</td>
<td>211292</td>
</tr>
</tbody>
</table>

### EAGLE’S TAIL KITS

- **(A)** Dual-Spreader (without nozzle) (Black) | 212287 |
- **(B)** Housing, Nozzle, Drilled in back | 1 |
- **(C)** Close-in Spreader Nozzle, 700 | 1 |
- **(D)** Housing Cover | 1 |
- **(E)** Retract Seal | 1 |
- **(F)** Cover Screw O-Ring | 1 |

### Stator / Poppet Configurations - Dual-Spreader & Cascade

<table>
<thead>
<tr>
<th>Color</th>
<th>Number</th>
<th>Electric Pressure Setting</th>
<th>Hyd, psi (bars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>28/14C</td>
<td>SPC</td>
<td>60 (4,1)</td>
</tr>
<tr>
<td>Blue</td>
<td>32/16C</td>
<td>SPO</td>
<td>70 (4,8)</td>
</tr>
<tr>
<td>Yellow</td>
<td>36/18C</td>
<td>SNP</td>
<td>80 (5,5)</td>
</tr>
<tr>
<td>Orange</td>
<td>40/20C</td>
<td>SPR</td>
<td>100 (6,9)</td>
</tr>
</tbody>
</table>

Note: Part numbers enclosed in brackets ( ) are not available individually, but may be sold in assemblies or kits.