How many bytes are in TCP header. What are the different fields? How are the field values set? Verify in Wireshark.

The TCP (Transmission Control Protocol) header is typically 20 bytes long, though it can be longer if options are included. Here are the different fields in a standard 20-byte TCP header and how their values are set:

1. **Source Port (16 bits)**: The port number of the sender. This value is set by the operating system based on the application initiating the connection.
2. **Destination Port (16 bits)**: The port number of the receiver. This is determined by the application and protocol being used (e.g., HTTP uses port 80).
3. **Sequence Number (32 bits)**: The sequence number of the first byte in the segment. It is set by the sender to keep track of the data being sent.
4. **Acknowledgment Number (32 bits)**: The next sequence number that the sender of the segment is expecting to receive. This is set by the receiver to acknowledge the receipt of data.
5. **Data Offset (4 bits)**: Also known as the header length, it indicates the size of the TCP header in 32-bit words. It is set based on the length of the TCP header, including any options.
6. **Reserved (3 bits)**: Reserved for future use and set to zero.
7. **Flags (9 bits)**: Control flags used to manage the state of the connection:
    - **URG (1 bit)**: Urgent Pointer field significant.
    - **ACK (1 bit)**: Acknowledgment field significant.
    - **PSH (1 bit)**: Push Function.
    - **RST (1 bit)**: Reset the connection.
    - **SYN (1 bit)**: Synchronize sequence numbers.
    - **FIN (1 bit)**: No more data from sender.

These flags are set based on the state of the connection and the control actions needed.

8. **Window Size (16 bits)**: The size of the receive window, which specifies the amount of data that the sender is willing to receive. It is set by the receiver based on its available buffer space.
9. **Checksum (16 bits)**: Used for error-checking the header and data. It is computed by the sender and verified by the receiver.
10. **Urgent Pointer (16 bits)**: If the URG flag is set, this field points to the sequence number of the byte following urgent data. It is set by the sender to indicate the end of urgent data.
11. **Options (variable)**: Optional fields that may be used for various purposes such as maximum segment size, window scaling, timestamps, etc. The presence and length of options are determined by the requirements of the connection and the protocols in use.
12. **Padding (variable)**: Added to ensure the TCP header length is a multiple of 32 bits. It is set to zero.

```
Transmission Control Protocol, Src Port: 55123, Dst Port: 25, Seq: 1, Ack: 1, Len: 0
   Source Port: 55123
   Destination Port: 25
   [Stream index: 5]
   [Conversation completeness: Complete, WITH_DATA (31)]
      ..0. .... = RST: Absent
      ...1 .... = FIN: Present
      .... 1... = Data: Present
      .... .1.. = ACK: Present
      .... ..1. = SYN-ACK: Present
      .... ...1 = SYN: Present
      [Completeness Flags: ·FDASS]
   [TCP Segment Len: 0]
   Sequence Number: 1    (relative sequence number)
   Sequence Number (raw): 812628718
   [Next Sequence Number: 1    (relative sequence number)]
   Acknowledgment Number: 1    (relative ack number)
   Acknowledgment number (raw): 724460698
   0101 .... = Header Length: 20 bytes (5)
```

```
▾ Flags: 0x010 (ACK)
    000. .... .... = Reserved: Not set
    ...0 .... .... = Accurate ECN: Not set
    .... 0... .... = Congestion Window Reduced: Not set
    .... .0.. .... = ECN-Echo: Not set
    .... ..0. .... = Urgent: Not set
    .... ...1 .... = Acknowledgment: Set
    .... .... 0... = Push: Not set
    .... .... .0.. = Reset: Not set
    .... .... ..0. = Syn: Not set
    .... .... ...0 = Fin: Not set
    [TCP Flags: ·····A····]
  Window: 512
  [Calculated window size: 131072]
  [Window size scaling factor: 256]
  Checksum: 0x1095 [unverified]
  [Checksum Status: Unverified]
  Urgent Pointer: 0
▾ [Timestamps]
    [Time since first frame in this TCP stream: 0.134071000 seconds]
    [Time since previous frame in this TCP stream: 0.000169000 seconds]
▾ [SEQ/ACK analysis]
    [This is an ACK to the segment in frame: 68]
    [The RTT to ACK the segment was: 0.000169000 seconds]
    [iRTT: 0.134071000 seconds]
```